FriGo: an actively cooled, portable cold chain solution for resource limited settings

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What challenge or opportunity did you try to address? Were existing solutions not available or not good enough?

An estimated 1.5 million children die each year from vaccine-preventable diseases. Besides vaccines, other life-saving drugs such as oxytocin, rectal artesunate, snake antivenom, insulin, and diazepam are unavailable at peripheral health centres due to a lack of cold chain facilities. Existing solutions are inadequate as they rely heavily on passive cold chain especially for the last mile, necessitating centralised models of healthcare delivery and leading to increased patient costs and limited access.

Why does this challenge or opportunity matter – why should MSF address it?

Desk research has shown that there is no single product that can address this gap. A solution would have a positive impact at scale in most complex medical emergencies and could be a ubiquitous tool for decreasing mortality in neglected populations.

Describe your innovation and what makes it innovative

We are rethinking the passive vaccine day carrier by developing FriGO, a long-term, portable, active cool box that uses off-grid sources of energy. FriGo utilises solar power, thermoelectric cooling, phase-change material, battery back-up and a unique construction to provide continuous portable off-grid cooling for prolonged periods of time. FriGo benefits from accurate condition logging and monitoring and preventive action warning system.

The technology that is utilised in FriGo has been individually proven in several other industries from international food shipping to outdoor camping. However, resource-limited healthcare settings require appropriately customised solutions. Although a handful of organisations are looking at this problem, a successful scalable solution is yet to be reached. The Covid-19 pandemic has brought a renewed focus on the vaccine cold chain industry and could act as a catalyst in bringing about this much needed change.

Who will benefit (whose life / work will it improve?) and were they involved in the design?

FriGo has the potential to decrease mortality and morbidity in most contexts where MSF works by increasing our reach and decreasing wastage.

What objectives did you set for the project – what did you want to achieve and how did you define and measure success (improved service, lower cost, better efficiency, better user experience, etc.)?

In October 2019, we conducted a user preference study involving field workers and technical specialists to define and design the project. The primary objective and measure of success was to prove that a portable chamber could maintain a temperature of 2-8°C for a minimum of 28 days without an external energy source.

What data did you collect to measure the innovation against these indicators and how did you collect it? Include if you decided to change the indicators and why

Three assessments (desk research, technical study, and user preference study) were conducted to assess available products, feasibility, minimum requirements, cost comparison, and unmet needs. A proof-of-concept is underway.

How did you analyse this data to understand to what extent the innovation achieved its objectives? Did this include a comparison to the status quo or an existing solution?

Phase 1 aimed at validating the use-cases and reviewing the available products in the market. The data was collected through interviews and correspondence with experts and analysed by the team. The objectives for phase 2 were to validate the specific design and features, through an in-depth interview-based user preference study and a desk research technology analysis.

Phase 3 objectives focus on validating the feasibility of the concept by building a proof-of-concept to demonstrate the proposed features of the product. The experimentation and testing are ongoing and will be assessed based on milestones established at the outset of the phase. The final milestone will be the ability to maintain a cold-life of 2-8°C for seven days with the possibility of continuous repeatability, without user-intervention or grid resources.

Were there any limitations to the data you collected, how you collected it or how you analysed it, or were there any unforeseen factors that may have interfered with your results?

Data collection was comprehensive, but non-exhaustive. Prototype data collection is underway but will need to be done in a range of field locations to ensure it works under various field conditions.

What results did you get?

Phase 1 revealed that existing solutions, while some of them innovative, did not address all the current problems highlighted by some of the use-cases, and did not greatly change the current possibilities.

The outcome of the user-preference study and technology analysis (phase 2) highlighted specific requirements such as being durable, easily carried on the back, suitable for all modes of transport, plug and play operation, and preferably around 2.5L in capacity. From a service perspective, the product needs to have prolonged cold life, minimal expertise and intervention, no grid dependency, non-circular route possibilities, fail-safe responses and decentralised operation.

FriGo is being designed, prototyped and tested based on these findings. Some of the results achieved include the ability to cool a 1L payload chamber to 2-8°C, with an ambient temperature of +30°C, in under 4 hours solely using solar power, a thermoelectric heat pump, and a phase-change material thermal battery; with a current cold-life retention of 28h through an insulating structure.

Comparing the results from your data analysis to your objectives, explain why you consider your innovation a success or failure?

These conclusions can only be drawn after field testing is completed.

To what extent did the innovation benefit people's lives / work?

This will be determined during the next phase of development, when FriGo is scaled-up and piloted.

Is there anything that you would do differently if you were to do the work again?

Framing the product lifecycle to anticipate partnerships and legal processes, and consider alternative pathways, would reduce negative impacts on progress and timeline.

What are the next steps for the innovation itself (scale up, implementation, further development, discontinued)?

Following a successful proof-of-concept, we will build and distribute prototypes for field testing, ideally in collaboration with a commercialisation partner.

Is the innovation transferable or adaptable to other settings or domains?

Besides humanitarian settings, FriGo can be used in other medical contexts (including developed countries), farming and other cold chain dependent industries, and in end-consumer applications such as food and beverage storage.

What broader implications are there from the innovation for MSF and / or others (change in practice, change in policy, change in guidelines, paradigm shift)?

If successful and cost efficient, FriGo could change the way MSF works by expanding reach for vaccination campaigns, allowing for decentralised healthcare delivery, and enabling home-based care in remote or conflict settings.

What other learnings from your work are important to share?

MSF would benefit from an innovation culture backed by standard operating procedures for product development aspects such as partnerships, intellectual property, commercialisation, and mentorship.

Ethics

This innovation project did not involve human participants or their data; the MSF Ethics Framework for Innovation was used to help identify and mitigate potential harms.

Eric Saldanha

Eric Saldanha is a curious thinker, problem-solver, and designer from India, recognised for the thoughtful user-centric products he creates. He is currently based in London, and is a graduate from the Royal College of Art, UK, with a background in mechanical engineering, and over four years of experience as a design consultant. Thriving in environments that constantly challenge and inspire him, he has created and collaborated on multiple award-winning projects in the sustainable and humanitarian space. His most recent collaborative project won an MSF Sapling Nursery Grant to research and develop a game-changing concept in cold-chain delivery. Instinctively drawn to unaddressed problems and neglected communities, he is a strong proponent of the role that innovators have, to create solutions that contribute towards a more equitable world.