HUMANITARIAN INNOVATION FUND
Early Stage Innovation Final Report

– Please try not to exceed 5 pages (Arial, 12pts) excluding attachments –

Organisation Name	Dahdaleh Institute for Global Health Research

Project Title	Chemical water quality and impacts on the treatment of severely malnourished infants and children
Partner(s)	Médecins Sans Frontières Operational Centre Amsterdam, Plantage Middenlaan 14, 1018 DD Amsterdam, Netherlands
Problem Addressed / Theme	Paediatric patients with severe acute malnutrition (SAM) in intensive therapeutic feeding centres (ITFCs) are highly sensitive to electrolyte and mineral inputs they receive during treatment. Thus, the composition of therapeutic feeding (e.g., F75, F100) and other products (e.g., ReSoMal) used in ITFCs are carefully calibrated with respect to electrolyte and mineral content. These products however are usually reconstituted using locally available water, which can have widely varying electrolyte and mineral concentrations, referred to as its chemical water quality (CWQ). Concerns that elevated levels of electrolytes and minerals could adversely affect the treatment and recovery of paediatric SAM patients in ITFCs have existed since 2007 following experiences in Somalia, and were reignited in 2017 following an unusual mortality cluster among paediatric SAM patients in an MSF ITFC in Ethiopia. In general, elevated CWQ concentrations are more likely to be encountered in arid regions where nutritional crises are also more likely to occur, however, at present, we have no guidance on allowable CWQ in ITFC water supplies. There is little research on this topic and limited understanding in the humanitarian sector on the scope of the problem or how to manage the issue.
Location	York University, Toronto, Ontario, Canada
Start Date	09/04/2018

End Date	20/12/2018

Total Funding	HIF contribution: £50,000 GBP Dahdaleh Institute for Global Health Research/York University in-kind contribution: £12,998 GBP
Total Spent	HIF contribution: £42,180 DIGHR/York in-kind contribution: £10,895

Innovation Stage	**Recognition:** of a specific problem, challenge, or opportunity to be seized, in relation to the provision of humanitarian aid. At this stage, a key focus is to make sure you are addressing an issue that really matters to those affected by crisis.
Type of Innovation	Problem Recognition
Project Impact Summary	This "Problem Recognition" grant project has successfully: • Articulated and increased awareness in the humanitarian sector on a hitherto unstudied problem having potentially critical humanitarian health implications; • Synthesized currently existing knowledge from distinct domains (engineering and medicine) on this problem in order to propose provisional management strategies relating to both clinical care (ITFCs) and water supply in humanitarian settings; • Mobilized specialists from multiple subject specialities (humanitarian response, medical, engineering, nutrition etc.) and convened an informal working group on this problem to advance further work; • Identified key knowledge gaps and research priorities for further work on this problem, that will be developed into subsequent research funding proposals; • Generated key knowledge products including ITFC water quality guidelines and technical briefs for humanitarian field workers (pending); • Yielded (or will soon yield) a total of 9 dissemination outputs including 1 research brief in a practitioner journal; 1 poster presentation to a practitioner audience; 1 webinar to a practitioner audience; 4 presentations at international scientific and practitioner conferences; and 2 journal publications (pending).

ACTIVITIES CARRIED OUT

1. Describe all the activities carried out. Please attach a workplan or log frame, if these were used.

The original Workplan from the grant agreement is reproduced below and built upon. A new column (rightmost) has been added that describes all of the results achieved through the activities in response to Question 4.

Expected Results	**Main Executed Activities**	**Results Achieved (Question 4)**
Annotated bibliographies; formation of expert review committee	Systematic review of knowledge bases	▪ Systematic review completed of medical literature pertaining to Upper Limits of intake for selected electrolytes/minerals among the paediatric SAM population ▪ Write-up and submission for journal publication now under way.
	Expert consultations	▪ Panel of malnutrition and water experts established and engaged on this research question. ▪ Expert consultations and review of project outputs on-going.
	Advisory group on-going review	▪ MSF Advisory Group (nutrition and water/sanitation) established and engaged on this research question. ▪ MSF advisors' consultation and review of project outputs on-going.
Synthesis of knowledge bases; identification of gaps; production of draft guidance	Preparation of knowledge base synthesis documents and draft guidance (ITFC water quality guidelines and technical management strategies)	▪ Key knowledge synthesis documents completed and being prepared for dissemination (more below).
Working guidelines for water quality in ITFCs; working technical management strategies; dissemination to sector; new grant	Expert review meeting (incl. planning)	▪ Two-day expert panel meeting hosted at York University, November 19-20, 2018. ▪ On-going expert consultations and review of project outputs.

applications for further R&D	Preparation of final guidance outputs	1) ITFC Water Quality Guidelines draft being completed; final review by experts and preparation of manuscript for publication under way. 2) Water and Sanitation Technical Documents: a. Knowledge Synthesis Report completed ("Chemical Water Quality And Intensive Therapeutic Feeding Centres - Background Report"). b. Technical Brief series produced from Knowledge Synthesis Report completed and provided to MSF for field use: i. Validating Water Quality Analyses; ii. Basic Geochemical Water Quality Sampling and Testing.
	Expert review approval of final guidance outputs	▪ Expert review of final guidance outputs on-going.
	Dissemination activity	**<u>Dissemination activities completed:</u>** 1) MSF-OCA Water and Sanitation newsletter, Sept 2018 (research brief). 2) International Association of Hydrogeologists–Geochemistry and Health Conference, London, Nov 2018 (poster). 3) MSF Greece – Associative Debate on migration and climate change, Nov 2018 (webinar). **<u>Conferences pending:</u>** 4) MSF Paediatrics Day, April 2019, Stockholm (accepted for oral presentation) 5) MSF Scientific Days, May 2019, London (abstract submitted) 6) Emergency Environmental Health Forum, Geneva, June 2019 (abstract submitted)

		7) 11th European Congress on Tropical Medicine and International Health, Liverpool, Sept 2019 (abstract submitted) **<u>Papers under preparation:</u>** 8) Systematic Literature Review paper (Upper Limits of intake for selected electrolytes/ minerals among the paediatric SAM population) 9) ITFC Water Quality Guidelines Knowledge Synthesis paper *(These two papers will form a series that we will aim to publish together in a leading open-access journal)*
	New grant development	▪ New grant development currently underway with experts, MSF advisory, and research team members; preparing submissions for: ○ "Dreamfund", Dutch Postcode Lottery (Expression of Interest, March 2019); ○ R2HC, (EoI, June 2019).

2. If you have made changes or amendments to the planned activities and objectives that have not been detailed in an *Agreement Amendment Form*, please list them here.

- We originally planned for a single conference for the dissemination activity; we have increased this to a total of 9 dissemination activities given the interest we have received so far on the topic.
- We had submitted a Budget Change Amendment Request, which was approved by HIF in August 2018 in order to structure a sub-grant to an external organization in order to contract a research associate. We ultimately found a solution to contract the research associate within our organization so did not have to execute the approved change.

ACHIEVEMENTS

3. Has the project demonstrated the success of the innovation or idea?

By 'success' we mean that the innovation has achieved the planned positive impact/outcome, or that the idea has proven effective.

☐ Completely successful

☑ **Significantly successful**

☐ Partially successful

☐ Completely unsuccessful

Please explain further:

This Problem Recognition grant has achieved what we would argue to be "significant success" in that it has:

1) Articulated and increased awareness in the humanitarian sector on a hitherto unstudied problem having potentially critical humanitarian health implications;
2) Synthesized currently existing knowledge from distinct domains (engineering and medicine) on this problem in order to propose provisional management strategies relating to both clinical care (ITFCs) and water supply in humanitarian settings;
3) Mobilized specialists from multiple subject specialities (humanitarian response, medical, engineering, nutrition etc.) and convened an informal working group on this problem to advance further work;
4) Identified key knowledge gaps and research priorities for further work on this problem, that will be developed into subsequent research funding proposals i.e., R2HC (pending);
5) Generated key knowledge products including ITFC water quality guidelines and technical briefs for humanitarian field workers (pending);
6) Yielded (or will soon yield) a total of 9 dissemination outputs including 1 research brief in a practitioner journal; 1 poster presentation to a practitioner audience; 1 webinar to a practitioner audience; 4 presentations at international scientific and practitioner conferences; and 2 journal publications (pending).

We will be able to declare that the project is "completely successful" once these pending items are completed. Overall, project outcomes are highly likely to catalyse further work on this issue by the research team itself, as well as other researchers and practitioners in the humanitarian sector. This is a meaningful realization of the objective of the "Problem Recognition" grants facility.

4. Please describe how the project achieved the planned objectives, and describe all of the results achieved through the activities indicated in Question 1.

Please refer to the "**Results Achieved (Question 4)**" column in the table for Question 1.

APPROACH

5. Describe how the approach, project design or methodology you used was OR was not appropriate to carry out the planned activities or to achieve the planned objectives.

This knowledge synthesis project relied on two primary methods for bringing together available knowledge on the core issue of chemical water quality and paediatric malnutrition, namely: 1) literature review and 2) expert consultation. We found these to be appropriate methods for investigating understudied or unstudied problems, such as this one, as it enabled us to identify both *formal and informal knowledge*. The former was primarily achieved by systematic review of the published literature within multiple domains. However, it was the latter that was more interesting and informative ultimately. Given the unstudied/understudied nature of this issue, we found that little had been formally published on the matter (borne out by the relatively small number of papers identified the systematic literature review). What was more interesting was discussing with experts from medicine, nutrition, paediatrics, and WASH, what they thought about the issue (is there a theoretical basis for concern?) as well as what they had heard about it previously (do they know of any informal or grey knowledge regarding it?). By engaging with a number of world-leading experts on paediatric malnutrition, including individuals who are presently or were previously engaged in the development and evaluation of therapeutic feeding products and interventions, we were able to access the limits of what is known, as well as confirm the legitimacy and currency of our research question. Basically, the experts confirmed that we're on to something here, and they were surprised that no one had thought of this issue before.

Conversely, a few limitations of our approach should be noted. While our review of the formal knowledge was systematic, we ultimately found little formal knowledge, as we suspected would be the case from the outset. On the other hand, the collection and integration of informal sorts of knowledge was ultimately more productive, but it was not by any means *systematic*, relying as it did on a small number of highly engaged experts. Naturally, increasing the number and depth of engagement with further experts could yield further insights on the core problem and deepen the sophistication of our analysis. While we had planned for only a single face-to-face meeting at the midpoint of this project, it would have perhaps been useful to plan for an additional one at its end to deepen the dialogue on the outputs and next steps. Developing a dialogue on an issue is, naturally, an iterative, emergent, and an extensive process with respect to time; the 9-month scope of the Problem Recognition grant is limited in this regard, but a useful first step in initiating this dialogue. Perhaps a way that we could have extended engagement more widely would have been to create a web platform to present information and host discussion; however the extent to which busy individuals can and will meaningfully engage with web-based content cannot of course be assumed.

MAJOR OBSTACLES

6. Please list the three most significant obstacles faced during the project and describe how they affected the planned activities and results.

Obstacle	Impact of Obstacle
1.Short project period	The short duration of the problem recognition grant means that important humanitarian health conferences where we want to present

	findings will take place after the close of the project grant. This limits our ability to disseminate research findings to practitioner and researcher audiences. Similarly, publishing papers in peer-reviewed journals can take many months to be finalized. The short grant duration means that it may not be feasible to support these major dissemination activities with project grant resources, limiting opportunities for dissemination.
2. Effectively collaborating in a transdisciplinary environment	Our core problem lay at the intersection of multiple specialties, namely: paediatrics, nutrition, water quality, and risk assessment. Working at such an intersection point was new to all participants including the research team members as well as the experts we engaged with. This meant that there were considerable challenges developing a shared understanding and vocabulary on a problem that was as yet undefined.

7. Please indicate what steps were taken to address these obstacles and whether the solutions were effective.

Solution	Effective?
1. With the permission of the HIF Project Officer, we booked travel to multiple conferences taking place in 2019 (to which we had submitted abstracts) prior to the close of the grant at the end of December 2018. This entails financial risk to the research team because if there are any changes or cancellations required for the pre-booked travel, we would have to find another way to cover those costs as the project grant had already been closed.	Moderately so.
2. It was important to provide a "briefing note" that discussed the problem, process, and preliminary findings in advance of the November 2018 expert panel meeting, so that everyone had a chance to chew on the content and come prepared to discuss with other experts. This is of course a small, limited contribution to a large fundamental challenge.	Highly effective.

OPTIONAL: PARTNERSHIPS AND COLLABORATION

If you received HIF funding with partners or collaborators, please answer questions 8 and 9.

8. How and why did the partnership change during the course of the project?

Our partner on this project was Médecins Sans Frontières. From the outset of the project, MSF played a key role in articulating the core problem, providing core advisory to the research team, participating in the research activities, and utilizing the guidance outputs from the project. These roles had been anticipated since the beginning, so there was no change per se in this regard.

9. Are there plans to continue your partnership, either while continuing this innovation or on other projects?

☐ Yes, with this innovation☑

☐ Yes, with another project

☐ Maybe

☐ No

Please describe further:

Yes, MSF, the DIGHR research team, and the external experts we engaged on this project will continue to develop further work on research priorities identified by this project, including developing an EOI for the upcoming Dutch Postcode Lottery "DreamFund" and the R2HC call in June 2019 focusing on field evaluations of guidance outputs, further characterization of the issue in field clinical settings, and fundamental biomedical research to better characterize and understand the pathophysiology of paediatric malnutrition.

DISSEMINATION

10. Please describe any steps taken to disseminate the outcomes of the project.

Please include all completed and forthcoming, as well as all planned and unplanned products (for example, research and policy reports, journal articles, video blogs, evaluations).

Please see table in Question 1.

NEXT STEPS

11. Will the project, idea or innovation be replicated, carried forward or scaled up?

☐ Yes☑

☐ No

☐ Maybe

Please describe further

Yes, MSF will utilize the guidance outputs of this project in its nutritional programs (ITFCs) and water supply projects in the field. In addition, we will continue to scale the findings to other humanitarian agencies carrying out nutritional responses (e.g., ACF). Finally, we will carry the research forward by developing further research projects on identified gaps and priorities as described above.

12. If the project or innovation could be carried forward, replicated or scaled up, please list the three most important issues or actions that will need to be considered *(where 1 = most important and 3 = least important)*

Suggestion/issue	*1*	*2*	*3*
1. Lack of fundamental biomedical understanding of paediatric malnutrition including on pathophysiology and metabolic effects of the disease. Biomedical studies are required to better define the allowable Upper Limits of intake of various electrolyte and mineral-related parameters (which are used to generate the chemical water quality guidance for ITFCs).	☑	☐	☐
2. Better characterizing if chemical water quality in ITFCs is indeed the cause of clinically observable adverse effects. There may be multiple competing explanations for what was observed in Ethiopia (the experience which prompted this investigation). A general lack of patient data and a lack of a counterfactual do not permit an unequivocal statement that chemical water quality was responsible for the adverse events observed in the ITFCs in Ethiopia. While our investigation confirmed that there is a legitimate reason for concern, it remains uncertain the extent to which a true hazard may exist. Carrying out controlled clinical studies to confirm the effect may also be problematic as it could entail exposing (or not preventing the exposure to) a potentially harmful condition to highly vulnerable patients	☑	☐	☐
	☐	☐	☐