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Computerized liver could one day be used to test new medicines; U of A student adapted software for oil and gas exploration to the human body

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EDMONTON -- As computer simulations go, **Rebeccah Marsh**'s new "virtual liver" doesn't offer the fun of learning to shoot a gun or fly a plane.

Yet despite its lack of video-game potential, the graduate student's creation could be destined for great things in the health-care industry.

With its ability to closely mimic the behaviour and function of a human organ, the computerized liver could one day be used to test new medicines and help doctors determine the best drug dosage for their patients.

"People have developed simulated organs before, but this is a dynamic simulation," said Marsh, who recently completed her PhD in biophysics at the University of Alberta.

"It's the first one of its type. What makes it different is that we can actually perform experiments of flowing blood and drugs through our virtual liver and then look at how the drugs react with it."

The simulation was created through a unique internship in which grad students with mathematical ability are linked with an Alberta company and asked to apply their research to help solve industry problems.

In Marsh's case, she got the chance to work with Computer Modelling Group, a Calgary-based company that had developed its own simulation software.

That software, however, was designed to help in the exploration of oil and gas deposits, so Marsh had to adapt it for the human body.

"Basically, we have come up with a new alley of research and application for this software," she said.

"Instead of modelling the flow of oil and gas through sediment, we can watch blood flow through liver tissue."

To ensure the simulation performs like a real organ, the virtual liver uses detailed information taken from scans of a patient's abdomen. Any patient's data can be loaded into the system, giving researchers the ability to look at all different kinds of livers.

"You could have several virtual livers, one healthy, one with hepatitis, and one with alcohol damage," Marsh said.

"Then you can perform the same experiments on each of these and see how they react differently, and what the consequences are for treating these patients."

As the liver is the primary site of drug metabolism in the body, one of the biggest potential applications of the simulator is in the development of new drugs.

Researchers could use it to do virtual tests at several stages in the process, Marsh said.

The program would act as a guide, keeping scientists on the right track. If negative side-effects are noticed, the drug could be recalibrated and put through the simulator again before expensive lab trials get underway.

In this way, the accuracy and cost-effectiveness of pre-clinical testing is improved, Marsh said.

"If the scientists can have an idea even before they step into the lab what has the most promise, that can be a big advantage," she said.

Then, when a new medicine has been established, the virtual liver could be used to help doctors determine the optimum dosage for each patient, including situations where a patient is taking more than one drug.

March's research supervisor, Jack Tuszynski, said there are big plans for the technology.

The next phase in the research is to analyze diseased livers and sections of tissue where tumours can form. Eventually, virtual hearts, kidneys and other organs could be made.

"Our goal is really to create an entire virtual human for the purpose of drug design," Tuszynski said.

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Illustration:
• Photo: Supplied / **Rebeccah Marsh** with her "virtual liver" creation, basically a computer simulation of a real liver.

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