

Online Supplementary Document

Kalter et al. Direct estimates of national neonatal and child cause-specific mortality proportions in Niger by expert algorithm and physician-coded analysis of verbal autopsy interviews

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Appendix 1: Verbal autopsy expert algorithms for neonatal and child causes of death and for maternal infection

Neonatal causes of death

- Neonatal tetanus
 - (Age 3–27 days at death AND convulsions or spasms)
AND EITHER
((Able to suckle normally during the first day of life and stopped being able to suckle) OR (cried within 5 minutes after birth and stopped being able to cry))
- Congenital malformation
 - Gross malformation present at birth
- Birth asphyxia
 - Neonatal respiratory depression: (Did not cry within 5 minutes after birth OR did not breathe immediately after birth)
AND
Neonatal encephalopathy: (Not able to suckle normally in the first day of life OR convulsions/spasms OR lethargy) OR 0 days old at death
- Birth injury
 - Bruises or signs of injury on the body at birth
- Preterm delivery with respiratory distress syndrome (combined with preterm for final cause distribution)
 - Pregnancy duration less than 9 months
AND
(Fast breathing starting on day 0 AND no fever AND no cold to touch)
- Meningitis
 - Fever AND (bulging fontanelle OR convulsions) AND (lethargic OR unresponsive/unconscious)
- Diarrhea

- More frequent loose or liquid stools than usual AND more than 4 stools on the day the diarrhea was most frequent
- Pneumonia
 - (Fast breathing lasting 1 day or more OR difficult breathing lasting 1 day or more and lasting until death)
AND
2 or more of the following 3 signs: (chest indrawing, grunting, never cried OR stopped crying)
- Possible diarrhea (combined with diarrhea for final cause distribution)
 - More frequent loose or liquid stools than usual AND VA sepsis (see below) AND No VA diarrhea
- Possible pneumonia (combined with pneumonia for final cause distribution)
 - Difficult breathing AND VA sepsis AND No VA pneumonia
- Sepsis
 - Fever OR cold to touch
OR
2 or more of the following 7 signs: (fever OR cold to touch, did not suckle normally on the first day of life OR stopped suckling, convulsions, vomited everything, stopped crying, lethargic OR unconscious, chest indrawing OR grunting)
- Neonatal jaundice
 - Yellow skin or yellow eyes AND (stopped being able to suckle normally OR lethargic OR unresponsive/unconscious) AND No fever or hypothermia
- Neonatal hemorrhagic syndrome
 - Bleeding from anywhere AND No fever or cold to touch
- Sudden unexplained death
 - Died suddenly without appearing ill AND No illness signs or symptoms
- Preterm delivery
 - Pregnancy duration less than 8 months
- Unspecified (all others)
 - All VA diagnoses are negative

Child causes of death

- Injury
 - Suffered from motor vehicle accident, fall, drowning, poisoning, venomous bite or sting, burn, violence or other injury
AND
(Died 1 day or less after the injury AND the illness lasted 1 day or less) OR (Injury and No other VA diagnosis (except malnutrition allowed)) OR (Injury that was the first illness sign/symptom AND had VA other infection or fever))

- AIDS
 - (Swelling in the armpits OR a whitish rash inside the mouth/on the tongue)
AND
3 or more of the following 6 signs: (limbs became very thin, protruding belly, more frequent loose/liquid stools than usual for more than 30 days, fever or a skin rash for more than 30 days, fast breathing, chest indrawing)

- Malnutrition (underlying)
 - Limbs became very thin during the fatal illness OR had swollen legs or feet during the illness
AND
One of these was the first symptom of the illness

- Measles
 - Child's age greater than or equal to 120 days AND rash for 3 or more days AND fever for 3 or more days AND the rash started on the face

- Meningitis
 - Fever AND (stiff neck OR bulging fontanelle)

- Dysentery
 - More frequent loose or liquid stools than usual AND more than 4 stools on the day with the most stools AND blood in the stools
OR
More frequent loose or liquid stools than usual for more than 14 days AND blood in the stools

- Diarrhea
 - More frequent loose or liquid stools than usual AND more than 4 stools on the day with the most stools AND No blood in the stools
OR
More frequent loose or liquid stools than usual for more than 14 days AND No blood in stools

- Pertussis

- Cough more than 14 days AND (severe cough OR vomited after coughing OR stridor)
- Pneumonia
 - (Cough more than 2 days OR difficult breathing more than 2 days) AND (Fast breathing more than 2 days OR chest indrawing OR grunting)
- Malaria
 - Fever that continued till death AND was on and off in character AND No stiff neck AND No bulging fontanelle AND (pallor OR difficult breathing OR convulsions OR unconscious till death) OR Fever that continued till death AND was severe fever AND No stiff neck AND No bulging fontanelle AND (pallor OR convulsions OR unconscious till death)
- Possible dysentery (combined with dysentery for final cause distribution)
 - More frequent loose or liquid stools than usual AND (fever OR convulsions OR unconscious up till death) AND blood in the stools AND No VA dysentery
- Possible diarrhea (combined with diarrhea for final cause distribution)
 - More frequent loose or liquid stools than usual AND (fever OR convulsions OR unconscious up till death) AND No blood in the stools AND No VA diarrhea
- Possible pneumonia or ARI (combined with pneumonia for final cause distribution)
 - (Cough or difficult breathing) OR (Fast breathing AND (chest indrawing OR stridor OR grunting OR wheezing)) AND (Severe cough OR post-tussive vomiting OR fast breathing OR chest indrawing OR grunting OR stridor OR wheezing OR fever OR convulsions OR unconscious up till death) AND No VA Pertussis AND No VA pneumonia
- Hemorrhagic fever
 - Fever AND (bled from anywhere OR had areas of the skin that turned black)
- Other infection
 - Fever AND (rash on trunk, abdomen or everywhere OR convulsions OR unconscious up till death)
- Possible malaria (combined with malaria for final cause distribution)
 - Fever AND No other VA infectious causes of death
- Malnutrition (combined with underlying malnutrition for final cause distribution)

- Limbs became very thin during the fatal illness OR had swollen legs or feet during the illness
- Unspecified (all others)
 - All VA diagnoses are negative

Maternal complication

- Maternal infection during pregnancy
 - Fever AND (severe abdominal pain OR smelly vaginal discharge)
- Maternal infection during labor and delivery
 - Fever AND (severe abdominal pain OR smelly vaginal discharge OR foul smelling liquor)

Appendix 2: Verbal autopsy hierarchies

Neonatal causes of death

Neonatal tetanus
 Congenital malformation
 Birth asphyxia or Birth injury
 Preterm delivery with respiratory distress syndrome (combined with preterm delivery for final cause distribution)
 Meningitis
 Diarrhea
 Pneumonia
 Possible diarrhea (combined with diarrhea for final cause distribution)
 Possible pneumonia (combined with pneumonia for final cause distribution)
 Sepsis
 Neonatal jaundice
 Neonatal hemorrhagic syndrome
 Sudden unexplained death
 Preterm delivery
 Unspecified (all others)

Child causes of death

Injury (from motor vehicle accident, fall, drowning, poisoning, venomous bite or sting, burn, violence or other)
 AIDS
 Malnutrition (underlying)
 Measles

Meningitis
Dysentery
Diarrhea
Pertussis
Pneumonia
Malaria
Possible dysentery (combined with dysentery for final cause distribution)
Possible diarrhea (combined with diarrhea for final cause distribution)
Possible pneumonia (combined with pneumonia for final cause distribution)
Hemorrhagic fever
Other infections
Possible malaria (combined with malaria for final cause distribution)
Malnutrition (combined with underlying malnutrition for final cause distribution)
Unspecified (all others)

Appendix 3: Physician minimal diagnostic criteria

Neonatal causes of death

- Neonatal tetanus
 - Stopped suckling normally more than 2 days after birth AND Spasms or convulsions
- Congenital malformation
 - Physical abnormality at the time of delivery
- Birth asphyxia
 - Did not breath immediately after birth OR Did not cry immediately after birth
- Birth trauma
 - Bruises or signs of injury at birth
- Preterm delivery with respiratory distress syndrome
 - (Pregnancy duration less than 9 months OR Pregnancy ended early)
AND
(Fast breathing AND No fever AND No cold to touch)
- Meningitis (part of “Serious Infection”)
 - Bulging fontanelle OR Spasms or convulsions
- Diarrhea
 - More frequent loose or liquid stools than usual

- Pneumonia (part of “Serious Infection”)
 - Difficult breathing OR Fast breathing
- Sepsis (part of “Serious Infection”)
 - (Fever OR Cold to touch) AND (No diagnosis of pneumonia or meningitis)
- Preterm delivery
 - Pregnancy duration less than 8 months OR Pregnancy ended early
- Unspecified (Unknown)
 - Does not meet any of the above criteria AND No other specified diagnosis

Child causes of death

- Injury (Venomous, Drowning, Fall, Fire, Poisoning, Road traffic, Violent, Unspecified)
 - Suffered an injury or accident
- AIDS
 - Whitish rash of tongue or mouth OR Swelling in the armpits
- Malnutrition (severe)
 - Limbs became very thin OR Swollen legs or feet OR Protruding belly
- Measles
 - Fever AND Rash
- Meningitis
 - Stiff neck OR Bulging fontanelle OR Generalized convulsions or fits
- Dysentery
 - More frequent loose or liquid stools than usual AND Visible blood in the stools
- Diarrhea
 - More frequent loose or liquid stools than usual
- Pertussis
 - Severe cough
- Pneumonia
 - Difficult breathing OR Fast breathing
- Malaria

- Fever
- Hemorrhagic fever
 - Bleeding from anywhere OR Skin turned black
- Other childhood infectious disease (not specified above)
 - Fever AND Infectious diagnosis not specified above
- Unspecified (Unknown)
 - Does not meet any of the above criteria AND No other specified diagnosis