

Letter of support for Aldehyde Stabilized Cryopreservation to be developed into a medical procedure

I, Kenneth Jeffrey Hayworth, a PhD neuroscientist, recognized expert in the field of connectomics, and president of the Brain Preservation Foundation, have seen sufficient evidence to convince me that Aldehyde Stabilized Cryopreservation (ASC) should be developed into a medical procedure that can eventually be offered as a form of doctor assisted suicide to terminally ill human patients. Based on published results that demonstrate that ASC can preserve the structural connectome of whole rabbit and pig brains under ideal laboratory conditions¹, based on my own extensive electron microscopic examination of ASC preserved brains², and based on a general understanding of what structural and molecular features of the brain can be preserved by perfusion fixation with glutaraldehyde^{3,4,5}, I judge that ASC, if properly performed, *will* preserve the *information content* of an individual human brain in a manner compatible with extremely long-term cold storage.

Of course glutaraldehyde fixation is fundamentally incompatible with *biological* revival given that it irreversibly crosslinks proteins together. This is why the ASC procedure should be viewed as a form of doctor assisted suicide. Despite this, the fact that the information content of the brain is being preserved means that there exists at least the possibility for the future revival of the patient through some very advanced technology—most likely through the scanning of their preserved brain to create a mind upload controlling a synthetic body. A small but significant fraction of terminally ill patients, patients who may already be considering doctor assisted suicide, will see this chance for future *synthetic* revival as an attractive alternative to oblivion. In fact to these patients this choice to undergo doctor assisted suicide by ASC will literally be their last chance for survival. In my opinion it would be profoundly unethical and immoral to withhold the ASC option from these patients. Speaking personally, if I, myself, were facing a terminal illness I would likely choose euthanasia by ASC in the hopes that I could be revived in the future by mind uploading. I believe it is the responsibility of the scientific and medical community to develop ASC into a reliable medical procedure as soon as possible.

Of course this will likely require some modifications to the published ASC procedure that has, as of this writing, only been tested on animals in ideal laboratory conditions. It will also require the development of a quality control protocol which, in my opinion, should include at a minimum these two checks: 1.) A whole-brain scan (e.g. x-ray CT or post-mortem angiography) that can identify any brain regions that did not receive adequate fixative or cryoprotectant, and that can identify any macroscopic irregularities. 2.) The retrieval and electron microscopic evaluation of needle biopsy samples taken from a number of brain areas.

These two checks should, in my opinion, be performed *after* the brain has been lowered to its target storage temperature and rewarmed so that any ice crystal damage will be visible in electron micrographs. Sufficient checks should also be implemented to ensure quality during the actual surgical procedure and throughout long-term storage. The results of these checks must be made available to the relevant parties (e.g. the patient's loved ones, the surgeons and hospital that performed the ASC procedure, any regulatory or insurance agencies, etc.) since the openness of these checks is the only feedback available to ensure quality on a patient-by-patient basis.

The entire ASC-for-human-application procedure and associated quality control protocol should be tested in suitable laboratory animals and/or in human anatomical donations *prior* to any medical

offering, and the results of these studies should be published so that they can be reviewed by the wider medical community *before* any medical offering is made. Consideration should also be given to developing a comprehensive consent agreement for patients that would elect to undergo ASC as a form of euthanasia. It must be made abundantly clear that the ASC procedure involves the perfusion of a deadly chemical through the patient's vasculature system, a procedure that ensures biological death. The consent agreement must make clear that the purpose of the ASC procedure is only to preserve the *information content* of the patient's brain in a static form, and it must be made clear that there is as yet no known method that can retrieve this preserved information.

It is my sincere hope that a reliable ASC procedure be developed and deployed in hospitals as soon as possible. When it is, I believe thousands of terminally ill patients will take advantage of this option, and each of these patients will find great comfort in the very real possibility that their uploaded mind may awaken in a healthy synthetic body in a much more advanced future world. And that future world will be incredibly thankful that our generation choose to develop the technology to preserve an irreplaceable part of their history.



-Kenneth Hayworth

President of the Brain Preservation Foundation

¹ McIntyre, R. L., & Fahy, G. M. (2015). Aldehyde-stabilized cryopreservation. *Cryobiology*, 71(3), 448-458.

² Images available on www.BrainPreservation.org

³ Hayat, M. A. (2000). *Principles and techniques of electron microscopy. Biological applications.*

⁴ Collman, F., Buchanan, J., Phend, K. D., Micheva, K. D., Weinberg, R. J., & Smith, S. J. (2015). Mapping synapses by conjugate light-electron array tomography. *Journal of Neuroscience*, 35(14), 5792-5807.

⁵ Murray, E., Cho, J. H., Goodwin, D., Ku, T., Swaney, J., Kim, S. Y., ... & McCue, M. (2015). Simple, scalable proteomic imaging for high-dimensional profiling of intact systems. *Cell*, 163(6), 1500-1514.