Description for the general public

In the last few years, the social and economic impacts of biomedical research have become increasingly evident to the public. However, what is less evident is that biomedical research is nowadays facing a series of significant problems. These issues include i) ***scientific challenges*** – the platforms currently used to test the efficacy of new drugs or new treatment protocols during pre-clinical research have been demonstrated to be often inadequate, ii) ***economic issues*** – the cost related to drug development is skyrocketing, and iii) ***ethical concerns*** – the use of animals for research purposes is perceived by the public opinion as cruel and unjust.

As one could easily guess, finding a solution that would address at the same time all these problems is not trivial. Currently, the most promising option resides within the development of **functional *in vitro* models**. Functional *in vitro* models can be considered as miniaturized replicas of a specific tissue that exhibit both a structure and a function similar to the native one.

In the last two decades, a great deal of work has been spent to develop sophisticated technologies to manufacture such systems. Despite the efforts, **current *in vitro* tissue models still suffer of some limitations.** One of the main drawbacks consists in the methodological approaches used to develop these platforms. In the great majority of cases, in fact, the conceptualization and manufacturing of these models are based solely on prior experience, intuition, and trial-and-error strategies. In addition, the cellular dynamic processes of *in vitro* tissue formation are often poorly investigated, leaving a significant gap in the understanding of such a complex process.

Therefore**,** breakthroughs in the design, manufacturing and characterization of artificial tissues are now needed to develop comprehensive knowledge and unravel elusive aspects of *in vitro* human biology.

In this context, we propose **to develop a data-driven, high-throughput workflow** – referred in jargon as *blueprint* – **for manufacturing the next generation of *in vitro* tissue models**. From a technical point of view, the proposed platform will enable to scan and quantitatively characterized a much larger set of experimental conditions compared to currently available systems. Notably, we aim at developing blueprints for a specific human tissue – namely the **skeletal muscle tissue** – to obtain i) the highest tissue *functionality* and *scalability potential*, and ii) prioritize the best *cost-effective* experimental conditions.

The project will be implemented using state-of-the-art technologies such as microfluidics, 3D biofabrication and machine-learning. **The core scientific objectives of the MYO-PATH project are i) the progress towards a deeper understanding and control of cellular dynamic processes** involved in the manufacturing of artificial tissues and **ii) the generation of a developmental atlas** *of artificial muscle morphogenesis in vitro*.

We believe that the outcome of the proposed project, if successful, may have in the mid- to long-term significant social and economic impact in various fields ranging from healthcare – with the development of new treatments for SM-related diseases – to food industry and environment protection – through the more sustainable production of meat.