



## CRYOPRESERVATION



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*Dr. Bischof recently presented at The Alliance 2024 National Innovation Forum, "The Future of Organs for Transplant." Bischof examined significant advancements and ongoing challenges in the field of cryopreservation, focusing on organ preservation.*

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Check out our Alliance On-Demand Learning Pathway, featuring "The Future of Organs for Transplant."

Scan the QR code below or visit <https://www.organdonationalliance.org/learning-pathways>.



### Challenges:

The limitation of preservation time of organs available for transplantation. This constraint impacts the availability and matching of donor organs to recipients, often resulting in the prolonged wait times for patients and suboptimal transplant outcomes.

### Objectives of the Clinical Intervention:

To extend organ storage time to days, weeks, or years, thus:

- Alleviating time constraints associated with ischemic damage.
- Enhancing donor-recipient matching.
- Transforming transplantation into an elective procedure with improved planning.

### Approach and Actions Taken:

Bischof's team, supported by a \$26 million NSF Engineering Research Center grant, has taken a multidisciplinary approach that focuses on:

- **Biological Engineering (Thrust Area 1):** We prepare biological systems to go into a state of suspended animation by adding antifreeze.
- **Multiscale Thermodynamics of Water (Thrust Area 2):** Manipulate water content within organs to achieve supercooling, isochoric, partial freezing, or vitrification without forming damaging ice crystals.
- **Rapid and Uniform Rewarming (Thrust Area 3):** Develop innovative techniques, such as nanoparticle-based inductive isochoric heating, to prevent cracking and crystallization during the rewarming process.

### Technological Breakthroughs:

- **Supercooling:** Successful preservation of rodent livers for up to four days and human livers for 28 hours using supercooling techniques.
- **Isochoric Preservation:** Stable preservation at sub-zero temperatures without ice formation.
- **Nano Warming:** Iron oxide nanoparticles enable uniform rewarming from within, preserving and successfully transplanting rodent kidneys preserved for up to 100 days.

### Results and Data:

- **Pancreatic Islets:** Successfully transplanted cryopreserved islets into diabetic mice, curing diabetes.
- **Rodent Kidneys:** Rewarmed and transplanted, showing normal biometrics over 30 days.
- **Scaling Up:** Techniques, especially high subzero techniques (supercooling, isochoric and partial freezing) are being adapted for larger organs, aiming for human applications soon.

### Future Directions:

The future of cryopreservation research looks towards expanding the preservation of larger and more complex organs and eventually transitioning to clinical applications. Goals include:

- Extend preservation duration to years.
- Apply techniques to other biological systems like organoids and cell therapies.
- Engage with ethical and regulatory bodies for safe technology adoption.

### Conclusion:

Dr. Bischof's presentation highlighted the transformative potential of cryopreservation in organ transplantation, emphasizing the collaborative and multidisciplinary efforts required to overcome current challenges and achieve significant clinical impact.