

ALCOR LIFE EXTENSION FOUNDATION

CRYONICS

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THE ALLOCATION OF LONG TERM CARE COSTS AT ALCOR

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FRED CHAMBERLAIN III
[1935 - 2012 - ...]

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BOOK REVIEW OF DAVID B. AGUS'S
'THE END OF ILLNESS

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CRYONICS



Cover Photo:
The Patient Care Bay at the Alcor Life Extension Foundation (photograph by Charles Platt)

COVER STORY: PAGE 7

The Allocation of Long Term Care Costs at Alcor

Board member Ralph Merkle presents a conceptual and quantitative analysis of the allocation of storage costs between neuro and whole body patients. Most Alcor members are aware that long term care costs for neuro patients are lower than for whole body patients but how are these numbers exactly derived and is the current allocation fair? This extensive article also includes new photos of the Alcor patient care bay, dewars, and patient enclosures.

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Fred Chamberlain III who, with his wife Linda, incorporated Alcor in 1972, was cryopreserved by Alcor on March 22, 2012. Read this 'Ode to Fred' by Linda Chamberlain.

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FROM THE EDITOR

One of the beneficial consequences of the recent discussions about patient underfunding is that it has prompted Alcor officials and members to take a closer look at the financial aspects of many of Alcor's operations. Costs associated with long term care are of particular interest because it might be possible to identify substantial cost reductions without sacrificing the quality of long term care such as reducing dewar boil-off rates, improving insulation in the patient care bay area, and re-negotiating liquid nitrogen contracts.

In this issue, Board member Ralph Merkle contributes an extensive and detailed treatment of the long term care costs associated with maintaining neuro patient and whole body patients. While many Alcor members may be aware that long term care costs for neuro patients are much lower due to taking up less space in a dewar, Ralph argues that if we would derive the relative cost allocation between neuro and whole body patients from space requirements alone, the Patient Care Trust allocation for whole body patients would need to be adjusted upwards and the neuro allocation could even be slightly revised downwards. Ralph concludes that it makes little ethical and practical sense to overprice the neuro cryopreservation and to subsidize whole body cryopreservation.

A potential rejoinder would be to argue that Alcor has good reason to subsidize the whole body option because this procedure constitutes a more credible link to conventional medicine. Another argument would be that the neuro option constitutes a (potential) PR and legal risk and needs to be priced accordingly. A more technical argument would argue that alternative dewar design would reduce the need to fill unused space with neuropatients. Ralph's article is not an official Alcor statement but aims to stimulate debate about this topic. We welcome readers to further weigh in on this topic at the Alcor Member Forums or write a response for the magazine.

Few people would argue with the claim that Alcor members constitute one of the most health-conscious populations in the world. In fact, *Cryonics* magazine has historically published a wealth of information on biogerontology and life extension strategies. Former Alcor President Steve Bridge and I agreed that it would be a good time to review one of the most popular health and life extension books on the market to understand the current thinking on these topics. In his review of David B. Agus's best-selling *The End of Illness* Bridge concludes that there is not much news under the sun and that any life extension strategy that goes beyond getting regular exercise and eating a healthy diet lacks hard supporting evidence.

As this issue of the magazine was being completed Alcor co-founded Fred Chamberlain was cryopreserved. In this issue we run Linda Chamberlain's *Ode to Fred* that was published online shortly after his cryopreservation. Expect more information about the case and Fred's contributions to Alcor and cryonics in the next issue of *Cryonics* magazine.

Aschwin de Wolf



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- Mike Perry, Ph.D. – (Early) Diagnosis of Alzheimer's Disease
- Max More, Ph.D. – Survival, Identity, and the Extended Mind

Please RSVP at <https://www.facebook.com/events/341429765900433> or send an email to contact@evidencebasedcryonics.org.

CEO Update

By Max More



Fred Chamberlain Cryopreserved

Fred Chamberlain III who, with his wife Linda, incorporated Alcor in 1972, was cryopreserved by Alcor on March 22, 2012. One week earlier, Fred relocated from Florida to a Scottsdale hospice. This allowed us to watch over him and respond immediately when needed. We believe that Fred received an excellent cryopreservation.

Although Fred had long planned to relocate to Scottsdale when the time came, in order to minimize ischemic time in transport, this almost didn't happen. He became too weak to travel, and wanted to stay close to his friends. Fortunately, a change in medication temporarily recharged him. We all took advantage of that: Aaron went out to Florida to bring him back, with Linda, and Lori Rhodes of Terasem also came to Scottsdale to help. As soon as he was admitted to a local hospice, Fred followed through on his determined and courageous plan to refuse food and fluids. This is currently the only legal way to hasten clinical death.

Even so, his body (remarkably well-maintained for his age) wouldn't quit. He would stop breathing for almost a minute, only to draw another breath. It took six days. His healthy vascular system meant there were no complications in our operating room. Fred was perfused easily and well.

I first met Fred in 1986 at the Lake Tahoe Life Extension Festival – one of the many cryonics activities he and Linda organized. Fred not only incorporated Alcor, he served as president twice, totaling more time in that position than anyone else – about six years and eight months. From 1959 to 1964 he was in the US Navy, serving as Electrical Division Officer, do-

ing weapons disposal, and he served in the Explosive Ordnance Disposal Unit One at Pearl Harbor, as well as a couple of other positions. From 1964 to 1966, in the US Air Force, Fred was responsible for a research program to develop active optical fusing on reentry vehicles.

From 1966 to 1979, he worked at the Jet Propulsion Laboratory, where he was Senior Engineer and later Member of the Technical Staff. Among his projects at JPL, Fred was responsible for a major new technology development for close-encounter navigation on final approach to Mars, for Mariner 69; coordinated all Celestial Sensors' systems development and flight hardware delivery for Mariner Venus-Mercury in 1971; and worked on the Long Duration Exposure Facility (LDEF) fiber optics space-exposure experiments.

Fred was an avid spelunker, starting in his college days. We hope and expect that he will one day be revived, to continue engaging in that and his other passions. Linda and his son are also Alcor members, and so can look forward to being back together, along with Fred's father (Alcor's very first patient) and Linda's mother.

Associate Membership

Introducing a new class of Alcor member. Supporters of Alcor who are not yet ready to make cryopreservation arrangements can now become Associate Members by paying \$10/month. Associate members are members of the Alcor Life Extension Foundation who have not made cryonics arrangements but financially support the organization. They will:

- receive *Cryonics* magazine
- discounts on the conference
- access to the Alcor Member

Forums

- and reduced or waived (after one year of associate membership) sign-up fees if they do decide to become full members.

We will encourage members who are having to drop their arrangements temporarily due to reduced income to remain as Associate Members.

Associate membership is \$10/month (or \$30/quarter, or \$120 annually). Send a check or money order to Alcor Life Extension Foundation, 7895 E. Acoma Dr., Suite 110, Scottsdale, Arizona 85260 or call D'Bora Tarrant at (480) 905-1906 ext. 101 with your credit card information. Or pay online using PayPal. There will be a dedicated PayPal button for this soon but, for now, please use the Donate button and note in the comment field what the payment is for. You do not need a PayPal account to make an online donation to Alcor (however, your browser will need to accept a harmless PayPal cookie or you will get an error message). If you want to receive *Cryonics* magazine, be sure to include your name and mailing address.

Alcor-40 Conference 2012

The Alcor-40 conference – our first in five years – will take place the weekend of October 19-21 at the Scottsdale Plaza Resort in Scottsdale (with a barbecue and tour at Alcor on Sunday afternoon). By the time you read this in the magazine, more details will probably be available on Alcor's blog. We are lining up a great roster of speakers. The topics covered are likely to include: Cryonics compared to alternatives; debate on optimal diet; improving your financial planning; aging theories and research prospects; personal genomics; optimizing your

cryonics arrangements; technologies for reviving cryo-patients; the evidence for cryonics; medical monitoring devices; and how to be persuasive when talking about cryonics.

While good speakers are important, many of us derive much value from the time in between sessions. We're scheduling sessions to allow plenty of time for networking. Get to know more people in our community. You may depend on some of them both to cryopreserve you and to revive you. You will also have an opportunity to see all the changes at Alcor, and to enjoy the barbecue. (We will cater to a variety of diets.)

Don't miss this event! It's the first Alcor conference in five years, and there won't be another for at least two or three years.

Communicating Cryonics: The recent BIL 2012 conference, held on the Queen Mary in Long Beach on the weekend of March 4-5, drew some 800 people. This "unconference" informal companion to the TED conference attracted a diverse group of people who nevertheless seemed predominantly creative, enthusiastic about creating better futures, and technology-positive. Bonnie Magee organized local Alcor members to volunteer at our table, situated fairly close to the main entrance, where we talked to interested passersby and handed out information packs and copies of *Cryonics*.

My talk on cryonics followed immediately after that of Aubrey de Grey, and was titled "Join the 0.00002% and Live." I took the approach of making a virtue of the rarity of people who have made cryonics arrangements. Rather than being defensive about the rarity of cryonics arrangements, I argued that it should be standard, and that people in the future will look back in horror and bafflement at people's passivity.

Along with Bonnie and the Alcor volunteers, I was able to seriously talk about cryonics and Alcor with many people over the weekend. Unexpectedly, I sat down at lunch on that Saturday with someone I had never met. By the end of lunch, she said she was definitely going to join Alcor and that she didn't understand why everyone wasn't doing so. Where can we find more of these "naturals?"

The video of my cryonics talk at the SENS5 conference in Cambridge is now available online: Here are two links: <http://exponentialtimes.net/videos/max-more-cryonic-life-extension-sens5> and <http://www.fightaging.org/archives/2012/03/sens5-video-max-more-on-the-necessity-of-cryonics.php>

www.fightaging.org/archives/2012/03/sens5-video-max-more-on-the-necessity-of-cryonics.php

We've had some interest from Canada recently, taking two forms: I was interviewed on February 21 by a writer doing a piece on cryonics for the Canadian Medical Association; and on March 13 the Radio Canada show, *Histoire d'objets* conveyed a bit of what we do, based around the idea of the freezer (their object of focus for that show).

If you live here in the Phoenix area, you can now pick up a copy of the Top Doctors special (March/April) issue of *Phoenix* magazine, which includes an illustrated interview that I did with them a few weeks ago. The story is: "Death (un) Ltd. What happens to your body after death? Probably what you expect. Or maybe not – after all, this is Arizona." Several pages of the article are devoted to Alcor, including several photos. The treatment is remarkably positive and accurate.

Also in the area of communication, I'm supporting an initiative by Aschwin de Wolf and Steve Bridge to produce a *Best of Cryonics Magazine* book. While he was in town this week, Aschwin and I visited our printer, were given a tour, and selected paper stock and binding style for both a paperback and limited hardcover version. The goal is to have the book available for the Alcor-40 conference in October. A two-part story, "Spending eternity in liquid nitrogen," in the Canadian Medical Association journal was less favorable, with the writer insisting on referring to our patients as "corpses," rather than the more neutral "bodies."

"Supporters of Alcor who are not yet ready to make cryopreservation arrangements can now become an Associate Member by paying \$10/month."

Resilience

When power went down this week at Alcor (and in a wide radius around us), we discovered that the backup uninterruptible

power supply for the server was not even connected to the server. Our regular backup generator was working well. However, the incident prompted Lisa Shock to ask about regular emergency preparedness checks. We will be reviewing and improving emergency plans and holding checks on a regular basis henceforth.

We are relieved that one of Alcor's previous two contract surgeons appears to have recovered his health. Even so, we talked to two new surgeons, both of whom closely observed our last surgery in March.

Question Everything

Organizations that have been around for a while, especially when they lack significant competition, can get so used to the way they do things that they forget to periodically question and challenge their practices and procedures. For Alcor, getting too settled in the status quo is unacceptable. The lives of our patients – and our own lives – depend on doing better. While some of us are already rethinking aspects of Alcor's policies and procedures (the current underfunding discussion being an example), I am formalizing this as the Question Everything initiative.

I have presented the following challenge to Alcor staff, and invite directors, advisors, and all interested parties to:

Identify three things that Alcor could do differently to reduce costs, increase efficiency, improve effectiveness, better safeguard patients, enhance the cryopreservation process, or otherwise further Alcor's mission.

If three things don't come to mind, surely *one* does. Please give this some thought. Have you ever wondered: "Why do we do it this way?" "Why must this cost so much?" "What's stopping us from cooling patients faster?" "I could improve our security..." "We should be doing *this*, if only someone would pay attention." "Damn, this is annoying. Why doesn't anyone fix this?" If so, don't assume it's recently occurred to others or that something will be done about it if only you wait. Let's make 2012 – Alcor's 40th year – the year to question everything. Rethink everything. Improve everything. ■

THE ALLOCATION OF LONG TERM CARE COSTS AT ALCOR

By Ralph C. Merkle

{The opinions expressed herein are those of the author and do not necessarily reflect those of Alcor or its Board.}

Abstract

Cryopreserved patients must be cared for for at least decades and some anticipate centuries. During this time, some caretaker organization must look after the patients. This involves paying the rent and utilities, replacing liquid nitrogen, maintaining and replacing dewars, hiring and paying staff, and a host of other activities that must be done reliably and economically. The usual arrangement is for the patient to make a lump sum payment into a common fund, the interest from which will then pay the expenses of maintaining a group of patients in cryopreservation for whatever period of time might be required. At Alcor, the lump sum payment is made into the PCT (Patient Care Trust), and the payment made by each patient is the “PCT allocation,” taken from the total payment made by the patient at the time of cryopreservation. Determining the appropriate amount of the PCT allocation can raise questions whose answers are not always obvious and can sometimes be quite dilemmatic.

When different kinds of patients occupy different volumes in the long term care system, making the PCT allocation proportional to the volume occupied by the patient provides a robust and stable answer to this question under a wide range of conditions.

Introduction

Alcor has two kinds of members: those who have signed up for whole body and those who have signed up for neuro. In the whole body procedure, as its name suggests, the entire body is perfused with

cryoprotectants and ice blockers and then cooled to the temperature of liquid nitrogen and held in long term care until such time as future medical technology can restore the patient to good health. The neuro procedure is similar, except the focus of attention is on cryopreserving the patient’s brain – while most of the rest of the body is dealt with conventionally. A concession to practicality is the retention of the entire head, to protect the brain from injury. In analogy to the whole body procedure, the brain is perfused with cryoprotectants and ice blockers and cooled, along with the rest of the head, to the temperature of liquid nitrogen and held in long term care until such time as medical technology can both restore the patient’s brain to good health and provide a suitable body in which to house it. Whatever approach is actually used to restore the patient to good health will presumably have to pass extensive testing before it is deemed safe and effective for human use.

Contractual and financial arrangements must usually be in place before a patient can be cryopreserved. The financial arrangements involve payment for both the up-front procedures and long term care. These payments are usually bundled, and at Alcor the total amount of money that is required is called the “funding minimum”. The funding minimum is usually paid with life insurance. Whole body minimums and neuro minimums are different and, as might be expected, whole body minimums are higher than neuro minimums. The focus of this article is on the lump sum pay-



Water vapor creates a mist partially obscuring the arrangement of four wholebody pods and a central neuro pod in a bigfoot Dewar. The pods are perforated to allow liquid nitrogen to enter them when they are lowered into the Dewar. A chain hoist is used to lift and lower each pod.

ment made into the common fund from the funding minimum by the patient at the time of the patient’s cryopreservation.

At Alcor, this lump sum payment is called the “PCT allocation” and is paid to the PCT (Patient Care Trust) shortly after a patient is cryopreserved. Alcor then pays the bills incurred in the process of keeping patients cryopreserved. These bills include payments for liquid nitrogen, rent payments, staff time allocated to maintaining dewars and topping off liquid nitrogen, and other miscellaneous items. Alcor records the amounts involved and bills the PCT, and the PCT then reviews the bills and, if appropriate, pays them. As a consequence of this arrangement, Alcor has good records of the total payments involved in keeping all of its patients cryopreserved. Alcor’s annual cost for maintaining 71 neuros and 36 whole body patients in 2011 was about \$170,000,¹ while the PCT had a net

¹ This article is not intended to review actual costs of long term care. It focuses on the allocation of costs between different kinds of patients, and in particular on the allocation of costs between neuro and whole body patients. However, it is useful to provide a rough idea of the costs actually incurred. More reliable and more accurate estimates require further review of the relevant data and detailed knowledge of when individual patients entered long term care, exactly what funds were received by the PCT when, etc.

worth of ~\$7M. This is an annual draw rate of ~2.4%, which somewhat exceeds our desired or target draw rate of 2%.

However, while Alcor knows quite accurately the total costs involved in keeping all its patients cryopreserved, the allocation of those costs among specific patients is not so clear cut. The issue of allocating costs among patients will arise in any cryonics organization that has pooled funds used to pay for patient care of cryopreserved patients kept in shared facilities. The fundamental question is this: on what basis should costs be allocated among different patients? More specifically, what lump sum payment into the common fund should be required up front when a patient is placed into cryopreservation?

At Alcor, this question may be stated as: **what should the PCT allocation be for each patient?**

Allocating costs

Having provided the background for the problem, we can now turn our attention to a more detailed description of the problem statement. We will consider only a simple case involving two kinds of otherwise undifferentiated patients: neuro and whole body. Neuro patients are smaller in volume than whole body patients. Specifically, ten neuro patients fit into the space occupied by one whole body patient.

Alcor currently uses large stainless steel cylindrical dewars which it calls “Bigfoot” dewars. Each Bigfoot can hold 4 whole body patients in four quadrants, each patient held in a “pod” which allows them to be easily slid into and out of the Bigfoot. In addition, each Bigfoot has enough space in the core, where the four quadrants meet, to hold 5 neuro patients. That is, a single Bigfoot dewar can hold 4 whole body patients, one in each quadrant, and at the same time 5 neuro patients in the central column, for a total of 9 patients. This particular packing arrangement creates its own issues with respect to pricing, as we shall see later.

While the Bigfoot can hold 4 whole body patients and 5 neuropatients, it can also hold 3 whole bodies and 15 neuros, 2 whole bodies and 25 neuros, 1 whole body and 35 neuros, or just 45 neuros.²

² The first Bigfoot arrived at Alcor on May 16th, 1990 (see www.alcor.org/cryonics/cryonics9006.txt). The July *Cryonics* made reference to the fact, common in many early articles (such as [This long term care system makes it clear that long term care of 1 whole body or long term care of 10 neuros is externally indistinguishable. Once patients are safely secured in a Bigfoot, the rest of the world is serenely indifferent about the contents thereof. Indeed, unless someone opens up the Bigfoot and looks, you can't tell what's inside. If I told you that a Bigfoot had 4 whole bodies and 5 neuros, or 45 neuros, or 2 whole bodies and 25 neuros, you could believe any one of these statements and never know whether it was right or wrong unless you popped the top and had a peek. Which rather suggests that it doesn't much matter, at least as far as looking after the dewar, and that we should therefore charge exactly the same for long term care for either 1 whole body or 10 neuros.³](http://www.alcor.org/Li-</p></div><div data-bbox=)

Allocation by volume

Given these numbers, and the fact that one neuro occupies one tenth the volume of a whole body, one might reasonably conclude that prices could be scaled with volume – that is, the lump sum payment made by a neuropatient to the common

³ [brary/html/CostOfCryonicsTables.txt](http://www.alcor.org/binary/html/CostOfCryonicsTables.txt)) that a Bigfoot can hold 54 neuros – with the 9 additional neuros being placed on the upper shelf. The more commonly cited capacity of 45 neuros leaves the upper shelf available for pets and samples. This limits any possible temperature rise of the human patients as long as the fill level in the Bigfoot remains above the level of the upper shelf. How significant this additional protection might be is unclear: liquid nitrogen levels are monitored carefully and temperature increases in vapor phase storage when conductive metal framing remains partially immersed in liquid nitrogen should be limited. In internal tests the temperature difference between the top and bottom of the patient space inside a Bigfoot, when the internal aluminum whole-body pods were left in place to conduct heat, was extrapolated to be only 15°C even when the last of the liquid nitrogen was boiling off at the bottom.

³ This neglects the fact that whole body patients actually come in different sizes. Alcor has an oversize pod that occupies part of the central column and three eighths of a circular section of a Bigfoot instead of one quarter to accommodate larger patients. While it has not yet been done in practice, it would also be feasible to accommodate two additional neuro patients in the volume occupied by a whole body patient if the whole body patient were particularly short. Finally, the additional volume of liquid nitrogen available in an emergency situation would vary depending on the volume occupied by the whole body patients. These secondary considerations are neglected in the following analysis, although in principle they could be taken into account in Alcor's fee schedule. Neuro patients arguably also come in somewhat different volumes, but the actual volumes vary by significantly less in this case.

fund used to pay for long term care should be one tenth the lump sum payment made by a whole body patient to the same fund.

Provided that the actual costs incurred by the common fund are a function of volume, this conclusion is quite reasonable. However, are there costs that are not a function of volume, or that scale significantly non-linearly with volume?

For an idealized system, the energy required to cool a given volume scales with the surface area, not the volume. However, as long as Alcor uses multiple identical long term care modules such as the Bigfoot dewar, scaling will be a linear function of the number of modules, and hence of the volume.

So we might first ask: will Alcor continue to use dewars for a sufficiently long time that the linear scaling of this type of system should be used in evaluating the costs of long term care?

While it is certainly possible that Alcor might decide to use more efficient units in the future, the Bigfoot dewar is made of #304 stainless steel, costs over \$30K, and should have a useful life in excess of 20 years. Alcor is unlikely to throw one away any time soon unless the savings are substantial. Boil-off of a well-built Bigfoot dewar is about 10 to 11 liters per day, and can be less. Liquid nitrogen costs can vary from as little as \$0.125 per liter or less when purchased in sufficient volume to over \$0.50 per liter. Transfer losses can also vary significantly, and might as much as double the effective liquid nitrogen usage.

A Bigfoot is likely to have a long useful life. More strongly, a modular long term care unit of some fixed size is likely to have an even longer useful life. While the concept of a large swimming pool of liquid nitrogen with cryopreserved patients in it has sometimes been proposed, the most serious design efforts for large long term care systems continue to use a modular approach for a variety of reasons, including safety, low manufacturing cost, ease of repair and maintenance, portability, rapid replacement of damaged units, and the ability to grow capacity incrementally in response to demand. The cost of a modular long term care system scales linearly with volume, so as long as modular units are used, linear scaling will remain the rule.

Regardless, the analysis that follows



The central box-shaped aluminum pod can contain six neuropatients, each in its separate cylindrical container, stacked vertically. This sequence shows the center pod being lowered into a dewar after a neuropatient has been added.

assumes that linear scaling, or least something close to linear scaling, continues to hold true.

Legal expenses

On the other hand, some expenses don't scale with volume and benefit all patients. An example would be legal costs involved in defending patients from legal attack. We certainly hear about legal attacks against cryonics patients, often brought by relatives who are seeking some or all of the funds that the cryopreserved patient sought to use for their cryopreservation.

While this kind of expense does not scale with volume, and if it were borne by the common fund used to protect all cryopreserved patients it would seem appropriate to charge it on a per-patient basis, Alcor made a decision that legal costs incurred from risks arising from the cryopreservation would not be borne by the PCT. The reason for this is quite simple: at the time a patient is cryopreserved emotions run high and relatives and others will engage in behavior that is unusual, unpredictable, and sometimes quite dangerous to Alcor and our patients.

But the purpose of the PCT is to *avoid* unusual, unpredictable and dangerous situ-

ations. It is to provide stable long term care for members, particularly long time members who made arrangements well in advance and took great care to avoid unusual, unpredictable and dangerous events. Often the most unpredictable events surround last minute cases – people who postponed arrangements until the very end, who failed to make appropriate arrangements, who left loose ends that others had to clean up, or who made no arrangements at all and left distraught relatives to fight over the appropriate disposition. Legally, the question is often whether or not the arrangements were properly made, bringing into question whether the PCT should be expending funds in the first place.

As a consequence, these legal expenses are viewed as more appropriately coming from Alcor, friends, relatives, indeed *anyone* or *any organization other* than the PCT. The purpose of the PCT is to wait until the dust clears, the risk is gone, and *then* to accept the patient and provide long term care and protection. Risk to the PCT is risk to all of Alcor's patients, and such risks should be avoided if at all possible.

Public relations

Another type of expense that would be viewed as appropriate to allocate on a per-patient basis would be public relations expenses. Again, while such expenses, if they were billed to the PCT, would quite reasonably be allocated in this fashion, Alcor has decided not to charge such expenses to the PCT. The purpose of the PCT is to pay for expenses that are strictly related to patient care. If it's not related to patient care, the PCT is not supposed to pay for it. Public relations expenses are paid for by Alcor, not the PCT.

Fixed expenses

It would seem that the common fund should pay for fixed expenses. This might seem to include rent, staffing, and the like. But in the long term, such "fixed" expenses are not actually fixed. In the long term, "rent" is a function of the number of Bigfoot dewars (in the case of Alcor today) or the number of long term care modules (more generally) that are being used.

If you have N Bigfoot dewars, you need to rent a facility with a number of square feet which grows in proportion to N. If you have twice as many Bigfoot dew-



After a neuropatient has been cooled near liquid nitrogen temperature, the cephalon is bagged and placed in a cylindrical container. A lid that has been coded with patient data is attached with loops of wire. The cylindrical container is then stored in a Bigfoot Dewar, or, as shown in this instance, is lowered into a smaller Dewar that is reserved for neuropatients only.

ars, you need twice as many square feet in your facility. This won't happen overnight, and you might spend many years in one facility before moving to the next, but in the end a small facility will just become too cramped and you'll need to move to a bigger facility that will hold more Bigfoot dewars.⁴

So rental costs ultimately scale linearly with the number of Bigfoot dewars, and the number of Bigfoot dewars scales linearly with volume.

Staffing expenses also look like they are "fixed," but again this is an illusion that only lasts as long as you focus on a short time period. After a few years, the larger the number of Bigfoot dewars the more people you need to look after them. Ultimately, staffing requirements scale linearly with the number of Bigfoot dewars, which scale linearly with the volume.

Restoring patients to good health and reintegrating them into society

The PCT is eventually going to be drawn on to restore patients to good health and reintegrate them into society. These

⁴ It can reasonably be argued that for sufficiently large N , there would be sufficient resources to optimize the design of the long term care module and so improve efficiency. While true, this still leads to an asymptotic limit which is linear in N : we are simply debating the final value of the constant factor. A similar argument can be made for other improvements that might be made in other areas when N is large. The exact final value of this constant factor is unclear. The author eagerly awaits the opportunity to gather experimental data on this point!

expected payments are sometimes called R&R expenses, or just R&R.

As R&R can be as large or as small as people can imagine, and can be imagined to be larger or smaller for neuro or whole body, it can be used to argue for or against any allocation of funds that might suit anyone's fancy. As a consequence, most serious discussions of cost allocation ban R&R outright not because it is not important but because no rational discussion on the subject is possible without a shared set of assumptions, and there seem to be no shared assumptions about what the future will look like except that my opinion is much better than yours.

As an example, consider the following argument. Person A says whole body patients will be less expensive to restore because they at least have tissues and organs, while neuro patients will be more expensive to restore because most of their tissues and organs are missing entirely and will have to be entirely replaced, a process that will surely be more expensive. Person B says the highly damaged tissues and organs of whole body patients will have to be expensively restored, because whole body patients will be upset if you just throw away their tissues and organs and replace them with better, cheaper artificial tissues and artificial organs; while neuro patients will be quite happy with better and cheaper artificial tissues and organs. So A and B reach diametrically opposite conclusions about the R&R costs of neuro and whole body patients, based on opposing conceptions of future medical technology.

In the absence of definitive proof about how expensive it will be for medical technology of the future to repair existing tissues and organs or, alternatively, to throw them out and entirely replace them, there's really no way in which this debate can be resolved. Both A and B can assert that future medical technology will have the properties they expect, and that the arguments advanced by the other person are wrong. Neither will be able to convince the other, and the discussion will reach an impasse.

About the only thing that all parties can agree on is that the PCT must pay for the expenses of maintaining patients in cryopreservation and that the PCT must have enough built in margin to ensure it will survive bad times and rebound in good

times. Fortunately, this minimal requirement that the PCT must meet is sufficient to cover everything else. Any fund with enough built in margin to have a high probability of survival over centuries should enjoy growth from compound interest that will eventually provide sufficient funds to cover whatever fixed costs must be met in order to revive the patients.

If we are sufficiently concerned about insuring that neither kind of patient gains an unfair financial advantage from the other we could create two funds: the neuro fund and the whole body fund. The neuro fund would receive the PCT allocation of neuro patients and would be used to pay for all expenses incurred while caring for neuro patients, while the whole body fund would receive the PCT allocation of whole body patients and would pay for all expenses incurred while caring for whole body patients. When the time came to revive patients, each kind of patient would be revived using assets only from its particular fund. If a particular fund had insufficient assets to pay for the revival of all of its patients, those patients would have to wait while compound interest caused enough growth to pay for their revival.

Until the day arrives when the technology to revive our patients is available, the actual payments the PCT will be making to keep our patients cryopreserved should⁵ scale linearly with volume. When we find out what the costs of reviving our patients actually are, *then* we can debate whether we should let one kind of patient remain in cryopreservation a few years longer while compound interest causes their share of the PCT to grow large enough and technological advances in revival cause costs to shrink small enough so that the former becomes larger than the latter.

Compound interest

The target draw from the PCT is 2% per annum. At that rate, it should grow robustly and exponentially. It should survive bad times and grow in good times. In 2011, the PCT had a net worth of about \$7M. Even with no additions or donations, in

⁵ There are arguments that sub-linear scaling will set in with large values of N . While this is difficult to know for certain in advance, should it happen then it will leave us in a better situation than we forecast, which is presumably beneficial.



Alcor Member Forums

Discussion board of the Alcor Life Extension Foundation

Discuss Alcor and cryonics topics with other members and Alcor officials.

- The Alcor Foundation
- Cell Repair Technologies
- Cryobiology
- Events and Meetings
- Financial
- Rejuvenation
- Stabilization

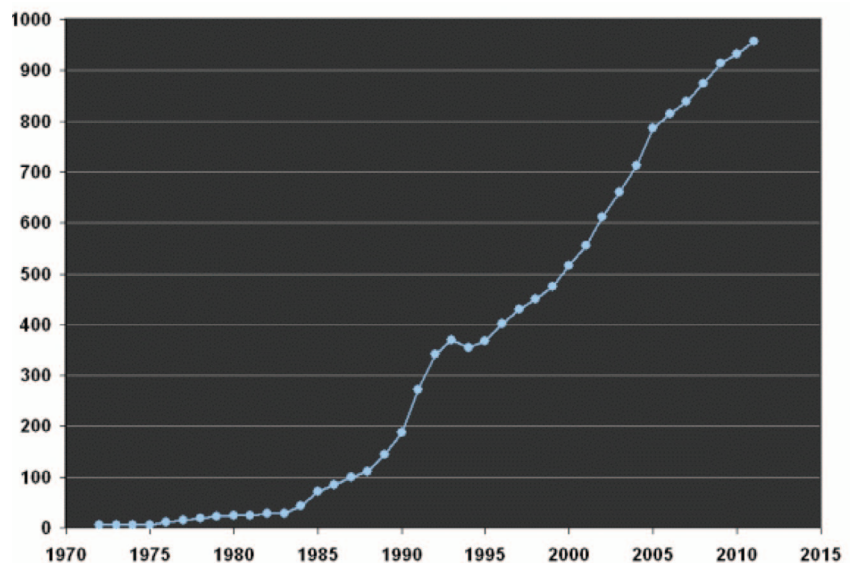
Other features include pseudonyms (pending verification of membership status) and a private forum.

<http://www.alcor.org/forums/>

Membership Statistics

	2012	01	02	03	04	05	06	07	08	09	10	11	12	
TOTAL		956	959											959
FINALIZED		2	4											6
REINSTATED		0	1											1
CANCELLED		3	2											5
CRYO-PRESERVED		0	0											0
NET GAIN		-1	+3											+2

Alcor members are people who have completed full legal and financial arrangements for cryopreservation with Alcor. As of February 29, 2012, Alcor had 959 members and 110 patients. Below is a chart with 2012 membership growth statistics to date and a graph showing the number of Alcor members and patients at year end since inception.





A “pod” is an aluminum clamshell to contain and protect a human patient while immersed in liquid nitrogen. The two sections of the pod are held together with sheet-metal screws. The “ears” at the top are to lift the pod before it is lowered into a Dewar. The two sections of a pod are shown here separated. Straps in the right-hand section will hold the patient in place.

two decades it should exceed \$18M⁶. The reason for this is compound interest. A long term real rate of return of 7% is reasonably possible with a prudent investment portfolio, and drawing 2% of that annually still leaves an annual return of about 5%.

Now consider what happens if we draw just a little bit more: 4% per annum. At that rate, the PCT might not grow at all. It might last for decades, but it might shrink instead of grow. It certainly wouldn’t enjoy robust growth. It might eventually disappear. While it would seem a 4% annual withdrawal should still leave

6 This is based on the assumption of a 7% annual return. The 2% draw reduces this 7% to 5%, giving 1.05²⁰ or a factor of 2.65 growth in 20 years. This results in \$7M x 2.65 = \$18.6M, which is “likely to exceed \$18M”. Long term inflation adjusted stock returns vary somewhat, but from 1950-2009 the S&P 500 had an inflation adjusted return of 7% (www.simplestockinvesting.com/SP500-historical-real-total-returns.htm). Bogle, in “Bogle on Mutual Funds” gives a real rate of return of 6.5% from common stocks from 1871 to 1992.

room for 3% annual growth, the problem is that an *average* 7% growth masks year-to-year fluctuations that can be quite large. Investing in high-return but risky stocks might yield 7% on average, but sometimes stocks go up and in other years stocks go down, sometimes by quite a lot. A few bad years in a row might reduce the capital in the PCT so much that the percentage draw increases to 6%, 7%, 8% or more. Once annual patient care costs exceed 7% per year, the PCT will likely shrink each year, entering a death spiral from which it might never recover. To prevent this problem, a significant percentage of the portfolio must be invested in safe assets, such as short term bonds, which have a lower return but which fluctuate much less. But this lower return brings the whole portfolio closer to the brink, the gap between income and the annual draw becoming smaller and smaller, so the risky (but high return) portion of the portfolio becomes even less acceptable. Increasing the draw, even from 2% to 4%, would move the PCT from a rate of withdrawal that had negligible long term risk and robust growth to a rate of withdrawal that had substantial long term risk and anemic growth.

The net result is that if you try to draw too much, you risk your whole investment. But if you draw a modest percentage, you can continue to safely draw that modest percentage indefinitely and at the same time enjoy robust growth of your principal. While 4% is often used as a safe rate of withdrawal for retirees, retirement accounts need only last a few decades. A modest risk of exhaustion in 30 or 40 years is acceptable, and growth is not required. Funds intended to maintain cryopreserved patients must last indefinitely and must also grow to cover any unexpected contingencies and the future costs of revival. They can tolerate essentially no risk of exhaustion even after a century or more.

The long term impact of compound interest cannot be overstated. Over longer periods of time, compound growth is exponential – it compounds. At a 7% real rate of return with a 2% draw, that \$7M in the PCT we have today becomes \$18M in 20 years, \$49M in 40 years, \$130M in 60 years, and that assumes no one else adds a penny to it. Eventually it will be large enough to fund whatever is needed to make cryonics work – for all of the patients at Alcor.

At the same time, the declining costs of technology are continually reducing the costs of reviving the cryopreserved patients. These declining costs are most famously illustrated by Moore’s law, the exponentially declining costs of computer circuitry on semiconductor chips. Other information based technologies are also seeing such exponentially declining costs, and the general pattern is expected to spread to essentially all manufactured products as molecular manufacturing becomes ubiquitous sometime during this century. The costs of restoring cryopreserved patients are expected to decline in a similar exponential fashion.⁷

Markets and marginal costs

The prices of goods are commonly set by markets, commonly thought of as places where many buyers and many sellers buy and sell large volumes of standard products. If we assume that many long term care organizations are competing to offer whole body and neuro long term care services to many customers, then we would expect to find that prices would reflect some mark-up over actual costs. Long term care organizations that provided the lowest priced, most reliable service would prevail, while those that charged too high a premium above their actual costs would lose business to long term care organizations that charged a smaller premium. In the end, the marginal costs of long term care for each additional patient, plus some reasonable profit⁸ to the long term care organization, would determine the price charged to the customer.

This model also assumes that the long term care organizations are acting purely as long term care organizations, and are not taking on other roles, such as Trust funds, marketing firms, etc. While not entirely re-

7 See, for example, the discussion of molecular nanotechnology in *A Cryopreservation Revival Scenario Using Molecular Nanotechnology*, available online at www.alcor.org/Library/html/MNTscenario.html, and *Economic Impact of the Personal Nanofactory*, available online at www.rfreitas.com/Nano/NoninflationaryPN.pdf.

8 Companies that make rich profits will be noticed, and companies that make less will copy their methods. Eventually, highly profitable companies will find their highly skilled employees are hired by competitors, or their highly skilled employees spin out competing firms. Whatever the details, profits substantially higher than competitors are difficult to maintain over long time frames in competitive markets.

alistic, it does provide us with a first-order model with which we can analyze what sort of price might result.

If we assume that long term care organizations use a simple long term care module which can hold either 1 whole body patient or 10 neuro patients, then the result is pretty straightforward: pricing will settle down at some value, and the price charged to care for a whole body patient will be ten times the price charged to care for a neuro. The simplest way to see this is to note that, once the long term care module has been filled, the long term care organization will deal with the long term care module from an external point of view and will simply fill it with liquid nitrogen as needed and otherwise do very little to it. It need not even know what's inside. If the long term care organization wants to charge above the market rate for maintaining a module, the customer could simply take the module to another long term care organization and have them maintain the module for the going market rate. While this might or might not be perfectly true in a specific case, it would be true enough often enough that long term care organizations that charged rates that were significantly above the going market price would rapidly find themselves losing market share.

This model results in a not-very-surprising conclusion: the price of long term care in a competitive market would be a linear function of volume.

Of course, the present situation is not one with a large number of long term care-only organizations competing with each other, and our long term care modules do not provide long term care for either 1 whole body or 10 neuros. How do these factors influence the price of long term care?

How much neuro and whole body patients pay into the PCT today

Today, in 2011, Alcor's PCT allocation for whole body patients is \$110K. That is, every time a fully funded whole body patient is cryopreserved, Alcor puts \$110K into the PCT. Alcor's PCT allocation for neuro patients is \$25K. Every time a fully funded neuro patient is cryopreserved, Alcor puts \$25K into the PCT.

The "fully funded" qualifier means that when Alcor cryopreserves "underfunded" members who signed up in previous years when funding minimums were

less than today's minimums and who do not have sufficient funds by today's standards, Alcor will usually put less than these amounts into the PCT. We omit this fact from the current analysis, as the "underfunding issue" is addressed elsewhere.

What is relevant is that each fully funded whole body patient today puts \$110K into the PCT, while each fully funded neuro patient today puts \$25K into the PCT. This is a ratio of 110:25 or 4.4:1. The reader will notice that this ratio is much less than 10:1, the "fair market ratio."

By this metric, either whole body patients are paying much too little into the PCT or neuro patients are paying much too much into the PCT, or some combination of the two.

If we use the approximate 2011 data and allocate \$170,000 per year among 36 whole body and 71 neuro patients, and use a 10:1 volume-based cost allocation ratio, then each whole body costs \$3,944 per year and each neuro costs \$394 per year.

Using 2% per year as our required draw on the PCT for each patient, this implies a whole body PCT allocation of \$3,944/0.02 or \$197,200 and a neuro PCT allocation of one tenth that amount, or \$19,720. If we assume that a volume-based allocation ratio is appropriate then the existing whole body PCT allocation should be almost doubled (increased by ~\$90,000) while the neuro PCT allocation could be safely reduced by about 20% (decreased by ~\$5,000). We might round off these estimates and refer to them as the "fair market neuro PCT allocation of \$20K" and the "fair market whole body PCT allocation of \$200K."

How did this state of affairs come about, and what are the reasons that justify it?

It came about like so many things come about – it just happened. So far as anyone can tell, it happened a little bit at a time, and it happened largely because raising the minimums for neuro members is easier because neuro prices are lower; and raising minimums for whole body members is harder, because whole body prices are higher. This process was repeated many times in the last 20 years and led to the ratio we see today.

In the absence of market forces, are there other forces still at work that would tend to counter this drift?



The "neuro column" is intended to store five cephalons in neuro cans, each of which will be wired into place on its shelf. Theoretically the column could store six cans, but the top section is usually left empty as a safety precaution in case of unexpected liquid nitrogen boiloff.

Impact of the long term care module

Alcor has a long term care module called a "Bigfoot dewar." As discussed before, it has a central column that can accom-



The Alcor Patient Care Bay. All dewars are equipped with level detectors and alarm systems. The lines above the dewar allow for automated dewar refills from a larger bulk tank.

modate 5 neuro patients. This is actually quite significant, for the following reason. As long as there are more than 5 neuro patients being cryopreserved for every 4 whole body patients, then almost every Bigfoot dewar can be completely filled. Aside from the last Bigfoot, which is partially filled, it's always possible to fill all the other Bigfoot dewars completely. When there are 10 extra neuros (because we're getting more than 5 neuro patients for every 4 whole bodies we'll accumulate extra neuros) then we put them into a whole body pod and treat them like a whole body. This means we'll never have more than 9 "extra" neuros.

The result is that as long as we have enough neuro patients, we can fill almost all the dewars.

However, if we are receiving more than 4 whole bodies for every 5 neuros, then we will not have enough neuro patients to fill the central columns of all the Bigfoot dewars. If we pack every Bigfoot dewar's cen-

tral column with 5 neuros whenever possible, and leave the rest empty, there will be at most one Bigfoot with a partially filled central column. If we don't have enough neuro patients we will have some Bigfoot dewars with empty central columns.

If we have 100 whole body patients and 100 neuro patients, then we will need 25 Bigfoot dewars to hold the 100 whole body patients. This requirement will exist even if we had no neuro patients at all: the Bigfoot can only hold 4 whole body patients, so 25 Bigfoot dewars are the minimum number required if you have 100 whole body patients.

The central columns of these 25 Bigfoot dewars will hold 125 neuro patients – which is more capacity than required to hold 100 neuro patients. There will be room for 25 more neuro patients than we actually have in this scenario. This means 20 of the Bigfoot dewars will have central columns that are occupied by neuro

patients, and 5 of the Bigfoot dewars will have empty central columns.

This is a fundamental problem caused by use of the Bigfoot dewar as a long term care module. If Alcor has more whole body patients than neuro patients, and uses Bigfoot dewars for long term care, then there will be empty central columns.

If we think of each Bigfoot and its associated support costs, including liquid nitrogen, rent, staff costs, depreciation, and its portion of all the other costs involved in running the long term care organization, as being paid for by its occupants, then the Bigfoot dewars that have empty central columns will have to be paid for by the 4 whole body patients who occupy it. But if there are many fewer neuro patients than whole body patients, then there will be more and more Bigfoot dewars that have no neuro patients in their central columns, and which will have to be paid for solely by their whole body occupants.

Of the 100 new members signed up by Alcor just prior to September 30th, 2011, 26 were neuro and 74 were whole body. When these 74 new whole body members become patients, they will require 18.5 Bigfoot dewars, and these 18.5 Bigfoot dewars will be able to hold 92.5 neuros in their central columns. When the 26 new neuro members become patients, they will occupy only 26 of the 92.5 spaces that the 74 whole body patients have made available for them in their Bigfoot dewars, so $26/92.5 = 28\%$ of those 18.5 Bigfoot dewars will have central columns that are occupied. The remaining 72% of the Bigfoot dewars would have to be “paid for” by just their 4 whole body occupants.

If current sign-up statistics continue, 72% of Alcor’s Bigfoot dewars would have empty central columns and would have to be “paid for” by their 4 whole body occupants. While not literally true, this is a compelling way of visualizing the magnitude of the shortfall that Alcor is going to suffer if current sign-up statistics continue unchanged.

The current whole body minimum is \$200K, while the current neuro minimum is \$80K. The recent sign up data is telling us that when the ratio of whole body minimum to neuro minimum is 2.5:1 (\$200K:\$80K), new members prefer the whole body option despite its higher price by a ratio of over 3:1. While the PCT allocation is not the only reason for this, it is a significant contributor. If Alcor subsidizes the whole body PCT allocation by increasing the neuro PCT allocation, one consequence is an increase in the number of whole body members, leading to a reduced occupancy of the central columns and an increase in the number of Bigfoot dewars that must be paid for solely by whole body patients. A second consequence is that the PCT allocation provided by whole body members is smaller, so that those fewer whole body patients can each contribute less money to pay for their Bigfoot dewars.

If Alcor increased the whole body PCT allocation to 10 times the neuro PCT allocation (the “fair market ratio”), and used the “fair market PCT allocations” of \$20K for neuro and \$200K for whole body computed above, then it could easily decrease the neuro PCT allocation from \$25K to \$20K, and pass along this decrease by adjusting the neuro minimums to \$75K; and the increase in the whole body PCT allocation

from \$110K to \$200K could be paid for by increasing the whole body minimum from \$200K to \$290K. We can call \$290K the “fair market whole body minimum.”⁹ This would both decrease the number of new whole body members and increase their ability to “pay for” the Bigfoot they occupied (again, not literally, but in the metaphor we are using to help visualize the magnitude of the financial loss Alcor will suffer if we do nothing about this problem).

The brief summary: New members are choosing whole body over neuro by a 3:1 ratio, so we’ll be forced to buy Bigfoot dewars just for whole body patients. A Bigfoot occupied only by whole body patients has to be “paid for” by the whole body occupants from their whole body PCT allocation with no help from the neuros who aren’t occupying the central column.

Unless this imbalance can be corrected, the whole body minimum will have to be increased to more than \$290K (the “fair market whole body minimum” computed above) because the subsidy to whole body patients has driven the neuros below the threshold where the Bigfoot central columns are fully occupied.

A simple example

A simple example illustrating the costs involved might be useful. If Alcor were to cryopreserve 5 neuro members and 4 whole body members, and place them in a new Bigfoot dewar, it would add $5 \times \$25K + 4 \times \$110K = \$565K$ to the PCT to look after that Bigfoot.

On the other hand, if Alcor were to cryopreserve 45 neuro members and place them in a new Bigfoot dewar, it would add $45 \times \$25K = \$1,125K$ to the PCT to look after *that* Bigfoot.

In both cases, Alcor has one additional Bigfoot dewar in the patient care bay. In both cases, every day, Mike Perry checks the Bigfoot to make sure it’s OK and still has liquid nitrogen. In both cases, once a

⁹ These “fair market” values are based on the assumptions that (a) a 10:1 volume ratio does in fact hold between whole body and neuro in long term care, an assumption that is discussed in greater detail elsewhere in this paper; (b) the 2011 cost estimate of \$170,000 for 71 neuro and 36 whole body patients is approximately accurate; and (c) for the “fair market whole body minimum” the up-front costs of \$90K for the whole body minimums are in fact approximately correct – a subject which is beyond the scope of the current paper and which needs to be analyzed elsewhere.

week, it gets topped off. In both cases it occupies a certain number of square feet in the patient care bay. In both cases the liquid nitrogen boils off at about 11 liters per day.

In one case there’s \$565,000 to pay for all of that. In the other case, there’s \$1,125,000.

Week after week, month after month, year after year: the same routine. Nothing much changes, nothing much happens.

But one of those Bigfoot dewars has almost twice as much money in the PCT to look after it.

That’s the current situation.

The marginal cost of neuro long term care with the Bigfoot

Perhaps the most interesting conclusion is that use of the Bigfoot with empty central columns results in marginal costs of long term care for neuro patients that are zero. If there are more than 4 whole body patients for every 5 neuro patients, then it will be necessary to purchase Bigfoot dewars just to accommodate the whole body patients. This will leave empty central columns that have already been bought and paid for by their whole body occupants. There are literally no additional costs incurred when an additional neuro patient is added. The boil-off of liquid nitrogen is not altered by the addition of a neuro patient in the central column, as the boil-off rate is a function only of heat loss by the Bigfoot dewar, which depends only on its insulation and surface characteristics, not on what is inside.¹⁰ There is no chance that an additional Bigfoot might have to be added, as by the definition of the situation there is extra room in the central column.

Because the marginal cost of adding a neuro patient is zero, the long term care organization should, according to standard economic theory, be willing to offer long term care to neuro patients in exchange for any benefit to the organization, no matter how small. As long as there are more new members selecting the whole body option than neuro, there will be available space in the central column. And as most people

¹⁰ Trivially, a Bigfoot with no liquid nitrogen will have no boil-off. While there is a slight variation in boil-off during normal operation as liquid nitrogen levels fluctuate, in normal operation a Bigfoot is kept near a certain “fill level” regardless of contents. In this mode of operation the boil-off is not changed by the addition or removal of fully immersed patients, either neuro or whole body.

prefer whole body to neuro, the only thing that keeps the percentage of neuro patients high enough to keep the central columns filled is a very low price for neuros, which we can offer because neuro patients occupy only one tenth the volume of a whole body patient. Indeed, if the preference for whole body is strong enough, we can offer long term care of neuro for free, as neuro patients can be cared for in the cracks of the whole body long term care system.

Changing the long term care module characteristics

This analysis depends on the characteristics of the Bigfoot. Could we not design a whole body only long term care module that would avoid this kind of issue? An obvious concept would be to design a module in which the central column was absent, or in which the central column was expanded so that it offered enough space to care for another whole body.

The cylindrical design of the Bigfoot is intended to maximize its cross sectional area while minimizing its surface area and therefore its heat loss. Cylindrical designs also more easily support a vacuum with thinner metal.¹¹ Rectangular designs are less thermally efficient.¹² Even though rectangular designs offer better packing efficiency, both on the floor (external packing) and inside the dewar (internal packing) experience at CI (Cryonics Institute) does not support the use of rectangular designs. They have adopted a cylindrical design in their cryostat, which has proven very effective.

In the Alcor Bigfoot, 4 patients are cared for in 4 pods, each pod being fixed in geometry, while a central column, also fixed in geometry, is available for neuro patients. If you divide a circle into four pie-shaped wedges, the region in each wedge near the center of the circle is less usable because it has a sharp 90 degree corner limiting how that space can be used. By combining these four less-usable-corners into one region, you

can create a very usable central column, and fill the rest of the pie-shaped-wedge with a pod that can hold a whole body patient.

In the CI cryostat, they divide their cylindrical long term care module into six sections, but this division is only approximate. While each of their patients is attached to a board to provide some structure, they are otherwise allowed to adjust to the particular shapes of the surrounding patients, and the board can be moved relatively freely within the cryostat. Their approach still seems to provide space near the center of the cylindrical region which is less likely to be used and more likely to be available. CI cares for pets in this region.

Cylindrical designs, adopted for energy efficiency reasons and because long term care of long, narrow objects (whole body patients) can be efficiently done in tubes seem rather naturally to provide long term care for patients near the walls of the tube and some additional space towards the center of the tube. This space can be used for neuro patients, pets, or other material.

Increasing the size of the tube until the central column is large enough to accommodate a whole body patient might allow a design which was both efficient (circular, low boil-off per patient) and which did not have any convenient nooks that could accommodate neuro patients. Whether or not such a design is feasible is unclear. Packing of large objects into an energy efficient cylindrical structure is harder than packing a combination of large and small objects into a cylindrical structure. There is also the question of whether designing a long term care module for the purpose of more easily subsidizing whole body patients at the expense of neuro patients can reasonably be justified when compared with potential alternatives. The most obvious alternative would be to adopt a 10:1 pricing ratio and see if this resulted in a sufficient shift in the whole body to neuro sign-up ratio that it allowed Alcor to keep the current long term care modules (the Bigfoot dewars) fully loaded with 9 patients each: 4 whole body and 5 neuro.

Higher packing densities

Another possibility would be to increase the packing density of patients. While higher packing densities for both neuro and whole body patients might theoretically be feasible, there seems a some-

what obvious possibility for increasing the packing density for neuro patients. Today, we first place neuro patients in neurocans and then place the neurocans either in the central column or into the space occupied by a whole body patient. However, the neurocan itself is an inefficient way of using space. A more direct method of long term care for neuro patients that more fully utilized the available volume should significantly increase the packing density.

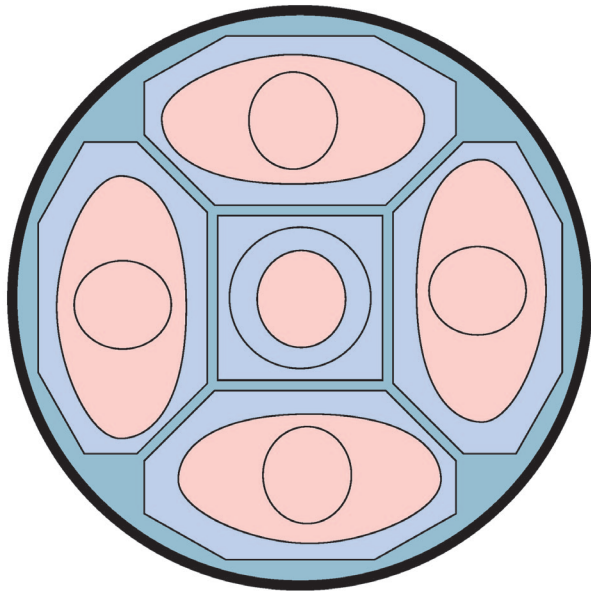
While no experiments have been conducted, informed estimates suggest that 12 neuropatients should fit into the central column of a Bigfoot if the neurocan was not used. Each patient could be wrapped in a thin layer of a suitable material to provide physical and thermal protection. As the critical tissue being protected is the brain, thermal excursions or physical damage would have to penetrate both the protective wrapping material and the skull. The material could be selected to be less dense than liquid nitrogen and to provide sufficient floatation to make the neuro patient almost neutral in buoyancy, so that the neuropatient near the bottom of the central column would not have to support unreasonable weight.

Each neuropatient could be tied to a retrieval line when they were lowered into the central column, and the retrieval line could be tagged and tied to a post. This would allow for easy identification and retrieval, with retrieval being in reverse order of entry into the central column.

While this method might be used to increase the packing density in the central column of a Bigfoot that held 4 whole body patients, the direct application of this approach to care for ~108 neuro patients in a Bigfoot might be problematic: for example, the lines might become tangled.

A more structured approach might divide the interior of the Bigfoot into a central column and four quadrants, each quadrant being defined by a framework which, externally, had the outline of a whole body pod but which internally was further divided into two. This would create a central column and would divide what were formerly whole body slots into two neuro columns. Each of these new neuro columns would have aluminum walls that would divide it from the other neuro columns, and would provide a structure into which we could place additional neuro patients without the

¹¹ Paul Wakfer said "the flat bases of the dewars are made of much thicker stainless steel, both for the inside and outside vessels, and even then there is considerable bending by each toward the other as the vacuum is drawn down (which is likely the source of some of the boiloff differences between dewars). The best dewars used to be made with rounded ends (called a "spinning") but this is harder to manufacture and more costly."
¹² Or as Hugh Hixon said: they are "an offense to rational engineering."



The traditional configuration of pods, seen from above, allowed storage of four patients around the perimeter of a bigfoot Dewar, with a central square-section pod containing a stack of six neuropatients, each in a separate cylindrical container.

possible complications that might be created by a less structured approach.

Each of the 9 neuro columns so created (1 central column and 8 surrounding neuro columns) would presumably be able to hold the same number of neuro patients – though it is possible that the surrounding columns might be slightly larger and so be able to hold slightly more neuro patients. If we assume that each column can hold 12 neuro patients, then a Bigfoot with 9 neuro columns could hold 9×12 or 108 neuro patients.

Whether or not this specific approach proves to be both feasible and competitive when compared with alternatives, it seems clear that a higher packing density could be achieved if neurocans were not used in the long term care of neuropatients. While there are issues with this approach (including, for example, the hold time as discussed below) further investigation of this possibility is worthwhile.

Impact of higher density on the hold time

In normal operation, the contents of a long term care module are submerged well below the level of liquid nitrogen. The level of liquid nitrogen is never allowed to fall very far before the module is refilled. Even if normal refilling operations are delayed

for some time, the level of liquid nitrogen will remain above the level of the patients. However, if some serious disruption of the liquid nitrogen supply should occur, then the level could fall below the level of the patients in the long term care module. In this case, the amount of liquid nitrogen between the patients acts as an emergency reserve and will delay the time at which all of the liquid nitrogen has boiled off and the interior of the module, along with the patients inside, begins to warm up.

A fundamental issue when patients are cared for in a fixed-size module in liquid nitrogen is that each additional patient reduces the “hold time” by an amount proportional to the volume of the liquid nitrogen displaced by the patient. That is, each new patient displaces a certain amount of liquid nitrogen, and the long term care module boils off a certain amount of liquid nitrogen per day. Dividing the former by the latter gives the number of days by which the hold time of the long term care module is reduced when the new patient is added to the long term care module. By definition, higher packing density involves more patients in the same long term care module, which will further reduce the hold time, i.e., the amount of time that the long term care module will be able to operate if an emergency should cut off the supply of

liquid nitrogen. In the case of a Bigfoot, with a boil-off of about 10 liters per day, and assuming each neuro patient occupies about 5 liters, then a more efficient packing that allows 12 neuropatients in the central column instead of 5, with the rest of the Bigfoot occupied by 4 whole body patients, then we have increased the occupied volume by $(12-5) \times 5 = 35$ liters. With a boil-off of 10 liters per day, this reduces the hold time of a Bigfoot in an emergency by ~ 3.5 days.

As the Bigfoot can normally operate for ~ 3 months without being refilled, this would have a minimal impact on its hold time. We conclude that higher packing densities for neuro patients in the central column of Bigfoot dewars that are otherwise occupied by whole body patients does not have a significant impact on the ability of the Bigfoot to keep its patients cold in situations in which liquid nitrogen supplies are unavailable for up to ~ 3 months.

If we wanted to use a single Bigfoot to hold only neuro patients, then a similar calculation shows a reduction in hold time of ~ 31 days. This would significantly reduce its hold time from ~ 3 months to ~ 2 months, which might be viewed as unacceptable. If the Bigfoot is one of many in operation at a facility, and the facility has a bulk delivery tank, then this decrease in hold time of the individual Bigfoot can be compensated by increasing the size of the bulk delivery tank. From a system perspective, we have purchased an increase in capacity at the cost of decreasing the hold time of the long term care module. This decreased hold time can be compensated, if we think it worthwhile, by increasing the capacity of the bulk delivery tank. If we want to add one additional neuro patient to a long term care module by increasing the packing density, and we think it worth the cost to maintain the same system hold time (a decision which depends on many factors), then we should increase the capacity of the bulk delivery tank by 5 liters, multiplied by an additional factor to account for the transfer losses between the bulk delivery tank and the long term care module. That is, we did not get the additional space for free; we had to pay for it by either accepting a decrease in the module hold time or by purchasing additional capacity in the bulk delivery tank to offset the decreased hold time in the long term care module. In-

creasing the capacity of the bulk delivery tank introduces its own scaling issues.

The ideal situation from the perspective of the individual patient would be a long term care module all to themselves – this maximizes their hold time in case of a shortage of liquid nitrogen. Any additional patients added to the long term care module reduce the hold time of the module.

How much should we pay for each additional day of hold time? This depends on our assessment of how many days we might be cut off from liquid nitrogen. If our worst case scenario shows that we will be able to get outside liquid nitrogen after 60 days, there is no point in paying good money to provide a system that will let us survive for 90 days without liquid nitrogen. Before designing the system the risk that liquid nitrogen will be unavailable for various periods of time, and the amount patients (or the system implementer) are willing to pay to mitigate that risk, are parameters that need to be known or estimated.

In summary: increasing the packing density can reduce costs. While hold times need to be considered, and while further investigation and analysis would be required before any such system could be adopted, the current packing density of neuro patients in a Bigfoot could likely be improved by about a factor of 2. Such an improvement would have a major impact on all the cost estimates and calculations in this paper. Further investigation of this possibility is worthwhile.

Would subsidies be useful?

While it is interesting to note that in a hypothetical free market prices would tend to be a function of volume, and that in the absence of a free market there are limits to how far from a volume-based price function it is possible to go, the question still remains whether it would be useful to deliberately adopt some non-volume-related pricing function and, if so, what should such a function look like?

The first question that must be answered in considering such a subsidy is: towards what end is the subsidy adopted? In the case of cryonics and Alcor the answer is quite clear: we wish to increase the probability of survival of Alcor's patients and of Alcor's members.

More broadly, each of us wants to survive, and we want our friends and loved

ones to survive. Pretty clearly, the lower the price and the more easily we can persuade them to sign up, the more of our friends and loved ones should survive.

This actually presents a complex set of issues. The argument in favor of subsidizing whole body patients is that many people, often including our own spouses, relatives and friends, don't like neuro and might be more easily persuaded to sign up as whole body patients. Unfortunately, subsidizing whole body patients is expensive, so doing this reduces the number of people we can help.

The argument in favor of subsidizing neuro patients is that they are cheaper: we can subsidize the long term care of one neuro patient for one tenth the cost of a whole body patient. Would you rather save one friend, or ten?

And, as our exit interviews have repeatedly shown, the single most important factor in recruiting and retaining members is price. This is also true for new members, as many people who sign up tell us they have been waiting "until I can afford it," that is, they have been waiting until after they have graduated, gotten a job, and have started earning enough money to pay Alcor's dues and the premiums on the required life insurance policy.

If we attempt to subsidize whole body patients by increasing the minimums for neuro patients, the result appears to be unstable. We are looking at the results of this experiment today, and the results are that we get more people signing up for whole body and fewer people signing up for neuro. People don't like to sign up for neuro, they like to sign up for whole body, and when we subsidize whole body by increasing the price of neuro, more people start signing up for whole body. This rapidly eliminates our ability to subsidize whole body and drives out neuro members.

If, on the other hand, we adopt volume-based pricing then we might well eliminate this instability.

Finally, conventional wisdom on maximizing revenue by market segmentation would have us overprice our more expensive product. If we were to adopt such a policy rich customers would pay us more and poor customers would pay us something. We have reversed conventional wisdom, and have priced our more expensive product below cost. It would seem desir-

able to adopt a policy in which whole body patients at least paid their actual costs, rather than being subsidized by neuro patients.

A numerical example showing a 20:1 PCT allocation ratio

A numerical example illustrating a 20:1 PCT allocation ratio shows more specifically how a change from the existing 4.4:1 PCT allocation ratio might work. Again using the data from 2011, we find that 71 neuro patients and 36 whole body patients, who cost in aggregate \$170,000 to maintain in cryopreservation for one year, and who require a PCT allocation sufficient to pay for this annual expense with a 2% draw, would have **PCT allocations of ~\$10,750 for neuro and ~\$215,000 for whole body**. Recall that the "fair market" or 10:1 PCT allocation was ~\$20K and ~\$200K, so this 20:1 allocation results in only a modest percentage increase in the whole body PCT allocation while providing a significant decrease (almost a factor of 2) in the neuro PCT allocation. This is because whole body patients are occupying the bulk of the dewar space and are making the bulk of the payments – the neuro patients occupy little space and are paying correspondingly less.

A 20:1 PCT allocation ratio would simply reflect reality if we were to achieve a factor of two improvement in packing density of neuro patients – an improvement that seems achievable if we did not use neurocans. Such an increase in packing density and the corresponding increase in the PCT allocation ratio would not greatly increase the price charged to whole body patients.¹³

If we charge a premium for our low-priced product to subsidize our premium product, then our affluent customers will pay us less for our premium product and some of our less affluent customers will be forced to abandon us because we have increased the price of our low-priced product. Rich customers will pay us less, and poor customers will pay us nothing.

¹³ This conclusion would have to be adjusted because the increase in the whole body minimums required to cover the increase in the whole body PCT allocation will likely reduce the total number of new members who choose the whole body option over the neuro option. However, as the price increase is not too great, the corresponding reduction in the number of new whole body members should also not be too great.

Various adjectives can be used to describe this approach, none of them flattering.

A numerical example showing a 4.4:1 PCT allocation ratio

A numerical example illustrating a 4.4:1 PCT allocation ratio shows more specifically how this might work. Again using the approximate 2011 data, **the whole body PCT allocation would be ~\$163,000 while the neuro PCT allocation would be ~\$37,000.** (Recall that the rates we currently charge: \$25K for neuro and \$110K for whole body, are in a 4.4:1 ratio, but are depleting the PCT and do not actually contribute enough to maintain a 2% draw. The calculations in this section assume that we actually contribute enough money to the PCT to maintain a 2% annual draw and do not deplete the PCT – hence the larger numbers). This is a large (almost doubling) of the neuro PCT allocation, from \$20K at the “fair market” 10:1 ratio to \$37K at the 4.4:1 ratio. At the same time, it reduces the whole body PCT allocation from ~\$200K (at the 10:1 “fair market” PCT allocation ratio) to about ~\$163K which, while noticeable, is likely to have a much smaller impact on recruiting new whole body members. The corresponding whole body minimums would be (assuming a straight pass-through of the whole body PCT allocation) \$290K and \$253K. That is, if we priced whole body minimums using a 10:1 ratio for whole body PCT allocations, the whole body minimum would be \$290K. If we priced whole body minimums using a 4.4:1 ratio, the whole body minimum would be \$253K. While a reduction in whole body minimums from \$290K to \$253K would be likely to encourage a few people to select the whole body option instead of the neuro option, it’s not clear it would have a big impact on this choice.

On the other hand, a similar analysis using the 2011 data leads to the conclusion that neuro minimums would increase from \$75K using a 10:1 ratio to \$92K using a 4.4:1 ratio. This would very likely have a dampening effect on new neuro members. As new neuro members do not have the option of selecting a cheaper option, many of them would not sign up at all. Others would decide that, given that neuro was priced at \$92K and whole body was priced at \$253K, they might as well opt for whole body. Recall that our current whole body

minimum to neuro minimum price ratio is \$200K:\$80K or 2.5, and the price ratio computed using a 4.4:1 PCT allocation ratio (using the 2011 approximate data) is \$253K:\$92K or 2.75:1.

Also recall that recent new members preferred whole body by a ratio of 74 whole body to 26 neuro, and that this preference exists when the price ratio between whole body and neuro is 2.5:1. The 2.75:1 price ratio that we would charge if we adopted a 4.4:1 PCT allocation ratio is very close to the 2.5:1 price ratio that we use now, and which is associated with a major shift in new members towards whole body. We can reasonably conclude that **if we subsidize whole body by neuro we will shift our membership base dramatically towards whole body. This will further increase our total costs.**

To consider a numerical example: if our patient care bay had 74 whole body patients and 26 neuro patients (the numbers we see in our new member sign up data), then our annual costs for maintaining these patients would be $\$3,944 \times 74 + \$394 \times 26 = \sim\$300K$. Note that there can be no arguments here about whether a 10:1 cost ratio is justified (the assumption used in deriving the \$3,944 and \$394 numbers) – this is simply the cost of maintaining this much dewar space, and represents what we would have to pay to cover the rent, liquid nitrogen, staff time, and other direct costs. If anything, we would have to pay more because this assumes that we are able to keep all the central columns occupied – and at these ratios, we would not be able to. But for this approximate calculation, we will neglect this factor.

Here is a numerical example of what happens if we change the composition of the patient care bay from what it is in 2011: 36 whole bodies and 71 neuros; to the composition we see in the current signup data: 74 whole bodies and 26 neuros. We keep everything else the same, and in particular keep the same 4.4:1 PCT allocation ratio. The neuro PCT allocation will increase from \$37K to \$43K and the whole body PCT allocation will increase from \$163K to \$190K. This is because fewer neuros are being asked to subsidize more whole bodies, so the subsidy is smaller and the amount that all patients must pay is larger. The amount the whole body patients must pay is larger because there’s just too much

volume for the neuro patients to subsidize. The amount the neuro patients must pay is larger because they have more whole body patients to subsidize.

Charging whole body members their fully loaded costs

Organizations normally charge more than the actual costs of providing a service. They charge more to cover the overhead of running an organization. Simply charging whole body members exactly what it costs Alcor to provide for their long term care does not seem prudent, and charging them below the actual costs of providing the service, which is today’s practice, seems contrary to the best interests of all involved. Neuro patients are currently charged \$25K for long term care, \$5K above the “fair market neuro PCT allocation”. In summary, if we increase the whole body PCT allocation to a value that fully covers the actual costs (is proportional to the volume) we can make the following observations:

1. Those who sign up for whole body will continue to want to sign up for whole body even if the price is higher, so if we increase the price of whole body those who have the means will continue to sign up for whole body and pay the higher price, while those of us who are less affluent will sign up for neuro.
2. Because the neuro PCT allocation is already disproportionately high, we can assist less affluent neuro members by eliminating the existing subsidy from neuro patients to whole body patients.
3. This pricing structure is stable and does not lead to collapse.
4. Charging a premium for your low-priced product so you can subsidize your high-priced product is a novel pricing strategy that can reasonably be expected to reduce both revenue and membership.

If our objective is to save lives and grow the membership, then decreasing the price of becoming and remaining a member has to be a top priority. The way to do this for most members is to keep the price of the neuro option as low as possible. We should certainly not increase this price, and deliberately subsidizing whole body

members by increasing the price for neuro members is a strategy that is both unstable and directly opposed to the core goals of the organization.

Conclusion

While there are a variety of options for determining the ratio between the whole body and the neuro PCT allocation, the simplest and most robust with respect to a variety of possible issues is to base this ratio on volume. Whole body patients occupy about 10 times the volume of neuro patients, so adopting a PCT allocation for whole bodies that is 10 times the PCT allocation of neuro patients provides a simple and effective method that deals with a number of otherwise problematic issues. Should the volumetric ratio change in the future, then the whole body PCT allocation to neuro PCT allocation ratio should be adjusted accordingly. Increasing the packing density of neuros would likely increase overall membership by permitting a

decrease in neuro minimums, which are expected to be a significant limiting factor in recruiting and retaining members; this possibility warrants further investigation.

Alcor's current whole body to neuro PCT allocation ratio of 4.4:1 is substantially lower than can be justified. The PCT allocation of neuro and whole body patients should be changed so that this ratio is 10:1. Whole body minimums should be significantly increased from their present values and whole body and neuro PCT allocations should be adjusted so that the whole body to neuro PCT allocation ratio is 10:1.

Once this is done, new member sign-ups should be monitored to verify that new members select the neuro option at rates approximating historical averages. If new whole body members continue to outnumber new neuro members, then a further increase in the ratio should be considered. Empty central columns do not pay for Big-foot dewars. ■

Acknowledgements

It is the author's pleasant duty to acknowledge (in alphabetical order by first name) the very helpful comments made by Bonnie Magee, Brian Wowk, Diane Cremeens, Hugh Hixon, James Clement, Max More, Michael Perry, Michael Riskin, Michael Seidl, Paul Wakfer, Ravin Jain, Saul Kent, and Tim Shavers. While their comments and assistance can be credited for anything that is well said or useful, the author must take the blame for anything that is rash, incorrect, or simply incoherent.

2012 Annual Giving Program

Alcor provides a wide array of services for you the member, and the general public. We inform and educate, we protect and preserve, and we strive to remain at the forefront of cryonics technology.

Since its founding, Alcor has relied on member support to maintain its mission and attract new members. Your support, regardless of size, can provide a better future for all cryonicists. Please act now.

Suggested Giving Levels

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- \$60 Junior Supporter
- \$120 Sustaining Supporter
- \$500 Advocate Supporter
- \$1,000 Leading Supporter
- \$2,500 Visionary Supporter
- \$5,000 Silver Supporter
- \$10,000 Gold Supporter
- \$25,000 Titanium Supporter
- \$50,000 Vanguard Supporter

We encourage every member to donate. Even if you can only afford \$5 right now, you will make a significant contribution to Alcor's future.

Donations may be made via the Donations button on the Alcor website, or by contacting Alcor's Financial Director, Bonnie Magee. Your donation may be made as a lump sum, or divided into easy monthly payments. ■

NEW PROGRAM: PRESS NOTIFICATION OF CRYOPRESERVATION

Are you a public Alcor member? Would you like to help Alcor increase the awareness of cryonics in your local community? If your answer is yes to these questions, Alcor would like to encourage you to participate in the new press release project.

For public members who submit consent forms, Alcor will send a press release to local hometown newspapers upon cryopreservation. These press releases will be brief; similar to the business notices that appear in many local papers.

If you'd like to participate, please print out the following consent statement, sign and date the document, list the name and address of your local newspaper, and, if desired, attach a brief biography of yourself to assist the press release authors. Send the documents to Alcor, attention Diane Cremeens, Membership Department Coordinator.

Consent to Publish a Cryopreservation Press Release

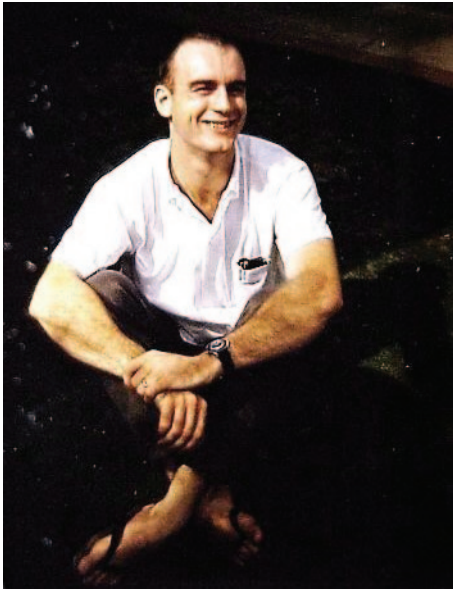
I, _____, Alcor suspension member number _____, hereby give my consent for Alcor to publish a press release upon my cryopreservation, to be distributed as determined by Alcor at the time of cryopreservation. I understand that Alcor staff will be authoring the document and have the right to edit or change any submitted materials as they see fit. I further understand that newspapers which print the press release may alter its contents to suit their needs, and that Alcor has no control over these actions.

Please include a press release to the following newspaper: _____

At the following address: _____

Date: _____

Signature: _____



FRED CHAMBERLAIN III: FIRST LIFE CYCLE: 1935-2012

By Linda Chamberlain

Fred Chamberlain III recently had his brain placed into cryostasis at the Alcor Life Extension Foundation in Scottsdale. His physical presence will be missed by many friends, biological family and chosen family until technology allows a future instantiation to be with us once again.

Among his many talents, Fred wrote inspiring poetry and loved to play the guitar and keyboard. He was one of the most intellectually creative and energetic people I've had the privilege to know. He just recently published *BioQuagmire*, which in my opinion is the best transhuman, life extension novel ever written.

Fred (together with me and other authors) published a volume of life extension and transhumanist short stories in the 1980s called *Life Quest*.

The picture above shows Fred when he was in his twenties working in bomb disposal as a Navy diver. He was interested in ethics and was a strong supporter of Ayn Rand's ideology. Fred became actively involved in cryonics in 1969 in order to get his father, Fred Chamberlain Jr., suspended (*Alcor News*, August 1976). Fred and I met and became Forever Buddies in 1970 while working on the committee to organize the second national cryonics conference, held in Los Angeles, CA.



Here we see Fred in his thirties, sitting on the rim of the Grand Canyon. He was an engineer at the Jet Propulsion Laboratory (JPL)

in Pasadena, southern California, where he worked on the Voyager missions to Jupiter and other fascinating projects.

That's when I first met and fell in love with him. One of our great intellectual and emotional bonds was our interest in technological means of extending life. Fred and I incorporated the Alcor Life Extension Foundation in 1972; the minutes of those early Alcor meetings can be viewed by those who might be interested. Many details from those early years are available on Wikipedia.



The photo to the right shows Fred in his sixties when he and I were again active in Alcor between 1997 and 2001.



This picture shows us in 2002 when we renewed our wedding vows on a beach in Cozumel with a traditional Mayan wedding with both of us wearing traditional Mayan wedding dress.



Inspired by the Mindfile tools and programs being developed by Terasem (including but not limited to CyBeRev.org and LifeNaut.com), and seeing Mindfiles as an absolutely essential part of any personal life extension plan, we moved to Melbourne, Florida in 2010 to contribute as much as possible to the Terasem Movement while we remain in biological bodies, and then continue doing so when emulated as cyberbeings. We made a presentation about Cybertwins at Terasem's 5th Annual Colloquium on the Law of Futuristic Persons in Second Life (on Terasem Island), on December 10th, 2009.

Fred recently had his brain placed into cryostasis at the Alcor Life Extension Foundation in Scottsdale to preserve his Connectome as additional Mindfile information. Though I will have to carry on alone for both of us for a short while before we see each other in cyberspace, Fred is still part of all of us in the Terasem Collective Consciousness and we will continue to enjoy his warm creativity again soon as well as through his poetry and many writings.

As they say on the Star Pebble, See you in the next cycle. With all my love,

Linda Chamberlain

To view online with active links:
<http://www.lifepact.com/OdeToFred.pdf>



THE END OF ILLNESS

By David B. Agus, MD. Free Press, 2011.

BOOK REVIEW BY STEVE BRIDGE

So, here's one of those choice games that young people play – We have a new medication. 75% of those who take it will become ageless and immortal; 25% die immediately. The only way to know which is which is to take it. What do you do?

Too unrealistic? OK, here is another medication. It fights cancer and heart disease and increases lifespan of perhaps 25% of individuals. It has no major observable effect on 50% of those who take it; but 25% of those who take it have *shortened* lifespans. What do you do? Don't know? You're probably already taking it. It might be Vitamin D, or beta carotene, or aspirin, or a statin drug, or a combination of many other substances for which the research has shown confusing results.

If you are reading this, you are probably taking a number of supplements and medications. We are each our own life extension experiment, with an experimental subject number of ONE. Some of us may turn out to win, some of us will surely lose; but in either case, we probably won't know why.

We start as individuals with unique genetic patterns, grown in the womb of a mother with a unique genetic pattern which produces a specific combination of proteins and hormones which help us grow differently from anyone else. Our mother has a unique set of experiences during our 9-months residence within her – exposure to chemicals, ingestion of food and drink, alcohol and tobacco use, medication, health problems, stress, etc. Those experiences filter down to our own growing bodies during that 9 months and affect us for the rest of our lives. When we are born, we continue our unique experiences – diet, surroundings, family life, pollution, weather, physical activity, exposure to viruses, bacteria, fungi, and so on without end.

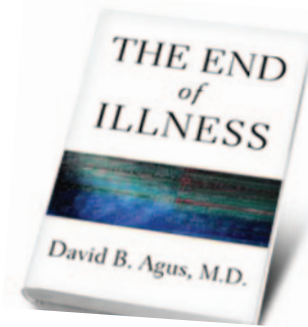
And now we as adults, with no way to control our own starting points, purposely take unique combinations of medications, vitamins and other supplements (whose specific content we may not know and cannot control), food combinations in a dizzying variety of diets (equally uncontrollable in their nutritional details), various forms of exercise and leisure activities, and equally diverse forms of sex, friendship, and other interpersonal connections.

Yet, in spite of that uniqueness, we still hope that some popular magic bullet of a pill or juice or food or perhaps some combination of them will help us feel better and live longer. We hope this with such a combination of great fervor and little evidence that we are easy marks for salesmen.

That is one of the central messages of *The End of Illness* by David B. Agus. In general, this message makes sense and goes along with many doubts I have had in the past, and I am positive that many of you recognize those doubts, too. So you might pick up a book with an optimistic (some might say “hubristic”) title like “The End of Illness” hoping to find a path to the answers. That title promises a lot more than the author delivers, although there is value in the book for many readers.

Agus has some useful thoughts about the future of medicine and about what you might do to improve your health today. However, if you are even moderately well read in general health magazines and books, you won't find too much new here.

Agus encourages the reader to know himself by asking relatives about the family's health history and by getting genetic testing to set up a baseline of knowledge. (Perhaps it's not a coincidence that the author owns Navigenics, a company which does genetic testing and counseling. But he doesn't dwell on that and I don't see a hard



sell for it.) He thinks that the real progress in future medical diagnosis and treatment will come from the study of *proteomics* – the identification and understanding of the proteins in the body. For Agus, genetics is like the blueprint for the house, but the blueprints cannot tell when the house was made with defective materials or when it is invaded by mice or mold. The proteins tell what is going on now. He believes that this is how physicians in the future will eventually be able to view each person as an individual and to prescribe individual treatments, diets, and lifestyles. (It is perhaps not a coincidence that the author also owns a company called Applied Proteomics).

Proteomics might cause a change in the way medicine is viewed in the future, from a current focus on the treatment of discrete diseases and conditions to an emphasis on maintaining the condition of “Health,” whether we understand the actual causes of illness or not. Hence, “the End of Illness.” “Nice,” I think. I’ve been saying exactly that in cryonics talks for 20 years, although I’ve been using other words like “nanotechnology” and “genetic manipulation” to explain how this will work. “Proteomics” will be another nice catchword to add.

At this point I was expecting Agus to really dig into this subject and offer several meaty chapters on how the study of proteomics might progress into the medi-

cal miracles of the future. And maybe the author wanted that, too. But the history of sales for detailed books on what medicine might be like in the future is a meager one. Five or ten thousand copies isn't what the good doctor or his publisher are going for. So the rest of the book is fairly standard advice for what you can do to be healthier today.

First, we spy a bit of inconsistency. In spite of his insistence that there isn't a magic pill for everyone, the author writes, "The end of illness is achievable because of two fundamental beliefs. For one, most diseases are delayable or preventable, and two, a sense of optimism that the 'magic pills' to treat many of the diseases of today will be available in the next two decades." I'll summarize some his main points on how to delay the problems.

Exercise. Don't have a job where you sit on your butt all day.

Eat fresh foods, not prepared foods. "Fresh" does not mean food sitting around in the grocery for a week.

Eat fresh whole fruit and vegetables. Juicing is a bad idea because tearing up the plants cells robs the juice of much of the nutritive value. But drink one glass of red wine 5 nights a week. (Isn't wine a form of "juice?")

A healthy gut, with the right kinds of bacteria might be as important as anything else.

Don't take vitamin supplements. You can get all the vitamins you need from fresh food. (More on this in a minute.)

Maintain a regular schedule of when you eat, sleep, and exercise. The body's rhythms are important.

Wear good shoes and do things to control inflammation. If you are over 40, take statin drugs. He is very insistent on this.

Get flu shots.

If you aren't sure what to do, doing nothing is often better than doing something radical. (Which would seem to go against the insistence on statins).

Each of these is filled out in some detail in the book.

The most controversial part of this book for some readers, including many of you, I suspect, will be Agus's insistence that you avoid nutritional supplements unless you have a specific deficiency that can be shown to improve with supplementation. Using the media hype over Vitamin D as an

example, he spends a whole chapter examining the claims for and against Vitamin D. He points out that many of the headlines of miracle cures associated with Vitamin D are actually from results in laboratories or in mice, not in human trials. Other research from observations of high Vitamin D levels being protective can be explained in other ways. He states that the actual human trials for Vitamin D show very mixed results. Part of the reason for this is that Vitamin D comes into the human body from sunshine and from a variety of food sources. It is almost impossible to precisely control how much Vitamin D a person actually receives or produces internally. He also says that the human body, as it does with many substances and conditions, attempts to maintain homeostasis in Vitamin D levels. Adding Vitamin D to the human system may simply cause the body to deactivate cell receptors for that vitamin in an attempt to maintain balance. And he points out that some studies show that higher blood levels of some forms of Vitamin D are associated with *higher* risks of cancer.

In shorter fashion, Agus discusses what he sees as the downsides of supplementation with Vitamin C, and especially beta carotene. He mentions research that suggests Vitamin C might both tend to prevent cancer but then accelerate the cancer growth once a tumor occurs. He even believes there is strong evidence that too many antioxidants will prevent the body's own free radicals from attacking cancer cells. "I am not aware of any clinical trial demonstrating a general health benefit to taking supplemental vitamins and have in fact come across some disturbing negative effects found in some studies."

I do not claim any expertise or even great knowledge of the research in vitamins or other supplements, yet I take many myself. I cannot argue either for or against Agus's opinions. I don't know whether or not my idiosyncratic combination of diet, exercise, supplements, and genetics is making me healthier or less healthy. I look pretty good and am very healthy for my age – but what factors are responsible for that? Aside from some well proven generalities (I don't smoke or use illegal drugs; I don't live what used to be called "a dissolute lifestyle."), there is no way I can know. I certainly am NOT going to advise you to either take or to avoid taking supplements

or anything else. If you want to argue with Agus's conclusions, argue with him, not with me.

So what makes this a "best-seller?" I kept waiting for the big revelation – the new information, the moment that would make me really pay attention or maybe get angry. It never happened. But *The End of Illness* has been a hot item – #1 on the New York Times non-fiction list and still #359 on Amazon after three months. There is a long waiting list for it at my library. But the book itself is mostly a pretty ordinary discussion of ways to live a healthy life, not much different from many others that have been published. The particular combination of details is unique, perhaps, but there is nothing earth-shattering, really nothing even controversial except for his rejection of vitamin pills. And that is hardly revolutionary; there are many writers in the anti-supplement camp.

The title is catchy, of course, even if it doesn't deliver on its promise. But this is pretty much a triumph of public relations. Lots of great quotes (from his friends, business partners, and people who have been praised in his book) on the cover. Well-planned appearances on influential TV shows like *The View* and *The Daily Show*. The book is easy to understand, written for a mass audience, and promises to make you feel better. If you haven't read a book about healthy living for many years, it might even work for you. But for the true "end of illness," we have a long way to go. ■



About the Author

David Agus (born January 29, 1965) is an American physician and a co-founder of Navigenics, a personal genetic testing company, and Oncology.com, the largest online cancer resource and virtual community and Applied Proteomics. He is a Professor of Medicine and Engineering at the University of Southern California.

The Ultimate Two-Per-Day Formula



NOW IN CAPSULES OR TABLETS!

The following table compares the daily dosage of key nutrients included in both the Life Extension Two-Per-Day Formula and Centrum® Silver® Adults 50+ Daily Tablet:

Sample Ingredient Comparison	LIFE EXTENSION TWO-PER-DAY	Centrum® Silver® Adults 50+
Vitamin C	500 mg	60 mg
Vitamin D	2,000 IU	500 IU
Vitamin B1	75 mg	1.5 mg
Vitamin B2	50 mg	1.7 mg
Vitamin B6	75 mg	3 mg
Vitamin B12	300 mcg	25 mcg
Niacin (as niacinamide)	50 mg	20 mg
Pantothenic acid	100 mg	10 mg
Vitamin E	100 IU (natural)	50 IU (synthetic)
Natural Folate	400 mcg	400 mcg (synthetic)
Zinc	30 mg	11 mg
Selenium	200 mcg	55 mcg
Lutein	5,000 mcg	250 mcg
Lycopene	2,000 mcg	300 mcg
Biotin	300 mcg	30 mcg
Boron	3 mg	150 mcg
Chromium	200 mcg	45 mcg
Molybdenum	100 mcg	45 mcg
Magnesium	100 mg	50 mg
Manganese	2 mg	2.3 mg
Iodine	150 mcg	150 mcg
Potassium	25 mg	80 mg
Vitamin A (as beta-carotene)	4,500 IU	1,000 IU
Vitamin A (preformed)	500 IU	1,500 IU
Choline (as bitartrate)	20 mg	(none)
Inositol	50 mg	(none)
PABA	30 mg	(none)
Calcium	12 mg	220 mg
Alpha Lipoic Acid	125 mg	(none)

Contains soybeans, rice, and corn.

For many years, Life Extension® members had to rely on commercial “one-a-day” supplements that provide very low potencies.

In response to requests for a science-based multi-nutrient, a special formula was compounded to provide the greatest potencies that can fit into two tablets. When compared to conventional “one-a-day” products, **Life Extension Two-Per-Day** contains up to **50 times more potency!** This Two-Per-Day formula is now available in tablet or capsule form.

The box on this page reveals how much more potent the **Two-Per-Day** formula is compared to the leading commercial multi-vitamin. Few consumers realize that commercial supplements often contain the cheapest form of nutrients that don't provide optimal benefits. For example, the 30 IU of synthetic vitamin E contained in Centrum® Silver® Adults 50+ may provide relatively little vitamin E to the bloodstream. The 100 IU of natural vitamin E contained in Two-Per-Day provides over **3 times more** vitamin E activity than does Centrum® Silver® Adults 50+.



Item # 01615
Tablets



Item # 01614
Capsules

Compared to Centrum® Silver® Adults 50+, Two-Per-Day Tablets or Capsules provide about:

- 4 times more Vitamin D
- 8 times more Vitamin C
- 2 times more Vitamin E
- 10 times more Biotin
- 20 times more Boron
- 4 times more Selenium
- 25 times more Vitamin B6
- 50 times more Vitamin B1
- 12 times more Vitamin B12
- More than twice as much niacin, zinc, and many other nutrients

Life Extension Two-Per-Day Vegetarian Tablets provide much higher potencies of key nutrients and represent a better value than many commercial brands. A bottle of 120 Life Extension Two-Per-Day tablets retails for \$20. If a Life Extension member buys four bottles, the price is reduced to \$13.50 per bottle. (The retail price for 180 tablets of Centrum® Silver® Adults 50+ is around \$14.) (Item # 01615)

A bottle of 120 Life Extension Two-Per-Day capsules retails for \$22. If a Life Extension member buys four bottles, the price is reduced to \$15. (Item # 01614) (Refer to back page of this magazine for information about Life Extension membership.)



Ratings based on results of the 2012 ConsumerLab.com Survey of Supplement Users. More information at www.consumerlab.com.

To order Life Extension Two-Per-Day Tablets or Two-Per-Day Capsules, call 1-800-544-4440 or visit www.LifeExtension.com

MEETINGS

About the Alcor Foundation

The Alcor Life Extension Foundation is a nonprofit tax-exempt scientific and educational organization dedicated to advancing the science of cryopreservation and promoting cryonics as a rational option. Being an Alcor member means knowing that—should the worst happen—Alcor's Emergency Response Team is ready to respond for you, 24 hours a day, 365 days a year.

Alcor's Emergency Response capability includes specially trained technicians and customized equipment in Arizona, northern California, southern California, and south Florida, as well as many additional certified technicians on-call around the United States. Alcor's Arizona facility includes a full-time staff, and the Patient Care Bay is personally monitored 24 hours a day.

ARIZONA

Flagstaff:

Arizona without the inferno. Cryonics group in beautiful, high-altitude Flagstaff. Two-hour drive to Alcor. Contact eric@flagstaffcryo.com for more information.

Scottsdale:

This group meets the third Friday of each month and gatherings are hosted at a home near Alcor. To RSVP, visit <http://cryonics.meetup.com/45/>.

At Alcor:

Alcor Board of Directors Meetings and Facility Tours – Alcor business meetings are generally held on the first Saturday of every month starting at 11:00 AM MST. Guests are welcome. Facility tours are held every Tuesday and Friday at 2:00 PM. For more information or to schedule a tour, call D'Bora Tarrant at (877) 462-5267 x101 or email dbora@alcor.org.

CALIFORNIA

Los Angeles:

Alcor Southern California Meetings—For information, call Peter Voss at (310) 822-4533 or e-mail him at peter@optimal.org. Although monthly meetings are not held regularly, you can meet Los Angeles Alcor members by contacting Peter.

San Francisco Bay:

Alcor Northern California Meetings are held quarterly in January, April, July, and October. A CryoFeast is held once a year. For information on Northern California meetings, call Mark Galeck at (408) 245-4928 or email Mark_galeck@pacbell.net.

DISTRICT OF COLUMBIA

Life Extension Society, Inc. is a cryonics and life extension group with members from Washington, D.C., Virginia, and Maryland. Meetings are held monthly. Contact Secretary Keith Lynch at kfl@keithlynch.net. For information on LES, see our web site at www.keithlynch.net/les.

FLORIDA

Central Florida Life Extension group meets once a month in the Tampa Bay area (Tampa and St. Petersburg) for discussion and socializing. The group has been active since 2007. Email arcturus12453@yahoo.com for more information.

NEW ENGLAND

Cambridge:

The New England regional group strives to meet monthly in Cambridge, MA – for information or to be added to the Alcor NE mailing list, please contact Bret Kulakovich at 617-824-8982, alcor@bonfireproductions.com, or on FACEBOOK via the Cryonics Special Interest Group.

PACIFIC NORTHWEST

Cryonics Northwest holds regular meetings for members of all cryonics organizations living in the Pacific Northwest.

For information about upcoming meetings and events go to: <http://www.cryonicsnw.org/> and <http://www.facebook.com/cryonics.northwest> A Yahoo mailing list is also maintained for cryonicists in the Pacific Northwest at <http://tech.groups.yahoo.com/group/CryonicsNW/>.

British Columbia (Canada):

The contact person for meetings in the Vancouver area is Keegan Macintosh: keegan.macintosh@me.com

Oregon:

The contact person for meetings in the Portland area is Chana de Wolf: chana.de.wolf@gmail.com

Washington:

The contact person for meetings in the Seattle area is Regina Pancake: rpancake@gmail.com

ALCOR PORTUGAL

Alcor Portugal is working to have good stabilization and transport capabilities. The group meets every Saturday for two hours. For information about meetings, contact Nuno Martins at n-martins@n-martins.com. The Alcor Portugal website is: www.alcorportugal.com.

TEXAS

Dallas:

North Texas Cryonauts, please sign up for our announcements list for meetings (<http://groups.yahoo.com/group/cryonauts-announce>) or contact David Wallace Croft at (214) 636-3790 for details of upcoming meetings.

Austin/Central Texas:

We meet at least quarterly for training, transport kit updates, and discussion. For information: Steve Jackson, 512-447-7866, sj@sjgames.com.

UNITED KINGDOM

There is an Alcor chapter in England. For information about meetings, contact Alan Sinclair at cryoservices@yahoo.co.uk. See the web site at www.alcor-uk.org.

If you are interested in hosting regular meetings in your area, contact Alcor at 877-462-5267, ext. 113. Meetings are a great way to learn about cryonics, meet others with similar interests, and introduce your friends and family to Alcor members!

WHAT IS CRYONICS?

Cryonics is an attempt to preserve and protect human life, not reverse death. It is the practice of using extreme cold to attempt to preserve the life of a person who can no longer be supported by today's medicine. Will future medicine, including mature nanotechnology, have the ability to heal at the cellular and molecular levels? Can cryonics successfully carry the cryopreserved person forward through time, for however many decades or centuries might be necessary, until the cryopreservation process can be reversed and the person restored to full health? While cryonics may sound like science fiction, there is a basis for it in real science. The complete scientific story of cryonics is seldom told in media reports, leaving cryonics widely misunderstood. We invite you to reach your own conclusions.

HOW DO I FIND OUT MORE?

The Alcor Life Extension Foundation is the world leader in cryonics research and technology. Alcor is a non-profit organization located in Scottsdale, Arizona, founded in 1972. Our website is one of the best sources of detailed introductory information about Alcor and cryopreservation (www.alcor.org). We also invite you to request our FREE information package on the "Free Information" section of our website. It includes:

A fully illustrated color brochure

- A sample of our magazine
- An application for membership and brochure explaining how to join
- And more! Your free package should arrive in 1-2 weeks. (The complete package will be sent free in the U.S., Canada, and the United Kingdom.)

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(The complete package will be sent free in the U.S., Canada, and the United Kingdom.)

HOW DO I ENROLL?

Signing up for a cryopreservation is easy!

Step 1: Fill out an application and submit it with your \$150 application fee.

Step 2: You will then be sent a set of contracts to review and sign.

Step 3: Fund your cryopreservation. While most people use life insurance to fund their cryopreservation, other forms of prepayment are also accepted. Alcor's Membership Coordinator can provide you with a list of insurance agents familiar with satisfying Alcor's current funding requirements.

Finally: After enrolling, you will wear emergency alert tags or carry a special card in your wallet. This is your confirmation that Alcor will respond immediately to an emergency call on your behalf.

Call toll-free today to start your application:

877-462-5267 ext. 132

info@alcor.org

www.alcor.org





Will You Be Alive and Healthy 10...20...30 Years from now?

Your best chance at achieving future immortality is to protect your precious health now so you can benefit from future medical breakthroughs. Staying informed about the latest health discoveries can mean the difference between life and premature death.

And the **Life Extension Foundation** can be your passport to the future. As the largest anti-aging organization in the world, we are dedicated to finding scientific ways to prevent disease, slow aging, and eventually stop death.

For more than three decades, Life Extension has been at the forefront of the movement to support revolutionary anti-aging research that is taking us closer to our goal of extending the healthy human life span indefinitely. We inform our members about path-breaking therapies to help keep them healthy and alive.

Join today and you'll receive these life-prolonging benefits:

- A subscription to *Life Extension* magazine (\$59.88 yearly newsstand value)...Over 100 full-color pages every month are filled with medical research findings, scientific reports, and practical guidance about using diet, nutrients, hormones, and drugs to prevent disease and slow aging.
- Access to a toll-free phone line to speak with **knowledgeable health advisors**, including naturopathic doctors, nutritionists, and a cancer expert, about your individual health concerns. You can also receive help in developing your own personal life extension program.
- **Discounts on prescription drugs, blood tests, and pharmaceutical quality supplements** that will greatly

exceed your membership dues. You'll receive a directory listing the latest vitamins and supplements, backed by scientific research and available through a unique buyers club.

FREE BONUS!

- ***Disease Prevention and Treatment* book** (\$49.95 cover price)...this hardbound fourth edition provides novel information on complementary therapies for 133 diseases and illnesses—from Alzheimer's disease to cancer, from arthritis to heart disease—that is based on thousands of scientific studies.

Life Extension Foundation funds advanced vitrification and gene-chip research. Your \$75 membership fee helps support scientific projects that could literally save your life.

Call 1-866-820-4967 today.

LIVE
Healthier & Longer

LifeExtensionSM
FOUNDATION

Join today. Call toll-free 1-866-820-4967. Or visit www.lef.org/pim

Mention Code: PIM