



Sentiment Towards Biostasis

A Comprehensive Report

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Executive Summary

Cryopreservation is the speculative practice of using low temperatures and medical-grade cryoprotective agents to halt the decay of a recently deceased person's brain and body, indefinitely leaving open the possibility of further medical intervention.

Although the topic has been common in popular culture and commercially available for decades, challenging popular notions about the nature of death, very little is known empirically about the public's sentiments towards cryopreservation for the purpose of medical biostasis.

The European Biostasis Foundation has conducted a survey of 1,487 internet users in the United States to measure familiarity with, interest in, beliefs about, and attitudes towards cryopreservation. It's the largest, most comprehensive survey ever of its kind. Furthermore, we conducted a followup survey in Germany with 244 participants, a representative sample.

Key Findings

- **The vast majority have heard of cryopreservation, but most have never thought about getting coverage.** Although 77% are aware of the operation, 59% have never thought about whether they're interested, and when asked why they haven't signed up yet, 48% said it's because they'd never thought about it before.
- **The general concept is well known, but the public knows little about how it is actually practiced.** Few respondents know the cost (42%), the number of cases (7%), and the number of providers of biostasis services (25%). Most exposure to the topic comes from internet articles (42%) and fictional TV/film (41%).
- **Half of the public is open to the topic, a quarter is interested, and about 5% is highly interested.** 48% agree that cryopreservation is exciting and they plan to research further. 28% have actively researched the topic before and 25% say they are interested in signing up. 6% have visited a provider's website, and 6% also report intending to be cryopreserved when they die.
- **Cost is a major factor.** 58% say that cost is a major consideration in making end-of-life arrangements, the most of any consideration. 39% say that cost is why they haven't made cryopreservation arrangements yet, the second most common response. However, the public doesn't greatly over-estimate the cost, with 40% under-estimating.

Key Findings, continued

- **Sentiment towards biostasis is more positive than assumed.** Although 14% think that “most people” support a ban on cryopreservation, we find that only 4% do, with this group being significantly more likely to believe in an afterlife and significantly less likely to have researched the topic.
- **Death attitudes strongly predict cryopreservation interest, and fear of death is associated with more concerns with cryopreservation.** Those agreeing with “pro-life extension” attitudes were significantly more interested, and those with “anti-life extension” attitudes were significantly less interested. Counter to expectation, greater self-reported fear of death was significantly associated with concerns about cryopreservation, such as that it would “hurt or be traumatic”.
- **German residents are less interested than Americans, but this may be due to Germans having less exposure to the topic.** A survey was also conducted in Germany, finding 43% had heard of cryopreservation and 22% intended to research further. While still high, this lower awareness may be because most of the history of cryopreservation has taken place in the U.S., so Americans will have seen more about it on the news.

58%
say cost is
a top factor



Introduction

Inducing metabolic stasis in humans (biostasis) using cryogenic temperatures (cryopreservation) was proposed in the 1960s as a way of preventing structural decay of the brain following the terminal failure of the body's critical systems.

Indefinitely preserving the brain's physical state leaves open the possibility of "resuscitating consciousness" by restoring function to the brain using one of several theorized but as of yet undeveloped techniques such as digital reconstruction or nanobot cellular repair. Because bodies can remain in biostasis indefinitely, samples preserved prior to the development of these theorized techniques would still benefit, thus there is a rationale for conducting cryopreservation on a speculative basis.

The first cryopreservation operation was performed in 1967, and that body remains in biostasis under the care of one of two major cryopreservation providers in the United States. The concept has become a popular plot device in fiction, such as in *2001: A Space Odyssey* (1968) or *Futurama* (1999).

Although the topic has been prevalent in culture for decades, and challenges popular conceptions of the nature of death, very little is known empirically about the public's sentiments regarding the practice.

The European Biostasis Foundation has commissioned the first comprehensive survey of the general public regarding medical biostasis, the largest survey of any kind on the topic. This report details our findings.

In July of 2020, 1,478 United States internet users completed our survey. The sample is representative of U.S. internet users, skewing slightly younger and more tech-savvy than the nation as a whole. Additionally, a survey of 244 German residents, accurately representing the German public, was conducted soon after.

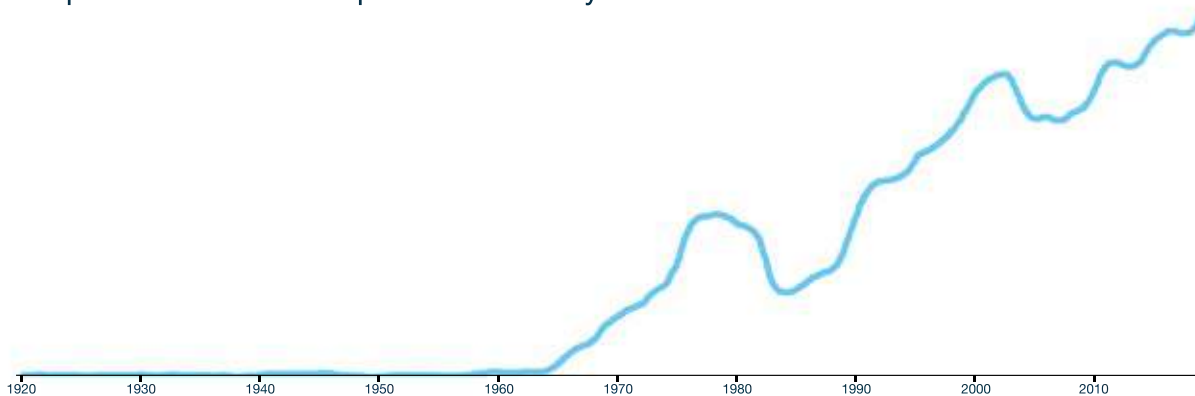
Familiarity with the concept of biostasis



The public is widely familiar with medical biostasis through cryopreservation, primarily from fictional TV/film and internet articles. 28% have actively researched the topic themselves.

A powerful idea hiding in plain sight

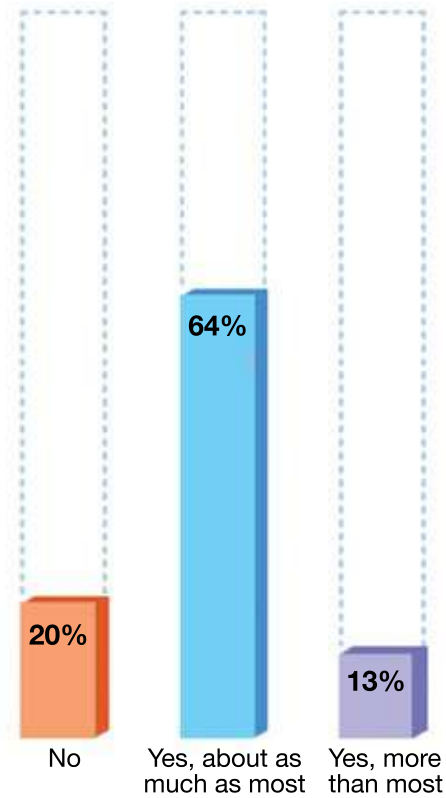
Biostasis through cryopreservation of the brain for medical purposes was popularized by Robert Ettinger's 1962 book *The Prospect of Immortality*, and interest in the topic has grown steadily since then. Since July of 2015, the English language Wikipedia page for cryonics has averaged 7,959 views per week. This graph shows the frequency with which "cryonics" appears in books, as a percent of all words published each year from 1920 to 2019.



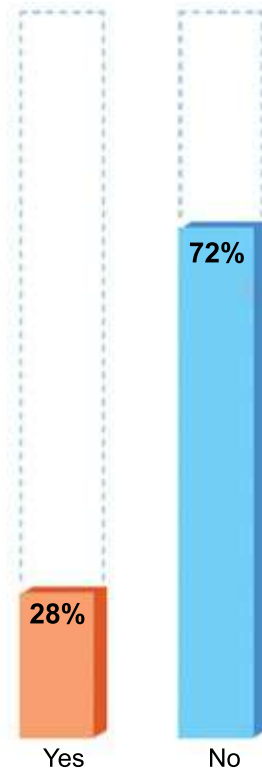
Source: Google Ngrams

The word "cryonics" was coined around 1965, though this term is used less frequently today because it is often confused with "cryogenics", the study of very cold temperatures. More fitting might be "biostasis" - preserving the physical state of the brain and body - and "cryopreservation" - the use of cold temperatures to achieve biostasis.

The vast majority of people have heard of cryopreservation: **64% have heard “about as much as most people” about the topic, and 13% have heard “more than most people”**. A smaller but substantial number have demonstrated high interest: **28% have “actively sought out information” about cryopreservation for themselves**.



Question: Have you heard of the practice of cryopreservation before?



Question: Have you ever actively sought out information about cryopreservation?

Men (16%) are significantly more likely than women (9%) to say they’ve heard “more than most” about cryopreservation. Responses to this question don’t differ significantly by age or economic achievement.

28%
have researched
biostasis before

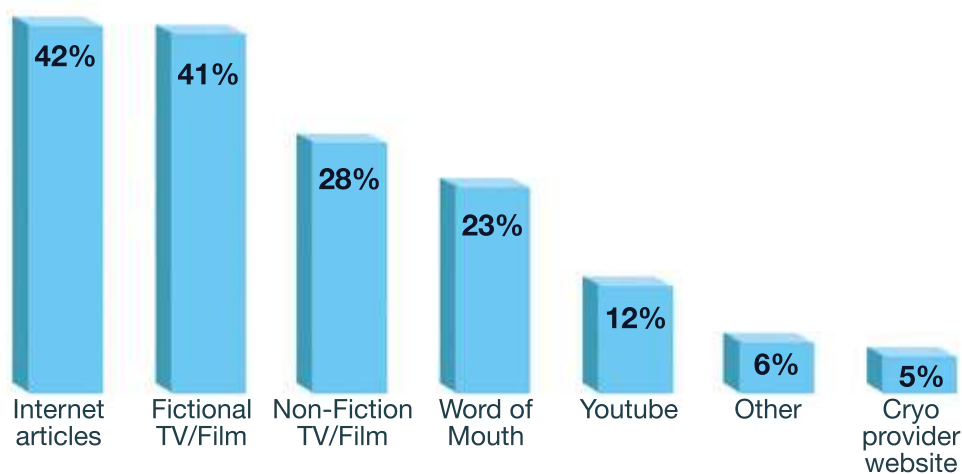


Given cryopreservation's long history and presence in popular culture, it's not surprising that so much of the public is aware of the topic, however public interest is higher than expected.

Having actively researched the topic is a strong demonstration of a person's interest because it requires deliberate action, rather than simply indicating interest on a survey question.

Most people reported getting information about the topic from fictional TV/film or internet articles, but **6% have visited a cryopreservation provider's website before.**

Those who have gotten information from a provider's website are significantly more likely to be "interested" in signing up (54%) than those who have not visited a provider's website (23%).



The most common news coverage of cryopreservation concerns legal cases and controversies. Fictional portrayals of cryopreservation are typically of "cryo-sleep" for deep-space voyages, rather than of a speculative medical procedure.

This survey indicates that most of the public's exposure to the topic is of this sort of content, rather than content that treats cryopreservation as a serious alternative to other end-of-life practices or as an extension of emergency medicine.

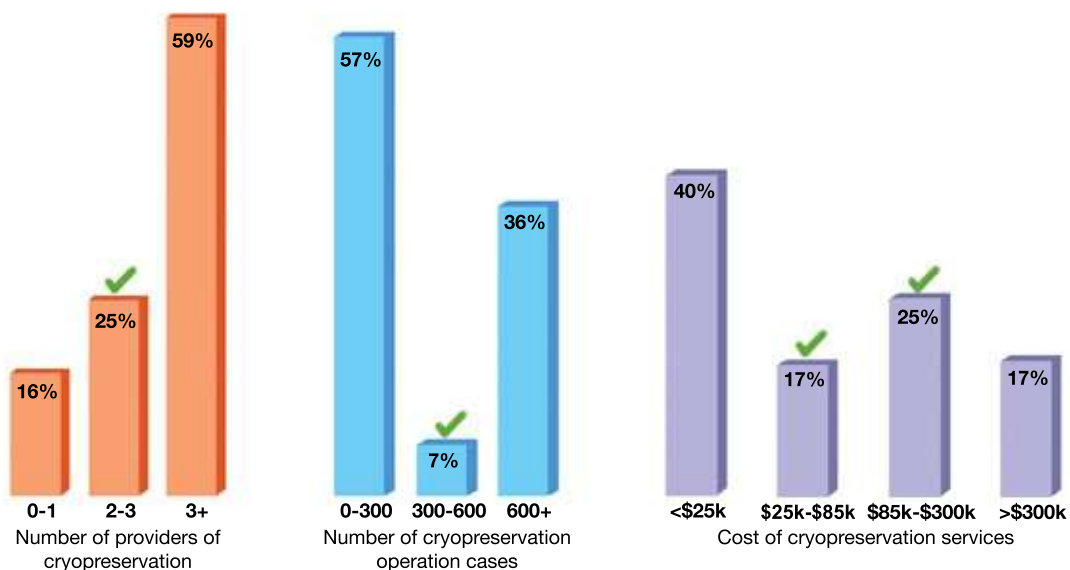
Testing the public's knowledge

Over a quarter of the public is somewhat aware of the core challenge of cryopreservation, reducing ice formation. 26% correctly guess that “vitrification” is employed “to reduce ice formation”. Those who answered this question correctly were significantly more likely to identify cryopreservation damage as a problem.

Most respondents (59%) overestimate the number of providers of cryopreservation services at 4 or greater, and 25% guessed in the correct range of 2-3.

Most respondents (57%) underestimate the number of cryopreserved bodies at fewer than 300. 36% overestimated, and 7% guessed in the roughly correct range of 300-600.

The plurality or respondents (40%) underestimated the cost of cryopreservation services at less than \$25,000. 17% correctly guessed in the lower-end range of \$25k-\$85k, 25% correctly guessed in the higher-end range of \$85k-\$300k, and the remaining 17% overestimated.



These responses indicate that although the public is familiar with the concept of cryopreservation, most people know little about the industry for cryopreservation services. In general, people tend to imagine an industry of many firms offering low-cost cryopreservation, with very few customers interested in their offering. While the industry is certainly quite small, the reality is that in the United States there are two dominant firms that are relatively more expensive and that have performed relatively more operations than the public imagines.

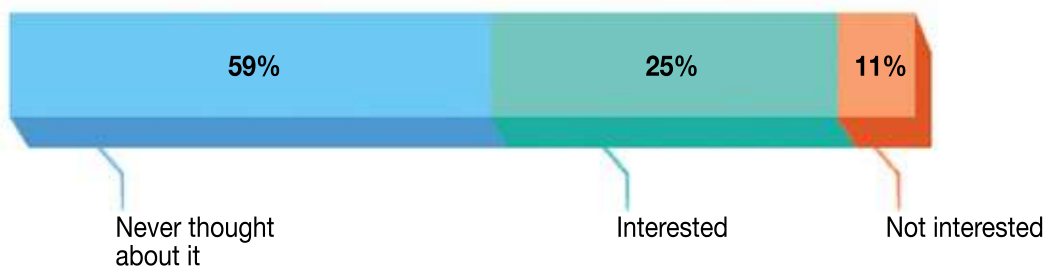
Interest in Getting Biostasis Coverage

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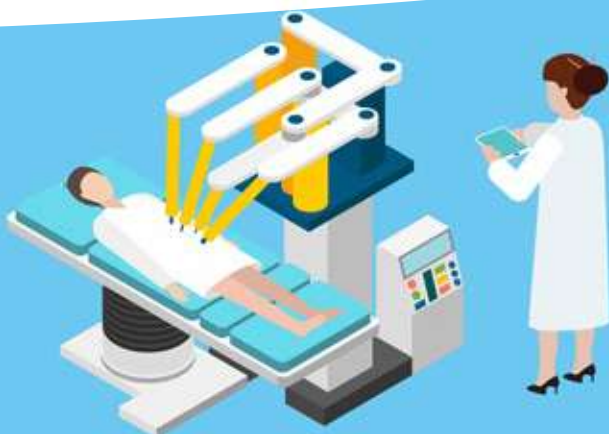
Most people have never thought about cryopreservation as a realistic end-of-life option. About a quarter of people are quite open to the topic, and another quarter are averse. Cost is the most common reason for not signing up.

Measuring the public's interest

Most people are neither interested nor disinclined, rather they simply haven't thought about the topic. **59% have "never thought about" signing up for cryopreservation.** 25% are "interested", and 11% are "not interested".

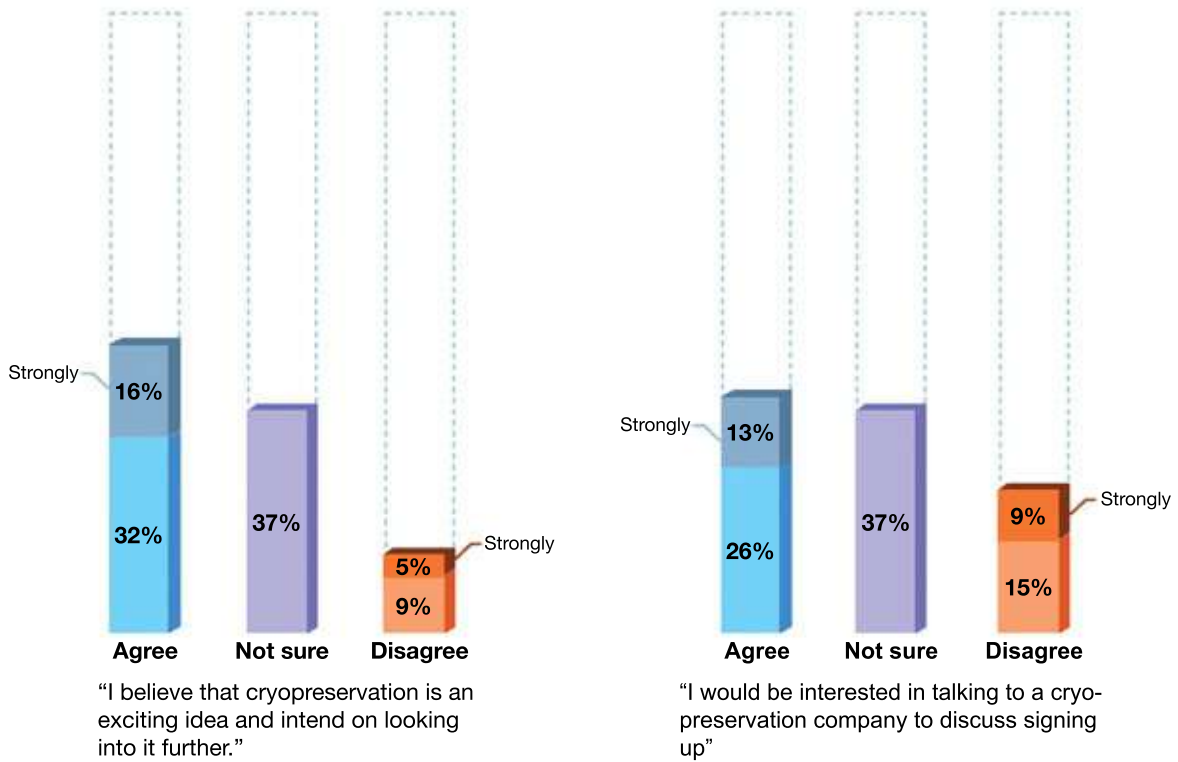


Men (31%) were significantly more interested than women (21%), and those with high age-adjusted income (30%) were more interested than those with low income (20%). Of those agreeing "there's a good chance cryopreservation will work", 31% are interested in signing up.

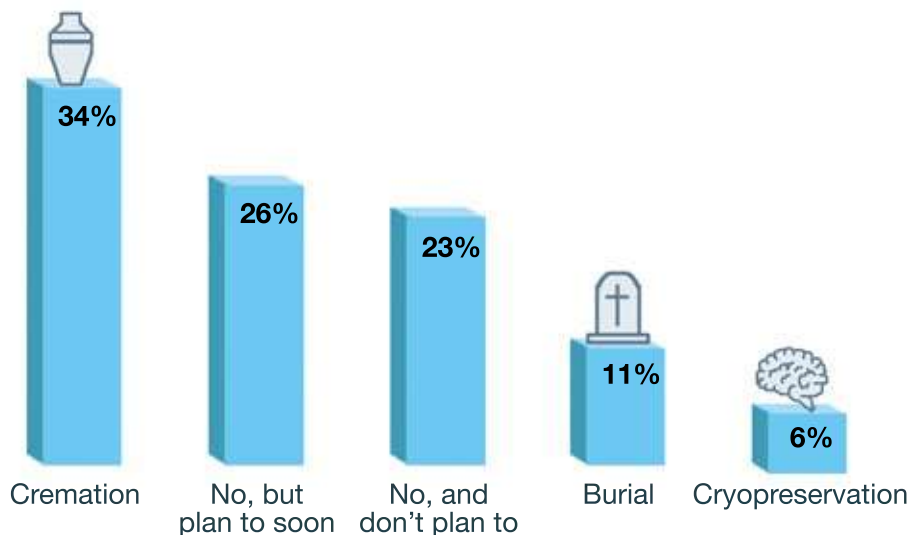


25%
are interested
in signing up

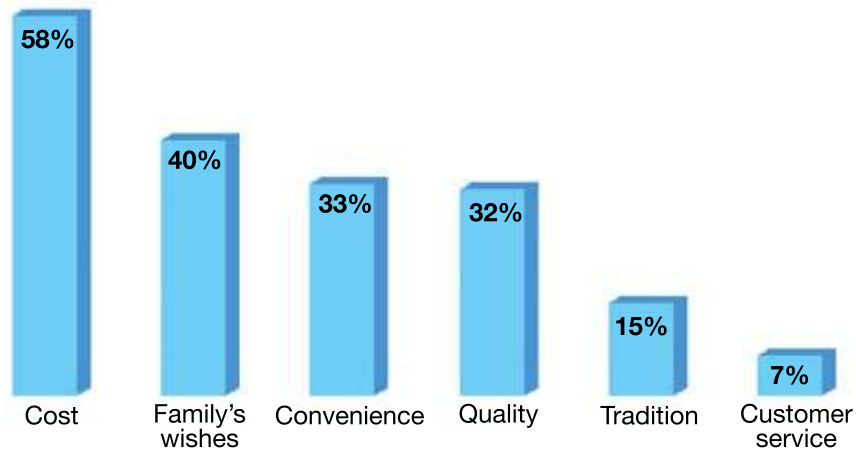
Agreement with statements of interest ranges from 40% to 50%. Totalling “strongly agree” and “agree” responses, 48% agree that “cryopreservation is an exciting idea” that they “intend on looking into further”, and 41% agree that they “would be interested in talking to a cryopreservation company to discuss signing up”.



Nearly half (49%) of respondents don't have end-of-life care plans. Cremation is the most popular choice, and **6% report intending to be cryopreserved upon death.** Those intending upon cryopreservation are significantly more likely to have researched the topic before and to agree there's a “good chance it works”, but 80% haven't formalized this intention, such as by telling loved ones by pre-paying for services.

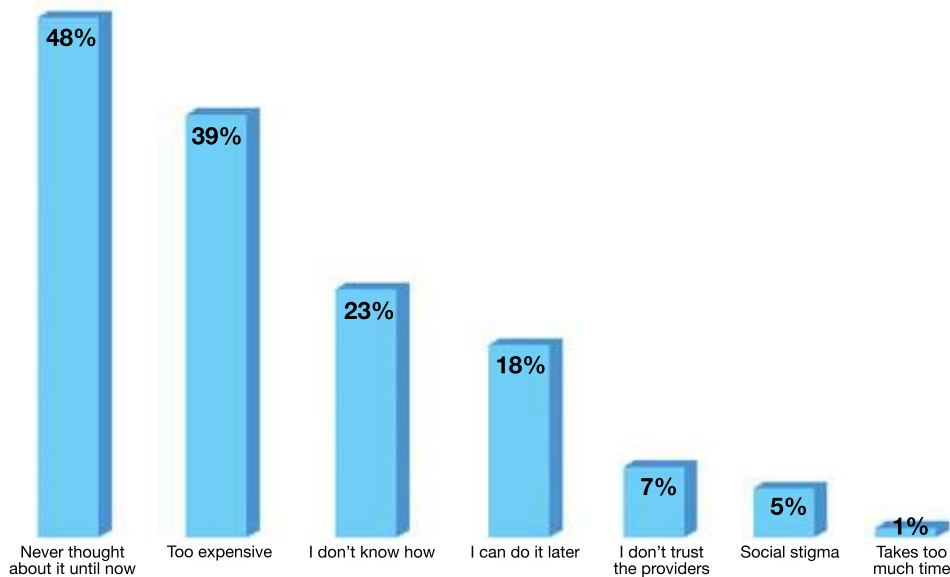


When rating the importance of various considerations in making their end-of-life wishes, respondents identify customer service and tradition as the least important. **Cost is the most frequently chosen (42%) end-of-life care consideration.**



Question: What are the most important considerations in your death care arrangements?

Most people who haven't signed up yet simply haven't considered it before. 48% say they've "never thought about it", and 23% say they don't understand how to sign up, supporting other indications that most people have never thought seriously about or researched cryopreservation as a real end-of-life option. **Of those who are "interested", 49% have never considered it before.**

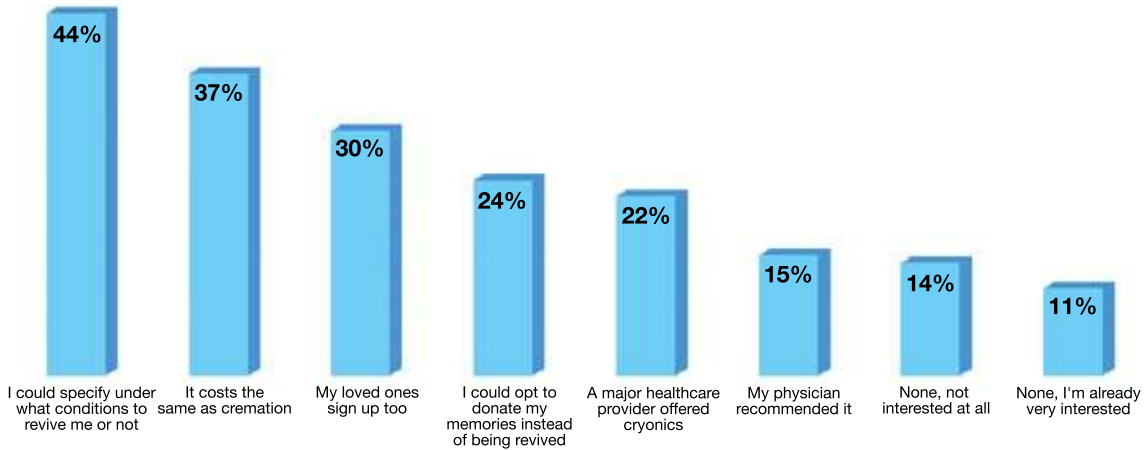


Question: Why have you not signed up yet?



23%
say knowing how to sign
up is a major barrier

Respondents strongly desired the ability to specify the conditions under which to be revived or not.



Question: I would be significantly more likely to sign up for cryopreservation if...

Common sense should indicate that cryopreservation clients would have this power, so the fact that the public seemingly does not expect to be able to specify revival conditions indicates that they have negative associations with cryopreservation having to do with loss of autonomy.

Participants were given the opportunity to describe in their own words what, if anything, would cause them to make arrangements for cryopreservation.

*If the procedure could **benefit society as a whole**, such as by contributing to scientific knowledge even if I can't be revived, I would be more interested.*

*If a **scientific journal article** in a well respected peer-reviewed journal states that cryopreservation has merit, I would take it seriously. Or **proof that people can be revived**.*

*Show me **evidence that it is safe** and that nothing will go horribly wrong, such as that I come back brain dead, paralyzed, or as a lab rat. I don't want to lose control of my life when I am revived.*

*I need to see **more research** and a provider with a **payment schedule that works for me**.*

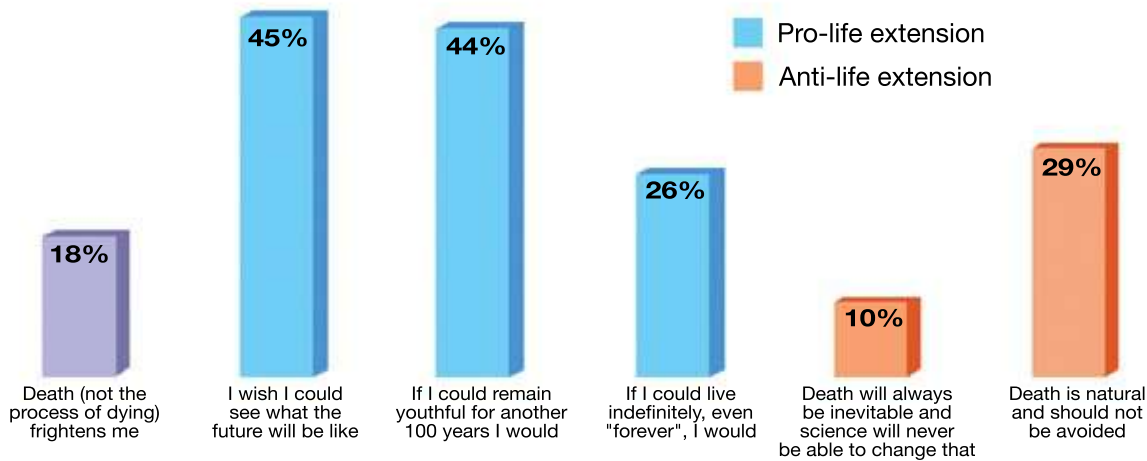
*I **don't know** what would convince me that it's worth signing up. I just **need more information**.*

*Maybe if my children signed up and wanted me to do it too. **My children would convince me** for sure.*



Effect of death attitudes on interest

The attitudes that one has towards death greatly influence their interest in cryopreservation. **Most people have death attitudes that are compatible with cryopreservation**, including roughly a quarter who agreed with a strong anti-death statement. However, **10% to 30% seem completely averse to the practice**, based on their stated death attitude.



Question: I would be significantly more likely to sign up for cryopreservation if...

Those who agreed with either of the two attitudes favorable towards life extension were significantly more likely to agree that the topic is “exciting” and that they “intend to look into it further” (54%) than those who did not agree (38%).

25% of those who wished to see the future had actively researched cryopreservation before, significantly more than the 17% who did not express that wish.

Of those who agreed with either of the two attitudes opposed to life extension, 17% had previously researched the topic, compared to 24% of everyone else.

Self-reported fear of death was not associated with increased interest in cryopreservation, rather those who reported fearing death expressed greater concern with the practice, such as that it would “hurt or be traumatic”.

Those who believe in an afterlife were significantly less likely to have heard of cryopreservation before - 71% versus 81% of everyone else.

26%
wish to live indefinitely



Attitudes and beliefs concerning biostasis



Most people do not hold negative attitudes towards medical biostasis. Those who do tend to have had less previous exposure to the topic. Only 4% of people support making the practice illegal.

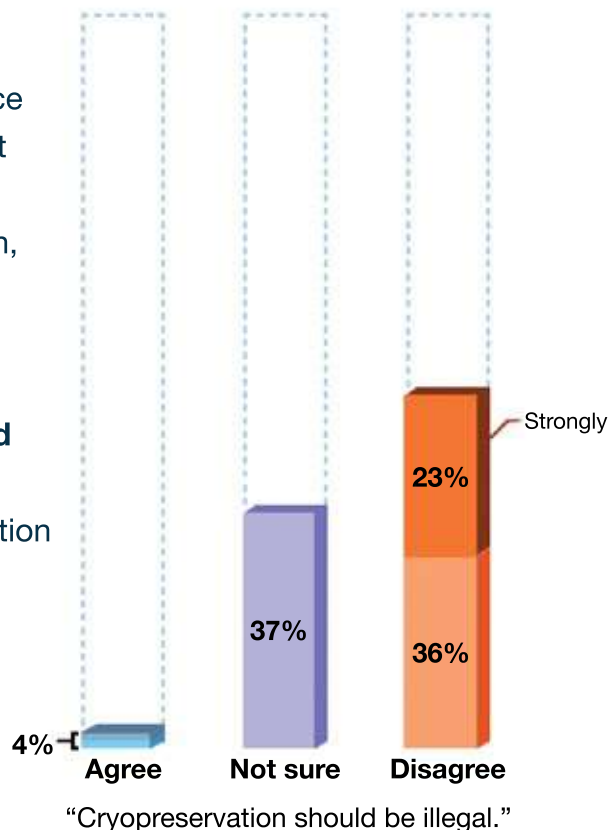
Surprisingly open minds

The biostasis community has been perennially concerned that attention on the topic could cause a public backlash, making cryopreservation illegal. However, **only 4% of the public agrees that cryopreservation should be illegal.**

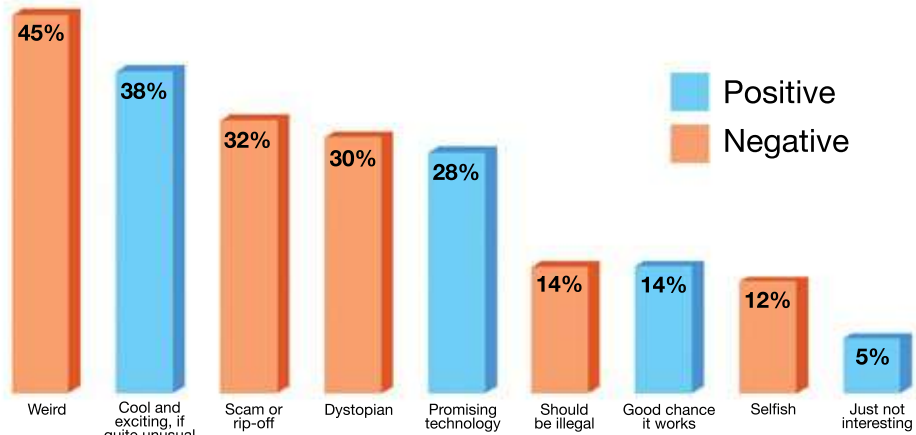
Women were more in favor of making the practice illegal, although only 4% of women selected that option in total. Those who believe in an afterlife are also significantly more likely to support a ban, though their numbers are small too.

Those supporting a ban on cryopreservation are significantly less likely to have researched the topic before. Of the entire dataset, slightly less than 1% had both researched cryopreservation and agreed that it should be illegal.

Despite these low numbers, 14% believe that “most people” support a ban, indicating that negative sentiment towards cryopreservation is significantly less common than is believed, both by the general public and the biostasis community.

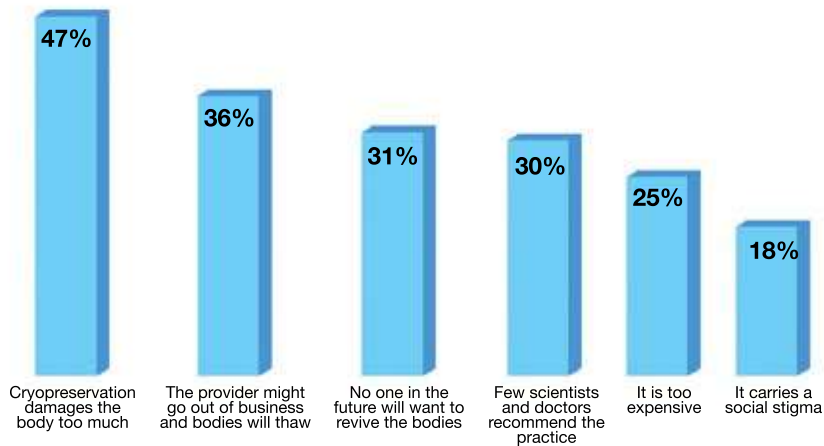


Respondents were asked to select statements that “most people” would agree is true of cryopreservation. This result indicates that **the public imagines that popular opinion concerning cryopreservation is generally negative.**



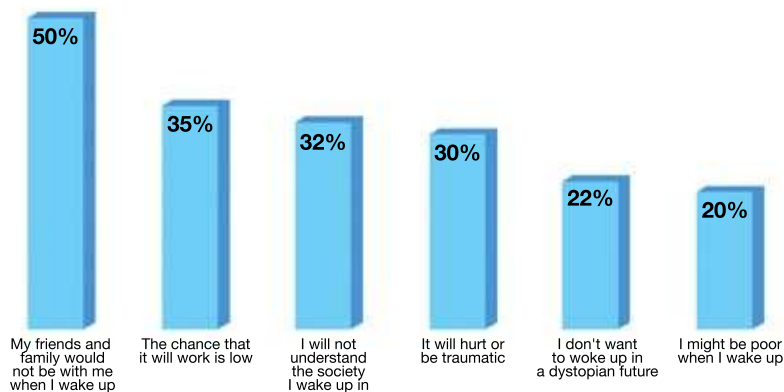
Question: Most people feel that cryopreservation is...

The public sees the primary problems with cryopreservation as scientific and institutional: 47% say the quality of cryopreservation techniques is a problem, and 36% say the provider might become insolvent.



Question: What are the biggest problems with cryopreservation today?

The primary concern with cryopreservation has to do with family; most people don't want to go into biostasis alone. The 35% concerned with the probability of success show that many don't see the operation as a bet - they want certainty.



Question: What are your biggest concerns about cryopreservation?

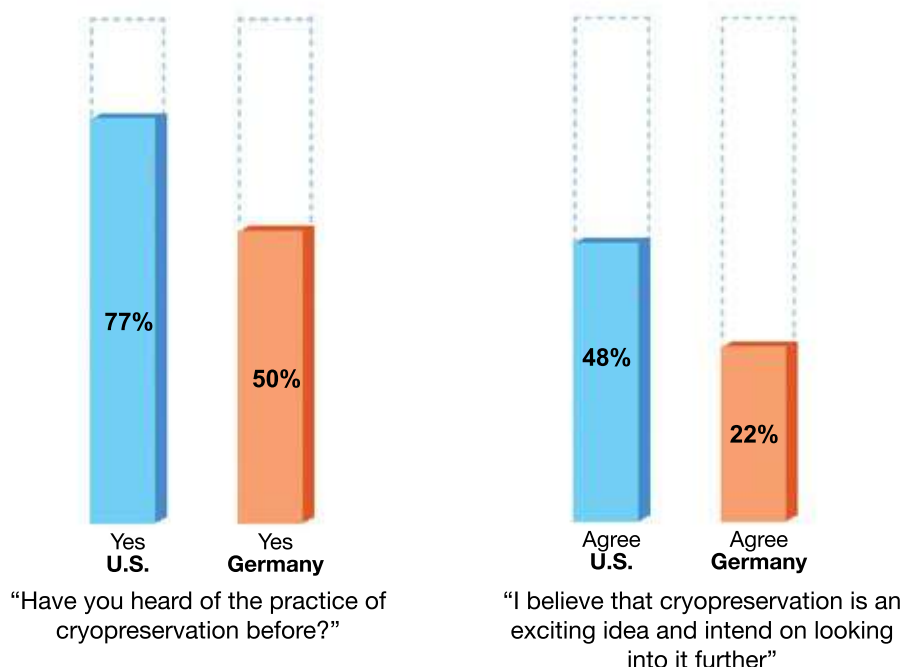
Comparing residents of Germany and the US

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Residents of Germany are significantly less excited about cryopreservation, but they also are much less familiar with the topic. This may indicate that more exposure to cryopreservation increases interest.

The German Survey

In order to provide a comparison with the major survey of the U.S., an additional, smaller survey was conducted with 244 residents of Germany. Because of the small sample size, the results can not be considered authoritative, however they may point towards real trends. While lower, the survey in Germany shows surprisingly high interest as well (22%).



Germans also have less knowledge of cryopreservation than Americans. This could be because most of the history of the topic has taken place in the United States. Germans' lower awareness of the topic may be why they are less excited about the topic, as the American survey shows that those with prior knowledge tend to be more interested.

Conclusion

We believe that, since the development of promising new preservation techniques like vitrification and aldehyde-stabilized cryopreservation, biostasis has passed, without much fanfare, from the realm of theoretical speculation into the far frontier of medical research.

Now is the time to engage stakeholders in developing and expand the legal, ethical, and operational frameworks for medical biostasis as a routine “backstop procedure” in terminal cases.

This survey shows promising results concerning the public’s sentiments towards medical biostasis. Familiarity with the concept is high, and though the public has mostly never considered biostasis as a realistic end-of-life alternative and knows little about how cryopreservation is practiced today, there is impressive interest and openness.

Much of the public understands the rationale for conducting cryopreservation on a speculative basis, as indicated by the large fraction of respondents who identify social and institutional risks to revival as more significant than crude cryopreservation procedures. And negative sentiments towards to practice is low compared to other medical frontiers like gene editing.

Most significantly, there is clear desire for medical biostasis as an alternative to burial or cremation. Much of the public seems to be interested to learn more about the topic as a realistic end-of-life option.

We believe that the public’s curiosity is warranted.

As a non-profit research organization, European Biostasis Foundation is dedicated to funding, conducting, and coordinating basic, translational, and applied research projects in the areas of biostasis, cryobiology, and biopreservation.

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