Cardiovascular diseases (CVD) are one of the leading causes of death worldwide, leading to 17.9 million deaths each year. CVD is a general term covering a wide range of disorders of the heart and blood vessels that most commonly affect people over the age of 60. Congenital heart disease (CHD) is one of the causes of chronic CVD, which is the most common cause of congenital pathologies and the most common congenital malformation, affecting almost 1% of all live births. In 2019, CHD was the leading cause of 217,000 deaths, of which 150,000 deaths were in infants under 1 year of age. A quarter of children affected by coronary heart disease will require major reconstructive surgery in their lifetime. Although significant improvements have been made in the treatment of congenital heart defects in recent decades, they remain the leading cause of death in the neonatal period. In the treatment of CHD, grafts made of synthetic materials such as polytetrafluoroethylene (PTFE or Gore-Tex) are used, which are prone to strictures, thromboembolism and infections. Graft failure rates have been reported to be 70 to 100% over 10 years. Therefore, patients require a series of reoperations to replace failed grafts, each of which is associated with mortality. Vascular tissue engineering provides a potential solution to these limitations.

The main goal of the project is to produce innovative bioimplants using the highly reproducible 3D bioprinting technique. The project involves the use of polymers of natural origin and synthetic polymers to produce the so-called bioink for direct 3D printing. Natural polymers with unique biological properties and mechanical properties, biodegradability, biocompatibility and bioresorbability will be used in combination with synthetic polymers with specific topography and fiber architecture, aimed at improving the stability and mechanical properties of the scaffolds. An additional advantage of the project is the addition of anti-inflammatory agents. The detailed impact of 3D-printed grafts on cell growth and behavior as well as interactions between two types of human cells (cardiomyocytes and endothelial cells) will be studied *in vitro* and in a designed *ex vivo* system that simulates blood flow. At each stage of the project, the bioprinted 3D construct will undergo a series of biological tests to verify its biocompatibility, as well as physicochemical and mechanical tests. The project aims to produce a highly stable cellular prosthesis construct that can be used in the treatment of cardiovascular diseases in the future.