Operational Field Evaluation of an Extended-Duration Passive Blood Transport Container for Military Blood Logistics

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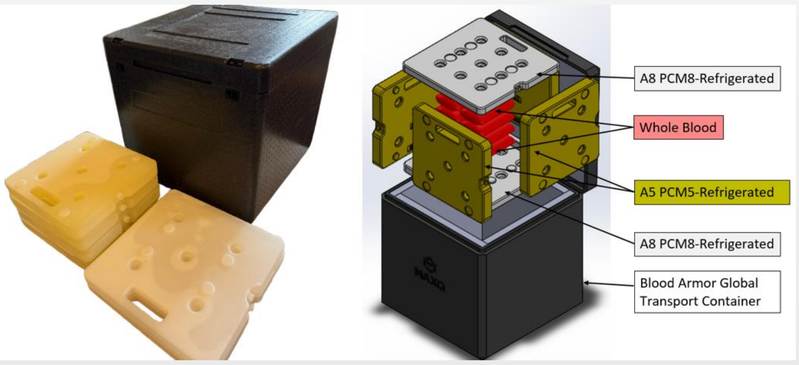
Introduction

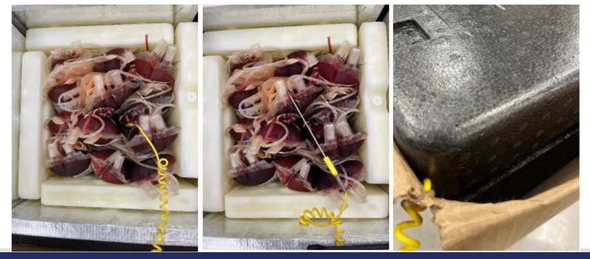
Hemorrhage remains the leading preventable cause of death in combat operations. Rapid access to whole blood is essential for resuscitation and prolonged field care; however, maintaining cold-chain compliance during transport in austere environments remains a major logistical challenge. This study reports an observational evaluation conducted by Tripler Army Medical Center under the supervision of LTC Nekkaya Glover to assess the thermal performance of a long-duration passive cold chain blood shipper under operationally relevant conditions.

Methods and Materials

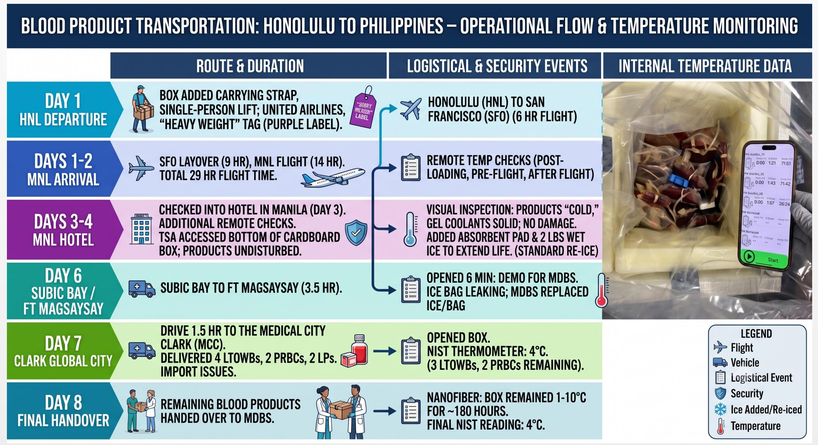
Materials: This study used Blood Armor Global Transport (BAGT) Container that is a high-performance passive shipper utilizing precise phase-change coolants to maintain up to 24 Whole Blood units at 1–10 °C for up to 13 days in rugged military logistics environments.



Methods: Two separate evaluation was executed under this study. **Evaluation 1:** Thermal performance was evaluated under controlled ambient conditions using 24 units of Whole Blood (WB, nominal fill volume = 500mL) utilizing the arctic pack-out configuration within the blood bank laboratory. Payload temperature was taken using a calibrated electronic thermometer (#CP327987) roughly every 24 hours until the temperature went out of range. The room temperature was recorded using Centron Presidio REES node 1, probe 50.

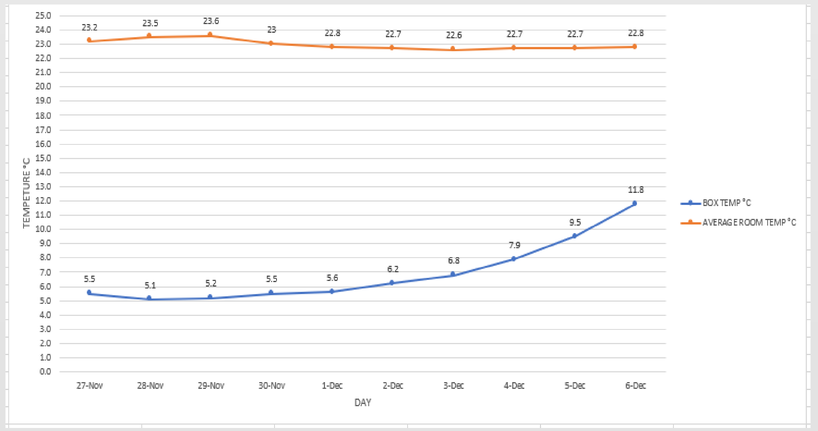


Evaluation 2: A field evaluation was conducted during the Balikatan Exercises in the Philippines, where the container was packed with 7 WB, 4 packed red cells (pRBC), two liquid plasma, and two medical-grade reagents in Hawaii and transported to the Philippines. The intent was to utilize a route that has multiple stops and deliver similar to a standard logistical "star route." Multiple temperature loggers recorded internal temperatures every 2-hours. Fully packed container was approximately 65 lbs.



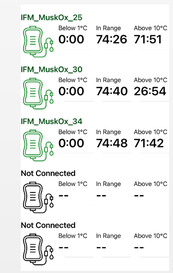
Results

Evaluation 1: The BAGT successfully maintained the payload temperature for over 8 days. However, it was observed that the thermometer wire created a small gap in the lid, leading to unintended thermal loss. This minor breach may have compromised the container's maximum thermal duration.



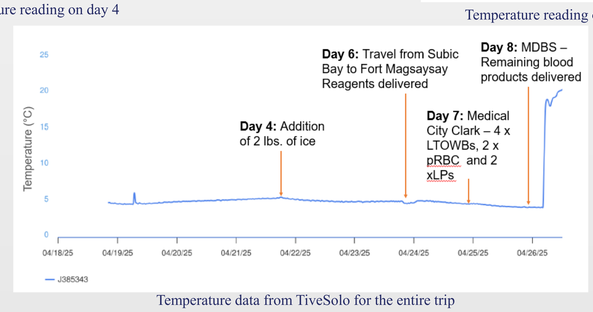
Evaluation 2: Two devices were used to measure temperature:

- TiveSolo monitored average container temperature and uploaded real-time data to a cloud-based web platform.
- NANO Fiber sensors monitored individual blood bag temperatures, reporting time <1°C, within 1–10°C, and >10°C via a smartphone app. Sensors were attached without pre-conditioning; monitoring began at attachment (time zero). Hence 71:51, 26:54 and 71:42 equaled a zero-start time for the 3 NANO fiber sensors.
- During the Balikatan Exercises in the Philippines, temperatures remained between 4–5.5°C for 8 days despite long-distance transport and tropical exposure. The container supported staged delivery of reagents (day 6), WB (day 7), and mixed blood products across three locations.



Temperature reading on day 4

Temperature reading on day 8



Temperature data from TiveSolo for the entire trip

Conclusions

The Blood Armor Global Transport (BAGT) container successfully maintained the required 1–10°C blood transport temperature across diverse operational environments, demonstrating reliable thermal performance for military blood transport. Field evaluations, including local testing in Hawaii and extended deployment to the Philippines, confirmed its ability to preserve cold-chain integrity under real-world conditions, supporting prolonged field care and mission-critical blood resupply in austere environments.

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