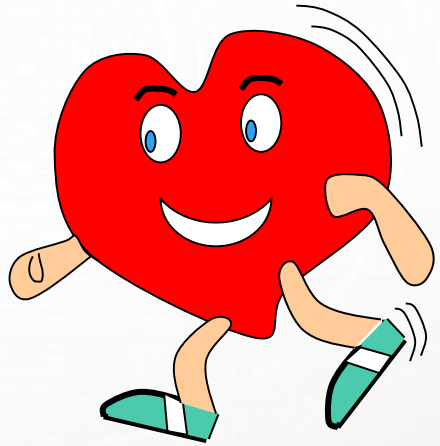
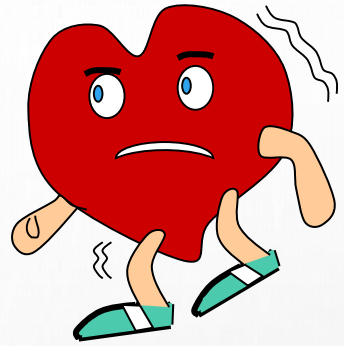




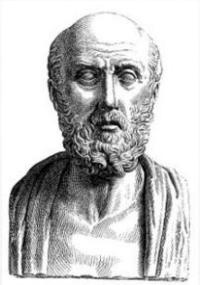
CARDIAC REHABILITATION WHY, WHEN AND HOW?

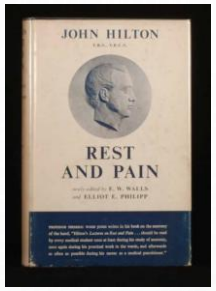
8th CHALLENGES in CARDIOLOGY

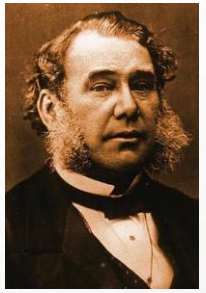
Alexandre Antunes

ONCE UPON A TIME EXERCISE IN MEDICINE…

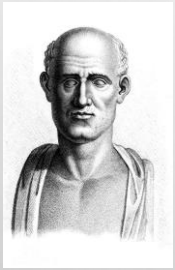
Hypocrates (Greece 460-370 BC)
"All diseases should be treated with rest and medicines"





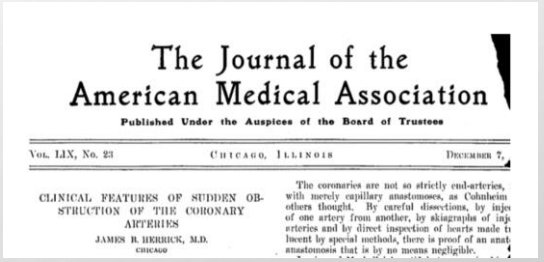


John Hilton (UK 1863)
"Prolonged rest to treat all diseases"

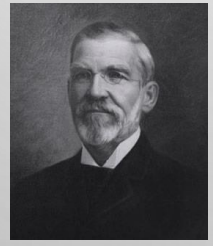


Asclepiades (Rome 124-40 BC)
"exercise program to treat cardiovascular diseases"

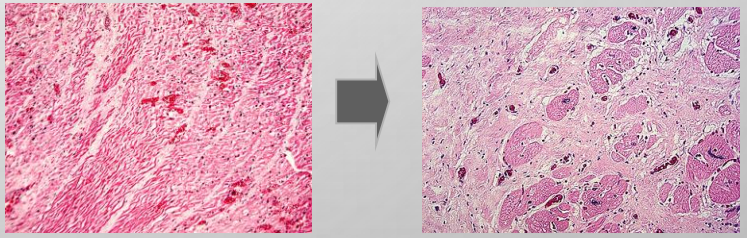
James Herrick (JAMA 1912)
"longstanding rest in Myocardial Infarction to prevent possible complications such as ventricular aneurysms or malignant arrythimas"


The Journal of the American Medical Association
Published Under the Auspices of the Board of Trustees
Vol. LIX, No. 23 CHICAGO, ILLINOIS DECEMBER 7,
CLINICAL FEATURES OF SUDDEN OBSTRUCTION OF THE CORONARY ARTERIES
JAMES B. HERRICK, M.D.
CHICAGO

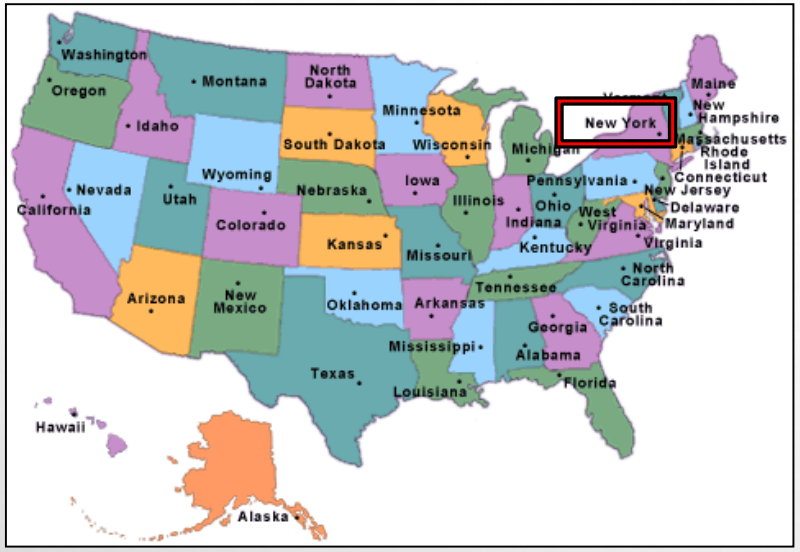
William Stokes (Dublin 1854)
"exercise program to treat Myocardial Infarction"



Mallory et all (1939)
"6 weeks from necrotic tissue to consistent fibrosis"

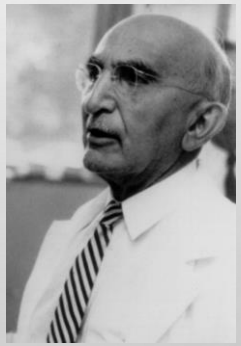


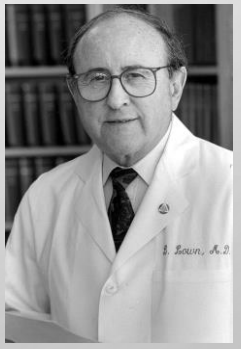
CARDIAC REHABILITATION EMBRYO…



USA 1940s: economic growth and lack of manpower. Studies showed high number of prematurely retired men over coronary heart disease.
1941: first AHA observation unit in NY. All patients were reassessed and had their medication adjusted. Most of them got back to work.
Other Units followed, all over the country

JAMA 1952: Samuel Levine and Bernard Lown publish "Armchair treatment of acute coronary thrombosis" – "recumbency in bed permit maximal venous return with associated increases in ventricular diastolic filling and augmented volume work for the heart…getting patients promptly out of bed and into a chair, we achieve more rest for the heart…there is also a lower probability of thromboembolic phenomena and respiratory complications





CARDIAC REHABILITATION EMBRYO…

1950s: first exercise programs after ACS discharge

New drugs for the treatment of coronary disease (1970s Aspirin, 1980s statins,…)

New non-pharmacologic treatments (1970s: percutaneous coronary angioplasty)

CARDIAC REHABILITATION NEWBORN

WHO 1993: "*The sum of activities required to influence favourably the underlying cause of CV disease, as well as to provide the best possible physical, mental and social conditions, so that the patients may, by their own efforts, preserve or resume a place as normal as possible in the community.*"

AHA 1994: "Cardiac rehabilitation programs should emphasize three areas:

1) Exercise training and activity prescription
2) Risk factor modification
3) Psychosocial and vocational evaluation and counseling

CARDIAC REHABILITATION RATIONALE

Cardiovascular disease (CVD) is a leading contributor to global mortality and morbidity. Internationally, it is the cause of approximately a third of total yearly deaths, with mortality rates in high-income countries ranging from 20% to 50%. CVD is responsible for approximately 20% of the worldwide disease burden and rapid, effective intervention is necessary.

Although there have been significant improvements in pharmacological therapy, percutaneous coronary intervention and cardiac surgery, it is now urgent to invest in the areas of prevention and rehabilitation, complementing the former interventions

CARDIAC REHABILITATION (CR) DEFINITION

Intervention intended to help the patient **recover or improve physical, psychological, social and vocational functioning** after an acute cardiac event or in the context of chronic **cardiovascular disease**.

It consists of an **integrated multi-disciplinary process** with various components, emphasizing **physical exercise**, changes in behaviours aimed at healthier lifestyles, **control of risk factors** and **intervention in psychological factors**, with the main purpose of delaying the progression of the underlying cardiovascular disease.

CARDIAC REHABILITATION (CR) DEFINITION

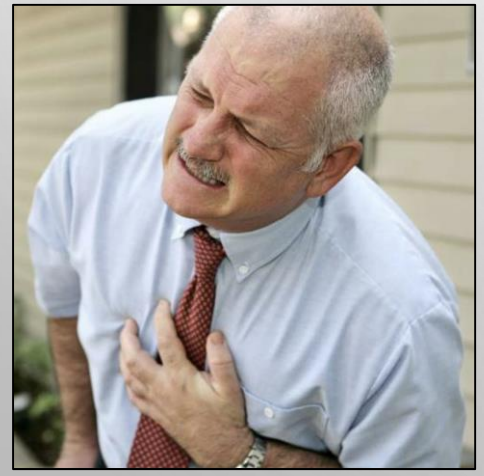
The benefits of CR have been thoroughly demonstrated,including reductions in mortality and morbidity following myocardial infarction, and improvements in quality of life and functional capacity in cardiovascular disease, including heart failure.

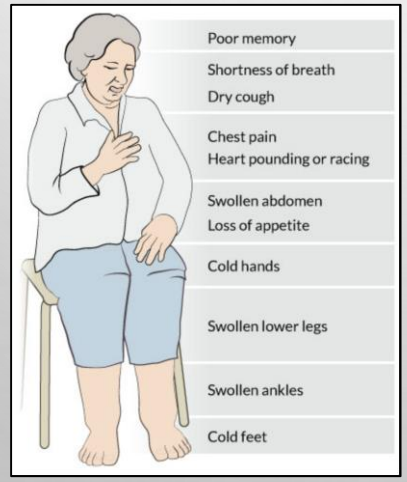
ESC/EAPC and the AHA/AACVPR classify CR as a therapeutic intervention with class I indication (mandatory), based on the highest levels of scientific evidence (A or B, according to the indications) in multiple cardiac conditions.

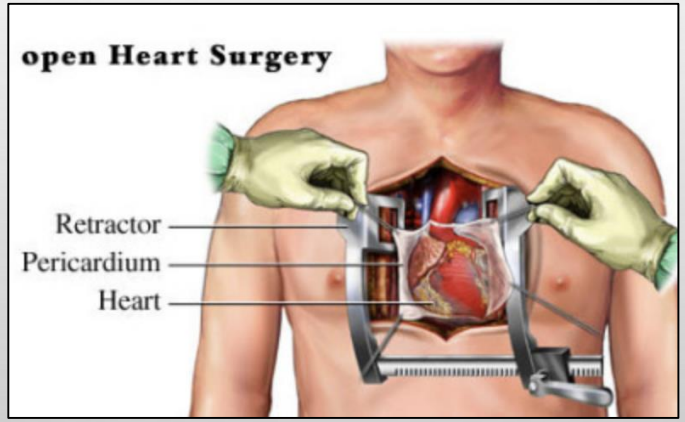
CARDIAC REHABILITATION TARGET POPULATION

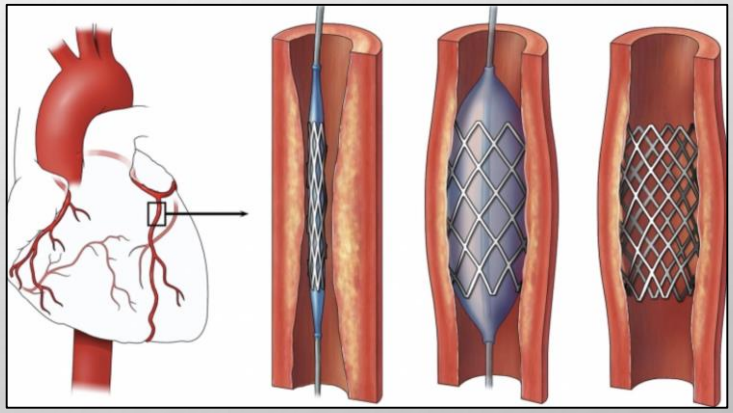
Current developments in cardiology, particularly in terms of percutaneous and surgical interventions, as well as increasing awareness of the benefits of CR, are leading to a significant widening of its indications:

- **Acute Coronary Syndrome**
- Chronic heart failure (with or without resynchronization/defibrillator or left ventricular assist device)
- Post cardiac surgery (valvular, coronary, congenital and cardiac transplantation)
- Post percutaneous intervention (coronary, aortic valve implant, mitral clip, and others)









CARDIAC REHABILITATION PHASES

PHASE I - hospital phase

Begins as soon the patient stabilizes after the acute event, usually after 24-48 hours

- Phase Ia - performed in the intensive care unit
- Phase Ib - performed in the ward.

Purposes:

- To **avoid problems associated with prolonged immobilization** (loss of postural reflexes, negative nitrogen balance, postural hypotension, deconditioning, joint stiffness, muscle atrophy, depression, ...)
- To identify and initiate **control of risk factors**
- To promote the adoption of a **healthy lifestyle habits**
- To identify and **minimize psychological disturbances** caused by the acute event, **establishing a positive attitude** that motivates the patient to continue the rehabilitation process and to take responsibility for long-term self-care

Cardiac rehabilitation team:

- Cardiologist
- Physical medicine specialist (Physiatrist)
- Rehabilitation nurse
- Physiotherapist
- Nutritionist
- Psychologist/psychiatrist
- Social Assistant

CARDIAC REHABILITATION PHASES

PHASE I - hospital phase

Before patients begin a phase I program, they should be assessed by the CR team, observing the admission criteria, contraindications and levels and progression of physical activity set out in the international guidelines.

Clinical stability criteria to begin a Phase I CR program:

- No angina or equivalent symptom in the last 8 hours
- MI biomarkers (CK, Troponin) stability or fall
- No decompensated Heart failure signs or symptoms
- No dynamic ST-T EKG changes or significant dysrhytmias in the last 8 hours
- Stable HR and BP in the last 24h

Clinical criteria to begin a Phase I CR **Educational** program:

- Hemodynamic and rythm stability
- Adequate conscious level
- Patient knows and accept the diagnosis

CARDIAC REHABILITATION PHASES

PHASE I - hospital phase

Before patients begin a phase I program, they should be assessed by the CR team, observing the admission criteria, contraindications and levels and progression of physical activity set out in the international guidelines.

ACTIVITY	METHOD	METs	HR (average)
In bed	turn Urinate	1-2 1-2	**<5 cpm**
Hygiene	Bathe in bed Bathe in the bathtub Shower	2-3 2-3 3-4	**10-20 cpm**
Walk	Flat ground 2 mph 3 mph	 2-2,5 3-3,3	**5-15 cpm**
Exercises with chest and arms	Thorax arms	2-2,2 2,6-3,1	**10-20 cpm**
Legs Calisthenics	Legs	2,5-4,5	**15-25 cpm**
Climb stairs	**1 flight =12 degraus** **1 flight downstairs** **1 flight upstairs**	 **2,5** **4,0**	 **10 cpm** **10-25 cpm**

Adverse response to exercise:

- Diastolic BP $\geq$ 110 mmHg
- Systolic BP fall > 10 mmHg
- Complex ventricular or SV arrythmia
- 2° or 3° degree AV block
- Signs or symptoms of exercise intolerance (angina, dyspnea, dizziness)

Adequate response that allow exercise progression:

- Adequate HR increase from rest
- Adequate systolic BP increase (10-40 mmHg from rest)
- No EKG ST-T dynamic changes or significant dysrrythmias
- No signs or symptoms of exercise intolerance

CARDIAC REHABILITATION PHASES

PHASE II - early post-discharge phase

This phase covers patients after hospital discharge and begins as soon as possible, ideally in the first two weeks or after diagnosis (for non-hospitalized patients). It consists of a **tailored and structured program** that includes:

- **Exercise program** specifically prescribed for each patient in terms of intensity, type (aerobic, continuous or interval, resistance), duration, frequency and modality.
- Formal program for **patient education and lifestyle modification**
- **Psychologic support** (anxiety and depression treatment, social and professional reintegration)

It can be performed:

- At the **hospital**
- In a specialized **CR center**
- In some cases at the patient's home (**Home-based program**)

CARDIAC REHABILITATION PHASES

PHASE II - early post-discharge phase

This phase covers patients after hospital discharge and begins as soon as possible, ideally in the first two weeks or after diagnosis (for non-hospitalized patients). It consists of a **tailored and structctured program:**

Purposes:

- To improve cardiovascular function, functional capacity, strength, balance and flexibility
- To optimize pharmacological therapy
- To detect and treat arrhythmias or hemodynamic and electrocardiographic changes occurring during exercise
- To educate the patient regarding how to exercise and remain active in the long term
- To work with the patient and his close family or care-giver to help them adopt a healthier lifestyle
- To improve the patient's psychological condition
- To individualize the exercise program in terms of intensity, duration, frequency, modality, and the type of physical activity
- To promote patients' autonomy regarding their treatment program.

CARDIAC REHABILITATION PHASES

PHASE II - early post-discharge phase

This phase covers patients after hospital discharge and begins as soon as possible, ideally in the first two weeks or after diagnosis (for non-hospitalized patients). It consists of a **tailored and structctured program:**

Cardiac rehabilitation team:

Core elements:
- Cardiologist
- Physiatrist
- Rehabilitation nurse
- Physiotherapist
- Nutritionist
- Psychologist
- Social Assistant

Consultant elements:
- Pneumologist
- Endocrinologist
- Urologist
- Psychiatrist
- Internal Medicine
- Vascular Surgeon

CARDIAC REHABILITATION PHASES

PHASE II - early post-discharge phase

Initial assessment and cardiovascular **risk stratification** (low, intermediate or high) is undertaken by the program's cardiologist. This stratification is based mainly on symptom severity, degree of left ventricular dysfunction, functional capacity, and the presence of residual ischemia or arrhythmias:

High risk for exercise participation (any one of these findings):

- Complex ventricular arrythmias during exercise testing
- Angina or other significant symptoms (unsusual shortness of breath, dizziness) at low levels of exertion (< 5METs) or during recovery
- High level of silent ischemia (ST-segment depression >2mm from baseline) during exercise or recovery
- Abnormal hemodynamics with exercise (cronotropic incompetence, flat or decreasing systolic BP with increasing workloads) or recovery (severe hypotension)
- Rest ejection fraction <40%
- Hystory of Cardiac arrest or sudden death
- Complex dysrhytmias at rest
- Complicated MI or revascularization procedure
- Presence of CHF
- Signs or symptoms of postevent or postprocedure ischemia
- Clinical depression

Moderate risk for exercise participation (any one of these findings):

- Mild to moderate level of silent ischemia during exercise or recovery (ST-segment depression <2mm from baseline)
- Angina or other significant symptoms (unsusual shortness of breath, dizziness) at high levels of exertion (> 7METs)
- Functional capacity <5 METs
- Rest ejection fraction 40-49%

CARDIAC REHABILITATION PHASES

PHASE II - early post-discharge phase

Initial assessment and cardiovascular **risk stratification** (low, intermediate or high) is undertaken by the program's cardiologist. This stratification is based mainly on symptom severity, degree of left ventricular dysfunction, functional capacity, and the presence of residual ischemia or arrhythmias:

Low risk for exercise participation (**all characteristics must be present**):

- No Complex ventricular arrythmias during exercise testing and recovery
- No angina or other significant symptoms (unsusual shortness of breath, dizziness) at low levels of exertion (< 5METs) or during recovery
- No silent ischemia (ST-segment depression) during exercise or recovery
- Normal hemodynamics with exercise (cronotropic competence, appropriate BP and HR variation with increasing workloads and recovery
- Functional capacity ≥7 METs
- Rest ejection fraction ≥50%
- No Hystory of Cardiac arrest or sudden death
- No complex dysrhytmias at rest
- Uncomplicated MI or revascularization procedure
- Absence of CHF
- No signs or symptoms of postevent or postprocedure ischemia
- Absence of clinical depression

CARDIAC REHABILITATION PHASES

PHASE II - early post-discharge phase

Complementary exams required for assessment include:

- Exercise testing (preferably cardiorespiratory testing in heart failure patients)
- echocardiogram (and other imaging methods if necessary)
- Blood tests
- 24-hour Holter monitoring (mostlyfor patients with arrhythmias)

Duration and weekly frequency:

- Phase II CR programs should last 8-12 weeks
- Exercise sessions 2-5 per week
- Education sessions 1-2 per week
- Psycologic support sessions 1-2 per week

At the end of this phase the patient should be reassessed to ascertain the extent to which the purposes were achieved, to quantify the gains of CR, and to help optimize therapy.

CARDIAC REHABILITATION PHASES

PHASE II – early post-discharge phase

Exercise training (Phases I and 2)

	Phase I	Phase II
Passive mobilization (ROM)	y	
Active mobilization (ROM)	y	
Corridor walking	y	
Descending stairs	y	
Ascending stairs	y	
Warm-up		y
Flexibility		y
Balance		y
Callisthenics		y
Continuous aerobic training		y
Interval training		If appropriate
Strength training		y
Games		
Cool-down		y
Duration of aerobic training		20-45 min

CARDIAC REHABILITATION PHASES

PHASE III - long-term phase

The long-term phase usually begins **after phase II,** according to the physician's indication, and should **last for the rest of the patient's life.** This phase covers other **low-risk patients who did not participate in phase II** and are refered (six months or more after the acute event) by phase II CR centers after medical assessment.

Purposes:

- To provide professional supervision of exercise, with clinical monitoring of symptoms and signs, heart rate, blood pressure and ECG (if required; only in high-risk patients)
- To teach self-monitoring
- To maintain patients'awareness of the behavioral aspects of cardiovascular disease and the need to continue preventive measures
- To maintain long-term control of cardiovascular risk factors and adherence to pharmacological therapy and healthy lifestyles
- To ensure annual assessment of patients through clinical, functional (exercise test), laboratory tests and echocardiogram

CARDIAC REHABILITATION PHASES

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Long-term programs should be implemented in **places able to accommodate a variety of activities,** including games, aerobic exercise, walking, dancing, running, and strength exercises. In some cases they can occupy the same site as the phase II program




CARDIAC REHABILITATION PHASES

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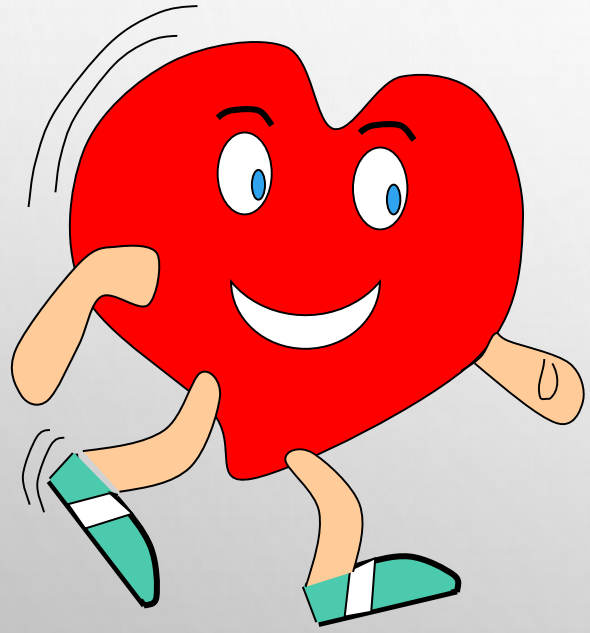
Long-term programs should be implemented in **places able to accommodate a variety of activities,** including games, aerobic exercise, walking, dancing, running, and strength exercises. In some cases they can occupy the same site as the phase II program

Some programs can be **home-based,** especially in low-risk patients, which eliminates the need for travel to CR centers and removes problems with scheduling. Monitoring of parameters and periodic supervision by a team which includes a nurse or physiotherapist are essential in these kind of programs.

CARDIAC REHABILITATION

CENTRO HOSPITALAR DE LEIRIA – CR PHASE II program



CARDIAC REHABILITATION

CENTRO HOSPITALAR DE LEIRIA – CR PHASE II program

CR PHASE II FLOW CHART

INFORMATIVE GROUP SESSION
- Welcome and Team presentation
- Global definition of CR
- Informed consent signature
- Distribution of CR patient's manual
- Scale forms filling (HADS, IIFE5, EuroQol5)
- Blood tests and Echocardiogram request (if not done yet)
- Treadmill test and 1st Cardiology appointment scheduling
- Doubts

CARDIAC REHABILITATION

CENTRO HOSPITALAR DE LEIRIA – CR PHASE II program

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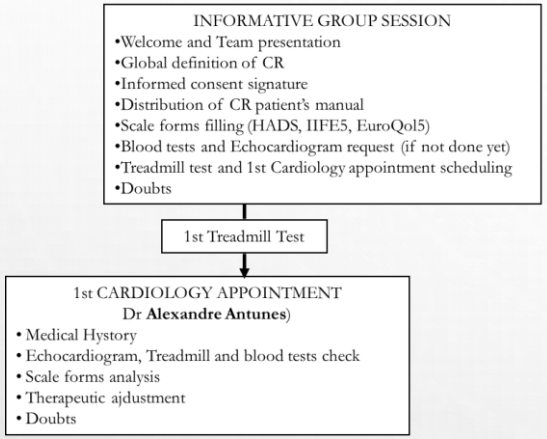

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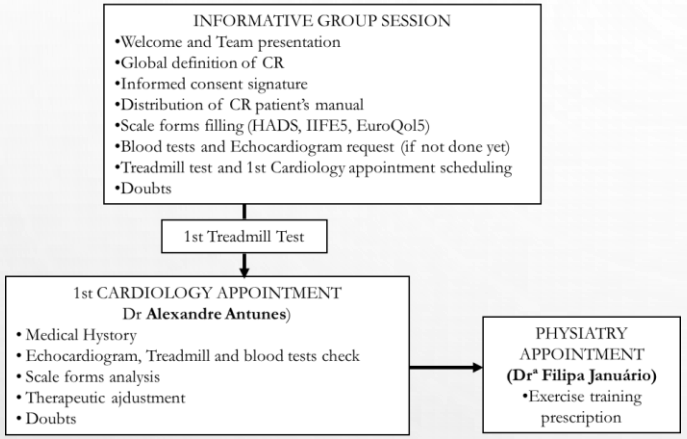

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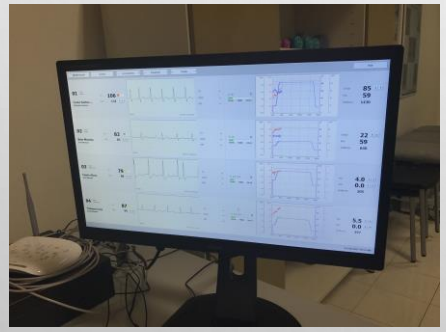

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↓

1st Treadmill Test

↓

1st CARDIOLOGY APPOINTMENT
Dr **Alexandre Antunes**)
- Medical Hystory
- Echocardiogram, Treadmill and blood tests check
- Scale forms analysis
- Therapeutic ajdustment
- Doubts

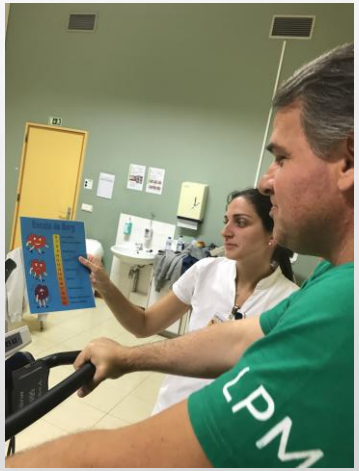
→ PHYSIATRY APPOINTMENT **(Drª Filipa Januário)**
- Exercise training prescription

↓

EXERCISE TRAINING
Physiotherapist Sandra Ferreira
12 weeks
(2 times a week)
+
Daily walk other days
(2nd treadmill, Echo and blood tests scheduling)

↓

- GROUP PSICOTHERAPY sessions
- RELAXATION sessions (once a week)
  Dr Luís Marques
- CV DISEASE, RISK FACTORS AND HEALTHY LIFESTYLE Classes
  Nurses Alexandra Costa, Mónica Santos, Isabel Pereira, Cristina Veríssimo, Anabela Norte (once a week)



CARDIAC REHABILITATION

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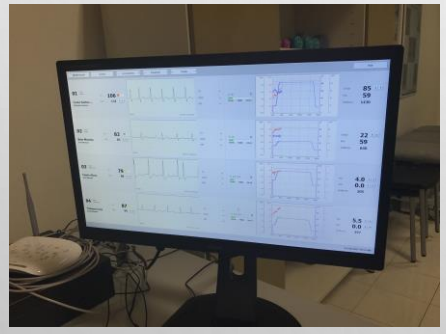

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1st Treadmill Test

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PHYSIATRY APPOINTMENT **(Drª Filipa Januário)**
- Exercise training prescription

EXERCISE TRAINING
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(2 times a week)
+
Daily walk other days
(2nd treadmill, Echo and blood tests scheduling)

PSYCHIATRY Appointment **Drª Sofia Fonseca e Dra Vera Domingues** (if needed)

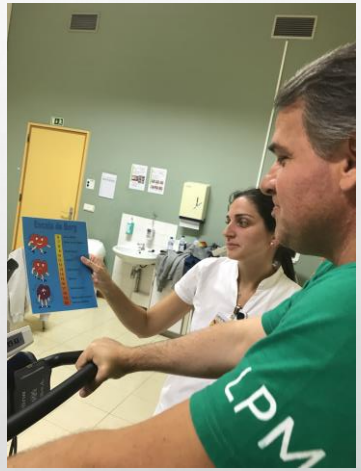
PNEUMOLOGY Appointment **Drª Sónia Silva** (if needed)

UROLOGY Appointment (if needed) **Dr Ricardo Borges)**

DIABETES Appointment **Drª Alexandra Vieira** (if needed)

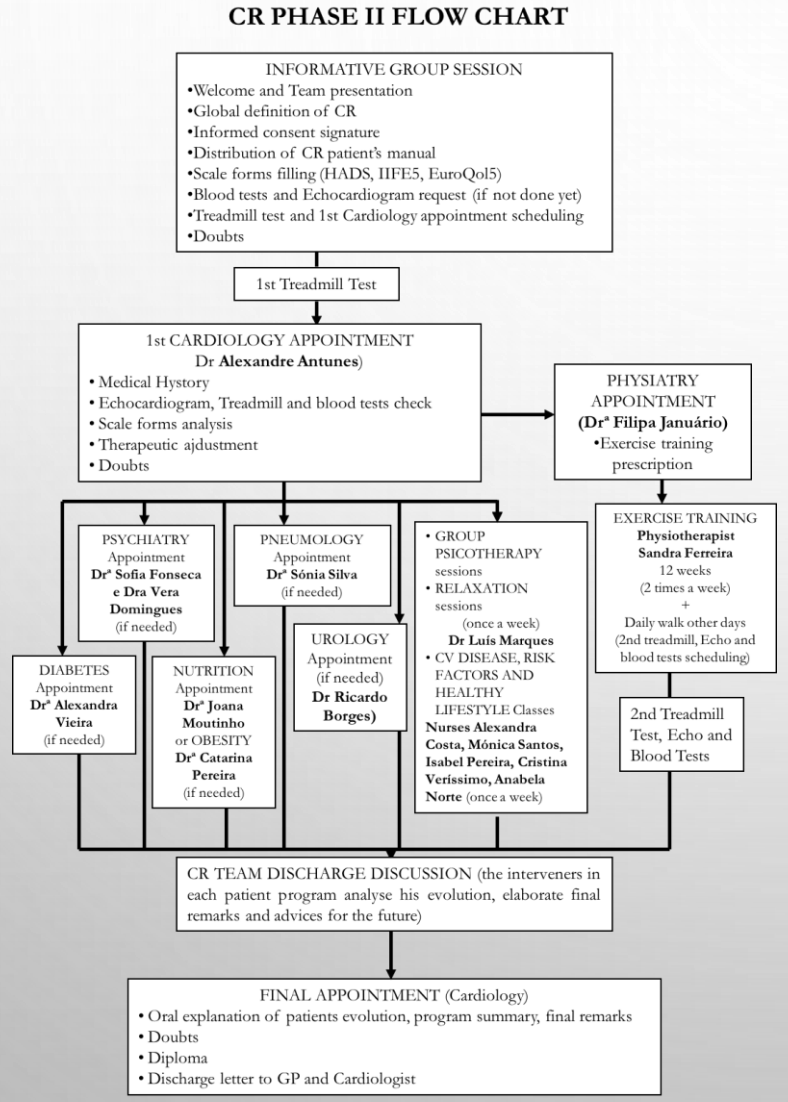
NUTRITION Appointment **Drª Joana Moutinho** or OBESITY **Drª Catarina Pereira** (if needed)

- GROUP PSICOTHERAPY sessions
- RELAXATION sessions (once a week) **Dr Luís Marques**
- CV DISEASE, RISK FACTORS AND HEALTHY LIFESTYLE Classes **Nurses Alexandra Costa, Mónica Santos, Isabel Pereira, Cristina Veríssimo, Anabela Norte** (once a week)



CARDIAC REHABILITATION

CENTRO HOSPITALAR DE LEIRIA – CR PHASE II program



CARDIAC REHABILITATION – WHAT'S NEXT?

NEW TECHNOLOGIES

CARDIAC REHABILITATION – WHAT'S NEXT?

NEW TECHNOLOGIES – Virtual Care

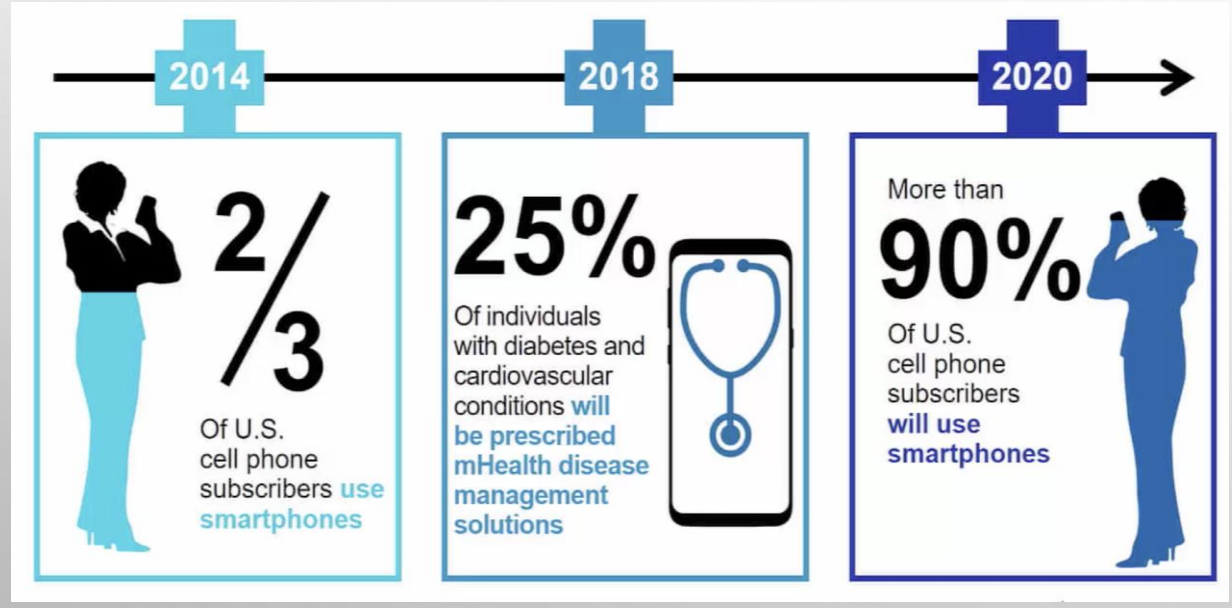
CARDIAC REHABILITATION – WHAT'S NEXT?

NEW TECHNOLOGIES – Virtual Care

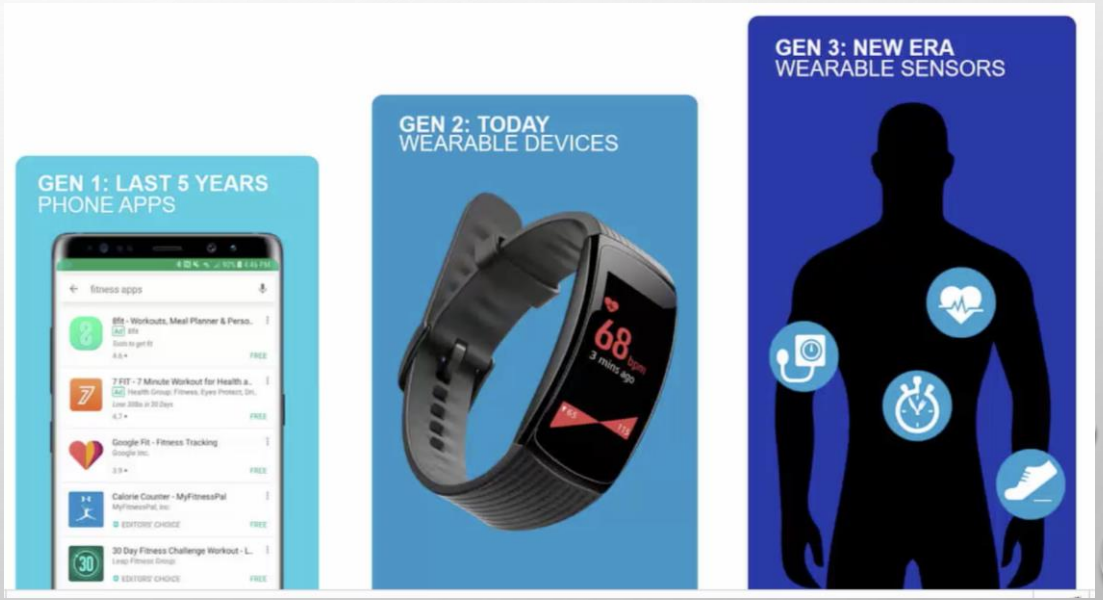
25th Annual World Congress on Anti-Aging Medicine 2017

December 14-16 2017 - Las Vegas, NV

USA Smart Phone Adoption Rates



Consumer adoption of digital health



CARDIAC REHABILITATION – WHAT'S NEXT?

NEW TECHNOLOGIES – Virtual Care

- Patient engagement
- Digitized care calendar
- Compliance checking
- Rehab bio-sensing

- Data management
- Behavior analytics
- Progress analytics
- Content provision

- Clinician intervention
- Patient assessment
- Patient provisioning
- Clinical content management

CARDIAC REHABILITATION – WHAT'S NEXT?

NEW TECHNOLOGIES – Virtual Care

MOVIDA platform:

Global health community program centered on a mobile application and a dedicated backoffice, to physical activity prescription and supervision supported by dashboards.

IPL	**INESC**	**CINTESIS**	**CHL**
(Polytechnic Institute of Leiria)	(Institute for systems Engineering and computers)	(Centre for research in health technologies)	(Centro Hospitalar de Leiria)

Rui Fonseca-Pinto[a], Ricardo Martinho[b], Rui Rijo[c], Pedro Assunção[d], Alexandra Seco[e],Pedro Correia[f], Gabriel Pires[g], Luis Oliveira[h], Maria Guarino[i], Catia Pontes[j], Dulce Gomes[k], Catarina Leitão[l], Filipa Januário, Alexandre Antunes, Bruno Carreira[m]1

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[a] *EssLei - School of Health, Polytechnic Institute of Leiria, Leiria, Portugal*
CiTechCare - Center for Innovative Care and Health Technology, Polytechnic Institute of Leiria, Leiria, Portugal
[b]*Instituto de Telecomunicações, Multimedia Sugnal Processing- Lr, Portugal*
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[a]*Polytechnic Institute of Castelo Branco, Leiria, Portugal*
Institute for Systems Engineering and Computers at Coimbra (INESC Coimbra), University of Coimbra, Coimbra, Portugal
Centre for Research in Health Technologies and Information Systems (CINTESIS), University of Porto, Porto, Portugal
Health Intelligence Laboratory, Faculty of Medicine of the University of São Paulo, Ribeirão Preto/São Paulo, Brazill
Centro Hospitalar de Leiria, Serviço de Medicina Fisica e Reabilitação, Leiria, Portugal
Centro Hospitalar de Leiria, Serviço de Cardiologia, Leiria,Portugal

CARDIAC REHABILITATION – WHAT'S NEXT?

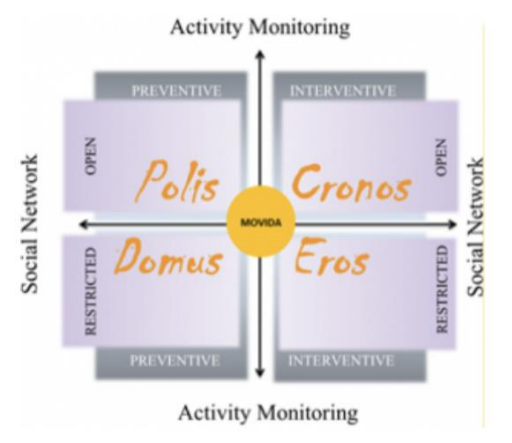
NEW TECHNOLOGIES – Virtual Care

MOVIDA platform:

Global health community program centered on a mobile application and a dedicated backoffice, to physical activity prescription and supervision supported by dashboards.

MOVIDA platform is divided into **4 main modules,** targeting several branches of the population:

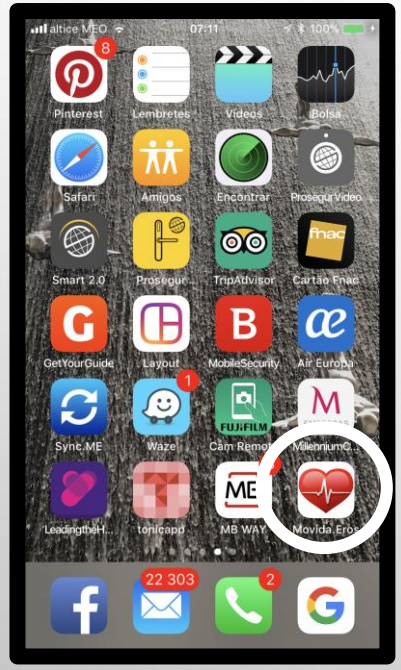
- **MOVIDA.cronos:** exercise prescription and monitor user's performance and adherence in **metabolic diseases patients**
- **MOVIDA.eros:** draw and follow a **cardiac rehabilitation program**
- **MOVIDA.domus:** track and quantify **indoor movements**
- **MOVIDA.polis:** access to a stratified **outdoor urban training circuit,** for **maintaining or improve fitness level**

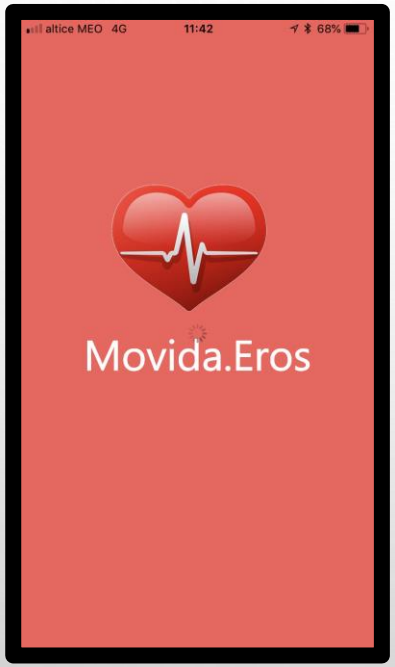


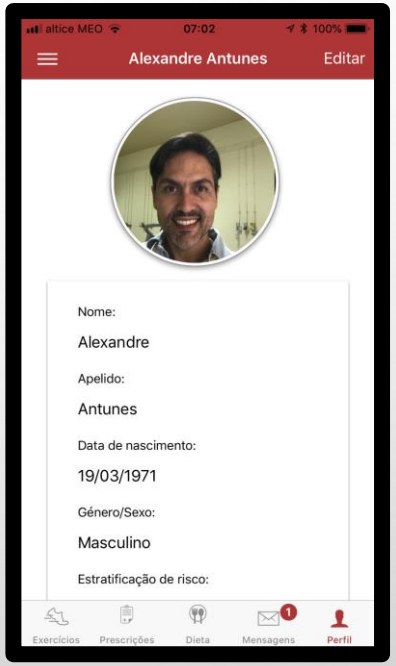
CARDIAC REHABILITATION – WHAT'S NEXT?

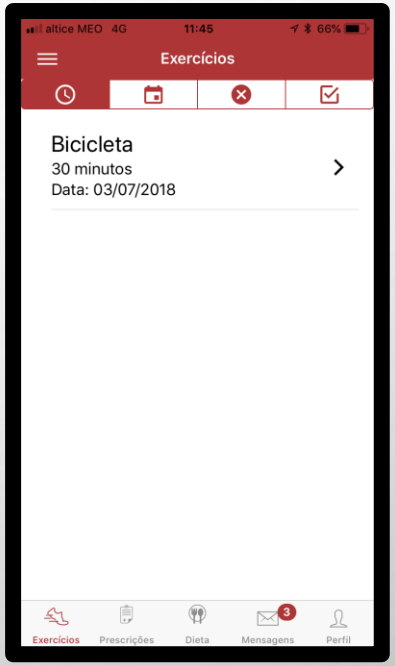
NEW TECHNOLOGIES – Virtual Care

MOVIDA.eros:





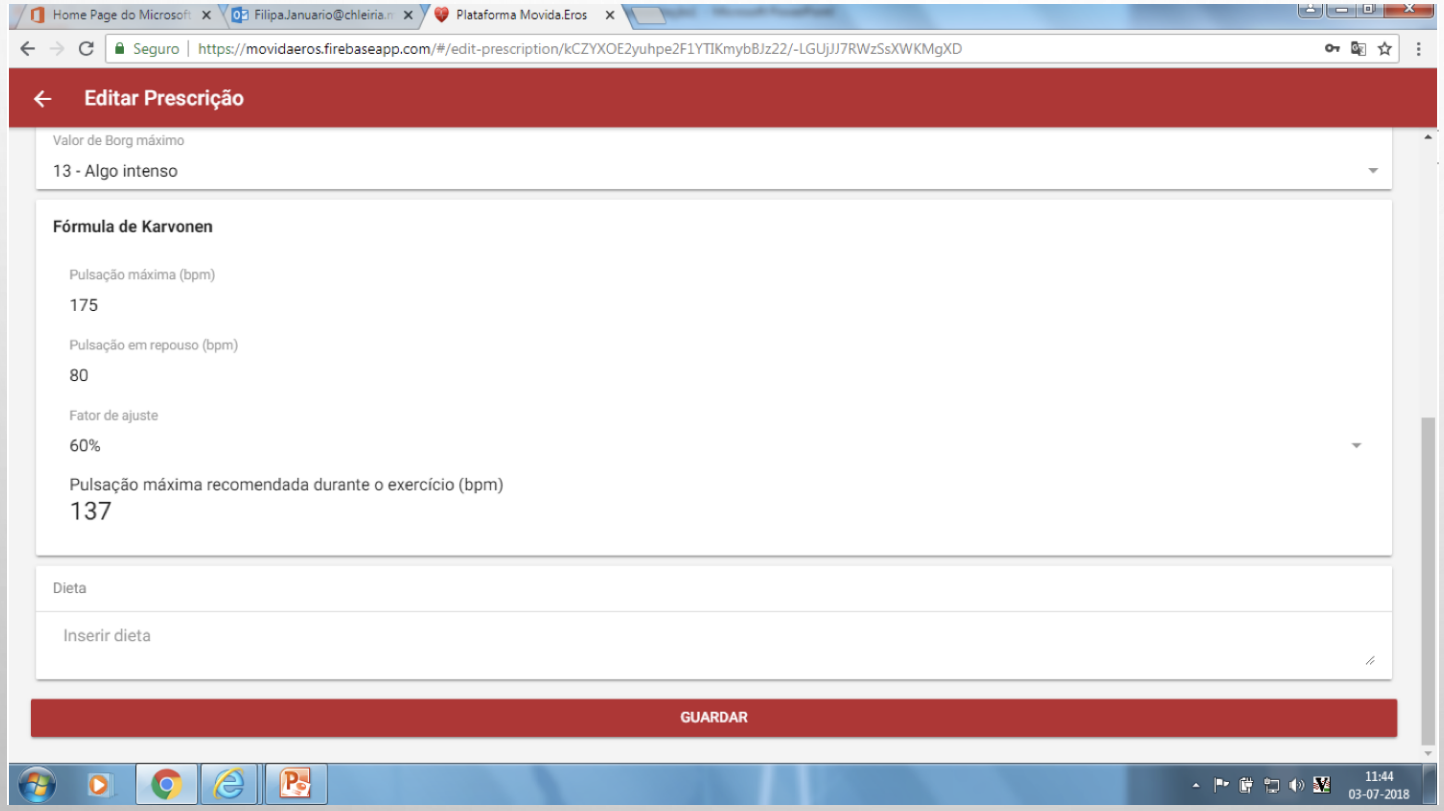




CARDIAC REHABILITATION – WHAT'S NEXT?

NEW TECHNOLOGIES – Virtual Care

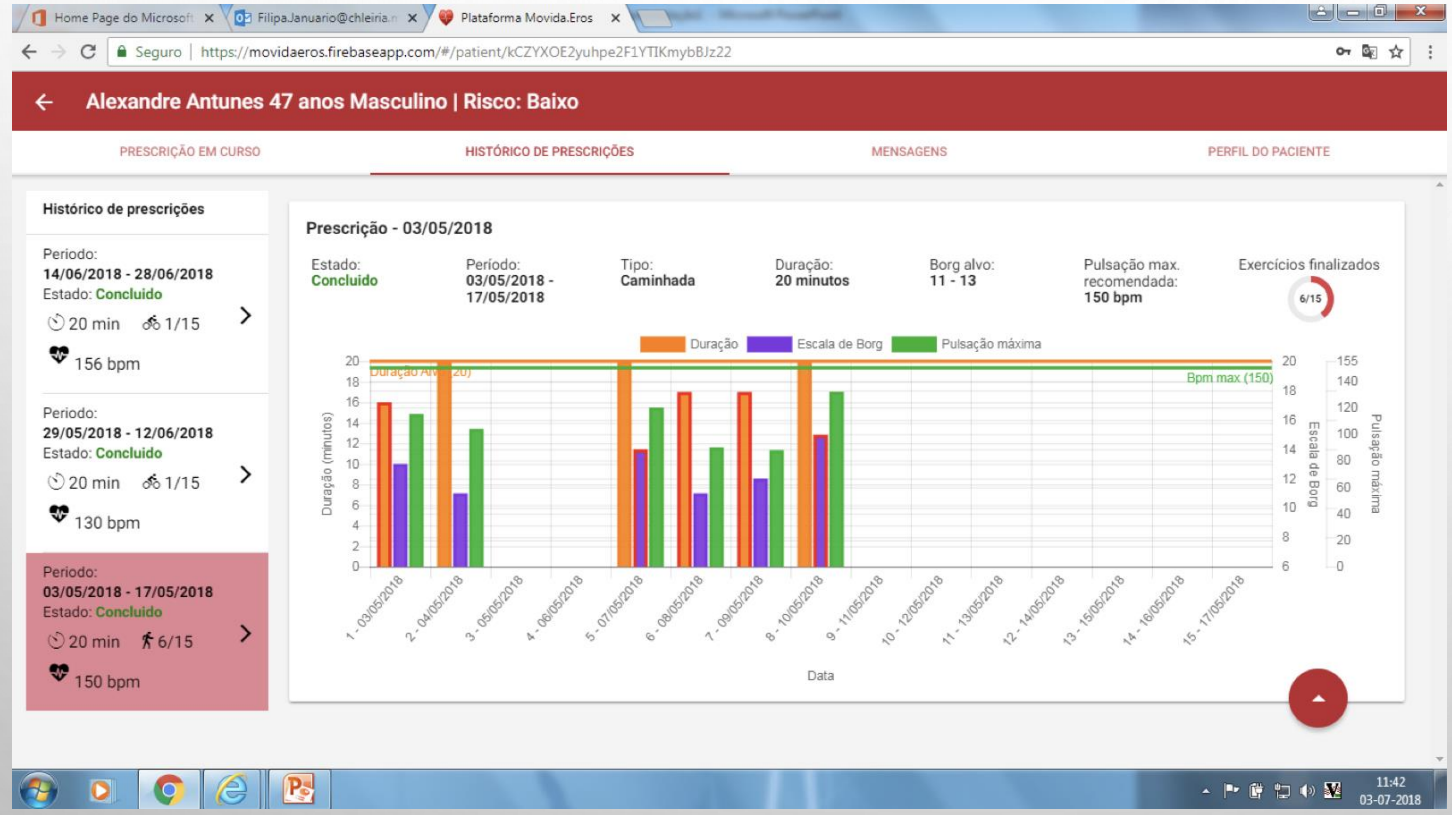
MOVIDA.eros:



CARDIAC REHABILITATION – WHAT'S NEXT?

NEW TECHNOLOGIES – Virtual Care

MOVIDA.eros:



CARDIAC REHABILITATION – WHAT'S NEXT?

NEW TECHNOLOGIES – Virtual Reality

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NEW TECHNOLOGIES – Virtual Reality

Medical training, Patient education and motivation

CARDIAC REHABILITATION – WHAT'S NEXT?

NEW TECHNOLOGIES – Virtual Reality

Medical training, Patient education and motivation