Title. A global research prioritization exercise on COVID-19 for maternal, newborn, child and adolescent health

ONLINE SUPPLEMENTARY DOCUMENT

Table 1a. Profile of experts who contributed the research ideas

	N=206 (100%)
Area/Domain of work*	
Maternal health	74 (35.9%)
Newborn health	97 (47.1%)
Child health	118 (57.3%)
Adolescent health	51 (24.6%)
Other	34 (16.5%)
Predominant role in the area of work	
Researcher	105 (51.0%)
Program planning and implementation	46 (22.3%)
Research funder or donor	12 (5.8%)
Policy maker/Government	12 (5.8%)
Clinicians/Academia	13 (6.3%)
Multiple roles	9 (4.4%)
Other	9 (4.4%)
Setting	
Upper income	78 (37.9%)
Upper middle	33 (16.0%)
Lower middle	56 (27.9%)
Lower income	36 (17.5%)
Current role in the context of COVID-19 pandemic*	
Managing COVID-19 patients	32 (15.5%)
Involved in COVID-19 related research	116 (56.3%)
Involved in programmatic response to COVID-19	79 (38.3%)
Developing guidelines or policy related to the COVID-19 pandemic	73 (35.4%)
Providing financial support to COVID related research or programmatic response	14 (6.8%)
Other	9 (4.4%)

**Due to multiple choice option, the total number does not tally 206.*

Table 1b. Profile of experts who scored research questions in different areas

	Maternal health	Newborn health	Child and Adolescent health	Cross-cutting
Total no. of scorers	**N=58 (100%)**	**N=56 (100%)**	**N=43 (100%)**	**N=20 (100%)**
Gender				
Male	27 (47%)	24 (43%)	25 (58%)	11 (55%)
Female	31 (53%)	32 (57%)	18 (42%)	9 (45%)
Predominant role in the area of work				
Academia/research	47 (81%)	43 (77%)	34 (79%)	9 (45%)
Government: Policy, program planning, and management	5 (9%)	5 (9%)	0	0
Non-Government: Policy, program planning, and management	6 (10%)	8 (14%)	9 (21%)	11 (55%)
Setting (by country of residence)				
Upper and upper middle	45 (78%)	45 (80%)	32 (74%)	11 (55%)
Lower and lower middle	13 (22%)	11 (20%)	11 (26%)	9 (45%)
Setting (by country of work)				
Upper and upper middle	24 (41%)	22 (39%)	14 (33%)	5 (25%)
Lower and lower middle	32 (55%)	31 (55%)	25 (58%)	13 (65%)
Work at global level	2 (3%)	3 (5%)	4 (9%)	2 (10%)

Ranking of final research questions by domain and theme

New questions, the ones that didn't feature in the top ten research priorities by area are marked in **blue.**

Table 2a. Top ranked research questions by domain (stratified by area; top 5 in each area)

Domain	Research priority questions
Discovery (new interventions)	**Maternal health** 1. Is the safety and efficacy of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) vaccine different in pregnant women compared to non-pregnant women? 2. What are the effective drugs or procedures to manage women with COVID-19 disease in the 1st, 2nd, and 3rd trimester of pregnancy? 3. What are the best laboratory or clinical markers for severe COVID-19 disease in pregnant women? **Newborn health** 1. In newborns with severe COVID-19 disease, is the addition of dexamethasone to the standard of care more effective in improving newborn survival compared to the standard of care alone? 2. Can Bacillus Calmette Guerin (BCG) vaccination at birth modify the immune response in infants who receive the SARS-CoV-2 vaccine once it becomes available for this age group? 3. What are the mechanisms by which breastfeeding can prevent SARS-CoV-2 infection or the development of COVID-19 disease or severe disease (e.g., the presence of SARS-CoV-2 antibody in human milk) in the newborn? 4. What are the incidence and the mechanism of the late-onset (onset after 48 hours of life) COVID-19 disease in newborns? 5. Do infants mount an immunological response to SARS-CoV-2? **Child and adolescent health** 1. Is there a non-invasive test to detect SARS-CoV-2 that is accurate and quick to use with children? 2. What is the best point of care SARS-CoV-2 RT-PCR assay in children?
Development (Improved intervention)	**Maternal health** 1. How can transmission between a SARS-CoV-2 infected parent to their newborn be prevented? **Newborn health** 1 What are safe and cost-effective approaches to provide oxygen to pregnant women, newborns, and children who need oxygen in resource-poor countries with limited oxygen supply? 2 What is the effectiveness of different interventions (e.g., maternal hygiene, use of facemask, maternal-newborn separation, etc.) to prevent neonatal acquisition of SARS-CoV-2 in the early postnatal period in the hospital and at home while breastfeeding, skin-to-skin contact, and kangaroo mother care (KMC), especially if the mother has symptomatic COVID-19 disease?

	Child and adolescent health 1 What are the effective and safe strategies for in-class education during the COVID-19 pandemic? What is the attack rate within schools and what interventions (e.g. face masks, physical distancing, hand disinfection/washing, etc.) are effective for the prevention of transmission of SARS-CoV-2 in schools, by age/school year and by type of school (e.g. day vs boarding)? 2 What are the most effective strategies for communication about the prevention of SARS-CoV-2 infection to adolescents and young adults? 3 What are the best risk-stratification tools (e.g., Integrated Management of Childhood Illness algorithm, biomarkers, clinical scores, etc.) to triage sick children with suspected SARS-CoV-2 infection or COVID-19 disease, and with sufficiently good performance to predict the severity and outcome? 4 Among children with COVID-19 disease and severe respiratory distress, does early use of CPAP compared to no CPAP, reduce the subsequent use of invasive mechanical ventilation? **Cross-cutting** 1 How can the spread of SARS-CoV-2 infection be controlled and the adverse impact of COVID-19 disease be mitigated in children and families who are displaced and living in fragile settings? 2 Which innovations are effective in reducing the unintended adverse consequences of service reorganization during the COVID-19 pandemic on optimizing positive pregnancy, childbirth, and postnatal experiences and ensuring safe outcomes for childbearing women and their neonates?
Delivery (Delivery of existing interventions)	**Maternal health** 1. How can the access to postnatal including home-based health services affected by the pandemic be improved (e.g., using telemedicine)? 2. How can the access to maternal and perinatal health services affected by the pandemic be improved? (e.g., skilled delivery, telemedicine, use of point of care ultrasound) 3. How can the provision of essential maternal and perinatal health commodities affected by the pandemic be improved? 4. Which package of personal protective equipment for mothers, companions, and health providers is associated with the lowest risk of SARS-CoV-2 transmission in the delivery room? 5. Which mode of delivery (vaginal or cesarean section) is associated with the best clinical outcomes in pregnant mothers with severe COVID-19 disease?

	Newborn health 1. What are the most effective treatment strategies for symptomatic newborns with SARS-CoV-2 infection, especially those with respiratory illness? 2. What is the most effective way to prevent the transmission of SARS-CoV-2 to preterm newborns receiving kangaroo mother care? **Child and adolescent health** 1. How can routine vaccination services for children be sustained/improved during the COVID-19 pandemic? 2. How can schools be utilized as platforms to deliver equitable academic and mental health interventions to children and adolescents 0-19 years of age during and post the COVID-19 pandemic? 3. What is the optimal treatment for multisystem inflammatory syndrome in children temporally associated with SARS-CoV-2 infection (MISC)? 4. What are the effective interventions to prevent malnutrition in children during the COVID-19 pandemic lockdown? 5. How can technology assist with the delivery of evidence-based psychosocial interventions to prevent or treat mental health problems in adolescents in the post-COVID-19 pandemic context? **Cross-cutting** 1. What are the barriers to the provision of essential reproductive, maternal, newborn, child, and adolescent health services during the COVID-19 pandemic? What are proven health system approaches/solutions that countries have adapted or implemented to ensure continuity of essential reproductive, maternal, newborn, child, and adolescent health services during the COVID-19 pandemic? 2. What are the effective health system adaptations to sustain care-seeking and support or resume high-quality essential services for women, newborns, and children in COVID-19 and post-COVID-19 contexts? 3. How can we organize health services during the COVID-19 pandemic to ensure the continuation of regular maternal, newborn, child, and adolescent health care?
Descriptive (Epidemiological research)	**Maternal health** 1 In pregnant women with SARS-CoV-2 infection or COVID-19 disease, what are the risk (e.g., co-morbidities, co-infection) and determinants (e.g., malnutrition, body composition) of adverse maternal and perinatal outcomes (e.g., maternal morbidity, stillbirth, etc.)?

	2 How has the COVID-19 pandemic affected health-seeking behavior for antenatal care, childbirth, or postnatal care (e.g. frequency of visits, birth at health facilities, family planning advice, etc.)? **Newborn health** 1 Is SARS-CoV-2 transmissible to healthy infants including newborns of mothers infected with the virus? What are the routes of transmission during the in-utero, intrapartum, and the postnatal periods (e.g., transplacental, contact with virus present in vaginal or fecal secretions during delivery, breastmilk, etc.)? Does the incidence and severity of infection in the newborn differ by the timing or transmission or mode of delivery (e.g., cesarean vs. vaginal delivery)? 2 What are the clinical presentations of SARS-CoV-2 infection in newborns? What is the burden of severe COVID-19 disease in newborns? 3 What proportion of newborns infected with SARS-CoV-2 presenting for care with hypoxemia receive oxygen therapy, and what is the case fatality rate in this population? **Child and adolescent health** 1 What are the protective factors including breastfeeding/feeding practices, maternal vaccination, against severe COVID-19 disease in infants, children, and adolescents (0-19 years), and do these differ by age? 2 What is the impact of comorbidities (e.g., asthma, diabetes, undernutrition, overweight or obesity, HIV-1 exposure or HIV-1 infection, etc.) in children and adolescents (0-19 years) with SARS-CoV-2 infection on development of disease and its clinical severity and outcome? 3 What is the effect of reopening schools on SARS-CoV-2 transmission among different age groups in the general population (based on real-life data)? 4 What is the sensitivity and specificity of SARS-CoV-2 RT-PCR testing in children? 5 What is the impact of the COVID-19 pandemic on essential child health services (both at a community level and facility level)? **Cross-cutting** 1. To what extent are resources (health workers, oxygen support, IPC supplies) being diverted from women, newborns, and children or routine services to provide care of COVID-19 disease? 2. What different models have countries taken to adapt or modify health services for maternal and newborn health during the COVID-19 pandemic and what is the effect of the new adapted or modified or redesigned COVID-19 models of care (e.g. remote antenatal and

	postnatal services replacing in-person contact) on access, coverage, quality of care and outcomes of mothers and newborns, especially for marginalized populations? 3. How do various factors (e.g., age, wealth or income or socioeconomic status, race or ethnicity, migrant or refugee status, etc.) influence individuals' access to COVID-19 related healthcare services (e.g., test, treatment, etc.)? 4. What are the effects of the COVID-19 pandemic on availability, access, care-seeking, and utilization of maternal and child health services? 5. How has care-seeking and quality of care (at every health service level) been affected by the COVID pandemic, and what are the features of positive outliers (i.e. settings and services that have been able to successfully maintain essential services against the odds)?

Table 2b. Top ranked research questions by theme (stratified by area; top 5 in each area)

Theme	Research priority questions
Pathogenesis, immune response, immunogenicity	**Maternal health** 1. What is the extent of in-utero transfer of SARS-CoV2 antibodies from infected mother to the fetus? How long after birth do the placentally transferred SARS-CoV-2 antibodies persist in the newborn baby? 2. In pregnant women infected with SARS-CoV-2, what are the SARS-CoV-2 immune response and longevity of the immune response to the virus? **Newborn health** 1. Can BCG vaccination at birth modify the immune response in infants who receive the COVID-19 vaccine once it becomes available for use in this age group? 2. What are the mechanisms by which breastfeeding can prevent SARS-CoV-2 infection or the development of COVID-19 disease or severe disease in the newborn (e.g., the presence of SARS CoV 2 antibody in human milk)? **Child and adolescent health** 1. Is there a non-invasive test to detect the SARS-CoV-2 virus that is accurate and quick to use with children? 2. After exposure to SARS-CoV-2 infection, does a child develop a protective immune response? If yes, for how long? 3. What is the seroprevalence of SARS-CoV-2 infection in children (0-19 years) and its comparison with other population groups by each country?

	4. What is the best point of care test SARS-CoV-2 RT-PCR assay in children? 5. How do premorbid HIV, TB, or malnutrition impact the immune response of infants/young children infected with SARS-CoV2?
Burden and risk factors	**Maternal health** 1. In pregnant women with SARS-CoV-2 infection or COVID-19 disease, what are the risk (e.g., co-morbidities, co-infection) and determinants (e.g., malnutrition, body composition) of adverse maternal and perinatal outcomes (e.g., maternal morbidity, stillbirth, etc.)? 2. Are pregnant women with complications such as pregnancy-induced hypertension, pre-eclampsia, gestational diabetes, malnutrition, anemia, HIV-1, malaria at increased risk of SARS-CoV-2 infection compared to women with uncomplicated pregnancies? 3. Are pregnant women at increased risk of SARS-CoV-2 infection or COVID-19 disease or differ in the clinical syndrome compared to women who are not pregnant? **Newborn health** 1. Do SARS-CoV-2 viral load and severity of COVID-19 disease in infected pregnant women predict the acquisition of infection and development and severity of COVID-19 disease in the newborn? 2. Does co-infection of the mother with other infections like HIV, hepatitis, malaria, syphilis, etc. along with SARS-CoV-2 increase the risk of the newborn acquiring SARS-CoV-2 infection and developing COVID-19 disease or severe disease? **Child and adolescent health** 1. What are the protective factors including breastfeeding/feeding practices, maternal vaccination against severe COVID-19 disease in infants, children, and adolescents (0-19 years), and do these differ by age? **2.** What is the prevalence of SARS-CoV-2 infection in breastfed vs non-breastfed infants? 3. What are the risk factors (biomarkers, environmental, nutritional, social, demographic, etc.) for SARS-CoV-2 infection and COVID-19 disease in children and adolescents (0-19 years), and do these differ by age? **4.** What is the impact of the COVID-19 pandemic on immunization preventable diseases (e.g. measles, pneumococcal, H. influenza, pertussis, tetanus, etc.) in children 0-19 years of age?
Clinical characterization	**Maternal health**

and management	1. What are the effective drugs/procedures to manage COVID-19 disease in the 1st, 2nd, and 3rd trimester of pregnancy? 2. Which mode of delivery (vaginal or cesarean section) is associated with the best clinical outcomes in pregnant mothers with severe COVID-19 infection? 3. Which maternal position during birth (e.g., prone with support, left lateral, other) is associated with best clinical outcomes in pregnant mothers with severe COVID-19 disease? **Newborn health** 1. What are the most effective treatment strategies for symptomatic newborns with SARS-CoV-2 infection, especially those with respiratory illness? 2. What is the effectiveness of different interventions (e.g., maternal hygiene, use of facemask, maternal-newborn separation, etc.) to prevent neonatal acquisition of SARS-CoV-2 in the early postnatal period in the hospital and at home while breastfeeding, during skin-to-skin contact and KMC, especially if the mother has symptomatic COVID-19 disease? 3. What are the clinical presentations of SARS-CoV-2 infection in newborns? What is the burden of severe COVID-19 disease in newborns? 4. What proportion of newborns infected with SARS-CoV-2 presenting for care with hypoxemia receive oxygen therapy, and what is the case fatality rate in this population? **Child and adolescent health** 1. What is the impact of comorbidities (e.g., asthma, diabetes, undernutrition, overweight or obesity, HIV-1 exposure or HIV-1 infection, etc.) in children and adolescents (0-19 years) with SARS-CoV-2 infection or COVID-19 disease on the clinical severity of the infection and outcome? 2. What is the sensitivity and specificity of SARS-CoV-2 RT-PCR testing in children? 3. What are the best risk-stratification tools (IMCI algorithm, biomarkers, clinical scores, etc.) to triage sick children with COVID-19 disease, and with sufficiently good performance to predict the severity and outcome? 4. What combinations of signs and symptoms (as used in iCCM/IMCI) best predict COVID-19 in children presenting with illness to a primary health care facility? 5. Among children with COVID-19 disease and severe respiratory distress, does early use of CPAP compared to no CPAP, reduce the subsequent use of invasive mechanical ventilation?

Modes of transmission and prevention of transmission	**Maternal health** 1. In postpartum women infected with SARS-CoV-2, what are the risk and determinants of SARS-CoV-2 transmission to the newborn by breastfeeding or breastmilk? 2. How can transmission between a SARS-CoV-2 infected parent to their newborn be prevented? 3. In SARS-CoV-2 infected pregnant women, what is the risk and determinants of viral transmission to the fetus and newborn during pregnancy and childbirth? 4. What proportion of lactating mothers infected with SARS-CoV-2 secrete replicating live virus in their breastmilk? What is the risk of transmission of SARS-CoV-2 to the newborn if fed breastmilk containing the live replicating virus? **Newborn health** 1. Is SARS CoV-2 transmissible to healthy infants including newborns of mothers infected with the virus? What are the routes of transmission during the in utero, intrapartum and postnatal periods (e.g., transplacental, contact with virus present in vaginal or fecal secretions during delivery, breastmilk, etc.)? Does the incidence and severity of infection in the newborn differ timing of transmission or mode of delivery (e.g., cesarean vs vaginal delivery)? **Child and adolescent health** 1. What are the effective and safe strategies for in-class education during the COVID-19 pandemic? What is the attack rate within schools and what interventions (e.g. face masks, physical distancing, hand disinfection/washing, etc.) are effective for the prevention of transmission of SARS-CoV-2 in schools, by age/school year and by type of school (e.g. day vs boarding)? 2. What are the most effective strategies for communication about the prevention of SARS-CoV-2 to adolescents and young adults? 3. What is the effect of reopening schools on SARS-CoV-2 transmission among different age groups in the general population (based on real-life data)? 4. What is the rate of transmission of SARS-CoV2 among children and adolescents 0-19 years of age, overall and by age?
Indirect effects of the pandemic	**Maternal health** 1. How can the access to postnatal including home-based health services affected by the pandemic be improved (e.g., using telemedicine)? 2. How has the COVID-19 pandemic affected health-seeking behavior for antenatal care, childbirth, or postnatal care (e.g. frequency of visits, birth at health facilities, family planning advice, etc.)?Is the

	safety and efficacy of the SARS-CoV-2 vaccine different in pregnant women compared to non-pregnant women? 3. How can the access to maternal and perinatal health services affected by the pandemic be improved (e.g. skilled delivery, telemedicine, use of point of care ultrasound)? 4. How can the provision of essential maternal and perinatal health commodities affected by the pandemic be improved? **Newborn health** 1. What is the effect of the COVID-19 pandemic on care-seeking for newborn illness? What are the major concerns and barriers faced by families in seeking care at health facilities for a sick newborn during the pandemic? 2. What is the best screening test for SARS-CoV-2 for newborns born to women who have tested positive for SARS-CoV-2 on RT-PCR? 3. What is the impact of the COVID-19 pandemic on the emergency admission rates for sick newborns and infants? 4. What is the impact of enablers and inhibitors of adoption of digital health solutions on antenatal and postnatal care in LMIC settings during the COVID-19 pandemic? **Child and adolescent health** 1. How can routine vaccination services for children be sustained/improved during the COVID-19 pandemic? 2. What are the effective and safe strategies for in-class education during the COVID-19 pandemic? What is the attack rate within schools and what interventions (e.g. face masks, physical distancing, hand disinfection/washing, etc.) are effective for the prevention of transmission of SARS-CoV-2 in schools, by age/school year and by type of school (e.g. day vs boarding)? **3.** What is the impact of the COVID-19 pandemic on essential child health services (both at a community level and facility level)? **Cross-cutting** 1. What are safe and cost-effective approaches to provide oxygen to pregnant women, newborns, and children who need oxygen in resource-poor countries with limited oxygen supply? 2. What are the barriers to the provision of essential RMNCAH services during the COVID-19 pandemic? What are proven health system approaches/solutions that countries have adapted or implemented to ensure continuity of essential MNCAH services during the COVID-19 pandemic? 3. What are the effective health system adaptations to sustain care-seeking and support or resume high-quality essential services for women, newborns, and children in COVID-19 and post-COVID-19 contexts?

	4. To what extent are resources (health workers, oxygen support, IPC supplies) being diverted from women, newborns, and children / routine services to provide care of COVID-19 disease? 5. What different models have countries taken to adapt/modify health services for maternal and newborn health during the COVID-19 pandemic and what is the effect of the new adapted/modified/redesigned COVID-19 models of care (e.g. remote antenatal and postnatal services replacing in-person contact) on access, coverage, quality of care and outcomes of mothers and newborns, especially for marginalized populations?

Table 3. Research priority Score (RPS) for all research questions in the four areas by income classification of scorer's country of work and country of residence

	By country of work		By country of residence	
	RPS score for scorers from upper and upper middle-income countries; Median (IQR)	RPS score for scorers from low and lower middle-income countries; Median (IQR)	RPS score for scorers from upper and upper middle-income countries; Median (IQR);	RPS score for scorers from low and lower middle-income countries; Median (IQR)
Maternal health	0.85 (0.79 to 0.91); n=24	0.80 (0.71 to 0.85); n=32	0.83 (0.75 to 0.88); n=45	0.79 (0.73 to 0.83); n=13
Newborn health	0.80 (0.76 to 0.89); n=22	0.73 (0.68 to 0.79); n=31	0.79 (0.71 to 0.85); n=45	0.75 (0.67 to 0.81); n=11
Child and Adolescent health	0.76 (0.68 to 0.83); n=14	0.80 (0.72 to 0.86); n=25	0.77 (0.70 to 0.82); n=32	0.82 (0.73 to 0.89); n=11
Cross-cutting	0.79 (0.66 to 0.89); n=5	0.84 (0.72 to 0.88); n=13	0.79 (0.69 to 0.85); n=11	0.85 (0.76 to 0.89); n=9

Table 4a. Ranking of the top ten research questions on maternal health by income classification of the scorer's country of work

Overall ranking of top ten research questions on maternal health		Ranking by World Bank country income classification	
		Upper and upper middle-income countries	Lower and lower-middle income countries
1	How can the access to postnatal including home-based health services affected by the pandemic be improved (e.g., using telemedicine)?	2*	1*
2	In pregnant women with SARS-CoV-2 infection or COVID-19 disease, what are the risk (e.g., co-morbidities, co-infection) and determinants (e.g., malnutrition, body composition) of adverse maternal and perinatal outcomes (e.g., maternal morbidity, stillbirth, etc.)?	5*	2
3	How has the COVID-19 pandemic affected health-seeking behavior for antenatal care, childbirth, or postnatal care (e.g. frequency of visits, birth at health facilities, family planning advice, etc.)?	3	3

4	How can the access to maternal and perinatal health services affected by the pandemic be improved? (e.g. skilled delivery, telemedicine, use of point of care ultrasound)	2*	1*
5	Is the safety and efficacy of the SARS-CoV-2 vaccine different in pregnant women compared to non-pregnant women?	4	6
6	What are the effective drugs/procedures to manage women with COVID-19 disease in the 1st, 2nd, and 3rd trimester of pregnancy?	5*	5*
7	How can the provision of essential maternal and perinatal health commodities affected by the pandemic be improved?	9	1*
8	In postpartum women with COVID-19, what are the risk and determinants of transmission of SARS-CoV-2 to the newborn by breastfeeding or breastmilk?	6	5*
9	Are pregnant women with complications such as pregnancy-induced hypertension, pre-eclampsia, gestational diabetes, malnutrition, anemia, HIV-1, and malaria at increased risk of SARS-CoV-2 infection or COVID-19 disease compared to women with uncomplicated pregnancies?	7	5*
10	What are the risk and determinants of severe disease or death in pregnant women with SARS-CoV-2 infection or COVID-19 disease (e.g., sociodemographic, immunological/hormonal, microbiota, nutritional)?	8	4

**These questions received the same RPS*

Table 4b. Ranking of the top ten research priority questions on newborn health by income classification of the scorer's country of work

Overall ranking of top ten research questions on newborn health		Ranking by World Bank country income classification	
		Upper and upper middle-income countries	Lower and lower-middle income countries
1	What are the most effective treatment strategies for symptomatic newborns with SARS-CoV-2 infection, especially those with respiratory illness?	4*	1
2	What is the effectiveness of different interventions (e.g., maternal hygiene, facemask use, maternal-newborn separation, etc.) to prevent neonatal acquisition of SARS-CoV-2 in the early postnatal period in the hospital	1*	4

	and at home while breastfeeding, during skin-to-skin contact or kangaroo mother care, especially if the mother has symptomatic COVID-19 disease?		
3	Is SARS-CoV-2 transmissible to healthy infants including newborns of mothers infected with the virus? What are the routes of transmission during in-utero, intrapartum, and postnatal periods (e.g., transplacental, contact with virus present in vaginal or fecal secretions during delivery, breastmilk, etc.)? Does the incidence and severity of infection in the newborns differ by the timing, transmission, or mode of delivery (e.g., cesarean vs. vaginal delivery)?	1*	3*
4	What are the clinical presentations of SARS-CoV-2 infection in newborns? What is the burden of severe COVID-19 disease in newborns?	4*	2
5	What proportion of newborns infected with SARS-CoV-2 presenting for care with hypoxemia receive oxygen therapy, and what is the case fatality rate in this population?	5*	3*
6	What is the most effective way to prevent the transmission of SARS-CoV-2 to preterm newborns receiving kangaroo mother care?	3	5
7	What are the major risk and/or protective factors (e.g., breastfeeding, skin-to-skin care or kangaroo mother care, low birth weight, Bacillus Calmette Guerin or other existing vaccinations, HIV-1 exposure, etc.) for the acquisition of SARS-CoV-2 infection or development of COVID-19 disease or severe disease in newborns of SARS-CoV-2 infected mothers?	5*	6
8	In newborns with severe COVID-19 disease, is the addition of dexamethasone to the standard of care more effective in improving newborn survival compared to the standard of care alone?	9	3
9	Which is the most appropriate diagnostic sample for diagnosis of SARS-CoV-2 infection in newborns (e.g., oral secretion, nasal swab, fecal swab, cord or peripheral blood, etc.?	2	8
10	What is the impact of maternal SARS-CoV-2 infection on newborn health outcomes (e.g., intrauterine growth restriction, prematurity, and birth asphyxia), and how can this be mitigated?	7	7

**These questions received the same RPS*

Table 4c. Ranking of the top ten research priority questions on child and adolescent health by income classification of the scorers' country of work

Overall ranking of top ten research questions on child and adolescent health	Ranking by World Bank country income classification	
	Upper and upper middle-income countries	Lower and lower-middle income countries
1. How can routine vaccination services for children be sustained/improved during the COVID-19 pandemic?	2	1
2. What are the effective and safe strategies for in-class education during the COVID-19 pandemic? What is the attack rate within schools and what interventions (e.g. face masks, physical distancing, hand disinfection/washing, etc.) are effective for prevention of transmission of SARS-CoV-2 in schools, by age/school year and by type of school (e.g. day vs boarding)?	1	5*
3. What are the most effective strategies for communication about the prevention of SARS-CoV-2 infection to adolescents and young adults?	4*	4
4. What are the protective factors, including breastfeeding/feeding practices, maternal vaccination against severe COVID-19 disease in infants, children, and adolescents (0-19 years), and do these differ by age?	7	5*
5. What is the impact of comorbidities (e.g., asthma, diabetes, undernutrition, overweight or obesity, HIV-1 exposure or HIV-1 infection, etc.) in children and adolescents (0-19 years) with SARS-CoV-2 infection on development of disease and on its clinical severity and outcome?	6	7
6. What is the effect of reopening schools on SARS-CoV-2 transmission among different age groups in the general population (based on real-life data)?	4*	5*
7. What is the sensitivity and specificity of SARS-CoV-2 RT-PCR testing in children?	15	3
8. What is the impact of the COVID-19 pandemic on essential child health services (both at a community level and facility level)?	16	2
9. What are the best risk-stratification tools (e.g., Integrated Management of Childhood Illness algorithm, biomarkers, clinical scores, etc.) to triage sick children with suspected SARS-CoV-2 infection or COVID-19 disease, and with sufficiently good performance to predict the severity and outcome?	2	11
10. What is the prevalence of SARS-CoV-2 infection in breastfed vs non-breastfed infants?	12	6

**These questions received the same RPS*

Table 4d. Ranking of the top ten research priority questions in cross-cutting/health systems area by the scorers country of work

Overall ranking of top ten research questions in cross-cutting/health systems area		Ranking by World Bank country income classification	
		Upper and upper middle-income countries	Lower and lower-middle income countries
1	What are safe and cost-effective approaches to provide oxygen to pregnant women, newborns, and children who need oxygen in low- and middle-income countries with limited oxygen supply?	7	1
2	What are the barriers to the provision of essential reproductive, maternal, newborn, child, and adolescent health services during the COVID-19 pandemic? What are proven health system approaches/solutions that countries have adapted or implemented to ensure continuity of essential reproductive, maternal, newborn, child, and adolescent health services during the COVID-19 pandemic?	3	2
3	What are the effective health system adaptations to sustain care-seeking and support or resume high-quality essential services for women, newborns, children, and adolescents in COVID-19 and post-COVID-19 contexts?	2	4
4	To what extent are resources (health workers, oxygen support, infection, and prevention control supplies) being diverted from women, newborns, and children or routine services to provide care for COVID-19 disease?	1	8
5	What different models have countries taken to adapt or modify health services for maternal and newborn health during the COVID-19 pandemic and what is the effect of the new adapted or modified or redesigned COVID-19 models of care (e.g. remote antenatal and postnatal services replacing in-person contact) on access, coverage, quality of care and outcomes of mothers and newborns, especially for marginalized populations?	4	6

Table 5. The list of experts who provided research ideas

SN	Name	Organizational affiliation
1	A S M Nawshad Uddin Ahmed	Dhaka Shishu (Children) Hospital, Bangladesh
2	Abigail Kazembe	Kamuzu College of Nursing, Malawi
3	Adegoke Falade	College of Medicine, University of Ibadan and University College Hospital, Ibadan, Nigeria
4	Adnan Bhutta	Pediatric Critical Care Medicine

5	AIDA MUJKIĆ	University of Zagreb, School of Medicine, A.STAMPAR School of Public Health, Croatia
6	Aleksandra WesoÅ‚owska	Laboratory of Human Milk and Lactation Research, Regional Human Milk Bank in Holy Family Hospital, Warsaw Medical University, Poland
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