What are the Implementation Research Priorities for Canadian Investments in Maternal, Newborn, Child and Adolescent Health Globally?

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Abstract

Background: Improving global maternal, newborn, child, and adolescent health (MNCAH) is a top development priority in Canada, as demonstrated by the $6.35 billion in pledges towards the Muskoka Initiative since 2010. We undertook an exercise to guide Canadian research investments by systematically establishing a set of research priorities on the implementation of MNCAH interventions in low- and middle-income countries.

Methods: We adopted the Child Health and Nutrition Research Initiative (CHNRI) method. We scanned the CHNRI literature and extracted research questions pertaining to the delivery of existing interventions, inviting Canadian experts with knowledge of MNCAH to generate additional questions. The experts systematically scored a combined list of 97 questions using five criteria: answerability, feasibility, deliverability, impact, and effect on equity. These questions were ranked using a "Research Priority Score" (RPS) and the "Average Expert Agreement" (AEA) was calculated for every question.

Results: The overall RPS ranged from 40.14 to 89.25, with a median of 71.84. The AEA scores ranged from 0.51 to 0.82. Highly ranked research questions varied across the continuum of care and focused on improving detection and care-seeking for childhood illnesses, overcoming barriers to intervention uptake and delivery, effectively implementing human resources and mobile technology, and increasing health coverage among at-risk populations. Children were the most represented target population and most questions pertained to interventions delivered at household or community level.

Interpretation: The list of priorities is a valuable tool for guiding Canadian research investments that could have a high impact on MNCAH outcomes over the next fifteen years.

Introduction

The United Nations' Millennium Development Goals (MDGs), a set of interrelated targets adopted by world leaders in the year 2000, catalyzed political commitment towards improving child survival and maternal health. MDGs 4 and 5 called for a two-thirds reduction in the under-5 mortality rate (U5MR) and a three-quarters reduction in the maternal mortality ratio (MMR) between 1990 and 2015, respectively [1]. Five years before the MDG-era came to a close, the Muskoka Initiative was launched at the G8 summit to intensify efforts towards improving maternal, newborn and child health (MNCH) in low- and middle-income countries (LMICs), with Canada investing $2.85 billion to reduce the burden of disease, improve nutrition, and strengthen health systems in areas with the greatest need [2]. While there have been substantial gains in reducing the global MMR and U5MR, progress has been insufficient to achieve the MDG targets [3-4]. Unacceptably high numbers of women and children are still dying every year, largely due to conditions that could have been prevented or treated if existing cost-effective interventions were made universally available [5]. Currently, there is insufficient knowledge on how to effectively implement proven affordable interventions in resource-limited settings and generating this knowledge is a task of health research [6]. Over the past five years, Canadian funding through the Muskoka Initiative has focused on scaling up interventions to improve MNCH; however, investments in implementation research have been limited [7]. If we are to achieve high, sustainable, and equitable coverage of life-saving interventions, addressing this research gap is essential.

The year 2015 marks the beginning of a new global framework – the Sustainable Development Goals – and an additional Canadian pledge of $3.5 billion towards the Muskoka Initiative [2,8]. These renewed commitments towards improving MNCH present an opportunity

to address the unfinished agenda of the MDGs and bridge the gap in implementation research. However, the number of potential investment options in implementation research outweighs the amount of available funding, highlighting the need to systematically establish a set of priorities to guide research investments.

The SickKids Centre for Global Child Health (C-GCH), in collaboration with the Canadian Network for Maternal, Newborn and Child Health (CAN-MNCH), undertook an exercise to identify the top research priorities on the implementation of maternal, newborn, child and adolescent health (MNCAH) interventions in LMICs, with the aim of informing and guiding Canadian research investments over the next fifteen years.

Methodology

Study Design

We adapted and applied the Child Health and Nutrition Research Initiative (CHNRI) method [9]. The CHNRI method was designed to assist policy-makers and investors to identify research gaps and examine the potential risks and benefits of investing in different research options. This systematic and transparent approach has now been applied to a wide range of topics, including but not limited to: birth asphyxia, childhood pneumonia and diarrhea, and adolescent sexual and reproductive health [10-13]. The CHNRI method involves four stages: (i) defining the context and criteria for priority-setting with input from investors and policy-makers; (ii) listing and scoring of research investment options by technical experts using the proposed criteria; (iii) weighting the criteria according to wider societal values with input from other stakeholders; and (iv) calculating Research Priority Scores and Average Expert Agreement. An additional stage was added that included extracting implementation-focused research priorities from the existing CHNRI literature before inviting input from technical experts.

Stage 1: Define the Context and Criteria for Priority-Setting

The concept for this priority-setting exercise was shared at the CAN-MNCH meeting of 200 sector leaders in November 2014. The exercise aimed to inform and guide the CAN-MNCH community about research investment options that are expected to improve implementation of MNCAH interventions in LMICs. The timeline of fifteen years was set to coincide with the SDG targets.

In selecting the criteria on which to evaluate the proposed research questions, we modified the CHNRI criteria from previous exercises in order to better reflect the context of implementation [9,14]. The five criteria selected were: (i) answerability by research; (ii) research feasibility; (iii) deliverability; (iv) impact; and (v) effect on equity. Table 1 displays the three specific sub-questions under each criterion used to evaluate the research questions.

Stage 2: Identify Research Questions from the CHNRI Literature

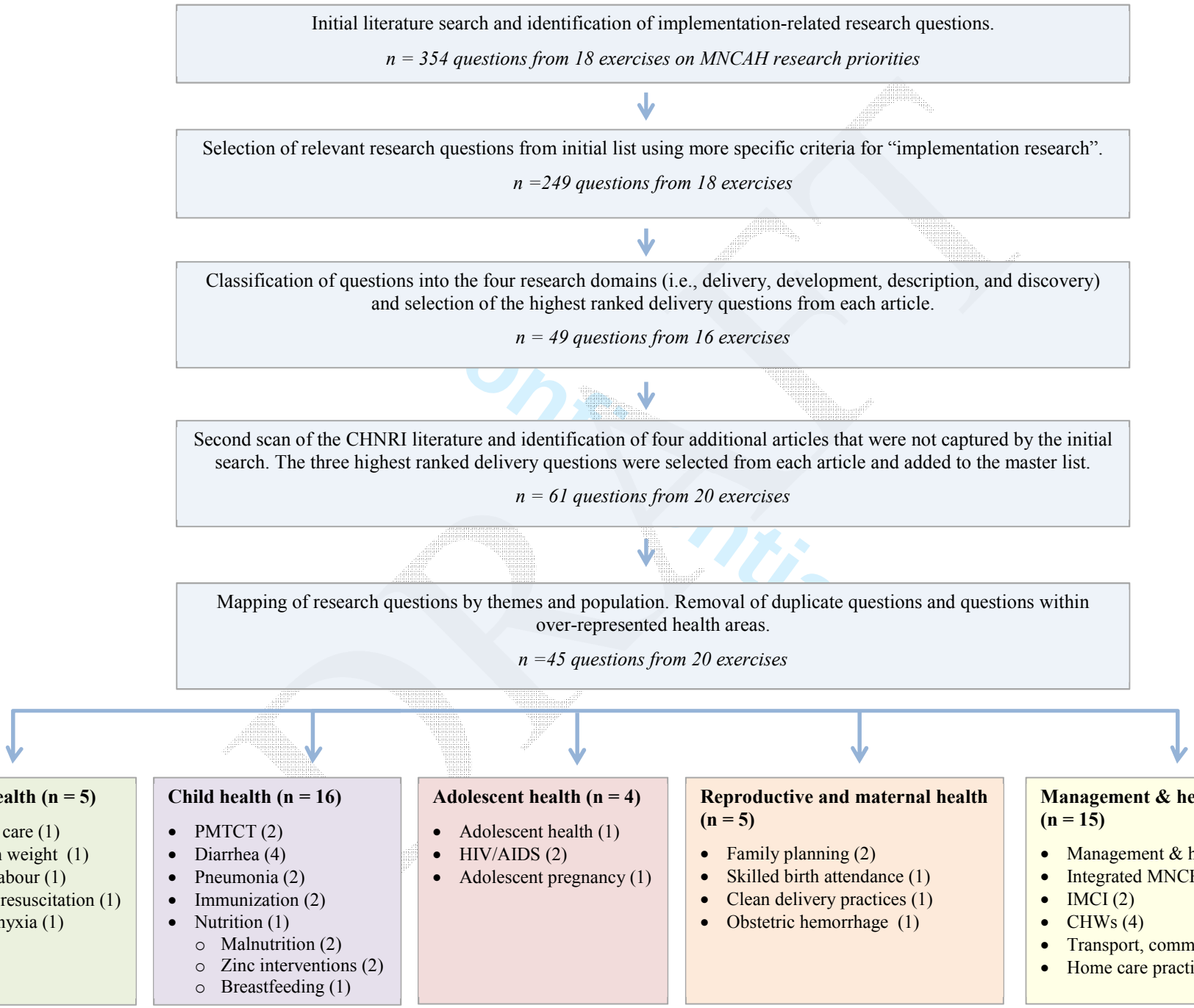
Figure 1 illustrates how our team identified relevant research questions from the existing CHNRI literature. Through an initial literature search, a team member identified 354 implementation-related research questions from 18 published CHNRI exercises [10-27]. Two researchers then reviewed this list using a more specific definition for 'implementation', narrowing down the list to 249 questions. These questions were then classified into four domains: description (epidemiology), discovery (new interventions), development (improving existing interventions), and delivery (health policy and implementation). We selected the highest ranked delivery questions from each article, yielding 49 questions from 16 reports. Through a second scan of the CHNRI literature, we identified four additional articles that were not captured by the initial search [28-31]. The three highest ranked delivery questions were selected from each article and added to the list, resulting in 61 questions from 20 articles. In the final step in

this stage, we mapped the research questions by theme and position on the continuum of care, removing duplicates and questions within over-represented health areas. The final list contained 45 research questions from the literature.

TABLE 1: Criteria for Implementation CHNRI

Criterion	***Sub-Questions***
Answerable by Research	1. Would you say the research question is well framed? 2. Can a single study or a very small number of studies be designed to answer the research question? 3. Do you think that a study needed to answer the proposed research question would obtain ethical approval without major concerns?
Research Feasibility	1. Is it likely that there will be sufficient capacity to carry out the proposed research? 2. Is it feasible to provide the training required for staff to carry out the research? 3. Is the cost and time required for this research reasonable?
Deliverability	1. Taking into account the level of difficulty with implementation of the potential delivery strategy (e.g., need for change of attitudes and beliefs, supervision, transport infrastructure), would you say that this strategy would be deliverable? 2. Taking into account the resources available to implement the intervention, would you say that the potential delivery strategy would be affordable? 3. Taking into account government capacity and partnership required, would you say that the potential delivery strategy would be sustainable?
Impact	1. Will the results of this research fill an important knowledge gap? 2. Are the results from this research likely to shape future planning and implementation? 3. Will the results of this research lead to a long-term reduction in disease burden?
Effect on Equity	1. Would you say that the present distribution of the target disease burden/health issue affects mainly the poor and marginalized in the population? 2. Would you say that the poor and marginalized would be the most likely to benefit from the results of the proposed research? 3. Would you say that the proposed research has the overall potential to improve equity in disease burden distribution in the long term (e.g., 10 years)?

FIGURE 1: IDENTIFICATION OF PRIORITY RESEARCH QUESTIONS FROM THE CHNRI LITERATURE



MNCAH – Maternal, newborn, child and adolescent health; PMTCT – Prevention of mother-to-child transmission of HIV; IMCI – Integrated Management of Childhood Illness; CHW – community health worker

Stage 3: Technical Experts List and Score Research Options Using Predetermined Criteria

This exercise drew upon the expertise of researchers, clinicians, and implementing partners from various institutions across Canada. Six experts volunteered to contribute to this exercise at the CAN-MNCH meeting in November 2014, and an additional 32 experts were formally invited by e-mail to participate. Experts were selected based on affiliation with CAN-MNCH, the Coalition of Centres in Global Child Health, and/or SickKids Centre for Global Child Health. We also recruited known Canadian experts in the field of MNCAH. Participants' expertise ranged across the continuum of care, representing knowledge of all four target populations.

Experts were asked to individually review the 45 questions identified from the literature and propose additional research questions. In total, 24 experts submitted 71 research questions. Our team then thematically organized the 116 questions by position on the continuum of care, removing overlapping options and questions outside the scope of the exercise. The 97 remaining questions were organized into a marking tool for scoring.

Experts scored each proposed research question against these five predetermined criteria:

- **Answerable by research:** likelihood that the research question can be answered ethically.
- **Research feasibility:** likelihood that there are sufficient resources and time to carry out the research.
- **Deliverability:** likelihood that the research can result in a deliverable, affordable and sustainable implementation strategy.
- **Impact:** likelihood that the results from this research will fill crucial knowledge gaps and shape future planning in implementation research.
- **Effect on equity:** likelihood that the implementation strategy will reduce inequity.

We asked experts to score 1 for yes, 0 for no and 0.5 if they were informed but undecided. If the experts did not feel sufficiently knowledgeable to answer a particular question, they were instructed to leave the cell blank. Twenty experts returned completed scoring sheets.

Stage 4: Solicit Input From Societal Stakeholders to Weight the Criteria

The relative importance of the scoring criteria may vary between different stakeholders. For previous exercises, a wide range of stakeholders were polled to weight the criteria; however, prior to scoring, our team decided not to assign weights for this exercise. We scored all five criteria equally in the analysis, as we felt they were of equal importance.

Stage 5: Calculation of Research Priority Scores and Average Expert Agreement

The Research Priority Score (RPS) and Average Expert Agreement (AEA) were calculated for each research question. The RPS is the mean of the scores across the five criteria. The AEA is the average proportion of scorers who chose the mode (most common score) for each research question. The AEA was calculated as follows:

$$AEA = \frac{1}{15} \times \sum_{q=1}^{15} \frac{\text{N(scorers who provided the most frequent response)}}{\text{N(scorers)}}$$

where q is a question that experts are being asked to evaluate competing research investment options, ranging from 1 to 15.

Results

Table 2 shows the research questions with a rounded RPS of 80 or above, and Annex I shows the complete list of ranks and scores for all 97 questions. Both tables present the perceived likelihood that each research question will comply with each of the five chosen priority-setting criteria. The RPSs ranged from 40.14 to 89.25, with a median of 71.84. There was good discrimination between the levels of agreement among experts; the AEA scores ranged from 0.51 to 0.82, with a median of 0.64. Similar to past CHNRI exercises, AEA tended to show a positive association with RPSs, indicating that there was more agreement among experts about what were considered priority research questions.

The top fifteen research questions varied across the continuum of care. Children were the most represented target population, with six out of the fifteen questions pertaining to child health. While there were highly ranked questions about maternal (#10, 13) and newborn health (#5, 8, 9, 14), there were no top-ranked questions that explicitly mentioned adolescents. The highest ranking for an adolescent health question was 19 – "what factors facilitate uptake, retention and adherence to antiretroviral therapy and minimize HIV treatment failure among adolescents".

A wide range of topics was covered in the top fifteen research questions. Diarrhea was the most frequently mentioned health condition, with two questions about oral rehydration solution and one question about detection and management of dehydration in children with diarrhea.

Research questions varied in specificity. For example, broad questions like "what are effective delivery strategies to ensure that the most vulnerable individuals receive critical RMNCAH services" were scored alongside specific questions like "can a simplified neonatal resuscitation program delivered by trained health workers reduce deaths due to intrapartum events and complications and birth asphyxia". Both broad and specific questions were ranked in the top and bottom fifteen research questions, suggesting that no bias existed against the kind of question asked.

TABLE 2 Top 15 research questions according to their achieved research priority score (RPS), with average expert agreement (AEA) related to each question

Rank	Research Question	Criterion 1: Answerable by Research	Criterion 2: Research Feasibility	Criterion 3: Deliverability	Criterion 4: Impact	Criterion 5: Equity	RPS	AEA
1	How can caregivers be mentored in recognizing child health danger signs (e.g. for pneumonia)?	0.90	0.97	0.91	0.89	0.80	89.25	0.82
2	Identify and evaluate delivery strategies to increase coverage of oral rehydration solution (ORS) and zinc among remote populations and the poorest of the poor.	0.74	0.91	0.76	0.94	0.98	86.61	0.78
3	Can improved methods of detecting and managing dehydration in children with diarrhea reduce mortality?	0.93	0.88	0.88	0.85	0.77	86.26	0.82
4	Evaluate whether coverage of antibiotic treatment can be greatly expanded in safe and effective ways if administered by community health workers.	0.80	0.91	0.81	0.95	0.82	85.62	0.79
5	How can smart phone iCCM (integrated community case management) apps be implemented to accurately identify newborns and under-five children requiring referral from their communities to a health facility?	0.88	0.93	0.85	0.90	0.66	84.23	0.78
6	What are effective delivery strategies to ensure that the most vulnerable individuals receive critical *RMNCAH services?	0.70	0.85	0.68	0.95	0.99	83.31	0.77
7	Evaluate ways to reduce the financial barriers to facility births at the community level, such as through user fee□exemptions, emergency loans, conditional cash□transfers, and transportation vouchers.	0.73	0.89	0.78	0.84	0.87	82.05	0.74
8	Can a simplified neonatal resuscitation program delivered by trained health workers reduce deaths due to intrapartum events and complications and birth asphyxia?	0.81	0.89	0.91	0.77	0.70	81.69	0.77
9	Can a standardized newborn kit (simple bag/mask, clean blades/knives, and cord clamps) with appropriate education reduce newborn mortality and morbidity?	0.78	0.93	0.82	0.66	0.90	81.54	0.72
10	How can mobile technology be used to identify mothers and children at risk, reduce unneeded transports, and facilitate earlier timed care?	0.81	0.88	0.78	0.85	0.75	81.52	0.75
11	What factors drive care-seeking behaviour during childhood diarrhoeal disease, and how can we position oral rehydration solution (ORS) and zinc to best respond to these factors?	0.62	0.81	0.88	0.88	0.88	81.32	0.71
12	Identify and evaluate strategies for retention and motivation of community health workers.	0.73	0.95	0.82	0.84	0.71	81.30	0.73
13	Identify innovative mechanisms to support and utilize existing trained but underutilized human resources in health (such as community midwives in Pakistan, auxiliary nurse midwives in India, and clinical officers in Malawi) to provide high quality maternal health services in remote and rural areas.	0.64	0.84	0.74	0.88	0.93	80.62	0.72
14	How can we overcome the barriers to implementing kangaroo care in low-resource settings?	0.76	0.94	0.89	0.87	0.53	79.75	0.72
15	How can we overcome barriers to uptake of modern contraceptives in settings with very low prevalence of contraceptive use?	0.59	0.93	0.80	0.87	0.79	79.61	0.72

*RMNCAH: Reproductive, maternal, newborn, child and adolescent health

Interpretation

Improving global MNCAH continues to be a top development priority in Canada, as demonstrated through the additional pledge of $3.5 billion towards the Muskoka Initiative [2]. The context of the present exercise was to guide Canadian research investments by systematically establishing a set of research priorities on the implementation of MNCAH interventions in LMICs. The process engaged a diverse group of Canadian experts with knowledge and experience across the continuum of care. The modified-CHNRI approach used offered greater transparency and replicability than Delphi or other consultative processes [32]. The systematic ranking of proposed research priorities against predetermined criteria also made apparent the strengths and weaknesses of competing research investment options.

The comprehensive list of research priorities generated by this exercise addressed leading causes of newborn, child, and maternal mortality, including intrapartum events and complications, diarrhea, and barriers to facility births [33]. The three most important coverage gaps identified by the Countdown to 2015 for Maternal, Newborn, and Child Survival group (Countdown) were also present in our list of priorities; they included family planning, interventions addressing newborn mortality, and case management of childhood diseases [33]. Countdown reported that there are relatively smaller inequities in coverage for interventions that are delivered close to home [34]. Our list of priorities was consistent with this finding as most highly ranked research questions pertained to interventions that could be implemented at the household or community level. Seven of the fifteen top ranked questions originated from the CHNRI literature and two of these questions (#7, 12) came from CHNRIs explicitly focused on implementation, indicating strong agreement between our expert group and the existing literature [14, 26].

Although the CHNRI method represents a systematic attempt to address the challenges inherent in the complex process of research investment priority setting, the approach is not without limitations. It is possible that there were sound research options that were not included in the list of questions generated by the existing literature and experts. These options, therefore, could not have been scored and identified as priorities. Proposed research questions and their subsequent scores were also limited to the opinions of the experts involved in the exercise. In an effort to minimize response bias, we employed a comprehensive process of identifying experts with relevant knowledge and experience to participate in the study. Although this process was non-systematic, we deliberately invited only Canadian experts given the focus of the exercise on informing Canadian research investments. The predetermined CHNRI criteria also ensured that questions were anonymously scored against a transparent, fair, and standardized set of values; thus, eliminating the advantage of more eloquent speakers advocating for their own research agenda. An additional potential limitation was that experts might have scored questions about patient populations or health conditions outside of their area of expertise. To avoid inaccurate scores, experts were instructed to leave the cell blank when they did not feel sufficiently knowledgeable to answer a particular question. These blank cells were not included in the calculation of scores.

The top fifteen research questions varied across the continuum of care, but there were no highly ranked questions that explicitly mentioned adolescents. Our team noted that the existing CHNRI literature on adolescent health was limited. In light of this gap, we made an effort to recruit adolescent health experts to propose additional research questions and provide scores. Adolescent health is an emerging priority in global health and while this population was not explicitly mentioned among the top ranked research questions, it should be noted that questions

pertaining to maternal and reproductive health could also be relevant to adolescents, especially in LMICs. Moreover, we are aware of currently ongoing CHNRI studies focused on different areas of adolescent health.

Current investments in health research predominantly target diseases prevalent in high-income countries and tend to favour basic science research [35]. If progress towards improving MNCAH is to be made by 2030, improving implementation is crucial to maximizing the impact of existing interventions and reducing inequity. The research gaps identified through this priority setting exercise cannot be addressed in isolation; they must be integrated with the measurement and accountability agenda, so as to ensure there is timely data on the quality and coverage of effective interventions [36]. Coupled with improved measurement, the findings are a valuable tool in guiding the broader MNCAH community on research investments that could drive significant improvement in health outcomes over the next fifteen years.

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TABLE 1: Criteria for Implementation CHNRI

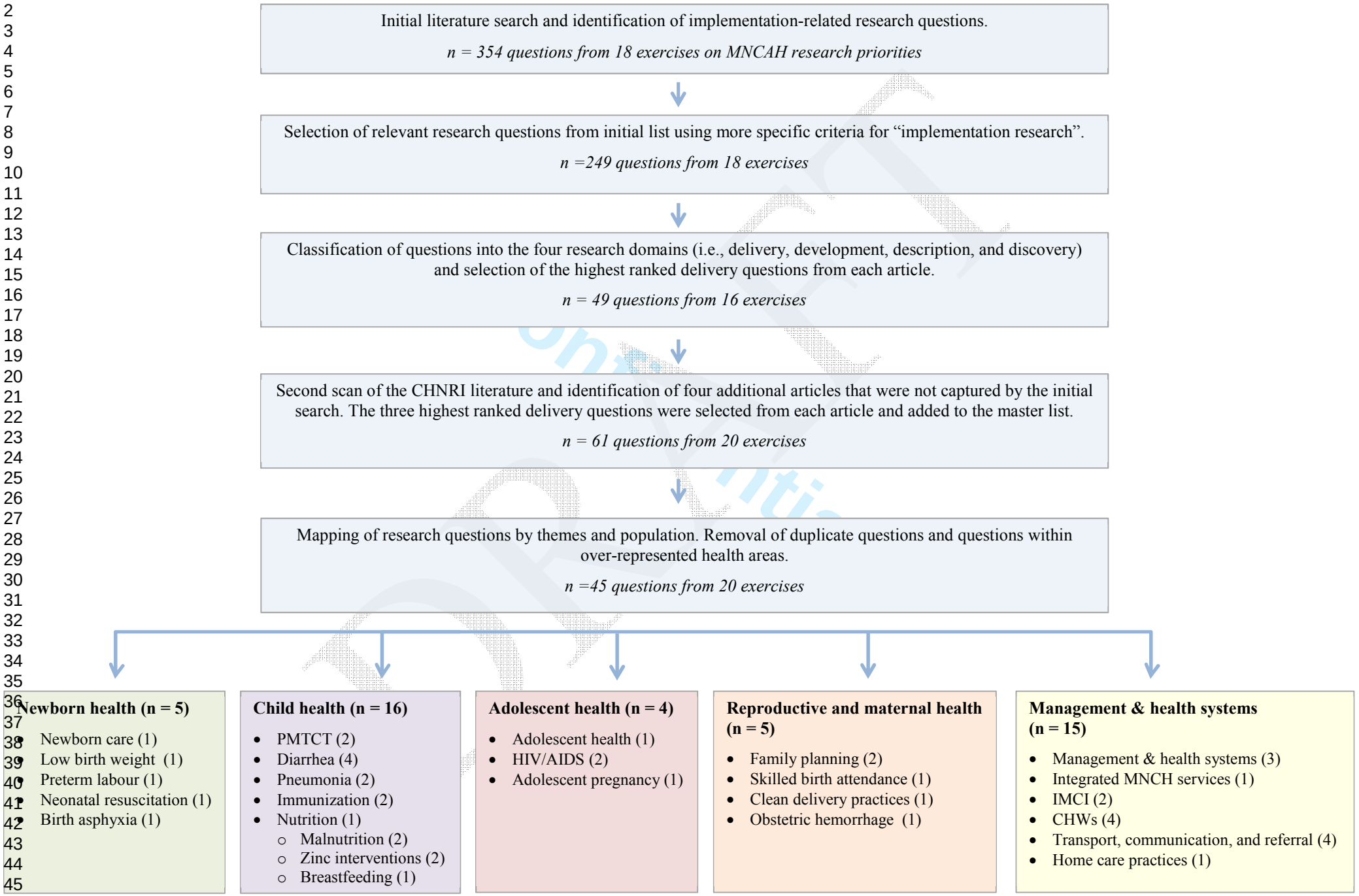
Criterion	*Sub-Questions*
Answerable by Research	1. Would you say the research question is well framed? 2. Can a single study or a very small number of studies be designed to answer the research question? 3. Do you think that a study needed to answer the proposed research question would obtain ethical approval without major concerns?
Research Feasibility	1. Is it likely that there will be sufficient capacity to carry out the proposed research? 2. Is it feasible to provide the training required for staff to carry out the research? 3. Is the cost and time required for this research reasonable?
Deliverability	1. Taking into account the level of difficulty with implementation of the potential delivery strategy (e.g., need for change of attitudes and beliefs, supervision, transport infrastructure), would you say that this strategy would be deliverable? 2. Taking into account the resources available to implement the intervention, would you say that the potential delivery strategy would be affordable? 3. Taking into account government capacity and partnership required, would you say that the potential delivery strategy would be sustainable?
Impact	1. Will the results of this research fill an important knowledge gap? 2. Are the results from this research likely to shape future planning and implementation? 3. Will the results of this research lead to a long-term reduction in disease burden?
Effect on Equity	1. Would you say that the present distribution of the target disease burden/health issue affects mainly the poor and marginalized in the population? 2. Would you say that the poor and marginalized would be the most likely to benefit from the results of the proposed research? 3. Would you say that the proposed research has the overall potential to improve equity in disease burden distribution in the long term (e.g., 10 years)?

TABLE 2 Top 15 research questions according to their achieved research priority score (RPS), with average expert agreement (AEA) related to each question

Rank	Research Question	Criterion 1: Answerable by Research	Criterion 2: Research Feasibility	Criterion 3: Deliverability	Criterion 4: Impact	Criterion 5: Equity	RPS	AEA
1	How can caregivers be mentored in recognizing child health danger signs (e.g. for pneumonia)?	0.90	0.97	0.91	0.89	0.80	89.25	0.82
2	Identify and evaluate delivery strategies to increase coverage of oral rehydration solution (ORS) and zinc among remote populations and the poorest of the poor.	0.74	0.91	0.76	0.94	0.98	86.61	0.78
3	Can improved methods of detecting and managing dehydration in children with diarrhea reduce mortality?	0.93	0.88	0.88	0.85	0.77	86.26	0.82
4	Evaluate whether coverage of antibiotic treatment can be greatly expanded in safe and effective ways if administered by community health workers.	0.80	0.91	0.81	0.95	0.82	85.62	0.79
5	How can smart phone iCCM (integrated community case management) apps be implemented to accurately identify newborns and under-five children requiring referral from their communities to a health facility?	0.88	0.93	0.85	0.90	0.66	84.23	0.78
6	What are effective delivery strategies to ensure that the most vulnerable individuals receive critical *RMNCAH services?	0.70	0.85	0.68	0.95	0.99	83.31	0.77
7	Evaluate ways to reduce the financial barriers to facility births at the community level, such as through user fee□exemptions, emergency loans, conditional cash□transfers, and transportation vouchers.	0.73	0.89	0.78	0.84	0.87	82.05	0.74
8	Can a simplified neonatal resuscitation program delivered by trained health workers reduce deaths due to intrapartum events and complications and birth asphyxia?	0.81	0.89	0.91	0.77	0.70	81.69	0.77
9	Can a standardized newborn kit (simple bag/mask, clean blades/knives, and cord clamps) with appropriate education reduce newborn mortality and morbidity?	0.78	0.93	0.82	0.66	0.90	81.54	0.72
10	How can mobile technology be used to identify mothers and children at risk, reduce unneeded transports, and facilitate earlier timed care?	0.81	0.88	0.78	0.85	0.75	81.52	0.75
11	What factors drive care-seeking behaviour during childhood diarrhoeal disease, and how can we position oral rehydration solution (ORS) and zinc to best respond to these factors?	0.62	0.81	0.88	0.88	0.88	81.32	0.71
12	Identify and evaluate strategies for retention and motivation of community health workers.	0.73	0.95	0.82	0.84	0.71	81.30	0.73
13	Identify innovative mechanisms to support and utilize existing trained but underutilized human resources in health (such as community midwives in Pakistan, auxiliary nurse midwives in India, and clinical officers in Malawi) to provide high quality maternal health services in remote and rural areas.	0.64	0.84	0.74	0.88	0.93	80.62	0.72
14	How can we overcome the barriers to implementing kangaroo care in low-resource settings?	0.76	0.94	0.89	0.87	0.53	79.75	0.72
15	How can we overcome barriers to uptake of modern contraceptives in settings with very low prevalence of contraceptive use?	0.59	0.93	0.80	0.87	0.79	79.61	0.72

*RMNCAH: Reproductive, maternal, newborn, child and adolescent health

FIGURE 1: IDENTIFICATION OF PRIORITY RESEARCH QUESTIONS FROM THE CHNRI LITERATURE



MNCAH – Maternal, newborn, child and adolescent health; PMTCT – Prevention of mother-to-child transmission of HIV; IMCI – Integrated Management of Childhood Illness; CHW – community health worker

Setting Research Priori	
Rank	**Research Question**
1	How can caregivers be mentored in recognizing child health danger signs (e.g. for pneumonia)?
2	Identify and evaluate delivery strategies to increase coverage of oral rehydration solution (ORS) and zinc among remote populations and the poorest of the poor.
3	Can improved methods of detecting and managing dehydration in children with diarrhea reduce mortality?
4	Evaluate whether coverage of antibiotic treatment can be greatly expanded in safe and effective ways if administered by community health workers.
5	How can smart phone iCCM (integrated community case management) apps be implemented to accurately identify newborns and under-five children requiring referral from their communities to a health facility?
6	What are effective delivery strategies to ensure that the most vulnerable individuals receive critical RMNCAH services?
7	Evaluate ways to reduce the financial barriers to facility births at the community level, such as through user fee exemptions, emergency loans, conditional cash transfers, and transportation vouchers.
8	Can a simplified neonatal resuscitation program delivered by trained health workers reduce deaths due to intrapartum events and complications and birth asphyxia?

9	Can a standardized newborn kit (simple bag/mask, clean blades/knives, and cord clamps) with appropriate education reduce newborn mortality and morbidity?
10	How can mobile technology be used to identify mothers and children at risk, reduce unneeded transports, and facilitate earlier timed care?
11	What factors drive care-seeking behaviour during childhood diarrhoeal disease, and how can we position oral rehydration solution (ORS) and zinc to best respond to these factors?
12	Identify and evaluate strategies for retention and motivation of community health workers.
13	Identify innovative mechanisms to support and utilize existing trained but underutilized human resources in health (such as community midwives in Pakistan, auxiliary nurse midwives in India, and clinical officers in Malawi) to provide high quality maternal health services in remote and rural areas.
14	How can we overcome the barriers to implementing kangaroo care in low-resource settings?
15	How can we overcome barriers to uptake of modern contraceptives in settings with very low prevalence of contraceptive use?
16	What strategies are effective in increasing demand for, and use of, skilled attendance (e.g., conditional cash transfers)?
17	What are appropriate and sustainable compensation models for community health workers?
18	How can health workers' skills in preventing and managing intrapartum events and complications and birth asphyxia be scaled up?
19	What factors facilitate uptake, retention and adherence to antiretroviral therapy and minimize HIV treatment failure among adolescents?

20	How effective are village health teams in improving MNCH, and what supportive measures are needed to improve these teams?
21	What can be done to facilitate prevention, diagnosis, and management of newborn hypoglycemia when there are limited resources?
22	What is the feasibiliy and cost-effectiveness of different models of scaling up community Integrated Management of Newborn and Childhood Illness (IMNCI)?
23	Evaluate the effectiveness and cost of strategies to improve the quality and uptake of maternity services (e.g. maternity waiting homes, improved communication via mobile phones, and community awareness strategies) to improve early detection and management of antenatal, intrapartum and postpartum complications.
24	Identify mechanisms to integrate postpartum family planning services with other interventions, such as child vaccination and control of HIV infection.
25	Develop and evaluate strategies for locally appropriate transport, communication and referral systems for obstetric and newborn emergencies.
26	What is the feasibility and effectiveness of training staff in the acute care of resuscitated newborns to facilitate the safe transfer of neonates to a higher care facility?
27	What is the impact of birth planning and community emergency health funds on promoting facility births and related outcomes at the population level?
28	How can health policy and systems be improved to achieve better quality of care of moderate/severe diarrhoea cases through standardized case management?
29	What is the impact of home delivery of clean delivery kits on newborn mortality, and what is the cost-effectiveness of this approach?
30	What is the cost-effectiveness of maternal/newborn vitamin D supplementation, taking into account infant growth and infection?

31	What is the feasability and cost-effectiveness of implementing peer-support groups in low-resource settings to improve maternal and newborn health?
32	What models of service delivery, including nurse-led initiation or other decentralization approaches, can accelerate scale-up and implementation of prevention of mother-to-child transmission (PMTCT) interventions and lifelong antiretroviral therapy by HIV-infected pregnant women or mothers?
33	What are approaches to improve quality of care of low birth weight infants in health facilities?
34	What is the effectiveness of different delivery platforms (i.e., growth monitoring, EPI injections, community-based organizations) to provide preventive zinc supplements?
35	What is the effectiveness of scaling up zinc in the treatment for diarrhoea and pneumonia in high-risk countries and regions?
36	What are effective means of providing contraceptive services to adolescents who need it?
37	How can we overcome the barriers to increasing coverage by available vaccines, such as the Hib vaccine and pneumococcal vaccine, in different contexts and settings?
38	Identify and evaluate strategies for improving referral between communities and health facilities, including referral compliance.
39	How can we overcome the barriers to increasing demand for and compliance with vaccination for measles, pertussis, pneumococcal infections and Hib in different contexts and settings?
40	How can health policy and systems be improved to achieve increased usage of antibiotic treatment for pneumonia?
41	Assess the perceptions of beneficiaries and levels of community satisfaction in community health workers' capacity to diagnose and treat children with malaria, pneumonia, diarrhoea and severe malnutrition at the community level.

42	What is the effectiveness and return on investment of using digital devices to achieve multiple MNCH objectives, particularly with rural and remote populations, and the systems serving them?
43	How can mechanisms addressing risk factors for neonatal sepsis be implemented in emergency settings?
44	How can preconception nutrition interventions, such as diet diversity, micronutrient supplementation, and achieving optimal BMI, be integrated into broader nutrition and/or health programs in a cost-effective manner?
45	Design a community participation package to improve recognition and acting by community members for mothers in high-risk labor, including transport and phone/radio communication.
46	What is the feasibility, effectiveness, and cost of different approaches to promote the following home care practices: early initiation and exclusivity of breastfeeding; hygienic cord and skin care; prompt care-seeking for illness from an appropriate provider; and hand washing of caregivers?
47	How can we overcome the barriers to health care access and care-seeking for children with pneumonia in different contexts and settings in developing countries?
48	What are approaches to increase the use of antenatal corticosteriods in preterm labor in resource-poor settings?
49	What is the cost-effectiveness of different service delivery models for integrated MNCH services?
50	How can we overcome the barriers to delivering evidence-based care for diarrhea and pneumonia by health care providers in district and referral hospitals?
51	Evaluate whether community health workers can effectively identify a limited number of high-risk conditions (e.g., multiple pregnancy, breech, and short maternal stature) and successfully refer women for facility birth.

52	Identify, implement and evaluate novel prediction tools for preterm birth and intrauterine growth retardation in low-resource settings.
53	What is the feasibility, effectiveness, and cost of approaches to increase coverage of clean delivery practices in facilities and homes?
54	What is the feasibility, effectiveness, and cost of different approaches to promote early initiation and exclusivity of breastfeeding?
55	What are the modifiable factors and methods influencing the choice of birth setting?
56	What is the feasibility and effectiveness of point-of-care tests to detect and manage severe pre-eclampsia?
57	What is the cost-effectiveness of various approaches to providing early postnatal and newborn care?
58	How do user fees affect access to, use of and retention in treatment among adolescents living with HIV?
59	What are the key opportunities/optimal time for incorporating infant severe acute malnutrition (SAM) management into other healthcare programs?
60	What are the criteria for determining the appropriateness of scalability and sustainability on RMNCAH interventions and packages?
61	What is the feasibility and cost-effectiveness of setting up newborn care corners in first referral units and district hospitals?
62	What policy and system supports are evolving to potentiate and reinforce community and intersectoral action on MNCH and determinants of health?
63	How can health policy and systems be improved to achieve increased vitamin A supplementation coverage?
64	How can the private health sector best be involved to increase access, uptake, and the quality of prevention of mother-to-child transmission (PMTCT) care?
65	What are the optimal ratios of community health workers to households/population?

66	How do we strengthen data collection and utilization for decision-making within public sector RMNCAH programs?
67	How can effective interventions to prevent adolescent pregnancy and repeat adolescent pregnancy be delivered at scale?
68	Evaluate factors that enable knowledge mobilization and transfer systems to facilitate sound policy development in MNCH.
69	Do adolescent girls and adult women receive different antenatal, delivery and postnatal care? If so, how and why?
70	Can early identification of adolescent pregnancy increase uptake of available prenatal care?
71	What are the facilitators and barriers to incorporating new point-of-care diagnostic tools into health facilities and community-level care?
72	What is the importance of cultural practices and social capital in facilitating uptake of MNCH interventions?
73	What are the effects of civil society organization (CSO) engagement and local governance in improving MNCH outcomes?
74	Design locally-adapted training programs to orient health workers on the Integrated Management of Newborn and Childhood Illness (IMNCI).
75	What strategies can improve the use of antenatal care, skilled birth attendants, PMTCT and postnatal care by adolescents in resource-poor settings?
76	How can complex interventions that not only address the biomedical aspects of maternal health, but also the social and economic aspects simultaneously (i.e., those that address women's limited mobility and issues of lack of family support to work as midwives in South Asia) be implemented?
77	What are the most effectice communication strategies to inform community members and health care workers about Rhesus (Rh) disease?
78	Identify strategies to ensure that integrated services for maternal health and family planning are effectively adopted by governments.

79	What is the cost-effectiveness of supportive supervision and other linkage initiatives to make peripheral MNCH units and health centres interact effectively with referral units?
80	What aspects of RMNCAH programs should be monitored to improve their implementation, and what are effective ways feedback can be provided to continuously improve care?
81	What return on investment can be realized by building capacity of rural and remote communities (and the systems serving them) to address determinants of health and MNCH?
82	Evaluate the effectiveness and cost of training frontline healthcare workers (i.e., paramedics, doctors, CHWs, midwives, and nurses) to diagnose, manage and refer women with obstetric haemorrhage
83	How does a routine supply of prenatal vitamins to all adolescent girls affect maternal and infant outcomes on a population basis, compared to specifically targeting pregnant adolescents?
84	What are the barriers and enablers for translation of best health care worker MNCH practices into implementation at the community and district levels?
85	What are the key elements in a health information system that will improve maternal mortality and under-five child survival?
86	Compare cost-effectiveness of different incentives at various levels of health systems to adopt the Integrated Management of Newborn and Childhood Illness (IMNCI).
87	What is the rate of Group B Strep (GBS) sepsis and the most effective way to detect and manage maternal GBS?
88	Determine means of providing Rhesus (Rh) immunoglobulin prophylaxis to all Rh negative post-partum women at risk of developing Rh isoimmunization.

89	What is the feasibility and effectiveness of educating mothers and community members on the difference between beneficial bacteria and germs that cause infection, to discourage practices such as vaginal douching and water supplementation of breastfeeding?
90	How can a community-based kitchen network producing probiotic yogurt be aligned with zinc, oral rehydration solution (ORS) and micronutrient delivery to reduce maternal and infant infections?
91	How can antihomophobia education be implemented at the community level, and how will this intervention affect rates of suicide and assault in children and adolescents?
92	What is the feasibility, effectiveness, and cost of different models of interprofessional training (i.e., between physicians, nurses, midwives, CHWs) on newborn survival and outcomes?
93	What are the local perceptions among community health workers on the relative effectiveness of different MNCH interventions at the community level, and how do these perceptions vary by district and region?
94	How large a role does vomiting play in children who die from dehydration in remote locations?
95	Evaluate the potential political and economic reasons behind the privitization of maternal health services.
96	How can we identify, develop, and test new innovations to determine attribution in implementation programs?
97	What is the awareness around the Muskoka Indicators (the Commission on Information and Accountability for Women's and Children's Health Indicators) and interventions that affect them?

ties on the Implementation of RMNCAH Interventions - Final Re

Criterion 1: Answerable by Research	Criterion 2: Research Feasibility	Criterion 3: Deliverability	Criterion 4: Impact	Criterion 5: Equity
0.90	0.97	0.91	0.89	0.80
0.74	0.91	0.76	0.94	0.98
0.93	0.88	0.88	0.85	0.77
0.80	0.91	0.81	0.95	0.82
0.88	0.93	0.85	0.90	0.66
0.70	0.85	0.68	0.95	0.99
0.73	0.89	0.78	0.84	0.87
0.81	0.89	0.91	0.77	0.70

0.78	0.93	0.82	0.66	0.90
0.81	0.88	0.78	0.85	0.75
0.62	0.81	0.88	0.88	0.88
0.73	0.95	0.82	0.84	0.71
0.64	0.84	0.74	0.88	0.93
0.76	0.94	0.89	0.87	0.53
0.59	0.93	0.80	0.87	0.79
0.66	0.93	0.69	0.86	0.81
0.81	0.88	0.73	0.86	0.67
0.68	0.87	0.75	0.90	0.75
0.79	0.92	0.62	0.90	0.71

0.76	0.94	0.78	0.79	0.66
0.85	0.92	0.81	0.78	0.56
0.62	0.77	0.62	0.94	0.97
0.66	0.75	0.77	0.93	0.79
0.66	0.87	0.84	0.77	0.76
0.58	0.92	0.77	0.90	0.70
0.73	0.91	0.77	0.77	0.68
0.53	0.84	0.80	0.82	0.87
0.57	0.78	0.80	0.83	0.88
0.73	0.88	0.76	0.76	0.69
0.77	0.84	0.86	0.76	0.57

0.75	0.83	0.72	0.80	0.70
0.66	0.79	0.72	0.81	0.82
0.61	0.93	0.87	0.80	0.57
0.68	0.89	0.82	0.71	0.69
0.64	0.88	0.84	0.72	0.70
0.71	0.88	0.74	0.88	0.56
0.60	0.81	0.71	0.87	0.76
0.65	0.86	0.74	0.89	0.61
0.56	0.75	0.74	0.89	0.81
0.54	0.77	0.69	0.84	0.88
0.73	0.91	0.87	0.60	0.62

0.61	0.83	0.81	0.77	0.69
0.65	0.79	0.69	0.76	0.81
0.64	0.68	0.75	0.78	0.80
0.56	0.76	0.66	0.80	0.88
0.60	0.78	0.74	0.81	0.73
0.50	0.76	0.62	0.90	0.83
0.67	0.87	0.71	0.73	0.63
0.72	0.81	0.69	0.80	0.56
0.71	0.80	0.72	0.78	0.59
0.67	0.77	0.72	0.73	0.68

0.65	0.77	0.70	0.83	0.60
0.61	0.85	0.77	0.78	0.53
0.73	0.89	0.71	0.67	0.54
0.61	0.86	0.74	0.70	0.61
0.76	0.82	0.78	0.75	0.41
0.71	0.86	0.69	0.74	0.50
0.78	0.85	0.66	0.56	0.65
0.59	0.79	0.72	0.65	0.74
0.62	0.72	0.70	0.78	0.66
0.73	0.77	0.70	0.66	0.61
0.51	0.86	0.71	0.65	0.73
0.61	0.82	0.67	0.73	0.63
0.58	0.79	0.72	0.78	0.59
0.73	0.79	0.63	0.72	0.58

0.69	0.78	0.69	0.79	0.50
0.60	0.73	0.59	0.82	0.70
0.57	0.83	0.68	0.76	0.59
0.69	0.93	0.70	0.56	0.50
0.71	0.84	0.71	0.55	0.54
0.69	0.79	0.65	0.67	0.51
0.64	0.79	0.68	0.60	0.61
0.65	0.70	0.66	0.70	0.61
0.51	0.75	0.75	0.65	0.63
0.50	0.68	0.62	0.74	0.75
0.46	0.52	0.55	0.86	0.88
0.72	0.83	0.82	0.47	0.39
0.61	0.60	0.61	0.77	0.64

0.62	0.72	0.53	0.74	0.59
0.61	0.73	0.57	0.76	0.52
0.56	0.73	0.70	0.60	0.61
0.59	0.70	0.64	0.74	0.51
0.65	0.65	0.62	0.70	0.55
0.52	0.61	0.64	0.77	0.63
0.51	0.70	0.62	0.72	0.60
0.55	0.72	0.64	0.71	0.51
0.82	0.69	0.63	0.55	0.35
0.56	0.73	0.53	0.66	0.51

0.51	0.69	0.68	0.44	0.54
0.63	0.68	0.52	0.41	0.53
0.50	0.64	0.47	0.67	0.40
0.55	0.60	0.59	0.55	0.38
0.57	0.75	0.50	0.44	0.41
0.69	0.59	0.40	0.43	0.55
0.49	0.61	0.43	0.47	0.49
0.31	0.55	0.35	0.44	0.41
0.41	0.64	0.58	0.23	0.15

sults	
RPS	**AEA**
89.25	0.82
86.61	0.78
86.26	0.82
85.62	0.79
84.23	0.78
83.31	0.77
82.05	0.74
81.69	0.77

81.54	0.72
81.52	0.75
81.32	0.71
81.30	0.73
80.62	0.72
79.75	0.72
79.61	0.72
79.13	0.71
79.06	0.71
79.05	0.72
78.86	0.71

78.64	0.70
78.49	0.68
78.38	0.72
77.94	0.70
77.91	0.67
77.46	0.73
77.45	0.69
77.13	0.74
77.04	0.64
76.26	0.68
76.18	0.70

76.11	0.66
75.86	0.66
75.71	0.66
75.65	0.63
75.56	0.67
75.56	0.64
75.20	0.68
75.07	0.72
74.99	0.66
74.51	0.70
74.44	0.68

74.08	0.70
73.98	0.58
73.17	0.62
73.15	0.63
73.10	0.64
72.24	0.66
72.08	0.60
71.84	0.61
71.81	0.63
71.40	0.66

70.88	0.63
70.80	0.68
70.62	0.66
70.47	0.61
70.35	0.67
69.99	0.62
69.93	0.61
69.77	0.62
69.67	0.63
69.51	0.60
69.37	0.67
69.26	0.60
69.02	0.59
68.96	0.61

68.92	0.62
68.70	0.61
68.45	0.61
67.67	0.56
67.01	0.57
66.38	0.57
66.24	0.58
66.15	0.56
65.86	0.64
65.85	0.60
65.38	0.67
64.73	0.63
64.71	0.59

64.11	0.53
63.97	0.57
63.77	0.56
63.60	0.54
63.48	0.53
63.35	0.58
63.01	0.56
62.55	0.57
60.77	0.60
59.73	0.55

57.18	0.56
54.98	0.51
53.65	0.55
53.55	0.54
53.51	0.55
53.15	0.56
49.61	0.52
41.26	0.55
40.14	0.73