Airlift NW Blood Transportation

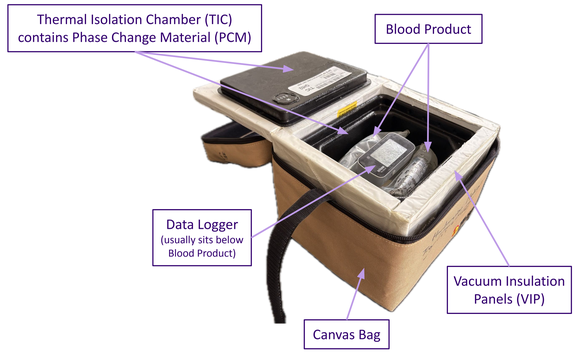
Advisor: Eli Patten[1] | Industry Advisors: Brenda Nelson[2], Kyle Danielson[2], Dave Gallagher[2]
Acknowledgments: Erin Tuott[3]
[1]UW Mechanical Engineering, [2] Airlift Northwest, [3]UW Medicine

Client Overview

Airlift NW provides critical care air emergency medicine services in affiliation with UW Medicine across the Pacific Northwest, Mountain West, and Alaska, using a fleet of helicopters and fixed-wing planes equipped with advanced medical technology and staffed by trained flight nurses.

Airlift's Need

Airlift NW is looking for a way to extend the time their blood transportation cooler can be outside of a refrigerator, while maintaining the ease-of-use of the current cooler, to decrease expenses by reducing the number of cooler exchanges with Harborview Medical Center (HMC).



Airlift's Current Process

Cooler Packing Process

Crēdo Cooler is packed with blood and plasma and sealed with a zip tie at Harborview Medical Center

Crēdo Cooler is either:
1) Picked up by an aircraft medical team
OR
2) Delivered to base by a third party courier.

Crēdo Cooler is placed in a fridge at base for temperature controlled storage

Blood Expiration Timers

A 24 hour running clock starts when the cooler is removed from the fridge. This timer *pauses* when the cooler is returned to the fridge after the emergency call but never resets.

A 7 day clock starts when the cooler is delivered to the base. This clock never pauses and never resets.

Pain Points for Airlift NW:
- Limited time with cooler causes higher frequency of exchanges
- Exchanging blood product is an expensive process

Returning the Blood

The cooler is returned to Harborview after one of the timers runs out (whichever comes first)

Once the zip tie is cut, the blood product must be administered to a patient **OR** returned to Harborview

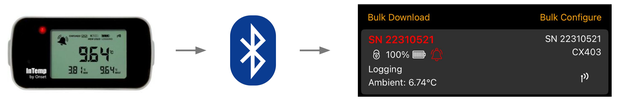
Pain Points for Airlift NW:
- Temperature data can only be accessed AFTER cooler has been returned to Harborview

Our Design Process

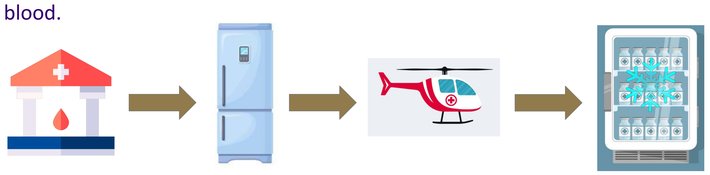
- Preliminary Ideas Considered: active cooling, cooler redesign, new material development, active temperature readout, phase change refreezing
- Eliminated concepts based on feasibility and practicality
- The combination of active temperature readout and controlled refreezing of the cooler's PCM was chosen to increase cooler life and usability while minimizing additional cost.

Our Solution

Active Temperature Readout: InTemp Bluetooth Ambient Data Logger offers live temperature data, custom configuration settings, and instant full report feedback, all accessible to flight nurses and staff via Bluetooth.

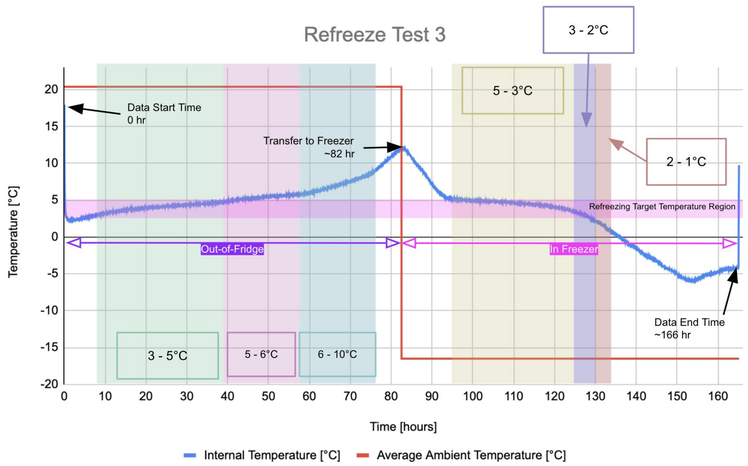


Refreezing the Cooler PCM:
Concept: When the cooler PCM has gone from solid to liquid, place packed cooler back into freezer to reverse the phase change without freezing the blood.



Validation

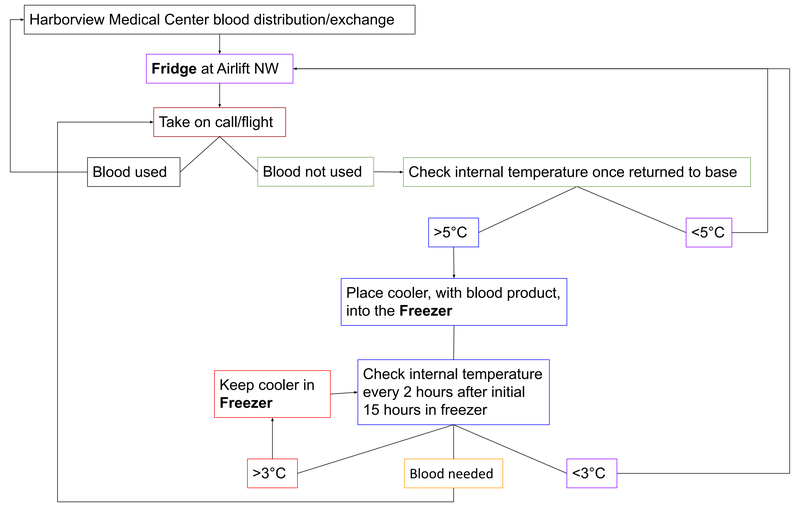
- Analysis of maximum time needed to achieve a given change in temperature out-of-fridge at ambient temperature of ~20°C versus in freezer
- Equipment: Wireless Temperature Loggers, NR500 DAQ System, Type J Thermocouples



Temperature vs. Time for Refreezing Test 3 including Elapsed Times per Temperature Ranges, Target Temperature Range for Safe Refreezing, and Procedure Stages

Final Recommendation

- Move to a temperature based timeline instead of 24 hr out of fridge clock.
- **Blood transport cooler life is extended by approximately 15 hours by implementing the refreezing process using the active temperature readout to place cooler in freezer at 5°C and take it out at 3°C.**
  - When blood reaches 5 ℃, place cooler in freezer until internal temperature reaches 3 ℃.
  - 3 ℃ lower bound provides at minimum 6 hours of safety to prevent the freezing of the blood.



IF cooler is removed from Freezer prior to reaching 3.0°C	Temperature [°C]	3.0	3.25	3.5	3.75	4.0	4.25	4.5
THEN note the internal temperature and the time until internal temperature reaches 5°C:	Time [hours]	15	13	11	9	7	5	3

Benefits of Final Recommendation

- By removing the 24 hour out of fridge limit on the cooler, the four Western Washington bases can save approximately 120 helicopter trips to Harborview to exchange blood per year
  - ALNW teams can prioritize their time helping patients instead of exchanging blood
  - Save over $100,000 / year
- The new data logger can provide real time temperature readings, so the blood is ensured to be safe before administering to patients

Mechanical Engineering Capstone Exposition

June 3rd 2025, Husky Union Building, University of Washington, Seattle

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