Gastroenteritis-associated deaths among children aged 1-59 months in rural and urban western Kenya, 2017-2021
Findings from the Child Health and Mortality Prevention Study (CHAMPS)

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Declining under-5 mortality, but still high in sub-Saharan Africa and South Asia

5-15% die before age 5

Deaths per 1,000 live births

- USA
- Finland
- South Africa
- Kenya
- Bangladesh
- Mali
- Ethiopia
- Sierra Leone
- Mozambique

Gastroenteritis (GE)

• GE: Inflammation of the intestinal lining
  • Caused by a virus, bacteria, or parasites
  • Accompanied with vomiting and diarrhoea
  • Untreated: Dehydration, kidney failure, and death

• Understanding GE mortality in children aged <5 years
  • Inform resource allocation for research and programs
  • Improve prioritization of prevention and treatment interventions
Child Health and Mortality Prevention Surveillance (CHAMPS)

- Prospective multisite under-5 mortality surveillance network
- Leveraging ongoing Health and Demographic Surveillance Systems (HDSS)
- Sites located in Sub-Saharan Africa and South Asia
- Identify the most preventable causes of mortality among children under-five years of age
- Produce and disseminate high quality data to inform policy and public health action
- Strengthen surveillance and health services infrastructure to prevent child mortality
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

Minimally Invasive Tissue Sampling

Molecular Diagnostics
- TAC (rectal swab, 57 targets covering 30 genera)

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

Pathology Results
- Site pathology report
- CDC Central Pathology Laboratory: special stains, immunohistochemistry
- Whole slide images
**Case definition and causal chain determination of death from ICD-10 and ICD-PM**

- **Gastroenteritis-associated Death (GEAD)** case definition: A deceased child aged 1-59 months, enrolled in the CHAMPS-Kenya study, and having gastroenteritis in the causal chain of death
  - GEAD: Gastroenteritis is the immediate, morbid or underlying cause of death

<table>
<thead>
<tr>
<th>Part 1</th>
<th>Immediate cause of death</th>
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<tbody>
<tr>
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<td><em>the disease or complication which directly preceded or directly led to death</em></td>
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<table>
<thead>
<tr>
<th>Part 1</th>
<th>Morbid causes of death</th>
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<tbody>
<tr>
<td></td>
<td><em>disease or injury that initiated the train of events leading directly to death, or circumstances of accident or violence which produced the fatal injury</em></td>
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<table>
<thead>
<tr>
<th>Part 2</th>
<th>Significant contributor</th>
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<td></td>
<td><em>Other conditions that contribute to death</em></td>
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**Source:** Blau, Dianna M., et al., 2019.
Deaths with Gastroenteritis in the causal chain, CHAMPS-Kenya, May 2017 to December 2021

Deaths reported (N=884)

Cause of death determined 617 (70%)

Deaths analysed (age 1-59 months) 225 (41%)

Excluded 362 (58.7%)
  a) Stillbirths; n=176
  b) Neonates; n=186

Non-Gastro Deaths (non-GEAD) 223 (88%)

Gastroenteritis associated deaths (GEAD) 32 (13%)
  Immediate cause: 17 (53%)
  Underlying Cause: 8 (25%)
  Morbid Condition: 7 (22%)

GEAD
• Median age 9 months (IQR 6-14)
• Female: 50%
• No change in frequency of GEAD from 2018 to 2021
  • 11% of deaths per year
## Characteristics of GEADs vs. non-GEADs

<table>
<thead>
<tr>
<th></th>
<th>Total Deaths (n=255)</th>
<th>GE Deaths (n=32)</th>
<th>Non-GE Deaths (n=223)</th>
<th>OR (95% CI)</th>
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<tbody>
<tr>
<td><strong>Place of Death</strong></td>
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<tr>
<td>Community</td>
<td>102 (40.0)</td>
<td>6 (18.7)</td>
<td>96 (43.0)</td>
<td>Ref</td>
</tr>
<tr>
<td>Hospital</td>
<td>153 (60.0)</td>
<td>26 (81.3)</td>
<td>127 (57.0)</td>
<td>3.28 (1.30-8.27)</td>
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<tr>
<td><strong>Residence</strong></td>
<td></td>
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<tr>
<td>Karemo (Rural)</td>
<td>123 (48.2)</td>
<td>8 (25.0)</td>
<td>115 (51.6)</td>
<td>Ref</td>
</tr>
<tr>
<td>Manyatta (Urban)</td>
<td>132 (51.8)</td>
<td>24 (75.0)</td>
<td>108 (48.4)</td>
<td>3.19 (1.38-7.42)</td>
</tr>
<tr>
<td><strong>Maternal Education</strong></td>
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<tr>
<td>1-8 years</td>
<td>127/200 (63.5)</td>
<td>10/23 (43.5)</td>
<td>117/177 (66.1)</td>
<td>Ref</td>
</tr>
<tr>
<td>&gt;8 years</td>
<td>73/200 (36.5)</td>
<td>13/23 (56.5)</td>
<td>60/177 (33.9)</td>
<td>2.54 (1.05-6.12)</td>
</tr>
</tbody>
</table>

*Age, Gender, HIV status, Current immunization, malnutrition, drinking water source and treatment, and maternal socioeconomic status were not associated with GE vs non-GE deaths*
• Malnutrition contributed to 34% of GEADs
• Malnutrition and HIV together contributed to 47% of GEADs
Etiologies of GEADs

- Rotavirus A
- Adenovirus
- Norovirus
- Campylobacter jejuni
- Salmonella spp
- No etiology identified

Death had both Adenovirus and Rotavirus identified (n=1)
Limitations

• Potential for missed deaths in 2017 and 2020
  • 2017: Study initiation included primarily facility deaths
  • 2020: COVID-19

• Multivariable analysis not feasible due to limited data
Summary and Recommendations

• Between 2018 and 2021, the rate of GEAD was stable (~11%)
  • Most deaths are preventable
  • Current clinical interventions may not be completely effective
• Children from families in urban areas with caregivers with more education were more likely to die of GE-related causes
• GEAD dominated by viral etiologies
• Malnutrition important underlying cause of death in GEAD
• Mortality surveillance using MITS is an important source of data to action for public health interventions
• Re-evaluation and update of GE clinical management guidelines important
Acknowledgements

• The Communities of the CHAMPS site
• The Family members of enrolled deaths
• The Ministry of Health of Kenya, Kisumu and Siaya counties
• CDC–Atlanta and Kenya
• The Kenya Medical Research Institute (KEMRI)
• CHAMPS staff
  • Determination of Cause of Death (DeCoDe) panelists
  • Clinic, Field, HDSS, Data, Laboratory, and collaborative project staff
• The CHAMPS project team and Investigators
• Bill & Melinda Gates Foundation
• Henry Jackson Foundation (HJF)
• Emory University Team- CHAMPS Network central coordination team
Thank you!
## Supplement

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<tr>
<th></th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>p-value*</th>
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<tbody>
<tr>
<td>Non-GEAD</td>
<td>(n=28)</td>
<td>(n=61)</td>
<td>(n=88)</td>
<td>(32)</td>
<td>(46)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>75%</td>
<td>89%</td>
<td>90%</td>
<td>88%</td>
<td>89%</td>
<td>0.23</td>
</tr>
<tr>
<td>GEAD</td>
<td>25%</td>
<td>12%</td>
<td>10%</td>
<td>13%</td>
<td>11%</td>
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*Cochrane-Armitage trend test*