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New advance in cryopreservation could change management of world blood supplies

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Engineers at Oregon State University have identified a method to rapidly prepare frozen red blood cells for transfusions, which may offer an important new way to manage the world's blood supply.

It's already possible to cryopreserve human red blood cells in the presence of 40 percent glycerol, but is rarely done because of the time-consuming process to thaw and remove the glycerol from the blood. This can take an hour or more and makes it logistically difficult to use frozen blood.

However, some initial experiments and computer modeling of a proposed new process suggest that this hour-long process can be reduced to as little as three minutes, using a membrane-based, microfluidic device. This could make it far more feasible to use frozen blood in emergency or time-constrained medical situations.

The findings were just reported in the journal *Biomicrofluidics*.

"Only a small fraction of our blood supply is now frozen, because it's often impractical to wait so long when a transfusion is needed immediately," said Adam Higgins, an expert in medical bioprocessing and associate professor in the OSU School of Chemical, Biological and Environmental Engineering.

"Because of that, our entire system depends on constantly balancing the use and supply of blood products that can only last six weeks or less with

refrigeration," he said. "This is difficult, and can lead to loss of outdated blood, periodic shortages, and other inefficiencies that could be solved with the use of frozen blood."

Researchers in the OSU College of Engineering, however, have become national leaders in the science of microfluidics, which uses microchannel-based approaches to processing fluids for various purposes, ranging from more efficient heat pumps to innovative methods for kidney dialysis.

In the case of frozen blood, extremely tiny microchannel plates and membranes could be used to precisely control removal of glycerol from blood at a time scale of seconds. This would allow much more rapid thawing of frozen blood, which isn't possible using the centrifugal cell washers that have been around for decades and are the only other way to remove glycerol from the blood.

The new approach should work, OSU experts say.

"Our results pave the way for development of a clinical device for ultra-rapid glycerol extraction, which would greatly improve the logistics of blood banking," the researchers wrote in their report.

According to their report, each year more than 100 million blood donations are collected worldwide, enabling millions of life-saving transfusions. But refrigerated blood has a short shelf life, and some recent studies even suggest that "older" blood being used within what's believed to be an acceptable refrigeration period may be linked to severe complications.

Cryopreservation could extend the shelf life of blood from weeks to years; dramatically smooth out the undependable supplies of blood; and according to recent research, produce cryopreserved red blood cells that have superior biochemical and tissue oxygenation capabilities compared

to refrigerated red blood cells.

This research has been supported by a CAREER Award from the National Science Foundation.

In continued studies, researchers said they hope to create working prototypes of the needed technology for further development and testing of the concept. An optimized process may also be even faster than the three minutes now being predicted, they said.

Provided by Oregon State University