39th Cycle Training Project

The PhD in ***Cardiovascular Pathophysiology*** and Therapeutics **(*CardioPath*) is** a PhD course in cardiovascular pathophysiology and therapeutics, established in 2015.

The PhD in *Cardiopath has its* administrative seat at the University of Naples Federico II (CF 00876220633) represented by the Rector, Prof. Matteo Lorito; the course coordinator is Prof. Esposito Giovanni.

The PhD programme in '*Cardiovascular Pathophysiology and Therapeutics*' is a PhD programme in association with the University of Catanzaro and the University of Calabria.

The PhD programme in '*Cardiovascular Pathophysiology and Therapeutics*' aims to provide a systematic understanding and advanced knowledge of the pathophysiological mechanisms underlying the main cardiovascular diseases and to explore the most innovative therapies in the cardiovascular field, in a structured *from bench to bedside* approach.

The training course lasts three years and is realised with the achievement of 180 ECTS (or CFU): 60 ECTS per year. The CFU are distributed in higher education courses, research/study, webinars, theses and supervised training and research activities chosen autonomously by the doctoral student after approval by the Academic Council, also taking into account the university's strategic planning.

The course is designed to provide guidance, support and excellent training to graduates interested in understanding the physiological processes underlying the main cardiovascular diseases and in contributing to the design and development of a research project - through advanced teaching programmes and individual in-depth studies, which in many cases also include cultural exchange with other countries - and results in the elaboration of a thesis conducted with a scientific method and with the most original content possible.

The PhD programme in '*Cardiovascular Pathophysiology and Therapeutics*' promotes internationalisation through the presence of prominent **international board members.** This means that the PhD programme offers the opportunity for students to collaborate and interact with world-renowned experts from different parts of the world, thus paving the way for new perspectives and knowledge. Furthermore, the inclusion of international members in the academic college can also lead to a greater diversity of cultures and ideas, creating a more stimulating and enriching learning environment for doctoral students.

The curricular areas of the PhD programme are:

a) Heart failure, arrhythmias and hypertension.
b) Non-invasive imaging of cardio-vascular diseases;
c) Interventional cardiology;

Within these areas of interest, doctoral students will develop specific skills and competences for the correct and reasoned use of scientific research tools (from basic to clinical research) with the aim of eventually acquiring the necessary autonomy for conducting pre-clinical and clinical studies, i.e. being able to conceive, design and carry out an innovative research project, evaluating possible complex research-related problems and their solutions. In addition, PhD students should be able to further extend the available knowledge in order to improve current diagnostic and therapeutic protocols for cardiovascular diseases and propose innovative approaches, through team collaborations with other researchers and dedicated personnel.

The training course is based on the following outline:

1) educational training to provide the necessary cultural and scientific basis for research activities,

2) experimental work in the laboratory or in a clinical setting under the supervision of a tutor,

3) Training in Italy and in a foreign location.

At the beginning of the course, all doctoral students, having assessed their specific inclinations and skills, are assigned to a tutor and placed in specific contexts with the aim of acquiring and expanding scientific knowledge through participation in transversal and interdisciplinary activities.

The teaching activities are, in fact, articulated according to a training programme that promotes the acquisition of multidisciplinary and integrated knowledge through cycles of lectures and seminars held by members of the Teaching Board, by lecturers holding teaching appointments and, in the case of seminars, by eminent Italian and foreign researchers.

The organisation of the PhD in '*Cardiovascular Pathophysiology and Therapeutics*' will enable individual students to utilise the expertise of leading national and international lecturers. In view of the importance of the social aspects of cardiovascular diseases, the possibility of training PhDs with integrated knowledge from different areas of cardiology represents a strong point in the development of future diagnostic and therapeutic tools. For this reason, the lecturers of the college promote PhD research activities through orientation activities in the various teaching courses.

Course objectives

The main objective of the PhD programme in '*Cardiovascular Pathophysiology and Therapeutics*' is the advanced training of researchers specialising in the study of cardiovascular diseases. Specific objectives of the programme include:

1) Deepening of basic theoretical and practical knowledge of cardiology, with a focus on the pathogenetic mechanisms of cardiovascular diseases and prevention and treatment strategies.

2) Acquire advanced skills in research methodologies, including laboratory techniques, cardiovascular imaging, data analysis and statistics.

3) Development of independent research capabilities through the design, execution and analysis of original scientific studies.

4) Collaboration with other researchers and health professionals to develop innovative strategies for the prevention and treatment of cardiovascular diseases.

5) Presentation and publication of research results in scientific conferences and journals in order to contribute to the advancement of knowledge in the scientific community.

6) Acquire the appropriate experimental procedures to solve problems in one's own research; know how to interpret the data obtained, know how to present them at scientific congresses, know how to organise them for the preparation of a scientific publication.
7) Writing and publishing papers in high-impact international journals.

In general, the PhD aims to train researchers engaged in the fight against cardiovascular diseases, providing them with the knowledge and skills needed to develop new prevention and treatment strategies and improve the cardiovascular health of the population.

Doctoral Course Curriculum

A number of specific minimum requirements have been identified that will be objectively evaluated by the Teachers' Board at the end of the course.

Core Curriculum: Minimum objectives to be achieved in the three-year training period (at least 3 out of 4)

1. Attainment of a language certificate of at least B1 level, of knowledge of the English language according to the guidelines established by the *Common European Framework of Reference for Languages* (CEFR) and issued by an accredited body.
2. 12-month stay abroad at prestigious research institutions for training and research activities in collaborative projects.
3. Co-author in at least 2 scientific articles or alternatively co-author under the first name of at least 1 scientific article published during the three-year training period in scientific journals with strict editorial control that are listed on the two citation databases (Scopus and Web of Science) approved by the MUR for the National Scientific Habilitation (ASN) procedures.
4. Participation as a speaker (oral communication or invited paper) in at least 2 National Scientific Congresses or alternatively at least 1 International Scientific Congress.

Compulsory course for all PhD students

English language course for language improvement and the attainment of English language certifications according to the guidelines established by the CEFR (*Common European Framework of Reference for Languages*)

English is the reference language of scientific knowledge in the biomedical field. For this reason, the CLA (Centro Linguistico di Ateneo) of the University of Naples Federico II organises English language courses to prepare doctoral students for Cambridge ESOL certification.

Courses are held at the CLA premises (via Mezzocannone 16 or via Partenope 36), which has achieved the Certificate of Excellence as one of the seven Cambridge centres in the southern Mediterranean area. More information on the activities and organisation of the courses is available on the CLA's institutional website (www.cla.unina.it).

Participation in the courses for doctoral students is free of charge. For access to the English courses, doctoral students must take a *placement* test and based on the result of the test they will then be assigned to a class appropriate to their level of language proficiency (levels B1, B2, C1).

PhD students should book to take the *placement* test after the publication of the opening of registration on the CLA website (www.cla.unina.it).

The courses will be conducted according to a timetable that will be communicated by the CLA managers after the classes have been assigned. Since participation in the courses is compulsory, it should be noted that at the end of the course it will be necessary to present a certificate of participation in at least one English language course at the CLA during the three-year period. This certificate is a prerequisite for obtaining the PhD degree.

At the end of the courses, an examination for Cambridge ESOL language certification is planned, the details of which will be communicated directly by the CLA lecturers.

Objectives National Recovery and Resilience Plan (NRP)

The PhD in '*Cardiovascular Pathophysiology and Therapeutics' (CardioPaTh)* is consistent with the objectives of the PNRR (National Recovery and Resilience Plan) as it represents an investment in education and advanced training, which is one of the key elements of the plan.
In particular, the NRP aims to promote innovation, research and technological development, as well as to strengthen the country's competitiveness through the training of highly qualified people.
The doctorate, being an advanced and specialised training course, can contribute to achieving these goals by providing doctoral students with the necessary skills to carry out innovative and high quality research, developing new technologies and creating knowledge.
Furthermore, the PhD is in line with the priorities of the NRP in specific areas, such as health, digitisation, skills and training, research, innovation and internationalisation.

The PhD programme in *Cardiovascular Pathophysiology and Therapeutics (CardioPath)* fits coherently into this context insofar as its main mission is to train researchers capable of managing research projects in the academic field through the acquisition of numerous skills in the field of biomedical research guaranteed by the synergies between the areas involved in the training programme.
Several features of *CardioPath* contribute to defining its vision and mission consistent with the objectives of the PNRR. For this reason, already in the 38th Cycle *CardioPath* received additional grants financed with PNRR funds.
Doctoral students holding these specific scholarships will follow specific research projects that will have to deal with topics aimed at a significant development of knowledge in the fields of interest of the NRP.

Furthermore, the training course must favour the involvement of other research centres and must necessarily include a period of study and research abroad of twelve (12) months. Finally, doctoral students holding these additional scholarships will be subject to a programme of verification and reporting ofactivities as provided for by the MUR.

The PhD in *'Cardiovascular Pathophysiology and Therapeutics' (CardioPath),* therefore, is consistent with the objectives of the NRP in that
A. concerns topics with a strong scientific-technological vocation in the field of cardiovascular diseases;
B. promotes internationality
C. provides for the implementation of the entire PhD programme at the Federico II University, except for periods of study and research abroad;
D. provides for study and research periods abroad of twelve (12) months;
E. ensures that the doctoral student benefits from qualified and specific operational and scientific facilities for study and research activities;
F. promotes the exploitation of research results and ensures the protection of intellectual property.
G. promotes integration into the world of work, demonstrated by the high employment rate of doctoral students from previous cycles.

The 39th cycle envisages no. 6 PNRR-funded grants (no. 3 PNRR Research area; no. 2 Public Administration area, of which no. 1 received from the University of Calabria, no. 1 PNC-HLS- DH from CIRMIS).

The themes identified are:

1. Multidisciplinary Study on Atrial Fibrillation: Understanding, Diagnosing and Treating'.

Objective: To explore atrial fibrillation in depth, identifying risk factors, developing new techniques for diagnosis and treatment, and promoting a better understanding of the underlying mechanisms of this disease.

2. Interdisciplinary Mechanisms between the Cardiovascular and Other Systems

Objective: To investigate the interactions between the cardiovascular system and other biological systems, focusing on neural, immune and endocrine regulatory mechanisms. The study aims to identify how these interactions influence cardiovascular health, opening new avenues for the prevention and treatment of heart disease.

3. Innovative Techniques in the World of Cardiology

Objective: This project focuses on the research, development and application of innovative technologies in cardiology, including new cardiac imaging modalities, big data analysis and telemedicine. The aim is to improve the diagnosis, monitoring and treatment of cardiovascular diseases.

4. Innovative Techniques in the World of Interventional Cardiology

Objective: This fellowship will focus on the development of new technologies and methodologies for interventional cardiology procedures, such as angioplasty and stent implantation. The aim is to improve the efficacy and safety of such procedures, enabling a faster recovery of patients. Fundamental is the collection of data for statistical studies through the collaboration of public administrations.

5. Innovative Techniques in Interventional Cardiology Objective: This

fellowship will focus on the development of new technologies and methodologies for procedures interventional cardiology. The aim is to improve the effectiveness and safety of these procedures, enabling a faster recovery of patients. Fundamental is the collection of data for statistical studies through the collaboration of public administrations.

6. Innovative technologies in the context of cardiovascular diseases in the CIRMIS area

Objective: Innovative technologies to improve the process of planning, intervention and monitoring of patients will be considered.

Planned/planned teaching activities

The *CardioPath* programme aims to provide a systematic understanding and knowledge of the pathophysiological mechanisms underlying heart disease and to expose people to state-of-the-art cardiovascular therapies.

The educational activities of the *CardioPaTh* doctoral programme consist of:

- Advanced training courses scheduled at the beginning of the year
- Webinar, continuously updated
- Research-related activities

- Training and research activities independently chosen by the doctoral student and approved by the Academic Board

The training activities of the *CardioPaTh* PhD programme focus on five main areas of interest:

a) Heart failure;
b) Arrhythmia and Electrophysiology;
c) Non-invasive diagnostics of cardiovascular diseases;
d) Interventional cardiology;
e) Arterial hypertension.

The training activities are theoretical, methodological and experimental, within Cardiology or transversal to other medical disciplines, aimed at developing the following skills:

a) Get to know the research tools (*from bench to bedside*) that enable a deeper understanding of the mechanisms and therapies of cardiovascular diseases;
b) Being able to conceive, design and execute a research project;
c) To develop the necessary skills to synthesise and evaluate possible complex problems related to research or innovation projects and how to overcome them;
d) To be able to further extend available knowledge in order to improve current diagnostic and therapeutic protocols for cardiomyopathies and propose innovative approaches.

PhD students are expected to participate in cultural initiatives, meetings, congresses, workshops at national and international level. PhD students will be encouraged to publish the results of their research activities as abstracts, manuscripts and publications in international journals. A compulsory training activity of at least 12 months at a non-Italian research or academic institution is envisaged.

The 3-year PhD Course

The doctoral course is spread over three years as follows:

1. During the first year, the doctoral student will choose together with his/her supervisor(s) the main research topic that he/she will develop over the 3 years. Training activities will take the form of webinars and advanced training courses specific to the chosen curriculum, as well as research-related activities.
2. During the second year, the doctoral student will consolidate his or her research activity by conducting research programmes preferably in a foreign location. The latter obligation may also be activated during the first year. Training activities will take the form of webinars and specific advanced training courses, as well as research-related activities.
3. During the third year, the doctoral student will be encouraged to finalise his or her research through the publication of its results and will devote adequate time to the preparation of the final thesis. Training activities will take the form of webinars and specific advanced training courses, as well as research-related activities.

Il dottorando è tenuto a conseguire 60 CFU annui così ripartiti:

	Corsi di alta formazione (min-max CFU)	Webinar (min-max CFU)	Attività legate alla ricerca (min-max CFU	Attività indipendenti di formazione e ricerca (min-max CFU)	CFU (o CFU)
1° Anno	4-8	16-20	20-28	8-16	60
2° Anno	4-8	16-20	20-28	8-16	60
3° Anno	0	8-16	10-18	34-42	60

Higher education courses:

- Basic and advanced statistical evaluation of research results;
- English;
- Design and management of clinical or translational studies;
- Courses already activated at Academic Institutions in the CardioPaTh network.

Webinar:

- National and international lecturers will hold web seminars (e.g. webinars) on topics of interest to cardiovascular research.
- PhD students are expected to devote adequate time to the preparation of each webinar by critically evaluating the available literature on the topic.
- Webinars are facilitated in order to encourage the doctoral student's development of critical thinking and stimulate debate and interaction with the faculty.
- The list of webinars is at cardiopath.eu/seminars

Research-related activities:

- These are activities related to research topics of interest in the form of participation as a participant in workshops, conferences and congresses.
- Involvement in collaborative research projects aimed at the doctoral student's scientific growth with research groups and laboratories outside the *CardioPaTh* network.
- Doctoral students could also be involved in limited integrated teaching activities during master's degrees.
- Research activities carried out on the foreign

campus Independent training and research activities:

- They include all the research activities approved by the Academic Council carried out independently by doctoral students in connection with the preparation of their final thesis.
- PhD students will be encouraged to present the results of their research at meetings in the form of abstracts, oral presentations.
- Publications will be considered according to position in the authorship: greater value will be given to the first and last authorship, or to the address for correspondence. Co-paternity will also be considered.

Course Title	CFU	Hours	Lecturer	Year
-Preclinical models of cardiovascular disease -Alteration of endothelial function in cardiovascular diseases. -Molecular mechanisms of heart failure	1	25	Prof. Michele Ciccarelli	1
-Acute aortic syndrome -Post implantation syndrome -Pulmonary pressure response exercise -Insights from the International Ref gistry Acute Aortic Dissection (IRAD)	1	25	Prof. E. Bossone	1
-Hypertensive Urgencies and Emergencies -Benefit of Physical activity and cardiorehabilitation -Echo and fluid balance in ICU -CardioVascular Emergency Organisation	1	25	Prof. N.De Luca	1
-Role of sex and gender in preclinical models of cardiovascular disease -Role of gut microbiota in cardiovascular health and disease -Induced pluripotent stem cells in cardiovascular disease	1	25	Prof. C. Perrino	1
-Unexaplined left ventricular hypertrophy: genetic and clinical aspects -New medical treatments in hypertrophic cardiomyopathy Amyloidosis aTRR: wt and genetic disease -Fabry-Anderson disease -The restrictive cardiac pathophysiology: implication for the correct medical treatment	1	25	Prof. M. Losi	1
-Impact of physical activity and exercise on the physiology of the Musculoskeletal system -Assessment of physical needs -The prescription of adapted physical activity -The impact of prescription in the main chronic pathologies	1	25	Prof. G. Iaccarino	2
-Obesity and heart failure -Insulin resistance and hypertension -Vitamin d and insulin resistance	1	25	Prof. C. Morisco	2
-COVID-19 and endothelial function: from the lab to clinical trials -Ketone bodies in heart failure -Calcium: from arrhythmias to diabetes -SGLT2 inhibitors and cardiovascular health	1	25	Prof. G. Santulli	2
-New atrial fibrillation ablation techniques -Percutaneous closure of the auricula in the prevention of cardioembolic risk -Treatment of cardiac disorders in patients with heart failure -Modulation of cardiac contractility in the treatment of heart failure	1	25	Prof. A. Rapacciuolo	2

Lessons will be held in the months between March and October 2024 in one of the following ways according to to the Covid-19 health emergency: a) AT A DISTANCE on the specific University digital platform Microsoft Teams, b) IN PRESENCE at the "Condarelli" Lecture Hall (Building 2, Ground Floor). The final arrangements together with the calendar with dates and times will be communicated by email to all PhD students.

Employment opportunities

The PhD in '*Cardiovascular Pathophysiology and Therapeutics*' offers several employment opportunities, including:

1. Academic career: graduates of the PhD programme in '*Cardiovascular Pathophysiology and Therapeutics*' can pursue an academic career as researchers, university professors or specialised lecturers at research institutes or universities.

2. Clinical research: graduates of the PhD in cardiology can work as clinical researchers at research institutes, health centres or pharmaceutical companies, where they are involved in the development of new drugs or treatments for cardiovascular diseases.

3. Public health: graduates of the PhD in cardiology can work as consultants or managers in public or private health care, developing campaigns for the prevention and treatment of cardiovascular diseases.

4. Biomedical industry: cardiology PhD graduates can work as consultants or technical experts in biomedical companies, where they are involved in the design and development of medical devices and innovative treatments for cardiovascular diseases.

5. Non-profit organisations: cardiology PhD graduates can work as consultants or managers in non-profit organisations involved in the prevention and treatment of cardiovascular diseases, such as the Italian Heart Foundation or the Italian Association for Cardiovascular Disease Research.

Overall, the PhD in '*Cardiovascular Pathophysiology and Therapeutics*' offers multiple career opportunities in academia, industry and healthcare, both in Italy and abroad.

A PhD student in *CardioPath* pursues an advanced education that focuses on research and study of the heart and cardiovascular system. During the PhD programme, the PhD student will acquire advanced skills and knowledge in areas such as cardiovascular anatomy and physiology, cardiac pathology, diagnosis and treatment of heart disease, clinical research and research methodology.

After completion of the PhD, the PhD student has several career opportunities
working closely with cardiology physicians and other healthcare professionals to develop new methods of diagnosing and treating heart disease, collaborating in the design and conduct of clinical trials, analysing data and writing scientific articles for publication in peer-reviewed journals.