Orpheus: Test Your Drug in a Living Human Organ

Bringing human biology earlier into drug development

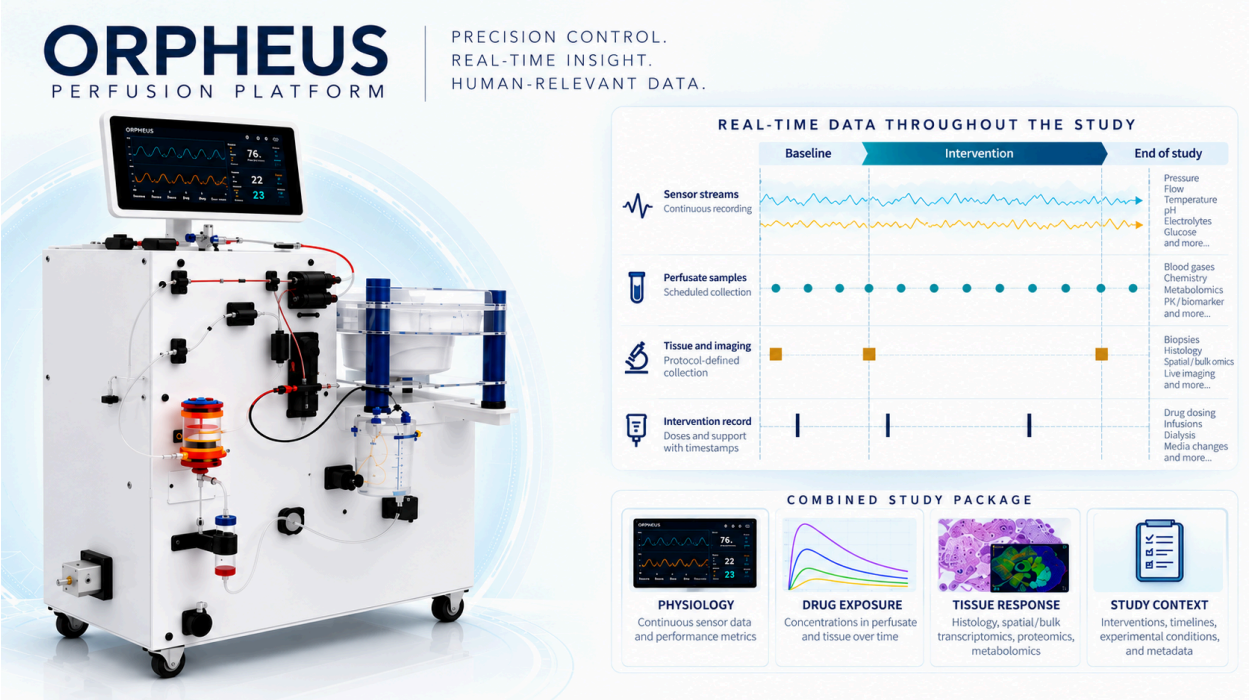
Drug development has a human prediction problem. A medicine can look promising in cells, perform well in animal models, and clear years of preclinical development only to fail when it reaches patients. Despite enormous advances in experimental models and computational tools, approximately 90% of drugs entering clinical development will ultimately fail.

At the heart of that challenge is a simple limitation: human biology remains difficult to predict without studying human biology at the source.

Revalia is creating a new way to do exactly that. With Orpheus, our research perfusion platform, drug developers can test medicines in functioning, donated human organs outside the body and directly observe how those organs respond.
This creates an opportunity to investigate some of the questions that matter most to a drug program before entering the clinic. Does the therapy reach the intended cell type of interest? Does it engage the biology we expect? How does the organ respond? Are there early signs of injury or toxicity? How does changing the dose or delivery strategy alter that response?

Historically, developers have answered these questions indirectly through cell systems, animal models, computational predictions, or, ultimately, in patients. Perfused human organs create another source of evidence: the ability to study a medicine in intact, functioning human biology before clinical testing.

We don't expect perfused human organs to replace all the models that underpin drug development today. Instead, they add a critical layer of human evidence that can help developers make better decisions about what to advance, what to change, and what to investigate next. Just as importantly, the data generated from these studies can help train and validate the next generation of AI models of human biology, improving our ability to predict how medicines will behave in people

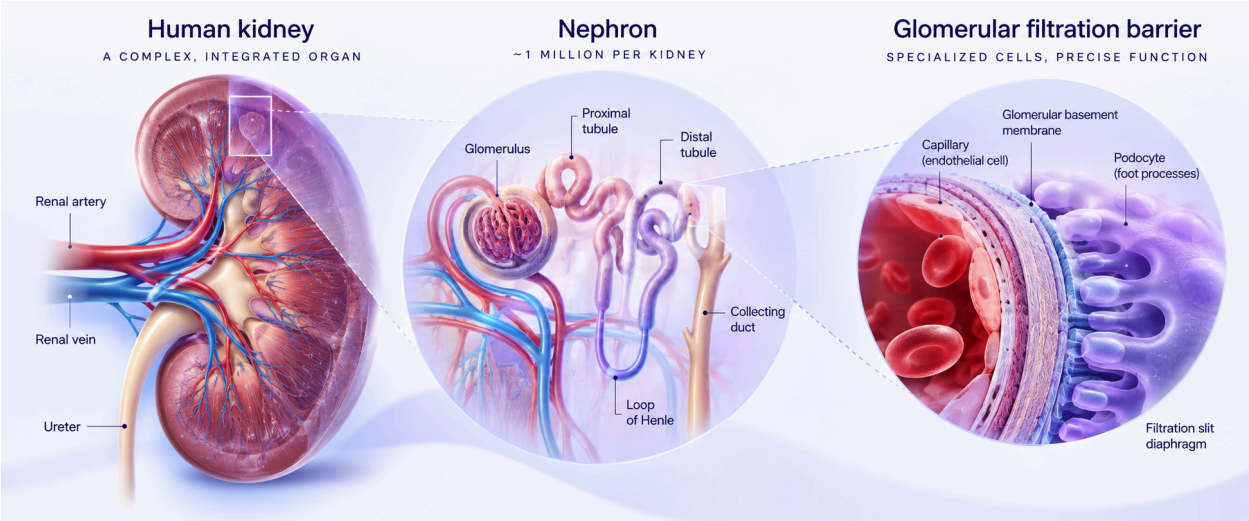


Orpheus, Revalia Bio's research perfusion platform, enables experimental medicines to be evaluated in functioning human organs outside the body.

From predicting human response to measuring it directly

An intact human organ offers something fundamentally different from a cell culture or isolated tissue sample. Its vasculature remains intact, multiple cell types remain organized within their native tissue architecture, and the organ continues to exhibit measurable physiology.

Consider the kidney. Each kidney contains approximately one million nephrons, intricate functional units that coordinate filtration, transport, fluid balance, and waste removal. Within each nephron, specialized cells, capillaries, and tubular structures work together to maintain organ function. A medicine's behavior can depend on where it travels through this architecture, which cells it encounters, and how those interactions influence the organ as a whole.



From whole organ to cell: Human organ function emerges from highly organized interactions among specialized tissues, cells, and vascular networks. Preserving this architecture allows researchers to investigate drug behavior in an integrated biological system.

Individual cell systems and organoids provide valuable insight into specific mechanisms, but they do not fully reproduce the interconnected physiology of an intact human organ. Studying a perfused human kidney creates an opportunity to investigate drug responses across these interacting structures within their native biological environment.

Perfusion makes it possible to preserve those characteristics outside the body. By circulating a proprietary, oxygenated, temperature-controlled perfusate through a donated human organ, Orpheus supports active metabolism while researchers introduce an experimental medicine and observe the response over time.

That creates a window into human biology that has historically been difficult to access during drug development. A medicine can circulate through human vasculature, distribute into tissue, interact with its intended target, and produce molecular, cellular, and physiological responses that can be measured within the same experiment.

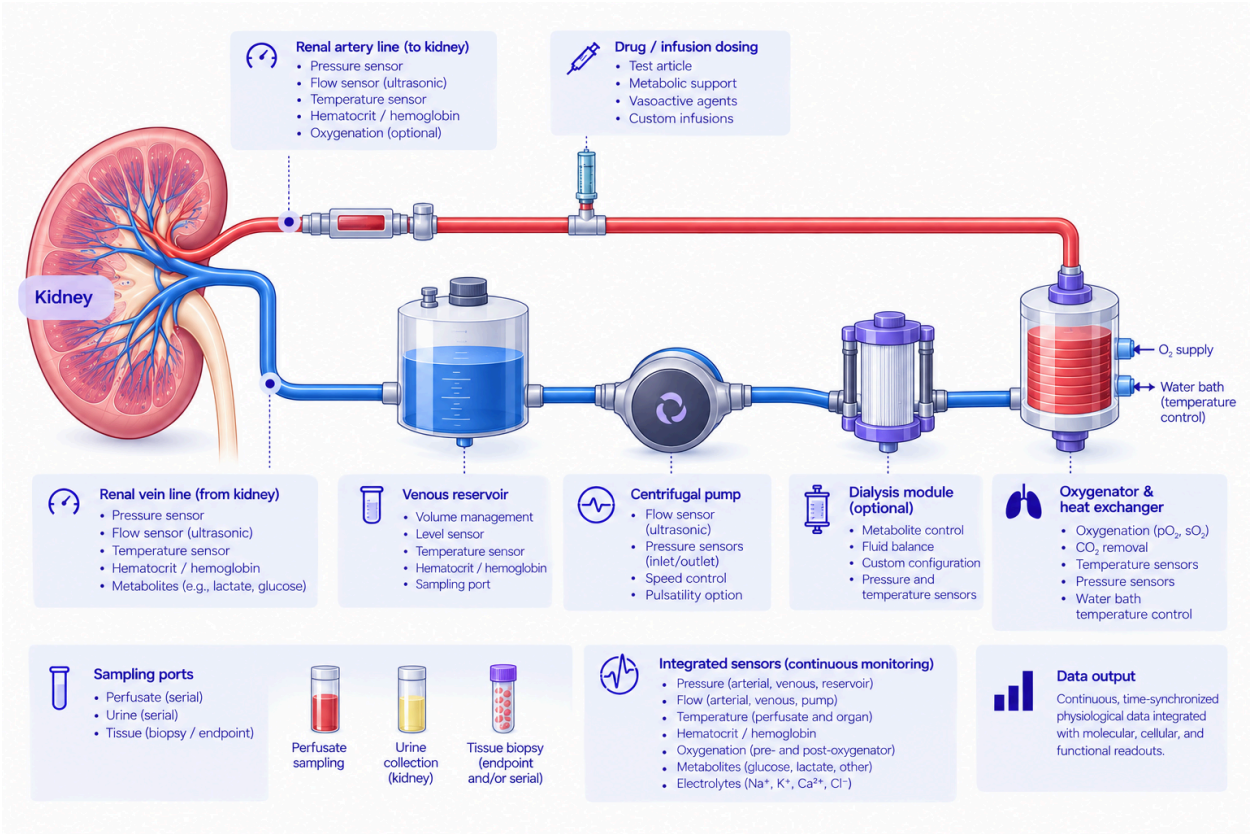
This means a drug developer can begin connecting a sequence of events that is often fragmented across multiple preclinical models: how was the drug administered, where it went, what biology it affected, and how the organ responded. Rather than relying entirely on predictions of what may happen in a human system, researchers can measure it directly.

Orpheus: Engineered for drug development research

Machine perfusion itself is not new. Its clinical roots are in transplantation, where perfusion systems are designed primarily to preserve and assess organs before transplant. Normothermic machine perfusion demonstrated that human organs could remain metabolically active outside the body, establishing the scientific foundation for a different application of the technology: testing medicines.

Research, however, asks more of a perfusion system than preservation alone. A drug development study may require researchers to change a dose, alter a delivery route, collect repeated samples, integrate new sensors, manipulate physiological parameters, or follow a biological response over an extended period. The conditions required for one organ, disease state, or therapeutic modality may be very different from those required for another.

Revalia developed Orpheus specifically for this environment. Orpheus combines three capabilities within a single research platform: maintaining functional human organs, precisely controlling experimental conditions, and continuously capturing biological responses. An organ is connected to a closed perfusion circuit that circulates oxygenated, temperature-controlled perfusate through its native vasculature. Integrated pumps, sensors, and metabolic support systems give our teams direct control over pressures, flows, temperature, metabolic support, infusions, dialysis, drug delivery, sampling, and other experimental parameters. Its modular architecture allows the system to be adapted around the organ and scientific question while maintaining a common approach to control and data capture.



Orpheus integrates controlled organ perfusion, experimental intervention, continuous physiological monitoring, and advanced molecular analysis. Together, these capabilities connect drug delivery with biological activity and organ-level response.

The objective is not simply to keep an organ functioning outside the body. It is to turn that functioning organ into a controlled and measurable human experimental system.

What makes Orpheus particularly powerful is the ability to connect real-time organ physiology with detailed molecular and cellular measurements. Continuous monitoring of the aforementioned parameters provides a picture of how the organ is functioning. Blood-equivalent perfusate, urine or other organ-specific fluids, and tissue samples can then be analyzed using histology, imaging, transcriptomics, proteomics, and other advanced methods. Together, these data allow researchers to connect drug exposure and distribution with target engagement, biological activity, and organ-level response, building a more complete picture of how a therapy behaves in human tissue.

A critical human layer for NAMs and AI

New Approach Methodologies are rapidly changing how the pharmaceutical industry approaches pre-clinical development. Organoids, organ-on-chips, advanced cell systems, computational models, and other NAMs are creating increasingly sophisticated ways to study human biology and reduce reliance on traditional animal models.

Perfused human organs are adding a powerful layer to that ecosystem because they provide an opportunity to evaluate a hypothesis in the complexity of an intact human organ. A signal discovered in a cell system can be investigated at the tissue and organ level. A delivery technology optimized in an animal model can be evaluated in human vasculature and tissue. A computational prediction can be compared with an experimentally observed human response (for medicine development or as part of a reinforcement learning loop).

Beyond informing individual drug development programs, these data have the potential to transform how we build AI models of human biology. Today's AI models are only as good as the data used to train them, and much of the biological data available today comes from systems that cannot fully capture how intact human organs function and respond to medicines. By combining continuous physiological measurements with detailed molecular and cellular analyses, Orpheus generates rich, multidimensional datasets that connect drug exposure to biological response in functioning human organs. These data can help train, refine, and validate a new generation of AI models that more accurately predict how medicines will behave in people, ultimately making drug development faster, more efficient, and less reliant on trial and error.

The goal is not for one model to replace every other model. The opportunity is to build a development strategy in which the right model answers the right question, and where critical assumptions about human biology can increasingly be tested directly in human biology.

We believe functional human organ data can become a foundational component of the next generation of NAM programs and AI-enabled drug development.

A future with less guessing

Drug development will always require prediction. No single experiment can reproduce the complexity of a patient or answer every question about a medicine. But when a critical question

can be investigated directly in functioning human biology, we must take advantage of that opportunity.

Orpheus makes that possible by bringing together human organ perfusion, experimental control, and multidimensional measurement in a platform designed specifically for drug development research. It allows researchers to test a medicine in a living human organ, understand where it goes and what it does, observe how the organ responds, and use that evidence to inform what happens next.

For an individual drug program, that can mean resolving an important uncertainty before moving forward. For NAM development, it creates a new layer of human evidence against which other models can be tested and refined. And for AI-enabled drug development, it can generate the human biological data needed to build better predictions.

The future of drug development should require less guessing about what happens in humans. Orpheus gives us a way to start measuring it in real time.