# *In Situ* Self-Expanding Polyurethane Polymer Foam

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***Abstract*—The Defense Advanced Research Projects Agency has developed an "In situ forming hemostatic foam implant", specifically made to increase the survival rate for victims of internal hemorrhaging. The agency primarily developed this foam to aide in the treatment of U.S. soldiers suffering from intracavitary non-compressible hemorrhaging.**

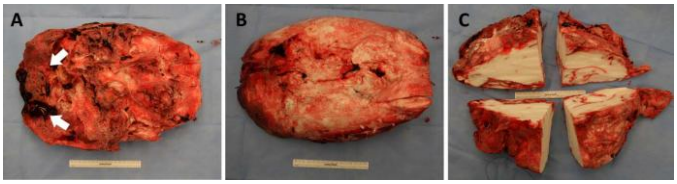
## I. Introduction

The Defense Advanced Research Projects Agency (DARPA) has recently developed a self-expanding foam that can be injected into a wounded U.S. soldier to prevent blood loss. Over eighty percent of preventable deaths on the battlefield are due to hemorrhaging. Typically, battlefield casualties need to get medical attention within one hour. The casualty's survival rate drops dramatically after that point. Current methods of stopping blood loss are somewhat affective, but they are situation dependent. These methods include field dressings, pressure dressings, tourniquets and blood clotting bandages. Field and pressure dressings are sometimes not adequate enough to stop bleeding, tourniquets can lead to amputation, and blood clotting bandages are only advisable to use in certain life-threatening situations. Even with all of these methods available there were still no effective options for intracavitary hemorrhaging. Viewing an obvious gap in the needs of battlefield medicine, DARPA developed the *In Situ* Self-Expanding Polyurethane Polymer Foam.

## II. Methods

The foam is applied to casualties via a liquid injection of polyol and isocyanate.

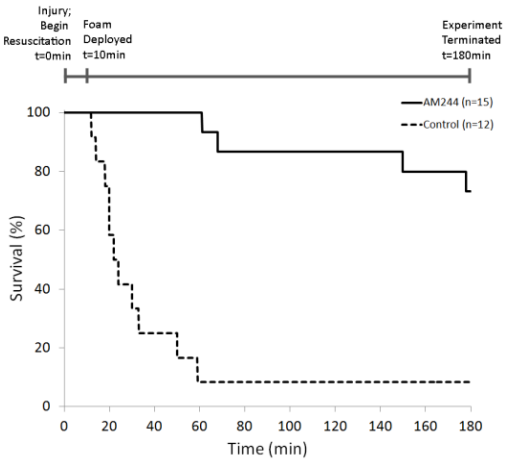
Once the two liquids combine, they simultaneously form into a foam while expanding to approximately thirty times larger than their original size.




Upon expanding, the foam fills the individuals body, filling in gaps and blocking blood flow from injured areas. Surgical removal of the foam can be conducted in under one minute.

## III. Results

DARPA tested the foam on the closed abdominal cavity injury of a swine. Compared to a control group (using conventional treatment methods). survival rates increased by almost 300%, and blood loss was decreased by approximately 84% while using the foam. (See figure 1)




(Figure 1)

## IV. Discussion

The development of this technology is a force multiplier for the United States armed forces. The use of DARPA's new foam could mean not only a reduction in battlefield fatalities via hemorrhaging, but also less casualties resulting from the treatment of casualties during a firefight. If the size of the syringe on the smaller side and easily carried, then it is very plausible that U.S. soldiers will be carrying their own foam injector in the near future.

## References

[1] Official DARPA website <http://www.darpa.mil/NewsEvents/Releases/2012/12/10.aspx>
[2] United States Patent Application Publication US 2012/0107439 A1 Pub. Date May 3 2012.
[3] U.S. Medicine Website <http://www.usmedicine.com/articles/military-seeks-new-products-to-halt-battlefield-bleeding.html#.URamNqV1FBk>