Supplemental file to:
Pulse Oximetry and Oxygen Services for the Care of Acutely Unwell Children Attending Frontline Health Facilities in Lagos, Nigeria (INSPIRING-Lagos): Study Protocol for a mixed-methods evaluation.

Supplemental file

- Annex 1: Description of intervention facilities
- Annex 2: Secondary outcomes, process and economic indicators
- Annex 3: Healthcare worker in depth interview (IDI) and focus group discussion (FGD)
- Annex 4: Caregiver focus group discussions (FGDs)
- Annex 5: Caregiver in depth interview (IDI)
- Annex 6: Time use study tool
- Annex 7: Program management

Annex 1: Description of intervention facilities

	Admission duration	Admit neonates	Power supply/day	Tech support	Ward (beds)	Oxygen	Pulse oximeter
Government "flagship" primary health centres (PHCs)							
PHC1	Overnight, 1-2 days	No	24hrs	No	General (18)	Cylinder: maternity Concentrator: not functional	No
PHC2	6 hrs	No	6hrs	No	General (2)	Cylinder: maternity, clinic Concentrator: storage	No
PHC3	5 hrs	No	24 hrs	No	General (1)	Cylinder: maternity Concentrator: not functional	No
PHC4	2-3 hours	No	24 hrs	No	General (2)	Cylinder: none Concentrator: not functional	No
PHC5	2-3 hours	Yes	3-8 hrs	No	General (2)	Cylinder: not functional Concentrator: not functional	No
PHC6	6 hours	No	8hrs	No	General (1)	Cylinder: maternity Concentrator: none	No
PHC7	2-4 hours	No	variable	No	General (2)	Cylinder: maternity Concentrator: maternity	No
Private health facilities							
PRV1	Overnight, no limit	Yes	24 hrs	No	General (12)	Cylinder: emergency Concentrator: not functional	No
PRV2	Overnight, no limit	Yes	15-20 hours	Yes	Paediatric (3)	Cylinder: emergency Concentrator: not functional	Yes
PRV3	Overnight, no limit	Yes	24 hours	No	Paediatric (6) Neonatal (5)	Cylinder: none Concentrator: not functional	Yes
PRV4	Overnight, no limit	Yes	24 hours	No	Paediatric (6)	Cylinder: emergency Concentrator: not functional	Yes
PRV5	Overnight, no limit	Yes	24 hours	Yes	Paediatric (10)	Cylinder: paediatric ward Concentrator: not functional	Yes
PRV6	10 hours	No	10 hours daily	No	General (10)	Cylinder: operating theatre Concentrator: not functional	No
PRV7	Overnight, no limit	No	15-18 hours	No	General (10)	Cylinder: emergency, operating theatre Concentrator: emergency	No
Government secondary health facilities							
H1	Overnight, no limit	Yes	24 hours	Yes	Paediatric (6) General (33)	Cylinder: piped to wards Concentrator: not functional	Yes
H2	Overnight, no limit	Yes	24 hours	Yes	Paediatric (6) Neonatal (6) Postnatal (20) Adult (265)	Cylinder: all wards Concentrator: not functional	Yes

Annex 2: Secondary outcomes, process and economic indicators

Process Evaluation	Indicator	Frequency of data collection	Person collecting	Source of data	Tool required	Data type
Intervention delivery						
	Training fidelity	Once	Lagos UCH manager	Observation	Checklist	Quantitative/Qual
	Pre/Post testing	Once	STC trainer	Participant self-completed	Questionnaire	Quantitative
	Supervision reports	Monthly	STC supervisor	Observation	Checklist	Text
	Supervision visits conducted	Monthly	STC supervisor	Work plans	-	Quantitative
	Device breakages / presence	Bi-weekly	UCH data collectors	Observation	Checklist	Quantitative
	Training coverage over time	TBD	STC trainer	Observation	Checklist	Quantitative
	Oxygen system functionality	Bi-annual	UCH data collectors	Equipment testing and interviews	Questionnaire	Quantitative
	Oximeter functionality	Bi-annual	UCH data collectors	Equipment testing and interviews	Questionnaire	Quantitative
	Availability of PPE	Monthly	UCH data collectors	Observation	Checklist	Quantitative
	Availability of soap/alcohol gel	Monthly	UCH data collectors	Observation	Checklist	Quantitative
	Trainer/supervisor perceptions	Midline/endline	UCH data collectors	Interviews	Topic guide	Qualitative
	Provider perceptions	Midline/endline	UCH data collectors	Group discussions	Topic guide	Qualitative
Clinical indicators						
	14-day mortality	Daily	UCH data collectors	Clinical assessment and case notes	Questionnaire and checklist	Quantitative
	Correct IMCI assessment	Daily	UCH data collectors	Clinical assessment and case notes	Questionnaire and checklist	Quantitative
	Correct IMCI diagnosis	Daily	UCH data collectors	Clinical assessment and case notes	Questionnaire and checklist	Quantitative
	Correct treatment decision	Daily	UCH data collectors	Clinical assessment and case notes	Questionnaire and checklist	Quantitative
	Correct referral decision	Daily	UCH data collectors	Clinical assessment and case notes	Questionnaire and checklist	Quantitative

	Appropriate oxygen treatment	Daily	UCH data collectors	Clinical assessment and case notes	Questionnaire and checklist	Quantitative
	Referral attendance	Daily	UCH data collectors	Caregiver follow-up interviews	Questionnaire	Quantitative
	Drug stock audits	Three monthly	STC supervisor	Observation	Questionnaire	Quantitative
Community						
	Caregiver perceptions	Base/mid/endline	UCH data collectors	Interviews and discussions	Topic guide	Qualitative
	Delay in first seeking care	Daily	UCH data collectors	Caregiver recruitment interview	Questionnaire	Quantitative
	Location of first seeking care	Daily	UCH data collectors	Caregiver recruitment interview	Questionnaire	Quantitative
	Delay in attending referral	Daily	UCH data collectors	Caregiver follow-up interviews	Questionnaire	Quantitative
	Cost of care episode	Daily	UCH data collectors	Caregiver follow-up interviews	Questionnaire	Quantitative

Economic Evaluation	**Indicator**	**Frequency of data collection**	**Person collecting**	**Source of data**	**Tool required**	**Data type**
Provider side						
	Training	Endline	STC administration	STC accounts	Budget tool	Quantitative
	Supervision	Endline	STC administration	STC accounts	Budget tool	Quantitative
	Equipment	Endline	UCL/UCH administration	UCL/UCH accounts	Budget tool	Quantitative
	PPE costs	Endline	STC administration	STC accounts	Budget tool	Quantitative
	Salaries	Endline	STC administration	STC accounts	Budget tool	Quantitative
	Maintenance	Quarterly	STC administration	Supervision reports	Checklist	Quantitative
	Discrete choice experiment	Baseline	UCH data collector	Questionnaire	Questionnaire	Quantitiative
	Time use	Base/mid/endline	UCH data collector	Observation	Checklist	Quantitative
Patient side						
	Cost to patient	Daily	UCH data collector	Caregiver follow-up interviews	Questionnaire	Quantitative
	Caregiver motivations	Base/mid/endline	UCH data collector	Group discussion	Topic guide	Qualitative
	Time taken to seek care	Base/mid/endline	UCH data collector	Economic interviews	Questionnaire	Quantitative

Annex 3: Healthcare worker in depth interview (IDI) and focus group discussion (FGD)

We will be conducting interviews and focus groups with healthcare providers who work on paediatric wards, which can provide oxygen and nasogastric feeding for children.

1. Clinical context

- Can you tell me about a typical day in your setting?
    - Probe: What sort of duties do you have on the ward? How many children do you see?
- Can you describe a typical case of pneumonia in your setting?
    - How long are they admitted for? What sort of treatments do they get?
- How do you decide if it is a severe or non-severe case of pneumonia?

2. Oxygen

- Can you tell me about the last time you provided oxygen to a child?
    - What was the child's illness? Duration of oxygen? Did she/he recover?
- How often do you provide oxygen?
- How do you decide who to give oxygen?
- Do you encounter any challenges in giving oxygen?
    - For example, do you have children who you cannot give it to? Or who refuse? Or cannot afford to have oxygen?

3. Nasogastric feeding

- Can you tell me about the last time you inserted a nasogastric tube for feeding in a child?
    - What was the child's illness? Duration of NG feeds? Did she/he recover?
- How often do you provide nasogastric feeding?
- How do you decide who to give a nasogastric tube?
- Do you encounter any challenges in giving nasogastric feeding?
    - For example, do you have children who you cannot give it to? Or who refuse? Or cannot afford it?

4. Community perceptions

- How do caregivers react when you say their child needs oxygen?
- How do caregivers react when you say their child needs a nasogastric tube for feeding?
- Do caregivers refuse these treatments? If yes, why?

5. Recommendations

- What do you think is going right in your efforts to provide care for severely sick children? What are the main enablers of these efforts?
- What are the main barriers you face in providing care for severely sick children?
- What could be done in the communities to improve the health of children and prevent pneumonia?
- What could be done within your setting to improve the diagnosis and management of paediatric pneumonia?

Annex 4: Caregiver focus group discussion (FGD)

Pneumonia is a serious illness in children, which affects the lungs. This makes it difficult for children to breath, and can cause them to be very sick, and if it is not treated properly, can sometimes lead to children dying.

- Have you heard of pneumonia before?
- Do you know anyone who has had pneumonia, or a child with pneumonia?
- How is this different from other common infections and illnesses in children?

One of the treatments for pneumonia is to give them oxygen. We are going to tell you a story about a child who fell sick with pneumonia and was referred for oxygen treatment. We will pause in the story to ask you about your thoughts on ways their journey story could have been made better. Is that ok?

Narrative on the referral to hospital for treatment

- In this case, what challenges might the family face in going to the hospital?
- What factors would influence the decision to go?
- What would you do in this situation? Why?

Narrative on the recommendation for oxygen treatment at hospital

- Are you familiar with oxygen? What do you understand about this treatment?
- In this case, what challenges might the family face in accepting oxygen treatment?
- What factors would influence the decision to accept or not accept the treatment?
- What would you do in this situation? Why?

Narrative on the recommendation for nasogastric feeding at hospital

- Are you familiar with feeding through a tube? What do you understand about this treatment?
- In this case, what challenges might the family face in accepting tube feeding treatment?
- What factors would influence the decision to accept or not accept the treatment?
- What would you do in this situation? Why?

Narrative including a conversation in a community about misconceptions about feeding, force feeding and oxygen treatments

- Are you familiar with conversations such as these in your community?
- Why do you think people might think these things?
- Are you familiar with force feeding practices? What are these? When or why do they happen?

Annex 5: Caregiver in depth interview (IDI)

Thanks for agreeing to talk to me today. The point of the interview is to understand your experiences of your child's recent illness. First, I want to get to know a bit more about you and your typical family life. Can you tell me what an average day is like? What do you do? (Ice breaking question- also gives wider context)

1. Tell me a little bit about yourself and family.

- How many children do you have?
- What is your relationship with the father/mother of your children? (What kind of marriage?)
- Who lives in your household?
- Where were you born? Are you from here?

2. Care-seeking

Tell me the story of your child's recent pneumonia illness, including the care you received from any providers and the decisions you/your family/a healthcare provider made.

- Can you tell me about how you recognised that your child was ill and decided to seek care?
- What made you think your child was sick? What symptoms did you recognize?
- Did you know it was pneumonia? What do you understand of pneumonia?
- After you decided your child was sick, where and when was the decision to seek care made? Does anything about the child change this decision (e.g. gender/age)?
- Who made the decision to seek care, you, your partner, other family members? Together? How do you usually make decisions about seeking health care in your family?
- Did your communities cultural beliefs or religion influence your decision? If yes, how?
- Do your own cultural beliefs or religion influence where you decided to seek care? If yes, how?

3. Facility care

- Which facility did you attend first? Why did you decide to go there? Was this your first choice?
- How did you travel there, how long did it take and cost?
- What happened when you got to the facility?
- Was your child referred to hospital for review or admission? Did you take your child to hospital? If yes, what type of hospital was it (e.g. private/mission)? Why did you choose to go to this facility?
- At hospital, what care did your child receive? How many nights admitted?
- How much did this care cost? How long was your child admitted for?

4. Oxygen treatment

- Was your child recommended for oxygen treatment?
- How long did your child receive oxygen for? Was this the recommended time, or shorter/longer?
- How did you decide for your child to receive this treatment? Were you hesitant? Why?
- Did the healthcare provide explain this treatment to you?
- Did you pay for this treatment? Were you willing to pay? How much?
- Had you heard about oxygen treatment before you came here? What did you know about it?

5. Feeding

- Was your child recommended for tube feeding?
- How long did your child receive NG feeding? Was this the recommended time, or shorter/longer?
- How did you decide for your child to receive this treatment? Were you hesitant? Why?
- Did the healthcare provide explain this treatment to you?
- Did you pay for this treatment? Were you willing to pay? How much?
- Had you heard about tube feeding before you came here? What did you know about it?
- Did your child receive any other food or drink while they had this tube? Why was that given?

Annex 6: Time use study tool

Instructions: This tool aims to estimate the proportion of the clinicians' and nurses' time spent on Pneumonia patients. For this purpose, this tool tracks the various activities and time between clinician or nurse and patient. The time spent on activities will then be compared to the service providers' total time at work and her/his base salary. Thus an estimate of the monetary value of staff time in Pneumonia treatment will be created.

It is necessary to keep this tracking sheet for the same patient for the duration of hospitalization. To make sure the tool stays with the same patient, please fill in the patient information in the box below. In order to relate the time spent for Pneumonia patients to the workload due to other patients, it is also necessary to indicate the working hours of the respective service providers. This information stays within the project and is not shared to anyone outside of the project. Please do not exaggerate the working hours or the time spent with the patients, since both will bias the result of this study.

Please use the code of activities on the next page to describe the activity being observed. If you find the activity is not on the list, please use the code 88 and give some additional information. This coding is used to assess the time spent on Pneumonia patients in terms of the corresponding activities.

The first step to start the tracking should be to note the sequential number (1 for the first questionnaire, and so on) of this specific questionnaire as soon as the patient is assessed. We aim to have a sample of 30 severe and 30 very severe cases.

Questionnaire number: **_____ of 30 pneumonia**
_____ of 30 severe pneumonia

Health Facility:
Date of admission:
Time of admission:
Date of discharge:
Time of discharge:
Patient Name:
Address:
Age (months):
Sex (M/F):
Classification (pneumonia/severe pneumonia):

Codes

Activity	Code
Outpatient / Admission assessment and documentation, including clinical assessment, documentation, admission checklist etc.	1
Clinical handover about patients with pneumonia, including nursing and medical handover at beginning and end of each shift.	2
Ward round and other clinical discussions about patient management, including ward rounds, interdisciplinary discussions, etc.	3
Patient counselling and discussion, including providing advice, answering questions, giving emotional support, discussing health, etc.	4
Vital signs, including documentation, getting equipment, measurement, and documentation (e.g. heart rate, respiratory rate, blood pressure, weight, height, SpO_2)	5
Administration of IV or IM drugs, including documentation, drawing up, checking, and giving (e.g. benzylpenicillin, ceftriaxone, gentamicin, chloramphenicol)	6
Administration of ORAL drugs, including documentation, dispensing, checking, and giving (e.g. amoxycillin, paracetamol, ibuprofen)	7
Administration of INHALED drugs, including documentation, drawing up, checking, and giving (e.g. salbutamol)	8
Starting Oxygen therapy, including getting oxygen source, and setting up oxygen equipment and delivery devices, documentation, etc.	9
Monitoring and adjusting oxygen therapy, including pulse oximetry checks, adjusting flow rates, cleaning/adjusting prongs, suctioning, documentation, etc.	10
Administration of IV or NG (nasogastric) fluids, including documentation, drawing up, checking, setting up equipment, and giving (e.g. 0.9% saline, blood).	11
Administration of ORAL fluids, including documentation, dispensing, checking, and giving (e.g. ORS).	12
Chest Xray, including requesting, performing, reviewing results.	13
Other radiology/imaging, including requesting, performing, reviewing results (e.g. lung ultrasound).	14
Blood test, including requesting, taking sample, sending to lab, receiving results, reviewing results (e.g. Hb, HIV test, malaria film/RDT).	15
Other pathology/lab test, including requesting, taking sample, sending to lab, receiving results, reviewing results (e.g. wound swab, sputum sample, etc.).	16
Discharge planning and discharge, including talking to family, arranging follow up, giving discharge instructions, etc.	17
Other administrative tasks for patient: (please specify)	18
Other: (please specify)	88

Time Use Study Data Collection Tool

Day ___ of ____
Please start a new sheet for each day of the patient's stay in hospital

Start time	End Time	Activity (code)	Service Provider

Day countersigned by:

---------- ----------

Name Signature

Please start a new sheet for each day of the patient's stay in hospital

Annex 7: Program management

Table 5 INSPIRING collaboration partners and roles

Institution	Role
Save the Children UK, London, UK	Funder, Implementer
Save the Children Nigeria, Abuja, UK	Implementer
GlaxoSmithKline (GSK), Brentford, UK	Funder
GlaxoSmithKline (GSK) Nigeria, Lagos, Nigeria	Funding partner
Lagos State Ministry of Health, Lagos, Nigeria	Implementation partner
Ikorodu Local Government Area Office, Lagos, Nigeria	Implementation partner
University College London (UCL), London, UK	Lead Evaluation partner
Karolinska Institutet (KI), Solna, Sweden	Evaluation partner
University of Ibadan (UI) / University College Hospital (UCH), Ibadan, Nigeria	Lead Nigerian Evaluation partner
Murdoch Children's Research Institute (MCRI) / University of Melbourne (UoM)	Evaluation partner
Johns Hopkins University (JHU)	Evaluation partner