Causes of Death Identified in Neonates Enrolled Through Child Health and Mortality Prevention Surveillance (CHAMPS), December 2016 – February 2020

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Background

• Globally, 2.4 million deaths occur in neonates (<28 days age) each year.

• Majority of neonatal deaths occur in low- and middle-income countries, with neonatal mortality rates of 27 and 25 per 1000 live-births in sub-Saharan Africa and South Asia, respectively.

• Currently, causes of death attribution in LMIC is mainly based on ante-mortem clinical data and verbal-autopsies.

• Complete diagnostic autopsy is the gold standard for investigating the causes of death, although not feasible in resource constrain settings.

• Post-mortem minimal invasive tissue sampling (MITS) has been shown to have strong concordance in identifying the cause of death, especially for infectious causes.

• The Child Health and Mortality Prevention Surveillance program uses post-mortem MITS to investigate cause of death in <5 children.
Methods

• 0-27 days old neonatal deaths were enrolled.
• From Dec 2016 – Feb 2020. (pre COVID pandemic)
• Sites
  • South Africa
  • Kenya
  • Ethiopia
  • Mali
  • Mozambique
  • Sierra Leone
  • Bangladesh

• The MITS included collection of tissue from liver, lungs and brain and collection of blood, cerebrospinal fluid, stool, and nasopharyngeal swabs.
CHAMPS Determination of Cause of Death (DeCoDe)

Demographic Data
Verbal Autopsy
Clinical Abstraction
  Available medical records
Maternal Abstraction

DeCoDe Panel

Cause of Death Assignment
  ICD-10 and ICD-PM

MITS Collection Data
  • Anthropometrics
  • Photographs

Other Diagnostics
  • Blood and CSF culture
  • HIV (PCR)
  • TB (GeneXpert)
  • Malaria blood smears & RDT

Molecular Diagnostics
  TAC Results

Pathology Results
  • Site pathology report
  • CDC Central Pathology Laboratory: special stains, immunohistochemistry
  • Whole slide images
### Cause of death assignment following ICD-10 and ICD-PM: importance of causal chain

<table>
<thead>
<tr>
<th>Part 1</th>
<th>Part 2</th>
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</table>
| a. Immediate cause of death  
*“the disease or complication which directly preceded or directly led to death”* | Significant contributor  
*Other conditions that contribute to death* |
| b-c. Morbid causes of death | |
| d. Underlying cause of death  
*“disease or injury that initiated the train of events leading directly to death, or circumstances of accident or violence which produced the fatal injury”* | |

#### Morbid causes of death

**In the causal chain**

- a
- b
- c
- d

#### Underlying cause of death

**In the causal chain**

- a

#### Significant contributor

**Not in the causal chain**

- a
- b
- c
Enrolment by CHAMPS sites

Total neonatal death enrolled 847 and 98% (n=826) included in the analysis
Main maternal condition among neonate, by age group

- **Overall** maternal condition identified in 62% (n=512/826)
- **Death in 24 hours** maternal condition identified in 72% (n=244/341)
- **Early neonatal death 1-6 days** maternal condition identified in 61% (n=199/327)
- **Late neonatal death 7-27 days** maternal condition identified in 44% (n=69/158)
Leading underlying cause of death, by age group

- Overall underlying cause of death was identified in 98% (n=812)
- Death in 24 hours – Intrapartum events (41%)
- Early neonatal death 1-6 days – Prematurity (36%) & Intrapartum events (24%)
- Late neonatal death 7-27 days – Prematurity (44%) & Infection (27%)
Leading immediate/morbid conditions in the causal pathway

- Immediate condition - the disease or complication which directly led to death
- Morbid condition – antecedent condition in the causal pathway.

- Number of conditions in the causal pathway
  - 32% (N=236) only underlying condition was identified.
  - 32% (N=236) underlying condition along with immediate condition was identified in the causal pathway.
  - 20% (n=168) underlying condition along with immediate and 1 morbid condition was identified in the causal pathway.
  - 15% (n=127) underlying condition along immediate and more than 1 morbid condition was identified in the causal pathway.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Percentage</th>
<th>Count</th>
</tr>
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<tbody>
<tr>
<td>Perinatal asphyxia/hypoxia</td>
<td>9%, 78</td>
<td></td>
</tr>
<tr>
<td>Meningitis/Encephalitis</td>
<td>11%, 90</td>
<td></td>
</tr>
<tr>
<td>Lower respiratory infections</td>
<td>17%, 143</td>
<td></td>
</tr>
<tr>
<td>Sepsis</td>
<td>27%, 225</td>
<td></td>
</tr>
<tr>
<td>Preterm birth complications</td>
<td>30%, 249</td>
<td></td>
</tr>
</tbody>
</table>
Leading pathogens for infection in the causal pathway

- Infection in the causal pathway was identified among 42% (N=344) neonatal death
- Infection among 18% (n=62) death in 24 hours
- Infection among 47% (n=155) death in early neonates 1-6 days
- Infection among 80% (n=127) death in late neonates 7-28 days

Klebsiella pneumoniae
Acinetobacter baumannii
Escherichia coli
Streptococcus agalactiae
Staphylococcus aureus

WITS VIDA
WORLD HEALTH INFORMATION TECHNOLOGY AND DATA ANALYTICS PLATFORMS
CHAMPS
Preventability and recommendations

- 71% neonatal deaths are potentially preventable
- Improved clinical management (45%), Improved antenatal care (45%) and Improved Infection prevention (26%) are the main recommendations
Conclusion

• CHAMPS provides granular detail on the causal pathway to death.

• Obstetric care and infection play significant role in neonatal death.

• Unravelling the source of infection and development of appropriate preventive and therapeutic measures will help to reduce neonatal death in low- and middle-income countries.

• Highlights the complexities involved in each death along with the multiple opportunities for prevention
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