Science: Farming for answers to human diseases in the fish farm

February 27 2018, by From Mayo Clinic News Network, Mayo Clinic News Network

Aquariums are arranged in neat, illuminated rows. Fins, tails and flashing stripes are visible in every direction. On the Mayo Clinic campus in Rochester, Minnesota, zebrafish act as research stand-ins for us. They are tiny heralds of solutions for patients with some of medicine's most intractable problems.

But how can an aquarium fish help solve human disease? Because all living things are related.

Most of the genetic variants associated with human diseases can be found in zebrafish. Basically the differences between species arise from variations in the ways the parts of DNA are arranged. DNA is made up of nucleotides (As, Ts, Gs, and Cs) that together form into coherent instructions called genes that determine whether a creature has legs or fins.

Researchers have long used mammals like mice to study human disease. But zebrafish have become the model of choice in many medical laboratories in part because they breed more prolifically, hold more animals per research footprint and can be very resource friendly compared to other vertebrates.

AN UNLIKELY SUSPECT

Biochemist Stephen Ekker, Ph.D., is the director of the Mayo Clinic Zebrafish Facility, aka the "Fish Farm." As he gestures toward the aquariums bubbling all around, he explains, "With the combination of vertebrate biology like us, new gene editing tools such as CRISPR, new real-time imagers, and the ability to scale so we can test many scientific questions in parallel, the potential for zebrafish to impact and study health and disease seems limitless. "Housing more than 65,000 adult fish and generating 10,000 larvae a day, the farm is used by dozens of Mayo researchers to study processes that are difficult or impossible to follow in other animals. From the moment the eggs in the tanks are fertilized, it's possible to keep a close eye on developing embryos.

Because those embryos are transparent, they provide a window into development. Researchers can watch as organs form and hearts take their first beats. Also, whereas tumors develop over months or years in people, it only takes days or weeks for them to progress in the tiny fish. So with cancer tracing technology, it's possible to watch the development of tumors in real time.

And that can help real patients. Sometimes, the cause of a tumor is a typo in one or more genes. To understand that error better, the same mutation can be edited into zebrafish, and the fish can be examined for similar symptoms. That, perhaps, is the most valuable thing about zebrafish as a model: They can be genetically manipulated.