Project Details	
Project Code	MRCIIAR26Ex Ball
Title	Determining the potential human health impacts of microplastic contamination via direct injection, a novel exposure route for MP from medicinal products.
Research Theme	IIAR
Project Type	Wet lab
Summary	Environmental microplastics are a human health concern. Ingestion/inhalation have been thought to be the predominant routes into the human body, but do medicinal products provide a third route via direct injection? In 2025 IV bags were shown to shed microplastics internally and therefore are they and other medicinal products a direct source of human microplastics contamination and adverse drug interaction? The student will investigate distribution, host immune and innate interaction with medicinal microplastics and simultaneous drug exposure. Using high content imaging systems, focusing on development and musculoskeletal systems in zebrafish to determine if medical microplastics are an unrecognised health hazard.
Description	For over fifty years the world has observed the explosion of plastic, their use has permeated every area of human and environmental ecosystems to the point it has been described that the world has entered a “plastic epoch”. The prevalence of plastics at macro scale in our environment has been a concern for decades leading to the societal change to both recycle, capture and reuse these highly visible plastics. Unfortunately, it is the fate of the fragments of plastics, the micro (MPs <5mm) and nano (NPs <0.001mm) where the greatest environmental harm may occur. Both MPs and NPs are now ubiquitous in our environment, from the high Arctic to the deepest oceans, and they have also infiltrated our bodies, being found in multiple organs including the brain (Nihart et al., 2025) The presence of MPs and NPs in our systems have been determined in tissues including the placenta and excreted materials (Cho and Choi, 2021, Marfella et al., 2024; ‘Microplastics are everywhere — we need to understand how they affect human health’, 2024). How they pass into the circulatory system is not fully understood but key routes are likely through diet and inhalation. However, recent studies have highlighted that there could be an additional route from medical products used in temporary and long-lasting medical procedures. Medical equipment and pharmaceuticals often use plastic in their production, packaging and storage for efficient and safe usage. When these products are used in medical interventions there is the potential for the introduction of MP/NPs directly via injection into the host, bypassing native external barriers such as skin, gut lining, and lungs membrane. It was demonstrated that fibrous polypropylene MPs can form in medical saline bags and can potentially transfer directly to the patient (Huang et al., 2025). Intravenous (IV) bags are lifesaving equipment whilst it is hard to pinpoint the number of lives saved in the US alone blood IV bags save at least ten thousand lives a year through prehospital interventions. Within a medical setting IV use has increased with the mounting prevalence of chronic disease, an expanding geriatric population and the raising demand for advance healthcare services. A medium sized health trust (Gloucestershire Health and Care, NHS

	Foundation Trust) used around 65,000 IV bags over a 5-year period [2020-2025]. Of concern is medical intervention are normally associated with vulnerable individuals (adults with complex needs or pre- and post-natal children) which potentially carries a greater risk of unforeseen or long-term impacts. It is well understood that there is sorption between pharmaceuticals and plastic medicinal products and desorption from MPs (Gopinath et al., 2022). The student will use the zebrafish model species which was highlighted as an emerging model (Bhagat et al., 2020) to investigate the distribution and host interaction of microplastics. Direct injection of MPs to replicate human exposure to medical procedures has not been fully assessed, therefore the zebrafish can simulate this exposure route. The zebrafish model has distinct advantages, with the breadth of transgenic lines allowing for the marking of specific characteristics including immune response cells (neuromasts/macrophages) and reactive oxygen species response in a transparent vertebrate model allowing the determination of the risk associated with these microplastics. The small size during the larval stage (4mm long, 1mm thick) allows for detailed imaging within a whole vertebrate system via high content microscopy. The student will also determine the most appropriate and relevant type and concentrations of the MP/NPs to highlight the most persistent/high risk/ high incidence MP/NPs and possible combinations ("colours of MPs") and potential drug/chemical interactions which could occur with the MP/NPs. They will also determine the most appropriate transgenic model reporter lines to track and observe interactions within the larval zebrafish. This collaboration between Bristol (Prof Hammond) and Exeter University (Dr J Ball) will bring the combined, diverse and complementary resources of both institutions to support this studentship. Along with the expertise the access to the joint Transparent Approach to Costing (TRAC) facilities at both institutions which include the Bioimaging facility, the Aquatic Resource Centre (ARC), the Contrast Facility (Biomedical physics), the Animal Services Unit (ASU) and the Wolson imagining suites allows for the student to be resourced with high content imaging modalities along with a wide and varied zebrafish reporter lines and at different life stages of the zebrafish across the GW4 institutions. The student will be exposed to and trained in the broad range of imagining modalities available and determine the most appropriate high content imaging platform/s for tracking both the MP/NP and the MP/NP host interactions. These centralised facilities will allow the student to gain extensive training in Data Science skills while using Interdisciplinary facilities on an in vivo system to allow for the translation and Innovation in their 4-year studentship to understanding and potentially quantifying human health risk impact from medical MPs and NPs.
Supervisory Team	
Lead Supervisor	
Name	Dr Jonathan Ball
Affiliation	Exeter
College/Faculty	Health and Life Sciences
Department/School	Biosciences

Email Address	j.ball@exeter.ac.uk
Co-Supervisor 1	
Name	Professor Chrissy Hammond
Affiliation	Bristol
College/Faculty	School of Physiology
Department/School	Pharmacology & Neuroscience
Co-Supervisor 2	
Name	Dr Gary Codling
Affiliation	Exeter
College/Faculty	Health and Life Sciences
Department/School	Biosciences
Co-Supervisor 3	
Name	Professor Ceri Lewis
Affiliation	Exeter
College/Faculty	Health and Life Sciences
Department/School	Biosciences