BMJ Paediatrics Open

A Prospective, observational cohort study to identify neonates and children at risk of postdischarge mortality in Dar es Salaam, Tanzania and Monrovia, Liberia: the PPDM study protocol

Chris A Rees ,[1,2] Rodrick Kisenge,[3] Readon C Ideh,[4] Julia Kamara,[4] Abraham Samma,[3] Evance Godfrey,[3] Hussein K Manji,[5] Christopher R Sudfeld,[6,7] Adrianna Westbrook,[8] Michelle Niescierenko,[9,10] Karim P Manji,[3] Christopher P Duggan[6,7,11,12]

To cite: Rees CA, Kisenge R, Ideh RC, *et al*. A Prospective, observational cohort study to identify neonates and children at risk of postdischarge mortality in Dar es Salaam, Tanzania and Monrovia, Liberia: the PPDM study protocol. *BMJ Paediatrics Open* 2022;**6**:e001379. doi:10.1136/bmjpo-2021-001379

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/bmjpo-2021-001379).

KPM and CPD contributed equally.

KPM and CPD are joint senior authors.

Received 15 December 2021
Accepted 29 December 2021

For numbered affiliations see end of article.

Correspondence to
Dr Chris A Rees; chris.rees@emory.edu

ABSTRACT

Introduction Over half of the 5 million annual deaths among children aged 0–59 months occur in sub-Saharan Africa. The period immediately after hospitalisation is a vulnerable time in the life of a child in sub-Saharan Africa as postdischarge mortality rates are as high as 1%–18%. Identification of neonates and children who are at highest risk for postdischarge mortality may allow for the direction of interventions to target patients at highest risk.

Methods and analysis The Predicting Post-Discharge Mortality study is a prospective, observational study being conducted at Muhimbili National Hospital (Dar es Salaam, Tanzania) and John F. Kennedy Medical Center (Monrovia, Liberia). The aim is to derive and validate two, age population specific, clinical prediction rules for the identification of neonates (n=2000) and children aged 1–59 months (n=2000) at risk for all-cause mortality within 60 days of discharge from the neonatal intensive care unit or paediatric ward. Caregivers of participants will receive phone calls 7, 14, 30, 45 and 60 days after discharge to assess vital status. Candidate predictor variables will include demographic, anthropometric and clinical factors. Elastic net regression will be used to derive the clinical prediction rules. Bootstrapped selection with repetitions will be used for internal validation. Planned secondary analyses include the external validation of existing clinical prediction models, determination of clinicians' ability to identify neonates and children at risk of postdischarge mortality at discharge, analysis of factors associated with hospital readmission and unplanned clinic visits and description of health-seeking behaviours in the postdischarge period.

Ethics and dissemination This study received ethical clearance from the Tanzania National Institute of Medical Research, Muhimbili University of Health and Allied Sciences, the John F. Kennedy Medical Center Institutional Review Board, and the Boston Children's Hospital Institutional Review Board. Findings will be disseminated at scientific conferences and as peer-reviewed publications.

What is already known on this topic?

- Postdischarge mortality rates among children in sub-Saharan Africa are estimated to be as high as 1%–18%.
- Two clinical prediction rules have been derived from studies conducted in Uganda and Mozambique to identify children at risk of postdischarge mortality in sub-Saharan Africa.
- Neither of the existing clinical prediction rules have been externally validated and have not specifically targeted neonates.

What this study hopes to add?

- This prospective, observational cohort study in Liberia and Tanzania will derive and validate two, novel, population-specific, clinical prediction rules to identify neonates and children at risk of postdischarge mortality·
- This study will elucidate clinician gestalt in the identification of neonates and children at risk of postdischarge mortality·
- This study will add further understanding of postdischarge health-seeking behaviours for children in sub-Saharan Africa.

INTRODUCTION

Since the 1990s, mortality rates among children under 5 years of age decreased by >50% globally.[1] However, progress in reducing childhood mortality has been geographically uneven, with more than half of the 5 million annual deaths among children occurring in sub-Saharan Africa.[2] Limited access to

healthcare providers, long distances to healthcare facilities and delayed care seeking contribute to high rates of childhood mortality in sub-Saharan Africa.[3–5]

Recently, emphasis has been placed on increasing access to high-quality healthcare for children in sub-Saharan Africa.[6] However, the period immediately after hospitalisation is a vulnerable time in the life of a child in resource-limited settings. Postdischarge mortality rates among children in parts of sub-Saharan Africa are estimated to be as high as 1%–18%, even outpacing inpatient mortality rates in some studies.[7] Despite this documented vulnerability, postdischarge mortality has largely been neglected in policy and practice.[8]

Two clinical prediction rules have been derived to identify children at risk of postdischarge mortality in single countries in sub-Saharan Africa. Wiens *et al* derived a model to identify infants and children aged 6–59 months at risk of postdischarge mortality up to 6 months after discharge from two Ugandan hospitals with suspected or proven infections.[9] In addition, Madrid *et al* derived a model to identify children aged <15 years admitted with all diagnoses at risk of 90-day postdischarge mortality in Mozambique.[10] Only malnutrition, HIV-positive status and altered mental status were associated with postdischarge mortality in both studies. All other clinical parameters associated with postdischarge mortality differed between these two studies.

Neither of these clinical prediction rules have been externally validated, making their impact on reducing postdischarge mortality unclear. Moreover, neonates have not been the focus of either clinical prediction rule despite contributing to nearly half of all deaths among children aged 0–59 months.[11] Factors that predict postdischarge mortality for neonates may differ from those for children 1–59 months due to differences in leading causes of death by age. Identification of neonates and children who are at highest risk for postdischarge mortality may allow for the direction of interventions to target patients at highest risk.[8]

To this end, the Predicting Post-Discharge Mortality (PPDM) study will derive and validate two, age population-specific, clinical prediction rules to identify neonates and children aged 1–59 months at risk of all-cause mortality within 60 days of discharge from the neonatal intensive care unit (NICU) or paediatric ward at two sites in sub-Saharan Africa.

METHODS

Study design

PPDM is a prospective, observational study being conducted at Muhimbili National Hospital in Dar es Salaam, Tanzania and John F. Kennedy Medical Center in Monrovia, Liberia. The study protocol was developed by collaborators in Tanzania (Muhimbili University of Health and Allied Sciences and Muhimbili National Hospital), Liberia (John F. Kennedy Medical Center) and the USA (Boston Children's Hospital, Harvard T.H. Chan School of Public Health and Emory University School of Medicine). The study diagram is included in figure 1. Enrolment began on 1 October 2019. Patient follow-up data collection will conclude on 31 January 2022. This protocol follows the Strengthening the Reporting of Observational Studies in Epidemiology guidelines for cohort studies (online supplemental file 1).

The combined study population between Liberia and Tanzania will be approximately 4000 participants (2000 neonates, 2000 children aged 1–59 months) who are discharged from the two sites. Each site will enrol 1000 neonates and 1000 children aged 1–59 months. Enrolled neonates and children will be followed through phone calls after discharge at 7, 14, 30, 45 and 60 days to assess postdischarge outcomes and health-seeking behaviours.

Patient and public involvement

Caregivers, patients and the public were not involved in the development of the study protocol.

Primary and secondary objectives

The primary objective of the study is to derive and internally validate two, age population-specific, clinical prediction rules to identify neonates and children aged 1–59 months at risk of postdischarge mortality within 60 days of discharge from the NICU or paediatric ward at two sites in sub-Saharan Africa. Our secondary objectives are to (1) externally validate existing clinical prediction rules for postdischarge mortality developed from studies in Uganda and Mozambique,[9 10] (2) determine clinicians' ability to accurately identify neonates and children at risk of postdischarge mortality and hospital readmission at the time of hospital discharge, (3) describe factors associated with hospital readmission and unplanned clinic visits after discharge and (4) describe health-seeking behaviours in the postdischarge period among children who die as well as those who survive beyond 60 days.

Study setting

Muhimbili National Hospital and John F. Kennedy Medical Center are large, referral, training hospitals for Tanzania and Liberia, respectively. Both hospitals are government hospitals supported by each country's Ministry of Health. Both hospitals are located in urban areas with surrounding populations of 4 million for Muhimbili National Hospital and 1.5 million for John F. Kennedy Medical Center. Both hospitals have approximately 140–150 paediatric discharges and approximately 170 NICU discharges per month.

Eligibility

We will include participants aged 0–59 months with all diagnoses who are discharged from the NICU or the paediatric ward. Participants will be included if their caregivers consent to have their hospital admission data gathered and to receive follow-up phone calls. We will exclude children who (1) die during their initial hospitalisation, (2) are older than 59 months of age or (3) have non-consenting caregivers. We will not enrol participants

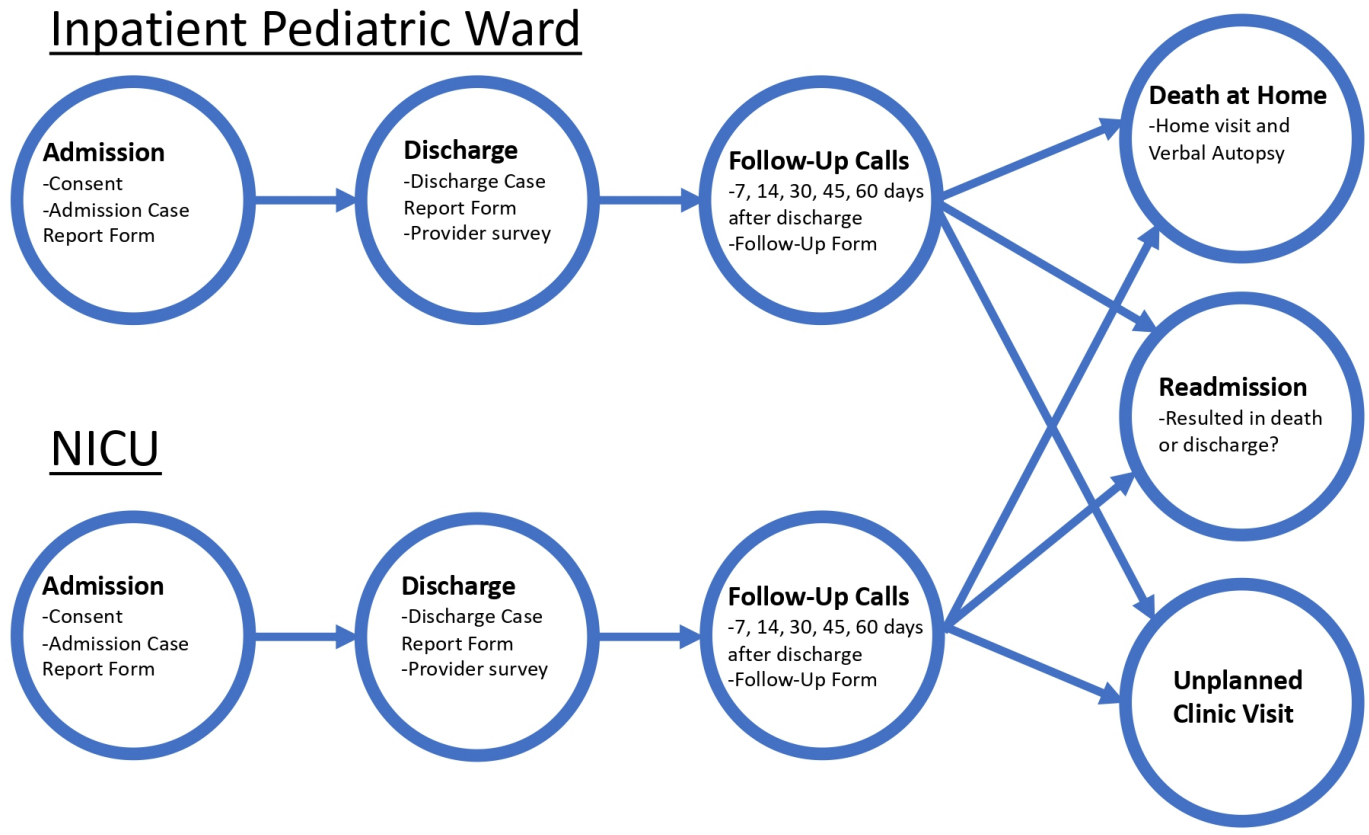

Figure 1 The Predicting Post-Discharge Mortality study design. (NICU: neonatal intensive care unit).

who are transferred to other hospitals; however, both hospitals are large referral hospitals and, therefore, transfer out is rare.

Sample size

Previous studies at Muhimbili National Hospital evaluating patients with malnutrition and abdominal pain suggest postdischarge mortality rates as high as 13%–15%.[12 13] Since there are no previous studies describing postdischarge mortality at John F. Kennedy Medical Center and postdischarge mortality rates among all discharged patients at Muhimbili National Hospital may be lower than among specific populations, we conservatively estimate a 5% postdischarge mortality rate. We also anticipate a lost-to-follow-up rate of 3% in each cohort. Therefore, we will enrol 1000 patients in each cohort (NICU and paediatric wards) at each site (n=4000 total) to derive and validate two, age population-specific, clinical prediction rules to predict postdischarge mortality (2000 in each population). We expect at least 100 deaths and 150 hospital readmissions in each cohort. Using the rule of 10 events per item in a clinical prediction rule and assuming a 5% mortality rate, we will be able to include at least five variables in each clinical prediction rule for postdischarge mortality.[14]

Standard of care

All enrolled children will receive standards of care per Tanzanian Ministry of Health guidelines at Muhimbili National Hospital and standards of care set forth by the John F. Kennedy Medical Center and the Liberian Ministry of Health. This care will be provided by the clinical care teams and not by this study's staff.

Recruitment

Caregivers of participants will be approached by research assistants at the time of hospital discharge and asked to consent to the study. Consenting providers will provide informed consent in their own language (written in Kiswahili or witnessed thumbprint if not literate in Tanzania and verbal consent in English in Liberia). We will collect data at the time of discharge using a secure case report form on password-protected tablets or computers. Research assistants at each site will undergo rigorous training regarding study enrolment, data collection, retention and follow-up.

Screening and enrollment procedures

Research assistants will identify consecutive patients eligible for study enrolment in the days preceding discharge. During that time, research assistants will confirm inclusion and exclusion criteria for each potential participant who is admitted to the NICU or the paediatric ward. For consenting participants, key clinical findings and laboratory data will be documented in case report forms for factors present at admission and discharge (online supplemental files 2, 3). If no contraindication to study participation is found, a research assistant will approach the primary caregiver of the child and describe the study procedures. If the child is eligible and

the caregiver consents to participation, informed consent will be obtained. The parent or guardian must provide informed consent prior to enrolment.

Research assistants will fill out case report forms on password-protected, encrypted software (Microsoft SQL in Tanzania and Kobo Toolbox in Liberia) with variables collected as part of the study. We will collect patient anthropometrics as measured during hospitalisation using standardised scales for weight, height/length as measured using available measuring boards and middle-upper arm circumference if documented by clinicians caring for children during their hospitalisation. We will calculate weight for height z-scores for age. We will collect data on documented nutritional status for the child during the hospitalisation (eg, severe acute malnutrition, kwashiorkor, etc).

Primary and secondary diagnoses at the time of admission and discharge will be collected by research assistants as documented. We will also collect information on any reported comorbidities (eg, HIV, tuberculosis, malignancies, etc) documented by the clinical care team. We will document the duration of hospital admission as documented in patients' charts. Research assistants will ask caregivers about recent hospitalisations and document responses. Research assistants will record results from labs and imaging done during the hospitalisation, receipt of therapies including oxygen (ie, nasal cannula, face mask, etc), intravenous fluids and mode of receipt (ie, bolus, maintenance fluids, etc), medications (both type and duration) received during hospitalisation and procedures or surgeries performed.

As this is an observational study, we anticipate there will be some missing variables in clinical documentation. Research assistants will attempt to fill in any missing variables prior to discharge. Variables for individual participants still missing after the research assistants' attempt to complete data will be accounted for with multiple imputations or excluded from analyses.

Research assistants will collect detailed contact information from the caregivers using a standardised patient locator form, including at least two working cell phone numbers for the caregiver, and a physical description of the whereabouts of the child's home. If a caregiver does not have a mobile phone, we will obtain the mobile phone information of a household member or friend. We expect fewer than 5% of participants to be without cell phone access.

Follow-up visits

Research assistants will make phone calls to each caregiver of children at 7, 14, 30, 45 and 60 days after hospital discharge to ascertain the child's vital status and to ask about health-seeking behaviours (online supplemental file 4). The equivalent of US$1 will be transferred via local phone companies to each participant for each follow-up phone call. Text messages will be sent to caregivers who do not answer the phone.[15] If caregivers are still unreachable, research assistants will conduct home visits. Participants whose caregivers are unreachable despite three phone calls, two text messages and a home visit will be classified as lost-to-follow-up.

At each telephone or in-person contact, a research assistant will ask the caregiver about the following and record the responses:

1. The child's status (ie, well, ill, hospitalised, dead).
2. Any intercurrent illnesses.
3. Any clinic or emergency department visits since hospitalisation.
4. The caregivers' seeking of other forms of treatment (ie, herbs, pharmacy, etc).
5. Reason for returning to clinic (eg, fever, vomiting, etc).

Caregivers will be asked by study staff to take their child to a clinic or hospital if they feel their children are severely ill between phone calls. For patients who are found to have died at home or in hospitals other than Muhimbili National Hospital and John F. Kennedy Medical Center prior to follow-up phone calls, research assistants will conduct home visits to use the WHO's 2016 Verbal Autopsy Tool[16] (online supplemental file 5) used to describe the death of a child outside of the formal healthcare system.[17 18] Home visits will be arranged at a time convenient for caregivers and with adequate time after the child's death to allow the family to mourn as is culturally appropriate. Research assistants will bring a contextually appropriate condolence gift (eg, a bag of rice) to caregivers of the deceased child. All research staff who will conduct home visits will undergo rigorous training in use of the WHO's 2016 Verbal Autopsy Tool.

Quality assurance

A study coordinator will be employed to assure that training of the field staff is high quality and rigorous. A data manager will generate weekly data summaries showing recruitment progress, follow-up and event rates to ensure high-quality and complete data reporting. These quality assurance approaches will be reinforced by each site's principal investigator and by collaborators from the USA. Data cleaning will be performed using consistency and range checks. Data quality checks will also be applied weekly, and feedback will be provided to the study coordinators at both sites.

Outcome measures

Our primary outcome of postdischarge mortality and secondary outcomes including hospital readmissions, unplanned clinic visits and other care-seeking behaviours will be measured by caregiver report during follow-up calls and in-person home visits.

Statistical analysis

All candidate variables will be selected *a priori* based on prior studies,[7 19–22] modified Delphi studies of factors thought to be associated with postdischarge mortality in sub-Saharan Africa,[23 24] and experience among the research team. For the derivation of the clinical

prediction rules, we will use elastic net regression,[25] including all candidate variables to assess the strength of the association of each candidate variable on postdischarge mortality. Associations with 95% CIs for adjusted ORs that do not cross one will be considered significant. To determine the weighted points assigned to each candidate variable, we will calculate the adjusted log coefficient of each candidate variable from the multivariable model, round it to the nearest 0.5, and then double the rounded log coefficients to form an integer.[26–29] We will assess the performance of the clinical prediction rules through internal validation using bootstrapping methodology with repetitions and calculate the area under the receiver operating characteristic (ROC) curve.[30–33]

We will also externally validate the clinical prediction rules derived in Uganda[9] and in Mozambique[10] by calculating the sensitivity, specificity and positive and negative likelihood ratios of each score at ≥ each specified cut point as defined in these rules. We will also create ROC curves for each existing score. We will assess the association of clinicians' estimated probability of postdischarge outcomes and actual outcomes using ROC curves. We will use multivariable logistic regression to identify factors independently associated with 60-day hospital readmission and unplanned clinic visits among neonates and children. As previous studies suggest that healthcare seeking is infrequent among children who experience postdischarge mortality,[34 35] we will review data from follow-up calls and verbal autopsies to calculate descriptive statistics of the proportion of caregivers who seek care in the postdischarge period and compare rates of care-seeking between children who die in the postdischarge period to those who survived.

ETHICS AND DISSEMINATION

This study received ethical clearance from the Tanzania National Institute of Medical Research, Muhimbili University of Health and Allied Sciences, the John F. Kennedy Medical Center Institutional Review Board and the Boston Children's Hospital Institutional Review Board. We will disseminate our results in the form of scientific conference presentations and as peer-reviewed publications.

Author affiliations
[1]Division of Pediatric Emergency Medicine, Emory University School of Medicine, Atlanta, Georgia, USA
[2]Emergency Medicine, Children's Healthcare of Atlanta, Atlanta, Georgia, USA
[3]Department of Pediatrics and Child Health, Muhimbili University of Health and Allied Sciences, Dar es Salaam, United Republic of Tanzania
[4]Department of Pediatrics, John F. Kennedy Medical Center, Monrovia, Liberia
[5]Department of Emergency Medicine, Muhimbili University of Health and Allied Sciences, Dar es Salaam, United Republic of Tanzania
[6]Department of Nutrition, Harvard T.H. Chan School of Public Health, Boston, Massachusetts, USA
[7]Department of Global Health and Population, Harvard T.H. Chan School of Public Health, Boston, Massachusetts, USA
[8]Pediatric Biostatistics Core, Emory University School of Medicine, Atlanta, Georgia, USA
[9]Division of Emergency Medicine, Boston Children's Hospital, Boston, Massachusetts, USA
[10]Department of Pediatrics, Harvard Medical School, Boston, Massachusetts, USA
[11]Division of Gastroenterology, Hepatology, and Nutrition, Boston Children's Hospital, Boston, Massachusetts, USA
[12]Center for Nutrition, Boston Children's Hospital, Boston, Massachusetts, USA

Acknowledgements The authors thank Juliana Mghambha, Mohamed Bakari, Dr. Nodermus Elias, Dr. Lawrence Kurwa, Dr. Tabu Mvile, Dr. Musa Malifedha, Veneranda Ndesangia, Naomi Mmbaga, Christina Japhet, Celestine Kagunila, Agnes Obed, Anna Fundi and Sarah Somji for their assistance in data collection and data management. We thank Melvin M. Kabba-Kay and Fidelis Njokanma for their support of this study. We also thank the nurses and nurse supervisors who have contributed to data collection at both Muhimbili National Hospital and the John F. Kennedy Medical Centre.

Contributors All authors contributed to the study conceptualisation, the study design, sample size calculations and writing of the protocol for this study. CAR, KM and CD prepared the first draft of the paper. All authors contributed to revisions of the manuscript and contributed to the revision of the final manuscript. All authors have read and approved the final manuscript.

Funding This work was supported by the National Institutes of Health (K24 DK104676and P30 DK040561 to CPD), the Boston Children's Hospital Global Health Program to CAR and the Palfrey Fund for Child Health Advocacy to CAR.

Disclaimer The funders had no role in the study design or in the collection, analysis, or interpretation of the data. The funders did not write the report and had no role in the decision to submit the paper for publication.

Competing interests None declared.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request to the corresponding author.

ORCID iD
Chris A Rees http://orcid.org/0000-0001-6449-0377

REFERENCES

1 You D, Hug L, Ejdemyr S, *et al*. Global, regional, and national levels and trends in under-5 mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Inter-agency group for child mortality estimation. *Lancet* 2015;386:2275–86.
2 GBD 2019 Demographics Collaborators. Global age-sex-specific fertility, mortality, healthy life expectancy (HALE), and population estimates in 204 countries and territories, 1950-2019: a comprehensive demographic analysis for the global burden of disease study 2019. *Lancet* 2020;396:1160–203.
3 Forde I, Tripathi V. Association of place of residence and Under-Five mortality in middle- and low-income countries: a meta-analysis. *Children* 2018;5:51.
4 Kinney MV, Kerber KJ, Black RE, *et al*. Sub-Saharan Africa's mothers, newborns, and children: where and why do they die? *PLoS Med* 2010;7:e1000294.
5 Kagabo DM, Kirk CM, Bakundukize B, *et al*. Care-seeking patterns among families that experienced under-five child mortality in rural Rwanda. *PLoS One* 2018;13:e0190739.

6 Kruk ME, Gage AD, Arsenault C, *et al*. High-quality health systems in the sustainable development goals era: time for a revolution. *Lancet Glob Health* 2018;6:e1196–252.
7 Wiens MO, Pawluk S, Kissoon N, *et al*. Pediatric post-discharge mortality in resource poor countries: a systematic review. *PLoS One* 2013;8:e66698.
8 Wiens MO, Kissoon N, Kabakyenga J. Smart Hospital discharges to address a neglected epidemic in sepsis in low- and middle-income countries. *JAMA Pediatr* 2018;172:213–4.
9 Wiens MO, Kumbakumba E, Larson CP, *et al*. Postdischarge mortality in children with acute infectious diseases: derivation of postdischarge mortality prediction models. *BMJ Open* 2015;5:e009449.
10 Madrid L, Casellas A, Sacoor C, *et al*. Postdischarge mortality prediction in sub-Saharan Africa. *Pediatrics* 2019;143:e20180606.
11 Liu L, Oza S, Hogan D, *et al*. Global, regional, and national causes of under-5 mortality in 2000–15: an updated systematic analysis with implications for the sustainable development goals. *The Lancet* 2016;388:3027–35.
12 Villamor E, Misegades L, Fataki MR, *et al*. Child mortality in relation to HIV infection, nutritional status, and socio-economic background. *Int J Epidemiol* 2005;34:61–8.
13 Sakita FM, Sawe HR, Mwafongo V, *et al*. The burden and outcomes of abdominal pain among children presenting to an emergency department of a tertiary hospital in Tanzania: a descriptive cohort study. *Emerg Med Int* 2018;2018:3982648
14 Moons KGM, Royston P, Vergouwe Y, *et al*. Prognosis and prognostic research: what, why, and how? *BMJ* 2009;338:b375.
15 Finocchario-Kessler S, Gautney BJ, Khamadi S, *et al*. If you text them, they will come: using the HIV infant tracking system to improve early infant diagnosis quality and retention in Kenya. *AIDS* 2014;28 Suppl 3:S313–21.
16 World Health Organization. Verbal autopsy standards: ascertaining and attributing causes of death, 2016. Available: http://www.who.int/healthinfo/statistics/verbalautopsystandards/en/ [Accessed 15 Jul 2018].
17 Islam MA, Rahman MM, Mahalanabis D, *et al*. Death in a diarrhoeal cohort of infants and young children soon after discharge from Hospital: risk factors and causes by verbal autopsy. *J Trop Pediatr* 1996;42:342–7.
18 Chelo D, Nguefack F, Ntoude A, *et al*. Verbal autopsy and therapeutic itinerary of children who die before arrival in a paediatric centre in Yaoundé, Cameroon. *Transl Pediatr* 2016;5:16–22.
19 Chhibber AV, Hill PC, Jafali J, *et al*. Child mortality after discharge from a health facility following suspected pneumonia, meningitis or septicaemia in rural Gambia: a cohort study. *PLoS One* 2015;10:e0137095.
20 Ngari MM, Fegan G, Mwangome MK, *et al*. Mortality after inpatient treatment for severe pneumonia in children: a cohort study. *Paediatr Perinat Epidemiol* 2017;31:233–42.
21 O'Sullivan NP, Lelijveld N, Rutishauser-Perera A, *et al*. Follow-Up between 6 and 24 months after discharge from treatment for severe acute malnutrition in children aged 6-59 months: a systematic review. *PLoS One* 2018;13:e0202053.
22 John C, Diala U, Adah R, *et al*. Survival and nutritional status of children with severe acute malnutrition, six months post-discharge from outpatient treatment in Jigawa state, Nigeria. *PLoS One* 2018;13:e0196971.
23 Wiens MO, Kissoon N, Kumbakumba E, *et al*. Selecting candidate predictor variables for the modelling of post-discharge mortality from sepsis: a protocol development project. *Afr Health Sci* 2016;16:162–9.
24 Nemetchek BR, Liang LD, Kissoon N, *et al*. Predictor variables for post-discharge mortality modelling in infants: a protocol development project. *Afr Health Sci* 2018;18:1214–25.
25 Zou H, Hastie T. Regularization and variable selection via the elastic net. *J Royal Statistical Soc B* 2005;67:301–20.
26 Reed C, Madhi SA, Klugman KP, *et al*. Development of the respiratory index of severity in children (RISC) score among young children with respiratory infections in South Africa. *PLoS One* 2012;7:e27793.
27 Gallagher KE, Knoll MD, Prosperi C, *et al*. The predictive performance of a pneumonia severity score in human immunodeficiency virus-negative children presenting to hospital in 7 low- and middle-income countries. *Clin Infect Dis* 2020;70:1050–7.
28 Harrell FE, Lee KL, Mark DB. Multivariable prognostic models: issues in developing models, evaluating assumptions and adequacy, and measuring and reducing errors. *Stat Med* 1996;15:361–87.
29 Le Gall JR, Lemeshow S, Saulnier F. A new simplified acute physiology score (saps II) based on a European/North American multicenter study. *JAMA* 1993;270:2957–63.
30 Steyerberg EW, Harrell FE. Prediction models need appropriate internal, internal-external, and external validation. *J Clin Epidemiol* 2016;69:245–7.
31 Steyerberg EW, Harrell FE, Borsboom GJ, *et al*. Internal validation of predictive models: efficiency of some procedures for logistic regression analysis. *J Clin Epidemiol* 2001;54:774–81.
32 Riley RD, Ensor J, Snell KIE, *et al*. Calculating the sample size required for developing a clinical prediction model. *BMJ* 2020;368:m441.
33 Iba K, Shinozaki T, Maruo K, *et al*. Re-evaluation of the comparative effectiveness of bootstrap-based optimism correction methods in the development of multivariable clinical prediction models. *BMC Med Res Methodol* 2021;21:9.
34 Chisti MJ, Graham SM, Duke T, *et al*. Post-discharge mortality in children with severe malnutrition and pneumonia in Bangladesh. *PLoS One* 2014;9:e107663.
35 Lapidot R, Larson Williams A, MacLeod WB, *et al*. Verbal autopsies for out-of-hospital infant deaths in Zambia. *Pediatrics* 2021;147:e20201767.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Supplement 2-4
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-9
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	7
		(*d*) If applicable, explain how loss to follow-up was addressed	7
		(*e*) Describe any sensitivity analyses	NA
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	NA
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	NA
		(b) Indicate number of participants with missing data for each variable of interest	NA
		(c) Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	Report numbers of outcome events or summary measures over time	NA
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	NA
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	NA
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	NA
Generalisability	21	Discuss the generalisability (external validity) of the study results	NA
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	10

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Admission Case Report Form

Date of Data Collection _____
DD/MM/YYYY

Admission Date _____
DD/MM/YYYY

Patient's FIRST name _____

Patient's LAST name _____

Patient's SEX: Male Female

Location of Admission: Inpatient Pediatric Ward NICU Oncology Ward Cardiology Ward MOI

Participant's Hospital Identifier _____ (Unique number assigned to each patient)

Patient's Age _____ (Reported in days (NICU), months, or years)

Patient's Date of Birth _____
DD/MM/YYYY

Caregiver's Name(s) _____

Caregiver's Age _____ (Reported in years)

Is the patient's mother or father deceased? Yes: Mother Yes: Father Yes: Both No

Is the patient's caregiver married? Yes No Divorced Cohabitating

What is the caregiver's highest level of education? No formal schooling

Completed secondary school Some secondary school Completed primary school

Some primary school Vocational/technical training Completed college/university

Some college/university Other

Caregiver's phone number (or number in which the caregiver can reliably be reached):

_____

Caregiver's Mapcues:

_____

Prior to admission to the hospital, what was the duration of symptoms? _____ (duration of symptoms in hours, days, weeks, months)

Prior to being admitted to MNH, did the child receive care at another health facility? Yes No

If Yes, what type of health facility(ies)?

Select all that apply.
Clinic
Health Center
Hospital
Pharmacy
Traditional Healer
Herbalist
Bone Setter
Other

If yes, what is the name of the referring health facility? _____

Who made the decision to bring the child to the hospital? Caregiver Other family member
Someone else in the community Other

Were there barriers in coming to MNH when the patient became sick? Yes No

If yes, what were the barriers?
Transportation
Money
Approval of family/community
Fear of hospital
Other

Does the child have any chronic medical conditions? Yes No

If yes, what chronic medical problems? _____

If yes, is the patient enrolled in any form of chronic care clinic? Yes No

Has the patient been admitted to the hospital before? Yes No

If yes, how many times? _____

If yes, how long ago was the last time? _____ (days, months, or years)

If yes, what was the diagnosis during the last admission? _____

If yes, did the patient receive a blood transfusion? Yes No

Does the patient take any medications chronically? Yes No

If yes, which medication(s)? _____

Has the patient ever had surgery? Yes No

If yes, when? _____ (month, year)

If yes, what kind of surgery? _____

Was the patient breastfed after birth? Yes No

If yes, exclusively? Yes No

If exclusively, until what age? _____ (in months or year)

Is the patient full immunized? Certificated Not certificated Incomplete Unknown
Not applicable (neonate)

Is the patient developmentally delayed? Yes No

Is the patient in school? Yes No

If yes, what grade is the patient in school? _____

Does the patient's parent(s) have any medical problems? Yes No

If yes, what medical problems? _____

How many children are in the household? _____

Have any children in the household died in the past? Yes No

If yes, at what age? _____ (in days, months, years)

If yes, what was the cause of death? _____

Are there any smokers in the home? Yes No

What is the household's primary source of drinking water? Piped Water Hand Pump Well Hand Pump Bore Hole Water from a Spring Rain Water Surface Water Mineral Water Other: _____

Does the household do any of the following to treat the household's drinking water? Boil it Filter it Buy it Treat it with chlorine/iodine None

What kind of toilets are used in the home? Flush toilet Outside/Pit Other

Does the patient sleep under a mosquito net? Yes No

How does the household get rid of waste? Garbage Dump near home Burn it Swamp Other

What type of health facility is nearest the home? Clinic Health Center Hospital Other

How long does it take to get to the nearest health facility? _____ (minutes, hours, days)

Patient's weight on admission: _____ (in kilograms)

Patient's height/length on admission: _____ (in centimeters)

Patient's head circumference on admission: _____ (in centimeters)

Patient's middle upper arm circumference on admission: _____ (in centimeters)

Admission temperature: _____ (in Celsius)

Admission heart rate: _____ (in beats per minute)

Admission blood pressure: _____ (in mmHg)

Admission respiratory rate: _____ (in breaths per minute)

Admission oxygen saturation: _____ (in percentage)

Presence of bilateral pedal edema: Yes No

Patient's alertness on admission: Alert Voice Pain Unresponsive

Presence of any of the following on physical exam: Cyanosis Pallor Jaundice Clubbing Dehydration Prostration

Primary admission diagnosis: _____

Severity: _____

Secondary admission diagnosis(es): _____

Severity: _____

Patient's condition on admission: Stable, critical

Shock present at admission: Yes No

If yes, what kind of shock? Septic Cardiogenic Neurogenic Hypovolemic

Is patient malnourished? Yes No

If yes, degree of malnutrition? Mild Moderate Severe Underweight Wasted Stunted Kwashiorkor

For NICU Admissions (these will be collected in addition to the above variables)

Mother's gravida number: _____

Mother's para number: _____

Mother's abortion number: _____

Mother's number of prior dead children at delivery: _____

Was the mother referred from another hospital? Yes No

If yes, what is the name of the other hospital? _____

Complications of this pregnancy: _____

Gestational age: _____ (weeks, months)

Type of delivery: Vaginal C-section Vacuum

Duration of labor: _____ (in hours)

Color of amniotic fluid: Clear Green Bloody Unknown

Apgar score at 1 minute: _____

Apgar score at 5 minutes: _____

Apgar score at 10 minutes: _____

Birth weight: _____ (in grams or kilograms)

Birth length: _____ (in centimeters)

Birth head circumference: _____ (in centimeters)

Discharge Case Report Form

Admission Date: _____
DD/MM/YYYY

Discharge Date: _____
DD/MM/YYYY

Date of Data Collection _____
DD/MM/YYYY

Patient's FIRST name _____

Patient's LAST name _____

Patient's SEX: Male Female

Participant's Hospital Identifier _____ (Unique number assigned to each patient)

Location of Discharge: Inpatient Pediatric Ward NICU Oncology Ward Cardiology Ward MOI

Disposition from the hospital: Discharge AMA Transfer

Is the patient to return to the hospital or clinic after discharge? Yes No

If yes, when? _____

If yes, what is the reason for follow up? _____

Primary discharge diagnosis: _____

Secondary discharge diagnosis: _____

Were any procedures done during the hospitalization? Yes No

If yes, which procedure(s)? _____

Did the patient have surgery during the admission? Yes No

If yes, what kind of surgery? _____

Discharge weight: _____ (in kilograms)

Discharge height/length: _____ (in centimeters)

Discharge head circumference: _____ (in centimeters)

Discharge middle upper arm circumference: _____ (in centimeters)

Bilateral pedal edema present? Yes No

Discharge temperature: _____ (in Celsius)

Discharge heart rate: _____ (in beats per minute)

Discharge blood pressure: _____ (in mmHg)

Discharge respiratory rate: _____ (in breaths per minute)

Discharge oxygen saturation: _____ (in percentage)

Were any laboratory investigations done? Yes No

If yes, what laboratory investigations were done? _____

What were the results of each laboratory investigation? _____

Was radiology imaging done? Yes No

If yes, what radiology imaging was done? _____

What was/were the results of each radiology imaging? _____

What medications were given during the admission? _____

How many days was each medication given for? _____

Were any IV fluids given during the admission? Yes No

If yes, what kind of IV fluids were given? _____

Did the patient receive oxygen therapy during the admission? Yes No

If yes, what form of oxygen therapy? Nasal cannula CPAP Positive pressure Ventilation Non-rebreather Ventilator Other

If yes, how many days did the patient receive oxygen therapy? _____

Did the patient receive nebulized treatments during the admission? Yes No

If yes, what kind? Salbutamol Normal saline Hypertonic saline Other

Did the patient receive treatment for malnutrition? Yes No

If yes, what treatment? F75 F100 Plumpy nut/RUTF IV fluids meant as nutrition

Did the patient receive a blood transfusion during the admission? Yes No

If yes, now many blood transfusions? _____

Did the patient receive an exchange transfusion during the admission? Yes No

Did the patient receive chemotherapy during the admission? Yes No

Were any of the following desired but not done during the admission? Laboratory tests Medications Procedures Other

If yes, why were these not done? Not available Cost Out of stock Other

What medications is the patient being discharged with? _____

Follow Up Call Form

Date of Data Collection _____
DD/MM/YYYY

Patient's FIRST name _____

Patient's LAST name _____

Patient's SEX: Male Female

Participant's Hospital Identifier _____ (Unique number assigned to each patient)

Discharge Date: _____
DD/MM/YYYY

Approximately, how many days has it been since the child was discharged?

7 14 30 45 60

Since the last phone call (or since discharge for the first call), how is the child doing?

Doing well Still sick Dead Other

Since the last phone call (or since discharge for the first call), has the child had any of the following symptoms? Common cold Cough Difficulty breathing Fever

Refusal to eat/drink/breastfeed Pus draining from the ears Vomiting Other

If yes to any of the above symptoms, for how many days? _____

If yes to any of the above symptoms, what did you do about the child's symptoms?

Took them to the hospital Took them to a clinic

Took them to an emergency department Went to a pharmacy

Gave them herbs Nothing

If the child was taken to a hospital, were they admitted to the hospital? Yes No

If the child was found to be ill during the phone call, did you instruct them to take the child to a health facility? Yes No

If yes, what kind of health facility? _____

Verbal Autopsy Form

Adapted from the WHO 2016 Verbal Autopsy Instrument.
To be conducted at the home of the deceased participant with the deceased's caregiver.

General Information

Date and Time of Data Collection [automatically entered]

Name of research nurse: _____

Medical Record Number:											

Name of deceased child: _____

Date of interview (dd / mm / yyyy)

Date of hospital/emergency discharge (dd mm / yyyy)

The patient was discharged from the:
- ☐ **1** hospital
- ☐ **2** NICU
- ☐ **3** emergency department

Name of caregiver: _____

What is your (the respondent's) relationship to the deceased?
- ☐ **1** mother
- ☐ **2** father
- ☐ **3** aunt
- ☐ **4** uncle
- ☐ **5** grandmother
- ☐ **6** grandfather
- ☐ **7** sister
- ☐ **8** brother
- ☐ **9** family friend
- ☐ **10** other. Please specify _____

Is the child's mother deceased?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** I don't know

Is the date of death known?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** refused to answer

If Yes,

(dd/ mm/ yyyy)

If Refused to answer, how old was the child at the time of death? _____

Circle one: weeks/months/years

Where did the deceased die?

- ☐ **1** hospital
- ☐ **2** other health facility
- ☐ **3** home
- ☐ **4** en route to hospital or facility
- ☐ **5** other. Please specify: _____
- ☐ **6** doesn't know
- ☐ **7** refused to answer

Where did the death occur? (specify country, province, district, village)

_____

Thank you for meeting with me. Can you please tell me in your own words about the events that led to the death?

Record detailed notes of response; use additional paper as needed. If needed, probe for additional details on when respondent recognized symptoms, care sought, barriers to care, issues with transport, abnormalities, etc.

Death from Injury or Accident

Did the deceased child die from an injury or accident?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, What kind of injury or accident?

- ☐ **1** road traffic accident
  - If Yes, What was the deceased child's role in the road traffic accident?
    - ☐ **1** pedestrian
    - ☐ **2** passenger in car
    - ☐ **3** passenger in motorcycle
    - ☐ **4** other
    - ☐ **5** doesn't know
    - ☐ **6** refused to answer
  - What was the counterpart that was hit during the road traffic accident?
    - ☐ **1** pedestrian
    - ☐ **2** stationary object
    - ☐ **3** car or light vehicle
    - ☐ **4** bus or heavy vehicle
    - ☐ **5** motorcycle
    - ☐ **6** pedal cycle
    - ☐ **7** doesn't know
    - ☐ **8** refused to answer
- ☐ **2** injured in a fall
- ☐ **3** poisoning
  - If Yes, with what? _____
- ☐ **4** drowning
- ☐ **5** bit or stung by a venomous animal
  - If Yes, What was the animal?
    - ☐ **1** dog
    - ☐ **2** snake
    - ☐ **3** insect or scorpion
    - ☐ **4** other. Please specify _____
    - ☐ **5** doesn't know
    - ☐ **6** refused to answer
- ☐ **6** injured by an animal (non-venomous)?
  - If Yes, What was the animal?
    - ☐ **1** dog
    - ☐ **2** snake
    - ☐ **3** insect or scorpion
    - ☐ **4** other. Please specify _____
    - ☐ **5** doesn't know
    - ☐ **6** refused to answer
- ☐ **7** injured by burns/fire
- ☐ **8** subject to violence (suicide, homicide, abuse)
- ☐ **9** injured by a firearm
- ☐ **10** stabbed cut or pierced
- ☐ **11** strangled
- ☐ **12** injured by blunt force

☐**13** injured by force of nature
☐**14** electrocution

If Yes, Was the injury accidental?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Health Status Before Death

Before the illness that led to death, was the baby/child growing normally?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

For how long was he/she ill before death?
_____
(Circle: days weeks months years)

Did he/she die suddenly?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Was there any diagnosis by a health professional of tuberculosis?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Was an HIV test ever positive for the deceased child?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

If Yes, Was there any diagnosis by a health professional of AIDS?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Did he/she have a recent (within 1 week of death) *positive* test by a health professional for malaria?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Did he/she have a recent (within 1 week of death) *negative* test by a health professional for malaria?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Was there any diagnosis by a health professional of measles?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Was there any diagnosis by a health professional of heart disease?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Was there any diagnosis by a health professional of diabetes?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Was there any diagnosis by a health professional of asthma?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Was there any diagnosis by a health professional of epilepsy?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Was there any diagnosis by a health professional of cancer?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Was there any diagnosis by a health professional of sickle cell disease?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Was there any diagnosis by a health professional of kidney disease?

- ☐ **1** yes

☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Was there any diagnosis by a health professional of liver disease?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

General Signs and Symptoms Associated with Final Illness

Did he/she have a fever?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, How long did the fever last? _____
(Circle: days weeks doesn't know)
If Yes, Did the fever continue until death?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, How severe was the fever?
☐**1** mild
☐**2** moderate
☐**3** severe
☐**4** doesn't know
☐**5** refused to answer
If Yes, What was the pattern of the fever?
☐**1** continuous
☐**2** on and off
☐**3** only at night
☐**4** doesn't know
☐**5** refused to answer

Did he/she have night sweats?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Did he/she have a cough?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, For how long did he/she have a cough? _____
(Circle: days weeks doesn't know)

If Yes, Was the cough productive with sputum?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, Was the cough very severe?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, Did he/she cough up blood?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, Did he/she make a "whooping sound" when coughing?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, Did he/she have any difficulty breathing?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, For how long did the difficulty breathing last? _____
(Circle: days weeks doesn't know)

If Yes, Was the difficulty continuous or on and off?
- ☐ **1** continuous
- ☐ **2** on and off
- ☐ **3** doesn't know
- ☐ **4** refused to answer

During the illness that led to death, did he/she have fast breathing?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, How long did the fast breathing last? _____
(Circle: days weeks doesn't know)

During the illness that led to death, did you see the lower chest wall/ribs being pulled in as the child breathed?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

During the illness that led to death, did his/her breathing sound like any of the following?
- ☐ **1** stridor
- ☐ **2** grunting

☐**3** wheezing
☐**4** doesn't know
☐**5** refused to answer

If the child was able to speak, did he/she have chest pain?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, How long did he/she have chest pain? _____
(Circle: days weeks doesn't know)

Did he/she have more frequent or loose or liquid stools than normal?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, For how long? _____
(Circle: days weeks doesn't know)
If Yes, How may stools did the child have on the day the loose stools were most frequent? _____
(Circle: days weeks doesn't know)
If Yes, How long before death did the frequent or loose stools start?
_____
(Circle: days weeks doesn't know)
If Yes, Did the frequent loose or liquid stools continue until death?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

At any time during the final illness was there blood in the stools?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, Was there blood in the stools up until death?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Did he/she vomit?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, Did he/she vomit in the week preceding the death?
☐**1** yes
☐**2** no
☐**3** doesn't know

☐**4** refused to answer

If Yes, Was there blood in the vomit?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

If Yes, Was the vomit black?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Did he/she have any belly (abdominal) problem?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

If Yes, Did he/she have belly (abdominal) pain?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

If Yes, Was the belly (abdominal) pain severe?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

If Yes, For how long did he/she have belly (abdominal) pain?

_____
(Circle: days weeks months doesn't know)

If Yes, Was the pain in the upper or lower belly (abdomen)?

☐**1** upper abdomen
☐**2** lower abdomen
☐**3** upper and lower abdomen
☐**4** doesn't know
☐**5** refused to answer

Did he/she have a more than usually protruding belly (abdomen) before death?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

If Yes, For how long? _____
(Circle: days weeks months doesn't know)

If Yes, How rapidly did he/she develop the protruding belly (abdomen)?

☐**1** rapidly
☐**2** slowly
☐**3** doesn't know
☐**4** refused to answer

If Yes, Did he/she have any mass in the belly (abdomen)?

☐**1** rapidly

☐**2** slowly
☐**3** doesn't know
☐**4** refused to answer
If Yes, For how long? _____ (Circle: days weeks months doesn't know)

Did he/she have a severe headache?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Did he/she have a stiff/painful neck during the illness that led to death?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, For how long? _____ (Circle: days weeks doesn't know)

During the illness that led to death, did the baby have a bulging or raised fontanelle (soft spot on the head)?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

During the illness that led to death, did the baby have a sunken fontanelle (soft spot on the head)?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Was he/she unconscious during the illness that led to death?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, Was he/she unconscious for more than 24 hours before death?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, How long before death did unconsciousness start? _____
(Circle: hours days doesn't know)
If Yes, Did the unconsciousness start suddenly, quickly (or at least within a single day)?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, Did the unconsciousness continue until death?
☐**1** yes

☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Did he/she have convulsions?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, Did he/she experience any generalized convulsions or fits during the illness that led to death?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If yes, Did he/she become unconscious immediately after the convulsion?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Did he/she have any urine problems?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, Did he/she urinate more often than usual?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, During the final illness before death, did he/she ever pass blood in the urine?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, Did he/she stop urinating?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Did he/she have sores or ulcers anywhere on the body?
☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer
If Yes, Did the sores have clear fluid or pus?
☐**1** yes
☐**2** no
☐**3** doesn't know

☐**4** refused to answer

If Yes, Did he/she have an ulcer (pit) on the foot?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

If Yes, Did the ulcer on the foot ooze pus?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

If Yes, For how long? _____
(Circle: hours days doesn't know)

During the illness that led to death, did he/she have any skin rash?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

If Yes, For how long? _____
(Circle: hours days doesn't know)

If Yes, Where was the rash?

☐**1** face
☐**2** trunk or abdomen
☐**3** extremities
☐**4** everywhere
☐**5** doesn't know
☐**6** refused to answer

If Yes, Did he/she have measles rash (use local term)?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

If Yes, During the illness that led to death, did his/her skin flake off in patches?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

If Yes, During the illness that led to death, did he/she have areas of the skin that turned black?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

If Yes, During the illness that led to death, did he/she have areas of the skin with redness and swelling?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

During the illness that led to death, did he/she bleed from anywhere?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, Did he/she bleed from the nose, mouth, or anus?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Did he/she have noticeable weight loss?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Was he/she severely thin?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

During the illness that lead to death, did he/she have a white rash on the inside of the mouth or on the tongue?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Did he/she have stiffness of the whole body or was unable to open the mouth?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Did he/she have puffiness of the face?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, For how long? _____
(Circle: hours days doesn't know)

During the illness that led to death, did he/she have swollen legs or feet?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, For how long? _____
(Circle: hours days doesn't know)

If yes, Did he/she have both feet swollen?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Did he/she have general puffiness all over his/her body?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Did he/she have any lumps?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, Did he/she have any lumps on the neck?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, Did he/she have any lumps in the armpit?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, Did he/she have any lumps in the groin?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

Was he/she in any way paralyzed?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, Did he/she have paralysis of only one side of the body?
- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, Which were the limbs or body parts paralyzed?
- ☐ **1** right side (arms and legs)
- ☐ **2** left side (arms and legs)
- ☐ **3** one leg only
- ☐ **4** one arm only
- ☐ **5** whole body
- ☐ **6** other. Please specify _____
- ☐ **7** doesn't know

☐**8** refused to answer

Did he/she have difficulty swallowing?
- ☐**1** yes
- ☐**2** no
- ☐**3** doesn't know
- ☐**4** refused to answer

If Yes, For how long? _____
(Circle: hours days doesn't know)

If Yes, Was the difficulty with swallowing solids, liquids, or both?
- ☐**1** solids
- ☐**2** liquids
- ☐**3** both
- ☐**4** doesn't know
- ☐**5** refused to answer

If Yes, Did he/she have pain upon swallowing?
- ☐**1** yes
- ☐**2** no
- ☐**3** doesn't know
- ☐**4** refused to answer

Did he/she have yellow discoloration of the eye?
- ☐**1** yes
- ☐**2** no
- ☐**3** doesn't know
- ☐**4** refused to answer

If Yes, For how long? _____
(Circle: hours days doesn't know)

Did his/her hair change in color to a reddish or yellowish color?
- ☐**1** yes
- ☐**2** no
- ☐**3** doesn't know
- ☐**4** refused to answer

Did he/she look pale (thinning/lack of blood) or have pale palms, eyes, or nail beds?
- ☐**1** yes
- ☐**2** no
- ☐**3** doesn't know
- ☐**4** refused to answer

Did he/she have sunken eyes?
- ☐**1** yes
- ☐**2** no
- ☐**3** doesn't know
- ☐**4** refused to answer

Did he/she drink more water than usual?
- ☐**1** yes
- ☐**2** no
- ☐**3** doesn't know

☐**4** refused to answer

Health Services Utilization Prior to Death

In the final 3 days before death, were there any doubts about whether medical care was needed?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Was care sought outside the home since we last spoke on the phone?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

If Yes, Where or from whom did you seek care?

☐**1** traditional healer
☐**2** homeopath
☐**3** religious leader
☐**4** government hospital
☐**5** government health center or clinic
☐**6** private hospital
☐**7** community-based health assistant
☐**8** private physician
☐**9** relative, friend (outside household)
☐**10** pharmacy
☐**11** other. Please specify _____
☐**11** doesn't know
☐**12** refused to answer

Did you use motorized transport to get to the health facility?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

In the final days before death, were any traditional medicines used?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Over the course of the illness, did the total costs of care and treatment prohibit other household payments?

☐**1** yes
☐**2** no
☐**3** doesn't know
☐**4** refused to answer

Did a healthcare worker tell you the cause of death?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, What did the health care worker say? _____

Death Certificate with Cause of Death

Was a death certificate issued?

- ☐ **1** yes
- ☐ **2** no
- ☐ **3** doesn't know
- ☐ **4** refused to answer

If Yes, Do you have the death certificate?

- ☐ **1** yes
- ☐ **2** no

If Yes, Is the date of registration available?

- ☐ **1** yes. Date of registration _____
- ☐ **2** no

Place of registration? _____

If Yes, Record the immediate cause of death from the certificate.

_____

If Yes, Record the antecedent cause(s) of death from the certificate.

_____
_____
_____
_____
_____