



Dottorato di Ricerca in *Cardiovascular Pathophysiology and Therapeutics*
Coordinatore: Prof. Giovanni Esposito

(Approved by the Academic Board in the session of 10.07.2023)

1. INTRODUCTION

The PhD in *Cardiovascular Pathophysiology and Therapeutics* (*CardioPath*) is a PhD course in cardiovascular pathophysiology and related therapies with administrative headquarters at the University of Naples Federico II, in the Department of Advanced Biomedical Sciences and is a PhD in associated form with the University of Catanzaro and the University of Calabria.

The **ongoing design document (39th cycle)** was drawn up in accordance with the AVA 3 system (Self-assessment, Evaluation, Accreditation), approved with resolution of the Board of Directors No. 26 of 02/13/2023 and with Ministerial Decree 226/2021 (procedures for accrediting locations and doctoral courses), on the basis of the indications provided by the PQA (University Quality Control) of the Federico II University , according to the indications present in the points of attention and in the aspects to be considered.

The PhD in “ *Cardiovascular Pathophysiology and Therapeutics* ” lasting three years, 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 path *from bench to bedside* .

The course is aimed at providing guidance, support and excellent training to graduates interested in understanding the physiological processes underlying the main cardiovascular diseases and contributing to the elaboration and development of a research project – through advanced teaching programs and individual study, which also include cultural exchange with other countries - and takes the form of the elaboration of a thesis conducted with a scientific method and with the most original contents possible.

The curricular areas of the PhD program are:

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

The teaching staff is made up of expert and qualified professors in different sectors:

MED/11- DISEASES OF THE CARDIOVASCULAR SYSTEM
MED/50- APPLIED MEDICAL TECHNICAL SCIENCES
MED/09- INTERNAL MEDICINE
BIO/09- PHYSIOLOGY

The Board is made up of numerous professors and, as per ministerial provisions, the members are chosen on the basis of a criterion of high scientific qualification (ref. art. 4, c. 1, lett . b, of DM n. 45/2013) . At the following link the establishment of the teaching staff: <https://www.cardiopath.eu>

The PhD in “ *Cardiovascular Pathophysiology and Therapeutics* ” promotes **internationalization** through the presence of high-profile international college members. This means that the PhD program provides the opportunity for students to collaborate and interact with world-renowned experts from different parts of the world, thereby paving the way for new perspectives and knowledge. Furthermore, the inclusion of international members in the academic board can also lead to a greater cultural and ideas diversity, creating a more stimulating and enriching learning environment for PhD students (inherent in the objectives formalized in the PNRR).



Furthermore, to favor integration with the production system and collaboration with other institutions, over time the financing of additional scholarships to those of the University has been promoted, through the stipulation of specific agreements, both with Italian and foreign public bodies, with private companies.

2. OBJECTIVES OF THE TRAINING COURSE

The PhD in “ *Cardiovascular Pathophysiology and Therapeutics* ” has as its main objective the advanced training of researchers specialized in the study of cardiovascular diseases. Specific program objectives include:

- 1) Deepening of the basic theoretical and practical knowledge of cardiology, with particular attention to the pathogenetic mechanisms of cardiovascular diseases and to prevention and treatment strategies.
- 2) Acquisition of advanced skills in research methodologies, including laboratory techniques, cardiovascular imaging , data analysis and statistics.
- 3) Developing independent research capabilities through the design, execution and analysis of original scientific studies.
- 4) Collaborate with other researchers and health professionals to develop innovative strategies for the prevention and treatment of cardiovascular disease.
- 5) Presentation and publication of research results in conferences and scientific journals, in order to contribute to the advancement of knowledge in the scientific community.
- 6) Acquire the experimental procedures suitable for solving the problems of one's own research; knowing how to interpret the data obtained, knowing how to present them at scientific congresses, knowing how to organize them for the preparation of a scientific publication.
- 7) Drafting and publication of 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 necessary to develop new prevention and treatment strategies and improve the cardiovascular health of the population.

PhD 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 acquiring at the end the autonomy necessary to conduct pre-clinical and clinical studies or be able to conceive, design and carry out an innovative research project, evaluating the possible complex problems related to the research and the relative solutions. Furthermore, PhD students will have to be able to further expand the available knowledge in order to improve the current diagnostic and therapeutic protocols of cardiovascular diseases and propose innovative approaches, through team collaborations with other researchers and dedicated personnel.



3. TRAINING

3.1 Educational activity

The training course includes:

- didactic training to provide the cultural and scientific foundations necessary for the research activity,
- experimental work in the laboratory and in the clinic under the supervision of a Tutor,
- training in Italy and in a foreign location.

At the beginning of the course, all PhD students, having assessed their specific inclinations and skills, are entrusted to a Tutor and placed in specific contexts with the aim of acquiring and expanding scientific knowledge through participation in activities related to their background .

The teaching activities are, in fact, organized according to a training program that promotes the acquisition of specific (multidisciplinarity) and integrated (transdisciplinarity) knowledge through cycles of frontal lessons and seminars held by members of the Academic Board, by Professors holding positions of teaching and, in the case of seminars, by eminent Italian and foreign researchers (interdisciplinarity).

The training course lasts 3 years and is achieved with the achievement of 180 credits: 60 credits per year. The credits are distributed in advanced training courses, research/study, *webinars* , theses and supervised training and research activities autonomously chosen by the PhD student after approval by the Academic Council, also taking into account the [university's strategic planning](#) .

The training activities are theoretical, methodological and experimental, in the field of diseases of the cardiovascular system and other medical disciplines, with the aim of developing the following skills:

- a) Know the research tools (from the bench to the patient's bed) that allow to deepen the mechanisms and therapies of cardiomyopathies;
- b) Be able to conceive, plan and implement a research project;
- c) develop the necessary ability to synthesize and evaluate any complex problems associated with research or innovation projects and how to overcome them;
- d) be able to further expand the knowledge available to improve the current diagnostic and therapeutic protocols of cardiomyopathies and propose innovative approaches.

PhD students are required 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 activity in the form of *abstracts* , manuscripts and publications in *peer-reviewed journals* . For PhD students there is a mandatory 12-month training activity at a non-Italian academic or research institution.

In addition, the Federico II University annually publishes a call for applications, reserved for doctoral students, for the conferment of assignments for tutoring and didactic-integrative, preparatory and recovery activities , to be carried out in the academic year . solar.

The PhD course develops over 3 years, organized as follows:

1. During the first year, the PhD student will choose together with his supervisor (or supervisors) the main research topic that will be developed over the three years. The training activities will take place below



form of *webinars* and advanced training courses specific to the chosen curriculum, as well as with research-related activities.

2. During the second year, the PhD student will consolidate his/her research activity through the execution of research programs preferably on a non-Italian campus. The latter requirement could also start during the first year. The training activities will take the form of webinars and specific training courses for the chosen curriculum, as well as with research-related activities.
3. During the third year, the PhD student will be encouraged to finalize his research through the publication of the relevant results and will devote adequate time to the preparation of the final thesis. The training activities will take the form of webinars and advanced training courses specific to the chosen curriculum, as well as with research-related activities.

The PhD student is required to achieve 60 credits per year as follows:

	Advanced training courses (min-max ECTS)	Webinars (min-max ECTS)	Research-related activities (min-max ECTS)	Independent training and research related activities (min-max ECTS)	ECTS (or CFU)
1 st Year	4-8	16-20	20-28	8-16	60
2 nd Year	4-8	16-20	20-28	8-16	60
3 rd Year	0	8-16	10-18	34-42	60

The lessons will be held in one of the following ways :

a) REMOTELY on the specific digital platform of the University Microsoft Teams, b) IN THE PRESENCE in the " Condarelli " Hall (Building 2, Ground Floor).

The definitive modalities together with the calendar with dates and times are communicated via email to all PhD students and will be visible on the official website and on the official calendar on the dedicated digital platform (Microsoft Teams):

<https://teams.microsoft.com/l/team/19%3af1qvcvwPzji9BA9YoWkIxmzcJiWgdDPKYt9nbn8qAv81%40thead.tacv2/conversations?groupId=a0f6278c-6d42-4491-9889-4ac671d0874b&tenantId=2fcfe26a-bb62-46b0-b1e3-28f9da0c45fd>

Seminars, courses, scientific events are communicated via email to all PhD students and will be visible on the official website: <https://www.cardiopath.eu/seminars>.

3.2 Research activity

The *CardioPath program* promotes education and research in the emerging fields of cardiovascular pathophysiology, diagnostics, and therapy. It operates within research centers of excellence and promotes the integration between research and clinical practice.

Our campuses are distinguished by:

- scientific excellence of the groups



- State-of-the-art centralized facilities
- Strong connection with clinical practice
- Strong international vocation
- Excellent publications

This practical learning program is made possible thanks to the wide availability of instrumental resources and advanced technologies in the laboratories of the related university departments. Furthermore, the training/experimental path foresees the inclusion of all PhD students in departmental research projects with the aim of enabling them to acquire the experimental skills typical of the related Curriculum and to promote the participation of PhD students in collaborative research projects.

The autonomous growth of doctoral students, of their critical spirit and their communication skills, is also pursued by periodic comparison with colleagues at the time of periodic presentation of the experimental data obtained during the execution of the thesis project.

The doctoral course also guarantees products directly attributable to the doctoral student. On the site, <https://www.cardiopath.eu>, in the alumni section, there are the references produced for each individual doctoral student.

As part of their educational-scientific activities, the PhD students will spend a stay of study and advanced research at prestigious university and research institutions in the United States and Europe. Furthermore, as per the provisions of the MUR, all doctoral students have access to an annual budget dedicated to supporting the doctoral student's training and research activity in Italy and abroad.

3.3 Intermediate and final checks

At the end of each academic year, the doctoral student must submit a written report (**Annual report of the doctoral students**) on their scientific and educational activities. Based on the evaluation of these activities, the Academic Council has the right to exclude the student from continuing with the doctorate with a written justification. Any extensions can be requested based on the current legislation of the Institution which will assume administrative responsibility for the student and with the consent of the supervisor and at least one co-supervisor.

The doctoral thesis is written in English, accompanied by an *abstract* both in English and in Italian. At the end of the course, the Academic Council formulates an evaluation of the thesis, the activities carried out during the course and the publications for each doctoral student. The thesis, a report by the PhD candidate on the activities carried out during the PhD course, can be evaluated by 2 researchers ("evaluators") not involved in the PhD programme. The evaluators, who are not part of the final examining commission, formulate a written evaluation of the thesis, approving the final discussion of the thesis or proposing further additions or corrections to the thesis itself, possibly delaying (by no more than 6 months) the final discussion.

The examination commission expresses an in-depth evaluation of the doctoral student with the following marks: sufficient, good, excellent. The examining commission can unanimously assign the doctorate " cum laudae " in case of scientific excellence of the results achieved.

Furthermore, some specific requirements have been identified which will be objectively assessed by the Academic Board at the end of the course:



1. Achievement of a linguistic certification 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. Research activity carried out during a 12-month stay abroad at prestigious research institutions for training and research activities in collaborative projects.
3. Co-author of at least 2 scientific articles or alternatively first-name co-author of at least 1 scientific article, published during the three-year training period in scientific journals with strict editorial control that are registered in the two citation databases (Scopus and Web of Science) approved by the MUR for the National Scientific Qualification procedures (ASN).
4. Participation as a speaker (oral communication or invited report) in at least 2 national scientific congresses or alternatively to at least 1 international scientific congress.

4. CONSISTENCY WITH THE OBJECTIVES OF THE PNRR

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 advanced education and training, which is one of the key elements of the plan.

In particular, the PNRR aims to promote innovation, research and technological development, as well as to strengthen the country's competitiveness through the training of highly qualified figures.

The doctorate, being an advanced and specialized training path, can contribute to achieving these objectives by providing doctoral students with the skills necessary to carry out innovative and high-quality research, developing new technologies and creating knowledge.

Furthermore, the doctorate is in line with the priorities of the PNRR in some specific sectors, such as health, digitalisation, skills and training, research, innovation and internationalisation.

The PhD in *Cardiovascular Pathophysiology and Therapeutics* (*CardioPath*) fits coherently into this context as its main mission is the training of researchers capable of managing research projects in the academic field through the acquisition of numerous skills in the field of biomedical research and technological development, guaranteed from the synergies between the areas involved in the training course. Numerous features of the *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 scholarships financed with funds from the PNRR.

The doctoral students holding these specific scholarships will follow specific research projects which must concern topics aimed at bringing about a significant development of knowledge in the areas of interest of the PNRR.

Furthermore, the training course must favor the involvement of other research centers and must necessarily include a period of study and research abroad of twelve (12) months. Finally, PhD students holding these additional scholarships will undergo a program of verification and reporting of activities as required by the MUR.

The PhD in “ *Cardiovascular Pathophysiology and Therapeutics* ” (*CardioPath*), therefore, is consistent with the goals of the PNRR in that:

- A. it concerns topics with a strong scientific-technological vocation in the field of cardiovascular diseases;
- B. promotes internationalization
- C. provides for the implementation of the entire doctoral program at the Federico II University , with the exception of periods of study and research abroad;
- D. includes periods of study and research abroad of twelve (12) months;
- E. ensures that the PhD student benefits from qualified and specific operational and scientific structures for study and research activities;
- F. promotes the exploitation of research results and guarantees the protection of intellectual property.



G. it favors entry into the world of work, demonstrated by the high percentage of employment of doctoral students from previous cycles.

5. RESOURCES

5.1 Federico II University of Naples

EDUCATIONAL AND SCIENTIFIC FACILITIES (Departments, Laboratories, Centers, etc.): Within the Department of Advanced Biomedical Sciences, the Cardiology Division has the following research laboratories:

Building no. 2 (University Headquarters - Via Pansini n. 5, Naples):

- a) Histology laboratory;
- b) Laboratory of Experimental Surgery;
- c) Laboratory of Molecular Biology;
- d) Laboratory for Radioisotopic Assays;
- e) Laboratory of Molecular Physiology;
- f) Laboratory of Physiology of Isolated Organs;
- g) Laboratory of Cell Biology;
- h) Stabularium for small animals.

Building no. 20 (University Campus - Via Pansini n. 5, Naples):

- a) Toxicology Laboratory;
- b) Laboratory of Histology and Regenerative Medicine.

Building no. 6 (University Campus - Via Pansini n. 5, Naples):

- a) Laser Laboratory in Biomedical Application.

OTHER RESOURCES (e.g. libraries, equipment, facilities, databases, etc.):

- 1) Library (Building n. 20, University Campus - Via Pansini n. 5, Naples);
- 2) Full access to 117 electronic cardiology journals within the Academic Center for Electronic Libraries of the Federico II University of Naples;
- 3) The electronic database that collects more than 10,000 hypertensive patients as part of the "Campania Salute" project.

Computer workstations are available in the libraries and laboratories for consulting online periodicals available at the virtual library of the Federico II University of Naples.

Also, they are available structures including multimedia classrooms of different sizes equipped with modern equipment projection audiovisual complete Of connection in net with system Wifi. Thank you to This support electronic and structural, PhD students will have access as part of the experimental activity programme to a series Of banks data experimental And Of patients entered in Education clinicians multicentric. Furthermore, Almost all the equipment necessary For there research in field biomedical I am managed from software natives provided by the manufacturing companies which allow the functioning of the equipment itself, the management of the results generated and statistical analysis. Each doctoral student will then have access, through his personal credentials, to numerous software that can be used for teaching and research such as the entire Office 365 ProPlus Suite , matlab, Simulink And others tools MathWorks .



5.2 Magna Graecia University of Catanzaro

EDUCATIONAL AND SCIENTIFIC FACILITIES (Departments, Laboratories, Centers, etc.):
Within the Department of Medical and Surgical Sciences, the Division of Cardiology has the following research laboratories:

- 1) Cardiovascular Research Center (Ed. Biosciences, Level 7)
 - 2) Cardiology Laboratory (Ed. Biosciences, Level 7)
 - 3) Animal enclosure for small animals (Ed. Biosciences, Level 9)
 - 4) Multimedia Room for Teaching and Training (Ed. A, Level 2)
- OTHER RESOURCES (e.g. libraries, equipment, facilities, databases, etc.):
- 1) Library (Ed. A Level 3)
 - 2) Instrumentation for molecular biology, cell biology and basic biochemistry, cell culture, flow cytometry and fluorescence microscopy, Q-PCR, analysis of proliferation, apoptosis and transcriptional activity based on bio- and chemiluminescence determination . (Ed. Biosciences)

5.3 University of Calabria

- EDUCATIONAL AND SCIENTIFIC FACILITIES (Departments, Laboratories, Centers, etc.):
- 1) Laboratory of Cellular and Molecular Cardiac Physiopathology, Cube 6 c ground floor, Via Ponte Pietro Bucci, Rende (CS), Operative Unit of the National Institute for Cardiovascular Research (INRC; Bologna). The structure is composed as follows:
 - 1) Organ Perfusion Section, cube 6c ground floor and second floor;
 - 2) Molecular Biology section (human and murine primary and secondary cultures; molecular techniques such as Western blot , qPCR , gene silencing , immunoprecipitation and ChIP ; Immunometry for the study of proteins, genes and enzymes and spectroscopies for metabolomic and lipidomic studies);
 - 3) section of Anatomy (cytological and histological techniques) and makes use of the support of the Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) facility .
- OTHER RESOURCES (e.g. libraries, equipment, facilities, databases, etc.):
- 1) Area-Technical-Scientific Library, Unical ; Piazza Chiodo, Block 2, Arcavacata di Rende (CS); Library of the Department of Pharmacy and Nutrition and Health Sciences (multipurpose building, Campus of Arcavacata di Rende (CS);
 - 3) Full access to the databases: database of protein sequences; protein interaction database; database of DNA and protein sequences; database of protein domains.
 - 4) Software specifically related to the envisaged research sectors, such as Graphpad for statistical analysis of biological data, PowerLab data acquisition system for analysis of physiological parameters of organ perfusion, ImageJ 1.6 software (NIH) for digitalized analysis of images in the biological field

6. ORIENTATION ACTIVITIES AND MEASUREMENT OF SATISFACTION WITH THE RESEARCH DOCTORAL COURSE FOR GRADUATE STUDENTS

The teachers of the Collegio, in addition to participating in the PhD course, also carry out teaching and internship activities for students enrolled in various master's degree courses and specialization schools at the University of Naples Federico II, including Medicine and Surgery, Dentistry and Dental Prosthetics, Medical Biotechnology, Pharmaceutical Biotechnology and Human Nutrition Sciences. This didactic activity is completed by an orientation activity for students attending the last year of these courses, which consists in the description of the postgraduate training options.

In order to intervene quickly and efficiently by making changes to the training course, the Collegio Docenti uses a system for monitoring processes, research results, satisfaction with the training offer and, for doctors who have completed the PhD cycle, with the impactoccupational That has had The achievement of the title Of Doctor Of Research.

In order to facilitate the implementation of the AVA3 system, starting from the academic year . 2022/2023 will be used i questionnaires



prepared by ANVUR. The questions in the questionnaires administered offer PhD students and PhD students the opportunity to express their opinion on the quality of the training received during the PhD Course and to report any elements of satisfaction/dissatisfaction.

7. EMPLOYMENT OPPORTUNITIES

The PhD in “ *Cardiovascular Pathophysiology and Therapeutics* ” offers several opportunities for outlet employment, between which:

1. Academic career: PhD graduates in “ *Cardiovascular Pathophysiology and Therapeutics* ” they may pursue an academic career as a researcher, university professor or lecturer specialized at institutes Of research or university.
2. Clinical Research: Graduates of the cardiology doctorate can work as clinical researchers at research institutes, health centers or pharmaceutical companies, where they are involved in the development of new drugs or treatments For the illnesses cardiovascular.
3. Public Health: Cardiology doctoral graduates can work as consultants or managers in public or private health sector, developing disease prevention and treatment campaigns cardiovascular.
4. Biomedical Industry: Graduates of the cardiology doctorate can work as consultants or experts technicians at companies biomedical, in which Yes they occupy of the design And development Of devices doctors And treatments innovative For the illnesses cardiovascular.
5. Non-Profit Organizations: Cardiology doctoral graduates can work as consultants or responsible at organizations no profit That Yes they occupy Of prevention And treatment from the illnesses cardiovascular, such as the Italian Heart Foundation or the Italian Association for Research on Illnesses Cardiovascular.

In general, the PhD in “ *Cardiovascular Pathophysiology and Therapeutics* ” offers multiple opportunity to career in scope academic, industrial And sanitary, is in Italy That abroad.

PhD student in *CardioPath* pursues an advanced education that focuses on the research and study of heart and cardiovascular system. During the PhD course, the PhD student will acquire skills and advanced knowledge in areas such as cardiovascular anatomy and physiology, cardiac pathology, diagnosis And The treatment from the heart disease, there research clinic And the methodology Of research.

After The completion of the doctorate Of research, The PhD student has several opportunity to career closely with cardiology specialists and other health professionals to develop new methods Of diagnosis and treatment from the illnesses cardiac, collaborating at the design and unfolding Of Education clinicians, analyzing the data And writing articles scientific For the publication in magazines specialized.