

## MEDICAL INNOVATION: SWAN-GANZ CATHETER (MEDICAL DEVICE: THERAPEUTIC)

**Physician: Dr. Jeremy Swan and Dr. William Ganz**  
**Industry: Edwards Lifesciences**

### Situation

#### ***No quick way to measure the need for blood in trauma patients***

Major trauma such as injuries from car accidents, falls and gunshot wounds, causes some 170,000 deaths annually in the U.S. It represents the leading cause of death in Americans up to age 44, and accounts for roughly half of total deaths in this age group overall. According to the National Trauma Institute, hemorrhage, or the rapid loss of blood from the body, accounts for 35% of the pre-hospitalization deaths from trauma, and 40% of overall deaths in the first 24 hours after injury.

For those patients who lose a significant amount of blood from their injuries and who do make it to the hospital, the rapid administration of replacement blood through a transfusion represents one of the most critical determinants in their survival. However, until the 1970s, there was no quick and precise way to measure how much blood to give trauma patients, and as a result, a great number of them died or suffered serious additional medical complications simply from receiving too little or too much blood in the emergency room.

### Physician-Industry Collaboration

#### ***Sailboats suggest a medical breakthrough***

In the late 1960s, two cardiologists in Southern California, Dr. Jeremy Swan and Dr. William Ganz, came up with an idea that, if successful, would make an enormous difference in the precise measurement of fluid replacement in emergency situations.

One day after a particularly difficult experience placing a catheter, or small diagnostic and therapy-delivering tube, through the vein and into the heart of an older patient as part of treating her for a heart condition, Swan went to the beach in Santa Monica. Watching sailboats off the coast, he noticed that those with large front sails known as “spinnakers” traveled quicker and more easily through the water than the other boats with regular sails.

Swan reasoned that a catheter with a similar “front sail” on it would travel easily through a patient’s vein, and would flow through the heart into place for diagnostic purposes with very little need for guidance. He approached his colleague Ganz, and they went to work with a nearby medical device company, Edwards Lifesciences, with their idea.

Within a couple of years, they developed such a catheter with an inflatable balloon tip that could catch the flow of the venous blood to the heart, through two valves and fall into place almost effortlessly in the pulmonary artery, the vessel that delivers oxygen-rich blood to the lungs.

This represented an enormous breakthrough in catheterization techniques, as until then, catheters had to be inserted in a special facility with guidance from a team including an x-ray technician, in a complicated procedure that often resulted in fatal perforations in blood vessels and injuries to the heart wall.

## Innovation Benefits

### ***Precise, realtime and continuous pressure monitoring***

Introduced in 1970, the so-called “Swan Ganz” catheter rapidly became ubiquitous in heart and trauma procedures worldwide. The catheters enabled physicians to install diagnostic and therapy-delivering devices quickly and far more safely into patients, allowing for precise, real-time and continuous monitoring of pressure in the pulmonary artery, an important indicator of blood volume and overall cardiovascular function.

Within minutes of patients arriving in the emergency room, and without requiring a detour to the catheterization lab, trauma physicians could for the first time determine exactly how much blood to give them, monitor their overall blood flow and degree of oxygenization, and also confirm other diagnoses such as heart failure. As of 2009, 30 million patients had benefitted from this technology in critical care settings.

## Patient Benefits

### ***Getting a wounded Marine the right amount of blood***

On patrol in Southern Afghanistan in 2009, young Marine Lance Corporal T. stepped on an improvised explosive device (IED) mine and sustained serious injuries to both legs. His squad mates applied tourniquets to stanch the bleeding and quickly called for a MEDEVAC helicopter. His condition was described as “Category A,” or critical.

Within 10 minutes a UH-60 helicopter arrived and evacuated the Marine, but it was clear that he had significant internal bleeding as well, so the tourniquets would not solve the issue of his blood loss – 80% of troops in Afghanistan and Iraq who die from “survivable wounds” do so from losing too much blood.

Upon touchdown at Kandahar airfield, T. was put in a field ambulance for the short trip to the trauma center. There, a team of doctors wet to work to save his life. They prepared him for surgery and right away inserted a Swan-Ganz catheter through a vein in his neck.

As they administered blood to him to replace several liters he had lost, the catheter gave the doctors instant, accurate and continuous readings of the pressure in his pulmonary artery. As the device indicated, he needed two more liters than they originally thought and they adjusted accordingly.

After surgery, the young Marine was stabilized, and lived to return to the U.S. for rehabilitation. While facing a tough struggle ahead, getting him the right amount of blood was critical to keeping him alive.