Breastfeeding: new knowledge, old failures

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- Simon Murch
Declarations

• No interests to declare

• Views expressed are personal and do not necessarily represent the policies or position of the World Health Organization
Old knowledge

Breastfeeding
The single most effective intervention for reducing child mortality

<table>
<thead>
<tr>
<th>Preventive Interventions</th>
<th>Estimated under-5 deaths prevented</th>
<th>Proportion of all deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breastfeeding</td>
<td>1301 (13%)</td>
<td>13%</td>
</tr>
<tr>
<td>Insecticide-treated materials</td>
<td>691 (7%)</td>
<td>7%</td>
</tr>
<tr>
<td>Complementary feeding</td>
<td>587 (6%)</td>
<td>6%</td>
</tr>
<tr>
<td>Zinc</td>
<td>459 (351*)</td>
<td>5% (4%)*</td>
</tr>
<tr>
<td>Clean delivery</td>
<td>411 (4%)</td>
<td>4%</td>
</tr>
<tr>
<td>Hib vaccine</td>
<td>403 (4%)</td>
<td>4%</td>
</tr>
<tr>
<td>Water, sanitation, hygiene</td>
<td>326 (3%)</td>
<td>3%</td>
</tr>
<tr>
<td>Antenatal steroids</td>
<td>264 (3%)</td>
<td>3%</td>
</tr>
<tr>
<td>Newborn temperature management</td>
<td>227 (0)*</td>
<td>2% (0%)*</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>225 (176)*</td>
<td>2% (2%)*</td>
</tr>
<tr>
<td>Tetanus toxoid</td>
<td>161 (2%)</td>
<td>2%</td>
</tr>
<tr>
<td>Nevirapine and replacement feeding</td>
<td>150 (2%)</td>
<td>2%</td>
</tr>
<tr>
<td>Antibiotics for premature rupture of membranes</td>
<td>133 (0)*</td>
<td>1% (0%)*</td>
</tr>
<tr>
<td>Measles vaccine</td>
<td>103 (1%)</td>
<td>1%</td>
</tr>
<tr>
<td>Antimalarial intermittent preventive treatment in pregnancy</td>
<td>22 (&lt;1%)</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment Interventions</th>
<th>Estimated under-5 deaths prevented</th>
<th>Proportion of all deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral rehydration therapy</td>
<td>1477 (15%)</td>
<td>15%</td>
</tr>
<tr>
<td>Antibiotics for sepsis</td>
<td>583 (6%)</td>
<td>6%</td>
</tr>
<tr>
<td>Antibiotics for pneumonia</td>
<td>577 (6%)</td>
<td>6%</td>
</tr>
<tr>
<td>Antimalarials</td>
<td>467 (5%)</td>
<td>5%</td>
</tr>
<tr>
<td>Zinc</td>
<td>394 (4%)</td>
<td>4%</td>
</tr>
<tr>
<td>Newborn resuscitation</td>
<td>359 (0)*</td>
<td>4% (0%)*</td>
</tr>
<tr>
<td>Antibiotics for dysentery</td>
<td>310 (3%)</td>
<td>3%</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>8 (&lt;1%)</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>
Widely cited knowledge

- Benefits to infants of prolonged breastfeeding
  - Lower infectious mortality and morbidity
  - Fewer dental malocclusions
  - Higher IQ
  - Protection against overweight and diabetes

- Benefits to mother
  - Reduced risk of breast cancer
  - Birth spacing
  - Probable reduction of ovarian cancer
  - Probable reduction of diabetes

About 800,000 child deaths could be prevented each year through increased coverage of optimal breastfeeding

- Paper 1: 1,095 citations
- Paper 2: 391 citations
Early growth differences: lifelong effects

Between 3-12 m: 3.2kg gain  
Between 3-12 m: 4.3kg gain

50th centile @12m = 9.6kg  
50th centile @12m = 10.4kg

50th centile @3m = 6.4kg  
50th centile @3m = 6.1kg
What happens at birth …

- Gut colonisation amplified
  - Bacteria induce responses in the baby
    - Rapid increase in intestinal lymphocytes
    - Enlargement of Peyer’s patches
    - Systemic immune response – cytokines
    - Other genes induced
  - Different bacteria have different effects

The gut hosts the majority of immune cells in the body

Simon Murch
Breastfeeding – exquisitely personalised medicine at a critical moment

- Individualised components of breast milk
  - Bacteria from the mother’s gut microbiome
  - Immune cells primed in the mother’s intestine
  - Carbohydrates that shape the baby’s microbiome
  - Small RNA’s that control genes in the baby
  - Microvesicles (exosomes) that control genes
Role of human milk in extremely low birth weight infants’ risk of necrotizing enterocolitis or death

Total amount of breast milk in first 14 days

Proportion of breast milk in enteral intake in first 14 days
Human milk oligosaccharide composition predicts risk of necrotising enterocolitis in preterm infants

- Human milk oligosaccharides (HMO), complex glycans that are highly abundant in breast milk but not in infant formula, prevent NEC in a neonatal rat model.
- Of the more than 150 HMO described to date, a single oligosaccharide, disialyllacto-N-tetraose (DSLNT), is responsible for the beneficial effects in neonatal rats.

**Gut 2017;0:1–7.**

Chloe A Autran,1 Benjamin P Kellman,1,2 Jae H Kim,1 Elizabeth Asztalos,3 Arlin B Blood,4 Erin C Hamilton Spence,5 Aloka L Patel,6 Jiayi Hou,7 Nathan E Lewis,1,2,8 Lars Bode1

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**Control**

- Bell stage 1
- Bell stage 2
- Bell stage 3

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**Graphs**

**A**

- DSLNT [μg/mL] vs. time post partum (days)

**B**

- Total HMO [μg/mL] vs. time post partum (days)
Bifidobacterial Dominance of the Gut in Early Life and Acquisition of Antimicrobial Resistance

Diana H. Taft, Jinxin Liu, Maria X. Maldonado-Gomez, Samir Akre, M. Nazmul Huda, S. M. Ahmad, Charles B. Stephensen, David A. Mills

A. ResFinder Number of AMR Classes Present in Early Life
   p = 0.0021

B. ResFinder Number of ARGs Present in Early Life
   p < 0.0001

Antimicrobial resistance (AMR) classes
Antimicrobial resistance genes (ARGs)
Long non-coding RNAs are large functional molecules that are transcribed from DNA but do not translate into proteins. They can however, influence and regulate epigenetic modifications that are important for cellular health, immune cell regulation, metabolic health and development.
Breastmilk Is a Novel Source of Stem Cells with Multilineage Differentiation Potential

Stem Cells 2012;30:2164–2174
The hyperpermeable gut of the newborn infant

• Allows entry to the body of whole cells and much larger molecules than usual

• For what purpose .... **Watch this space!**
Breastfeeding practices over time

For each doubling in national GDP per capita, breastfeeding prevalence at 12 months decreases by 10 percentage points.
How is it that the remarkable nature of breastmilk and breastfeeding has failed to captivate human practices?

• Yes, ...
  • Breastfeeding can be difficult
  • Some women cannot produce enough milk
  • Returning to school or work are real challenges
  • Some women prefer to give replacement milk

• But ...
Failure to measure what is important

BF at 12 months

Figure 1: Global distribution of breastfeeding at 12 months
Data are from 153 countries between 1995 and 2013.
Failure to invest

• “Abbott Laboratories, which makes Similac and other formulas, spent $790,000 on lobbying this year, (Center for Responsive Politics)

• Though the company spent more in past years, this year they lobbied the U.S. Trade Representative on “proposals regarding infant nutrition marketing.”

2016 Annual review
- CHF 10.3 billion
- 22.7% Trading operating profit margin

‘.. an exceptional year in exceptional times.’

Every $1 invested in enabling a mother to breastfeed generates $35 in economic returns.

= additional $ 5.7 billion = $4.70 per newborn
Failure to share the responsibility for creating a supportive environment for mothers to exercise choice.
Failure to protect science and policy

One of the most important ingredients in breast milk you've never heard of

Mother's milk is a rich source of many ingredients essential for a baby's first few months. Formula milk is unlikely to ever be a perfect substitute — but with the addition of human milk oligosaccharides, it has just got closer.

ADVERTISEMET FEATURE

FORMULA MILK

Overdiagnosis and industry influence: how cows' milk protein allergy is extending the reach of infant formula manufacturers

The condition may be helping the baby milk industry to form relationships with the paediatric profession, finds Chris van Tulleken — with potential for harm to mothers and children

Chris van Tulleken honorary senior lecturer, University College London, UK

- 2006 to 2016 (UK):
  - Prescriptions for CMPA increased by 500%
  - NHS spending on these products increased by 700% (£8.1m to £60m annually)
- Guideline members receiving funds from industry
  - 5/11 members of NICE guideline (2011)
  - 10/12 members of ESPGHAN guidelines (2012)
  - 5/5 members of MAP guidelines (2013)
  - 12/12 members of iMAP guideline (2017)
SURVIVE
THRIVE