RiHN
Redistributed Manufacturing in Healthcare Network

EPSRC Redistributed Manufacturing in Deployed Medical Care

Network Plus Feasibility Study Funding

Pharmaceutical Manufacturing

Notes for Applicants

1. The Redistributed Manufacturing in Healthcare Network

Redistributed Manufacturing (RDM) in healthcare involves moving production closer to the point-of-care, helping clinicians to deliver better outcomes through medical products, technologies and therapies that are available on-demand and tailored to patient needs.

The UK Engineering and Physical Sciences Research Council (EPSRC) first funded the Redistributed Manufacturing in Healthcare Network (RiHN) in February 2015 and a cross-disciplinary team of six Universities delivered pioneering feasibility studies and a comprehensive white paper[1] to guide future research and investment.

This new research programme was devised at a national strategic roadmapping workshop, collaboratively delivered by RiHN investigators and Defence Medical Services (DMS) in the UK.

The workshop involved expert participants from a range of disciplines, including experienced practicing military and emergency clinicians, defence laboratory and procurement professionals and academic researchers covering engineering, manufacturing, operations and innovation management.

The EPSRC provided RiHN with a Network Plus grant, to commence from July 2020. With a new team of investigators and partners, the RiHN has between £1m-£1.5m to fund novel applications of RDM for use in challenging mobile environments, supporting the practice of humanitarian, military and emergency medical care.

The Network has six research themes (see fig.1), covering four priority areas of manufacturing engineering research with the remaining two providing an integration research role by focussing on 'operational requirements' and systemic factors affecting 'translation' into practice.

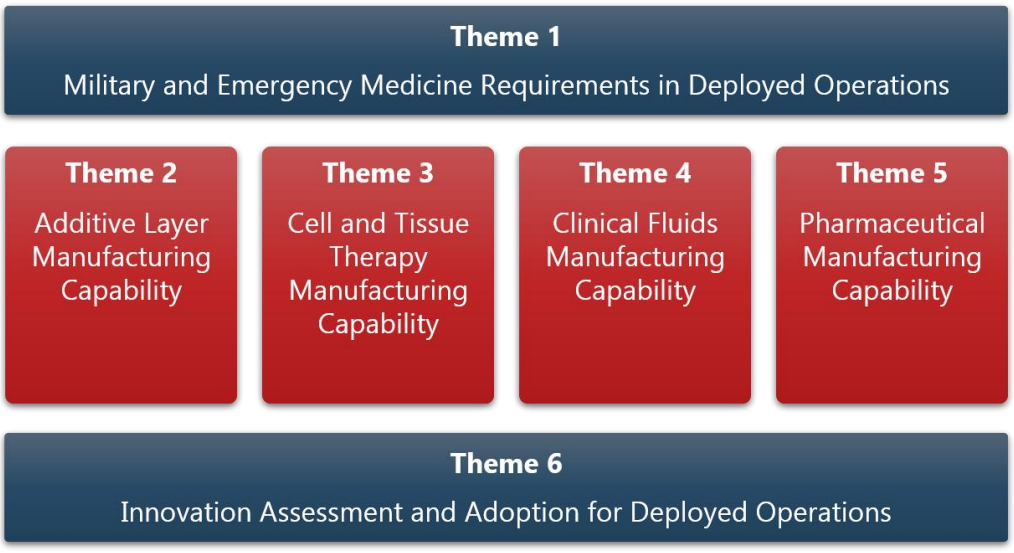

Figure 1 – Research Themes

For more information about the Network, please visit www.rihn.org.uk and for further background reading on RDM, download the RiHN white paper available for free on our website.

[1] http://rihn.org.uk/wp-content/uploads/2020/05/RiHN_WP_Full_double_web.pdf

2. Deployed Medical Care

Medical professionals and first-responders face the ongoing challenge of rapidly responding to urgent and unforeseen consequences in a range of logistically constrained environments, such as conflict zones, disaster relief, terrorist incidents and global pandemics.

The standard approach in such situations involves evacuating any seriously injured or ill casualties away from high risk zones to a more permissive location where an appropriately resourced medical capability can continue further treatment more effectively. However, the usual medical pathway cannot always be relied upon and emergency care, including urgent surgical interventions, or prolonged field care may be required in more austere conditions. A range of deployed medical treatment facilities and vehicle platforms exist - ranging from light, highly mobile and basic facilities to more static and capable, field hospitals of differing configurations.

Breakthroughs in 'advanced manufacturing' have the offered the potential to transform the treatment of patients closer to the point-of-injury, reducing loss of life and risk of sustaining longer-term health conditions or rehabilitation costs. However, further research is required to develop and evaluate the feasibility of redistributed manufacturing systems that can operate effectively in the more austere environment of deployed operations as well as produce products and therapies that can bring added value to both clinical personnel and patients alike.

High-level findings from our strategic roadmapping workshop (presented at an international conference[2]) provide an important guide for feasibility study proposals by setting out broad requirements for innovation in advanced manufacturing in deployed operations, these include:

- Increasing agility and immediacy for clinical effect (improved diagnostics, faster recovery)
- Enabling Prolonged Field Care (PFC) or immediate recovery stages before or after, according to operational demand/circumstances
- Enabling genuine transformation of medical activities in deployed operational locations, rather than facilitating improvisation/compromise
- Reducing complexity – allowing for reconfigurability, adaptability, modularity, reduction in raw materials dependence, and if beneficial, new designs that make use of delayed final assembly at the point of need
- Resilient, survivable, integrated, adaptive manufacturing units/devices or networks
- If applicable, units/devices allowing secure integrated data transmission or portability of useful data (i.e. anthropometric)

Applicants should read our conference paper[3], which is available on request and provides directions for further background reading.

[2] Phillips et al. (2020) Innovation in healthcare manufacturing: transforming deployed medical care, The ISPIM Innovation Virtual Conference – held on 7-10 June 2020

[3] http://rihn.org.uk/research/

3. Pharmaceutical Manufacturing

3.1 Background

This research theme is concerned with overcoming the challenges associated with production and supply of urgently needed pharmaceutical products used to treat injuries, infections and other threats to health or life in deployed medical care scenarios. In such contexts, the availability of medical supplies is often limited in terms of reach into emergency settings. Also, stockpiling, monitoring and preservation of pharmaceutical products can be overly resource intensive, ineffective in meeting fluctuations in demand, and lead to significant waste. It may take weeks or months to manufacture and airlift organic pharmaceuticals and protein therapeutics, etc. and they may not arrive when they are needed most. The aim of this research theme is to advance the development of miniaturised portable device platform(s) and techniques capable of producing small-molecule active pharmaceutical ingredients (APIs) and therapeutic proteins (e.g. analgesics, anaesthesia, antibiotics) in deployed operations.

3.2 Scope of the call

The scope of the call covers (but is not limited to) the following themes:

- **Rapid Live Bio-therapeutics manufacturing** (scale-up and delivery)- To advance promising approaches for the manufacture and packaging of therapeutics in the field, targeting the microbiome. Examples could include: pre-engineering/packaging of libraries of recombinant bacteria or spores for rapid deployment and large-scale manufacture in-situ via fermentation, in single-use fermenters. Testing and novel downstream processing such as dispensing the fermenter broth directly, to ingest the live microbes/microbial spores.
- **Redistributed manufacturing of Vaccines and Therapeutics** - Novel approaches for rapid vaccine and drug development and deployment locally and during emergencies. Possible areas of investigation include yeast and bacteria fermentation and RNA type platforms using chemistry and novel extraction and purification systems for manufacturing on demand and in situ.
- **3D Printing pharmaceuticals in emergency situations** - Promising approaches for on-demand printing combi-pills where 3D Printing is used to combine APIs into a single tablet at the point-of-use. Other areas include feasibility of printing the API crystal at the point-of-use. What are the barriers and enablers of 3D printing pharmaceuticals (pills, combi-pills and crystalized APIs) in deployed operations post natural and man-made disasters?

3.3 Expected activities and outputs

Key outputs may include establishing proof of concept for platform(s) capable of manufacturing single-dose levels of APIs and biologics (adhering to regulatory standards), demonstrating high purity, efficacy, and potency in short timeframes. Projects are expected to provide researchers with an opportunity to investigate and test the capability of RDM processes. Adopting a systems lens, proposals should give consideration to operational factors affecting the business case for adoption, such as the expected impact on logistics and supply chains.

4. How to apply

4.1 Research guidance

This call will support research which seeks to advance high-value applications of RDM research that will transform future deployed medical care capability. This document provides details for the Pharmaceuticals theme, which is one component of our four areas of funding:

1. Additive Manufacturing
2. Cell and Tissue Therapies
3. Clinical Fluids Manufacturing
4. **Pharmaceutical Manufacturing**

RiHN has allocated funding of around £300,000 at 80% Full Economic Cost (FEC) to each area, dedicated to advance research in those specific domains. This may be distributed between 1-3 assessment panels, however, depending on the quality of proposals, we may adjust the allocation. In exceptional cases we may consider innovative research proposals that seek to investigate an aspect of practical RDM engineering research that applies across disciplines.

Research project proposals are expected to take the form of a feasibility study, proof-of-concept or prototype development and testing (ideally TRL[4] Level 3 but seeking progression to 4), normally lasting from 3 to 6 months. If further funding is available and there is a strong case, the project can request a costed extension. Ongoing small projects are also welcome where close collaboration with RiHN's research theme leaders and achievement of objectives may allow for stage-gate control of funding tranches.

Proposals should clearly demonstrate industrial/practical relevance and ideally include at least one organisational partner(s) operating in relevant areas such as humanitarian, military or emergency medicine. Letters of support (1-2 pages per organisation) should accompany proposals. RiHN may be able to support early requests to identify potential partners.

Although it is not a requirement, we actively encourage exploratory discussions and participation in RiHN's pre-competitive workshops and online events, to gain feedback on early-stage propositions and potentially establish new links with other researchers or organisational collaborators. We advise all potential applicants to familiarise themselves with the application process and expectations for participation in the wider EPSRC Redistributed Manufacturing in Healthcare Network (RiHN) research programme.

[4] https://epsrc.ukri.org/research/ourportfolio/themes/healthcaretechnologies/strategy/toolkit/landscape/

4.2 Submission guidance

In all cases, please use our RiHN **application form**, which can be requested through our website: http://rihn.org.uk/funding/ website. Please observe the word count limits and as a minimum, use an 11-point size font and maintain 2cm margins for all pages.

Also, please note the following guidance for each section of the application form:

SECTION 1 – RESEARCH DETAILS

- *Please indicate the main area of research by ticking one box only*
- *We may consider proposals that cross several or all themes – however, in such cases it is recommended that you contact us for further guidance before preparing your application*
- *Following EPSRC grant arrangements, the RiHN will only fund 80% Full Economic Cost of the total funding and the host institution(s) must fund the remaining 20%*

SECTION 2 – RESEARCH BACKGROUND

- *Succinctly state the context of the proposed topic; rationale for research; problems and gaps.*
- *Explain relevance to RDM in deployed medical care and potential beneficiaries*
- *What is the maturity of the technology; current state of research (national and international)*

SECTION 3– AIMS AND OBJECTIVES

- *Succinctly state the context of the proposed topic and rationale for research*
- *Set out the research idea and overall aim of the project*
- *Include measurable objectives against which the outputs of the research will be assessed*

SECTION 4 – NOVELTY AND TIMELINESS

- *Explain the value of this topic, why it is not addressed elsewhere and extent of scientific ambition*
- *How will this lead to further research or funding?*

SECTION 5 – METHODOLOGY

- *Detail and justify the research methodology*
- *Describe the work programme, including structure of research and impact related activities*
- *Identify the contribution of the research team including any project partners and stakeholders*
- *Provide objectives and milestones that will be used to monitor progress and explain how the project will be managed (include a GANTT chart)*

SECTION 6 – PROJECT DELIVERABLES

- *Provide a summary of anticipated outputs resulting from the research*

SECTION 7 – PROFILE OF INVESTIGATORS

- *Provide a brief profile of all investigators and track records in the proposed area of research*

SECTION 8 – JUSTIFICATION OF COSTING

- *Who will conduct the research, over what duration, and what % of their time is dedicated?*
- *What resources are needed to prepare your data?*
- *Provide a full break down of costs, such as how many are travelling, where they going, and why*
- *Justify any resources requested to support impact activities, where appropriate*
- *Provide details of any contributions from project partners*

SECTION 9 – DECLARATIONS

- *Please state how all parties will comply with expected ethical standards and any mandatory governance requirements, including the handling of data and intellectual property*

All completed applications should be submitted via email to Dr Dharm Kapletia dharm.kapletia@uwe.ac.uk following the guidance in this document.

Please check our website for confirmation of funding call deadlines.

We particularly welcome proposals where a second funder is prepared to match (50%) the funding amount requested from RiHN (50% @80%FEC). In such cases compliance with EPSRC funding rules will still apply. Contributions from a match funder must clearly state actual monetary and any payment-in-kind values, correctly formatted for the financial details section of our application form.

Applications may only be submitted by staff at a UKRI qualifying institution. Funding is not available to support directly allocated staff, nonetheless it is expected that a permanent senior member of staff will supervise the delivery of the project. RiHN seeks to encourage participation of Early Career Research (ECR) staff (within 15 years of receipt of a doctoral qualification). Please consult your relevant bid/contracts team to ensure that financial information is prepared appropriately.

5. Assessment process

Proposals will be reviewed on an ongoing process and will receive a decision within 4 weeks, or further communication will be provided within that timeframe as to the earliest date of assessment.

All submissions will be considered and reviewed by the relevant RiHN investigator team and other independent experts from academia and practice.

The assessment panel will consider the following criteria:

1. Degree of fit to the RiHN's call
2. Potential for the development of further research and subsequent funding applications
3. Evidence of industrial, clinical or end-user interest and commitment to the study, especially in support for any follow-on project or funding
4. The likelihood of successful delivery of the project
5. Relevance of the project to the interests of the RiHN programme and its partners
6. Potential for attracting new members to RiHN
7. Involvement and development of ECRs
8. Track record of the applicants in the proposed area of study

To ensure a fair and objective selection process, final decisions will be subject to scrutiny by the RiHN's Advisory Board. Proposals should state details of any conflicts of interest.

This call for funding will not support:

- Fundamental scientific or epidemiological research
- A literature or systematic review
- Research that is out-of-scope of the EPSRC remit
- A software development project
- Mature applications of RDM that would qualify instead for higher TRL funding competitions (i.e. TRL 5-9)

6. Governance and Impact

6.1 Target Audience

The RiHN programme includes close collaboration with potential end-users of RDM research and innovation. It is anticipated that research proposal outputs will reach this audience and other national and international bodies involved in delivering deployed medical care. These include but are not limited to medical professionals and first responders operating in healthcare service bodies (MoD, NATO, NHS, WHO), policy makers/influencers, government departments and regulators (DoH, MHRA, RAND, RUSI), humanitarian organisations (MSF, UN), as well as industry scientific R&D and academic research communities. The ultimate goal of this programme is to pull through innovative research that has the potential to transform how injuries are treated in deployed operations and in the end improve patient outcomes.

Research funded through this programme is expected to be widely disseminated, especially through peer-reviewed journals and conferences. Researchers are also encouraged to consider innovative methods of dissemination where appropriate, including the preparation of content/media for the RiHN website and material for end-user community engagements. The mandatory, formal output from each project will be an end of grant report. The RiHN team will work with researchers to maximise opportunities for dissemination and impact.

6.2 Management and reporting

Successful proposals will have demonstrated as part of the assessment process that they have relevant governance procedures in place. The grant holders will be responsible for obtaining all ethical approvals required for the project and are also expected to meet relevant organisational and legal information governance requirements.

Project progress will be monitored through regular update meetings between a dedicated assigned RiHN investigator(s) and the research project lead or representative(s).

All funded projects must work collaboratively with RiHN researchers who have responsibility for providing an integration role, focusing on ‘requirements’ and ‘innovation’, as illustrated in fig 1. This is intended to be a mutually beneficial aspect of the programme and will assist funded researchers to develop outputs that are relevant to practice.

7. Further Information

If you have further questions about this funding opportunity, technical queries concerning the scope or content of the research can be directed to:

- **Professor Harris Makatsoris**, Kings College London (harris.makatsoris@kcl.ac.uk)
- **Dr Basil Omar**, University of the West of England (Basil.Omar@uwe.ac.uk)
- **Dr Samuel Roscoe**, University of Sussex (s.roscoe@sussex.ac.uk)

Any questions about programme strategy and collaboration should be directed to:

- **Professor Wendy Phillips**, UWE Bristol (wendy.phillips@uwe.ac.uk)
- **Dr Dharm Kapletia**, UWE Bristol (dharm.kapletia@uwe.ac.uk)