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BIOGRAPHY

Annalisa Tirella received her PhD in Materials for Environment and Energy from the University of Roma II developing a 3D printing system for cells and hydrogels. As Research Fellow, her research developed on engineering physiological *in vitro* systems using biomaterials with mechanical and physico-chemical properties similar to human tissues. She joined the University of Manchester within the Division of Pharmacy and Optometry as a Lecturer in 2014. Her research group works at the interface with multiple disciplines, with the main research areas being: manufacturing of nano/micro-technologies for drug delivery and design of (bio) engineered *in vitro* 3D models. She established a solid network of academic/industrial collaborations and she recently joined the North-West Centre for Advanced Drug Delivery. Through her career, she has made significant contributions to the advancement of hydrogel manufacturing and their physical characterization, as well as use of colloidal nanoparticles for targeted drug delivery (>25 research papers with >350 citations).

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TUMOUR 3D *IN VITRO* MODELS: ADVANTAGES OF BIOENGINEERING FOR THE RECAPITULATION OF EARLY STAGES OF TUMOUR DEVELOPMENT AND CHEMOTHERAPIES DELIVERY

In vitro models are useful tools for understanding many pathophysiological states, as well as being used for testing drug delivery and efficacy. Traditionally they are depicted as a monolayer of a single cell type, however *in vitro* models should better mimic the complex biological scenario-which is not flat (2D), but intricate and dynamic (3D, different cell types and dynamic). To better predict the efficacy of therapies it is necessary to re-think drug testing towards more relevant models. The combination of biomaterials in 3D structures, the control of biomaterials properties and their perfusion in a dynamic cell culture system is hence essential. Tissue engineering approaches and biomaterials can be used to better model tumours and their microenvironment *in vitro*. This can enable more precision to unravel molecular mechanisms and identify basic biological findings as well as better predict drug delivery mechanism and efficacy. The use of more relevant systems will help to bridge the gap between *in vitro/in vivo* models and help to translate findings. Insights on the design and characterization of biomaterials to mimic the tumour microenvironment and its dynamic will be discussed. Examples of engineering approaches to fabricate tumour models at early stages will be discussed, comparing expression of relevant biomarkers between traditional and engineered *in vitro* models. Final case study will describe the use of nanoparticles for target delivery; and differences between traditional and engineered models will be discussed. The importance of using biomaterials and tissue engineering approaches to better predict chemotherapeutics delivery will be discussed, evidencing how engineered *in vitro* models can be used to speed up the pre-clinical phase in the testing of medicines.