Sustainable off-grid oxygen concentration using direct solar power

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Introduction
Oxygen therapy can be lifesaving for children with pneumonia. It is also used for anaesthesia, and many other health conditions. In MSF, medical needs for oxygen are increasing, due to more complex treatment approaches, particularly for neonates. Production of medical grade oxygen in humanitarian settings is challenging because large amounts of fuel are needed. This project assessed the possibility of producing medical oxygen using direct solar power during daytime. Oxygen would then be stored for use during the night, instead of storing energy using batteries. This approach could have environmental and sustainability advantages, for example by enabling local actors to maintain healthcare facilities after handover. This innovation project was inspired by a conventional solar power installation in Shamwana, Democratic Republic of Congo (DRC), in 2016.

Methods
As background to the innovation, I investigated current oxygen usage in MSF field projects, using Logistics Reporting System data (to 2016), and specific oxygen usage data from Mweso hospital, DRC (March 2017). In addition, I used data collected in the Shamwana project, 2016, to evaluate current costs for oxygen provision. Market availability, and costs for oxygen storage solutions were determined by an international survey of all equipment providers. Finally, I tested a direct solar power solution and a low-pressure oxygen storage prototype.

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

Results
Extrapolations suggest that current oxygen supply to MSF field projects involves roughly 2000-3000 oxygen concentrators. These concentrators are used approximately 50% of the time at 75% of their capacity, equating to 200-300 m^3/hour consumption of medical oxygen. In a remote location like Shamwana, fuel costs are around 1€/m^3, using generator powered concentrators. Prototyping showed that a promising solar oxygen solution might comprise low-pressure storage of oxygen produced with standard concentrators. Tests verified that such a system, with an initial investment cost of roughly 16,000€, might produce up to 5,300 $m^3$of oxygen per year with no continuous operation cost. Potentially, such systems are cost saving after 3 years, compared to oxygen produced with generator power.

Conclusion
The proposed low-pressure oxygen system has potential for application in remote settings. Challenges include the need for high initial investment. I am currently exploring this solution with stakeholders within and outside MSF. Next steps would include the investigation of pipe distribution systems of oxygen to patients in field hospitals; additional development issues including power-saving compressor technologies, and field-testing of the system overall. The project report is available at https://bit.ly/2qFd8Oh

Conflicts of interest
None declared.