Independent Cryonics Educators Program

2.1: Cryonics as an extension of emergency medicine

Cryonics (from Greek *kryos* meaning icy cold) is the extremely low-temperature preservation of humans who can no longer be sustained by contemporary medicine, in the expectation they can be healed and resuscitated in the future using more advanced medical technologies. Cryonics is an extension of emergency medicine. Cryonics procedures are initiated when today's medical technologies and practices can no longer sustain a patient. Cryonics preserves life by pausing the dying process. It is the bridge between pronouncement of legal death and future medical technologies.

Three ideas are essential to understanding cryonics:

1. True, final, irreversible death is different from clinical or legal death.
2. Deep cold can halt the dissolution of biological systems.
3. Our current inability to revive cryopreserved people does not detract from the purpose of cryonics.

Death

The intention of cryonics is to stop the process of dying. At the same time, it is true that cryonics procedures do not begin until patients are *clinically* and *legally* dead. In fact, cryonics is only practiced following pronouncement of legal death. **A crucial point of understanding is that neither clinical death nor legal death are the same as death in any irreversible or final sense**.

Today, doctors declare legal death when they cannot resuscitate a patient with current medical technologies. (Or when the patient could be revived but with no expectation of recovery, such as following a "do not resuscitate" order.) This amounts to saying: "Given the skills and technologies available, I can do no more for this patient." Our ability to resuscitate patients improves over time. We can revive people in 2022 who were considered dead before 1960. The advent of cardiopulmonary resuscitation, defibrillation, and related methods shifted the point at which people were declared legally dead. Clinical death, in many cases, had become reversible. The cessation of respiration and heartbeat was no longer considered to be final death.

It is reasonable to expect further progress in the ability to revive people from conditions previously thought to be irreversible. People considered dead by today's criteria would be revived by means that have yet to be developed. The aim of cryonics is to pause the cellular dying process to buy time for more advanced technology and medical interventions to be developed in the future. As such, the goal of cryonics is to extend life, not to reverse death.

A person declared legally dead today may still be biologically alive. We've developed medical technologies to donate organs from *legally* dead people to save lives because the donated organs are still *biologically* alive. There are numerous cases of people who have been clinically dead for many minutes, some up to an hour or more, who are revived and survive. This may happen when someone falls into very cold water – which slows down metabolism – or when surgeons have a patient on external metabolic support.

Cold

A fundamental principle of cryonics is that metabolism, and therefore the dying process, slows down as temperature falls. Today, surgeons cool their patients to give them more time to operate or heal. Each reduction of 10°C slows metabolism down by 50%, a principle known as the Q10 rule. Thus, reducing someone's temperature from 37 °C to 7 °C (98.6 °F to 44.6 °F) slows their metabolism by 87.5%.

In cryonics research, patients are maintained at -196 °C (-320.8 °F) and metabolism stops. Decades or even centuries may pass, and a cryopreserved person will be unchanged biologically, even as the rest of the world continues on. Future medical innovations far more advanced than today's CPR or defibrillation, such as gene therapy or molecular nanotechnologies (MNT), may be developed to treat and cure ailments that result in death today.

Repair

No one who has been cryopreserved has yet been repaired and revived. Some critics appear to think that this fact makes the practice of cryonics pointless. They are missing a crucial piece of the puzzle. Our current inability to revive patients tells us very little about the prospects of eventually being able to do so.

While no one has been revived from cryopreservation yet, we currently cryopreserve and successfully rewarm and transplant skin, corneas, heart valves, blood vessels, eggs, sperm, and even embryos. Science is on the verge of reversibly cryopreserving human organs to increase the survival rate of people who need an organ transplant. There has already been some success in reversibly cryopreserving mammalian organs.

Reversing cryopreservation for people is not feasible today, but research into these medical technologies is ongoing and advancements are happening all the time. While medical technology continues to advance, Cryonics stops biological time to allow the application of those advancements to be realized.

We cannot be certain cryonics patients will one day be repaired, revived, and restored to better health. Nor can we accurately predict when it will happen, if it does. However, it does seem to be a reasonable bet. Cryonics is not in conflict with the laws of physics or biology. Advancing science and innovation to a point where cryonics becomes a universal lifesaving medical practice requires further research and technological progress. Claiming that we have a reasonable chance of reviving cryopreserved people in the future is rather like, in 1920, claiming that we would one day land someone on the moon. In 1920, we knew that achieving a moon landing violated no physical laws, but we had no idea how to build sufficiently powerful rockets, guidance systems, or life support systems.

The three primary phases of cryopreservation

The first phase is "standby, stabilization, and transport" (SST). Under ideal circumstances, the cryonics research team is bedside and starts procedures quickly after legal death is pronounced. These procedures include cooling the legally deceased, but biologically viable, patient while using a mechanical CPR device and ventilating to restart circulation and respiration as a series of medications to protect the cells from injury are administered. Then, the patient is quickly transported to a cryonics facility by vehicle or plane (Alcor's facility is in Scottsdale, Arizona).

During **the second phase**, a surgeon accesses the patient's vascular system and connects it to a computer-controlled pump and chiller. Blood and intracellular fluids are removed and replaced with cryoprotectant that allows the temperature to be reduced with less ice formation. Although the cryonics process is colloquially referred to as "freezing", today cryonics aims to *vitrify* the body, or bring it to a glass state. Vitrification avoids the damage caused by ice crystals and preserves cellular structure.

The third and final phase involves cooling the patient to -320 °F, stopping metabolism, and storing the patient in liquid nitrogen in a cryogenic dewar, an industrial size vacuum-insulated steel container, functionally like a very large and expensive Thermos flask. Temperature is maintained without electricity by periodically adding additional liquid nitrogen to the dewar. The first cryonics patient, James Bedford, has been maintained since 1967 and he continues to be entrusted to the care of Alcor today.

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Next: 2.2: Cryonics cryopreservation, cryobiology, and cryogenics

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