Blackfrog Technologies Pvt. Ltd. is a Manipal, KA based technology startup company that seeks to improve the efficiency of immunization supply chains. We have developed patented technologies for precision cold-chain and vaccine traceability systems with support from BIRAC (DBT) and leading impact investors in the nation including Venture Centre (NCL, Pune) and Social Alpha to provide logistical support in the last-mile delivery of vaccines.

Amid surging cases and an acute shortage in the supply of COVID-19 vaccines, the emerging economies certainly cannot afford vaccine wastage. However, since our immunization drive relies heavily on bringing vaccines to the people, rather than vice-versa, there is scope for vaccine wastage in transit during the 'last mile' (from healthcare centre to location of administration), due to exposure to non-optimal temperatures. Despite varying storage temperature and requirements, every drug currently being administered as part of the immunization drive across nations, including Pfizer, Moderna, Covaxin (BBL) and Covishield (AZ) require temperature between 2 and 8 degrees Celsius (35-40 deg F) during the last-mile of transport. More importantly, most vaccine candidates (BBL, AZ etc) are even freeze-sensitive. Therefore, in order to ensure their efficacy, exposure to temperatures outside the optimal range must be minimized.

Unfortunately, iceboxes, the predominant mode of last-mile vaccine transportation for COVID-19 vaccines, are not equipped for this task. Since they have no mechanism for temperature control and regulation, there exists the risk of accidental freezing and/or thawing, rendering the temperature-sensitive vaccines inefficacious. This is especially likely when vaccines are to be transported to distant and remote locations with harsh weather conditions. As a result, even when vaccines reach their destination in time, there exists the prospect that they have been compromised. Additionally, the lack of reliable temperature monitoring capabilities in iceboxes makes it challenging to determine the efficacy of the vaccines in advance. It is possible, then, that a proportion of the population receives inefficacious vaccines, significantly impeding immunization efforts.

Emvólio: Product Overview

Emvólio is a portable, battery-powered refrigeration device that will strictly maintain any preset temperature for over 12 hours for last mile transport of vaccines*. Emvólio's 1.8-litre capacity enables it to carry 30-50 vials, which is standard for a day-long immunization campaign. Further device capabilities include continuous temperature monitoring, location tracking, state-of-charge indication, communication with headquarters via live tracking, and vital statistics for improved coverage. This system has been helping remote hospitals relieve the economic burden of wasted vaccines. Further, it helps optimize human resources in vaccine delivery by removing the need for repeated immunization visits to account for the administration of unviable vaccines. Most importantly, our battery-powered device stands apart from the competition with its unmatched portability and ease of charging. Blackfrog is an ISO 13485 certified manufacturer of medical-devices and Emvólio has been designed in accordance with WHO-PQS E003 standards.

Ergonomic & Fits into a Backpack

*The product is designed in accordance with the draft-specifications of WHO-PQS for a portable fridge. The independence is 12 hours i.e. the device will maintain a strict 2-8 deg C at an ambient temperature of +43 deg C. The device is capable of operating for longer hours (up to 20 hours) in lower ambient temperatures.

Emvólio: Technology

Emvólio's patented technology ensures that all contents in the cold chamber are blanketed in strictly temperature-controlled air. The underlying refrigeration mechanism is solid-state cooling with a smart PID (Proportional Integral Derivate) controller, which guarantees precise temperature maintenance without the risk of noxious refrigerant leakage or cross-contamination. The lack of motors/compressors or any moving parts enables low-maintenance operation. The unique design of Emvólio promises:

1. **Uniform cooling:** No hot spots/cold spots within the cold chamber.
2. **Minimal freeze-thaw cycles:** This means every time a user opens the lid to retrieve a vial and subjects the cold-chamber to ambient air, the rapid-cooling system onboard Emvólio brings the cold-chamber back to safe limits (i.e. 2-8 degrees Celsius) over 96% faster than an ice-based product would.

Storing contents in Emvólio

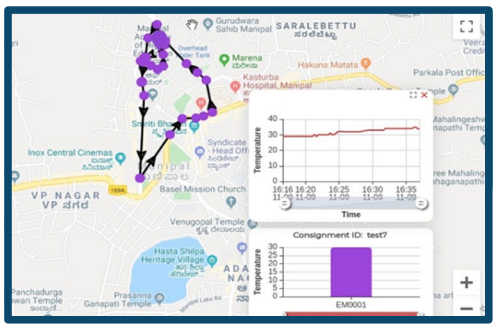
Deployment:

Emvólio being used at a Sub Health Center in Kamjong, Manipur

A group of researchers from the UK and Thailand conducted a study in 2017 on the 'Cost, health impacts and cost- effectiveness of ice-less refrigeration in India's vaccine cold chain'[1] to better understand the economic benefits of using a battery-operated device as a replacement for conventional iceboxes. The team concluded that the costs of wastage in the context of just rural India alone of the ice-based cold chain system is USD 7,512,930 and that even at a unit cost-price of USD 2000 for an iceless, battery-powered vaccine carrier, the cost-benefit ratio that avoids this wastage would 0.28, indicating that this is cost-beneficial.

Emvólio has been purchased by multiple hospitals and non- profit organizations engaged in improving healthcare and livelihood (SELCO Foundation, CInI TATA Trusts, Support Jharkhand, etc.).

One of Blackfrog's clients, SVYM Hospital in Sargur, near Mysore (Karnataka) have used Emvólio for a full year now. They report saving INR 13,000 every month as a direct consequence of not having to discard unused vaccines at the end of the day's field trip. The field doctors report that with Emvólio's battery performance, they are now able to immunize twice as many children in tribal regions as they were previously able to with ice-based systems.



GSM-GPS system transmits live vital statistics like temperatures, location, and usability patterns to an online dashboard.

Blackfrog has a production capacity of 1500 units/month and Emvólio is now being deployed in large volumes across seven states in India with necessary clearance from the National Health Mission. Blackfrog has also started exports to the Middle East-Asia region.

[1] Panarasri Khonputsa MSc PhD, Katherine Plewes MD PhD, Nicholas P.J. Day MD PhD, Yoel Lubell PhD. 'Cost, health impacts and cost-effectiveness of ice-less refrigeration in India's vaccine cold chain'. Center for Tropical Medicine and Global Health, Oxford, UK and Mahidol-Oxford Tropical Medicine Research Unit, Bangkok, Thailand.