

# Environmental Enteropathy

Ahmed Laving  
University of Nairobi

# Outline

Malnutrition & Stunting

The Dirty Chicken Story

Definition

Features

Management

# Malnutrition & Stunting

Malnutrition attributed to 1/3 of all deaths in children less than 5 years of age

Stunting: Height for age  $<3SD$

Globally: 25%, Kenya: 26%

Increased morbidity and mortality in childhood

Long term: affects cognitive function, work output, stunted women with small children

Levels and Trends in Child Malnutrition: UNICEF/WHO/The World Bank joint child malnutrition estimates, 2013

Kenya Counties Facts Sheets. 2014 Kenya Demographics and Health Survey (OF28)

**Table 1: Direct interventions with demonstrated effectiveness on maternal and child undernutrition<sup>29</sup>**

<b>Maternal and birth outcomes</b>	<b>Newborn babies</b>	<b>Infants and young children</b>
<p>Iron folate supplementation</p> <p>Maternal supplements of multiple micronutrients</p> <p>Maternal iodine through iodisation of salt</p> <p>Maternal calcium supplementation</p> <p>Interventions to reduce tobacco consumption or indoor air pollution</p>	<p>Promotion of breastfeeding (individual and group counselling)</p>	<p>Promotion of breastfeeding (individual and group counselling)</p> <p>Behaviour change communication for improved complementary feeding for infants*</p> <p>Zinc supplementation</p> <p>Zinc in management of diarrhoea</p> <p>Vitamin A fortification or supplementation</p> <p>Universal salt iodisation</p> <p>Hand washing or hygiene interventions</p> <p>Treatment of Severe Acute Malnutrition</p>

# Nutrition Interventions

Despite several nutrition interventions, rate of stunting has only decreased by 1/3

Any other factors?

Diarrhoea

Hygiene

Sanitation

HIV

# Dirty Chicken Study

## Dirty Chick

Raised in 'usual' chicken cages filled with feces, dust, and dander



## Clean Chick

Raised in cages that were steam-cleaned



Slides courtesy of J Humphrey



## Dirty Chicken Study

- 'Clean Chicks' grew better than 'Dirty Chicks'
- 'Dirty Chicks' fed antibiotics grew as well as 'Clean Chicks'
- Antibiotics did not improve growth in 'Clean Chicks'
- Poor growth in 'Dirty Chicks' accompanied by elevated plasma IL-1 (indicator of immune stress)
- Elevated IL-1 not observed in 'Clean Chicks' or 'Dirty Chicks' fed antibiotics



# Enteropathy

- Is subclinical inflammation of the GIT contributing to the malnutrition?
- Tropical enteropathy:
  - Adults visiting tropical regions developed malabsorption
  - Biopsies showed villous blunting
  - Treated with long term antibiotics
  - Resolution of symptoms on returning to “home” country
  - Children in low SES noted to have similar features
- Term replaced with Environmental Enteropathy



# Environmental Enteropathy

- Also known as Environmental Enteric Dysfunction (EED)
- Incompletely defined syndrome of GIT inflammation
- Flat, inflamed gut characterized by:
  - Villous blunting
  - Some malabsorption
  - Inflammatory cell infiltrates in the gut mucosa
  - Increased permeability
  - Bacterial overgrowth

# EE/EED: Features

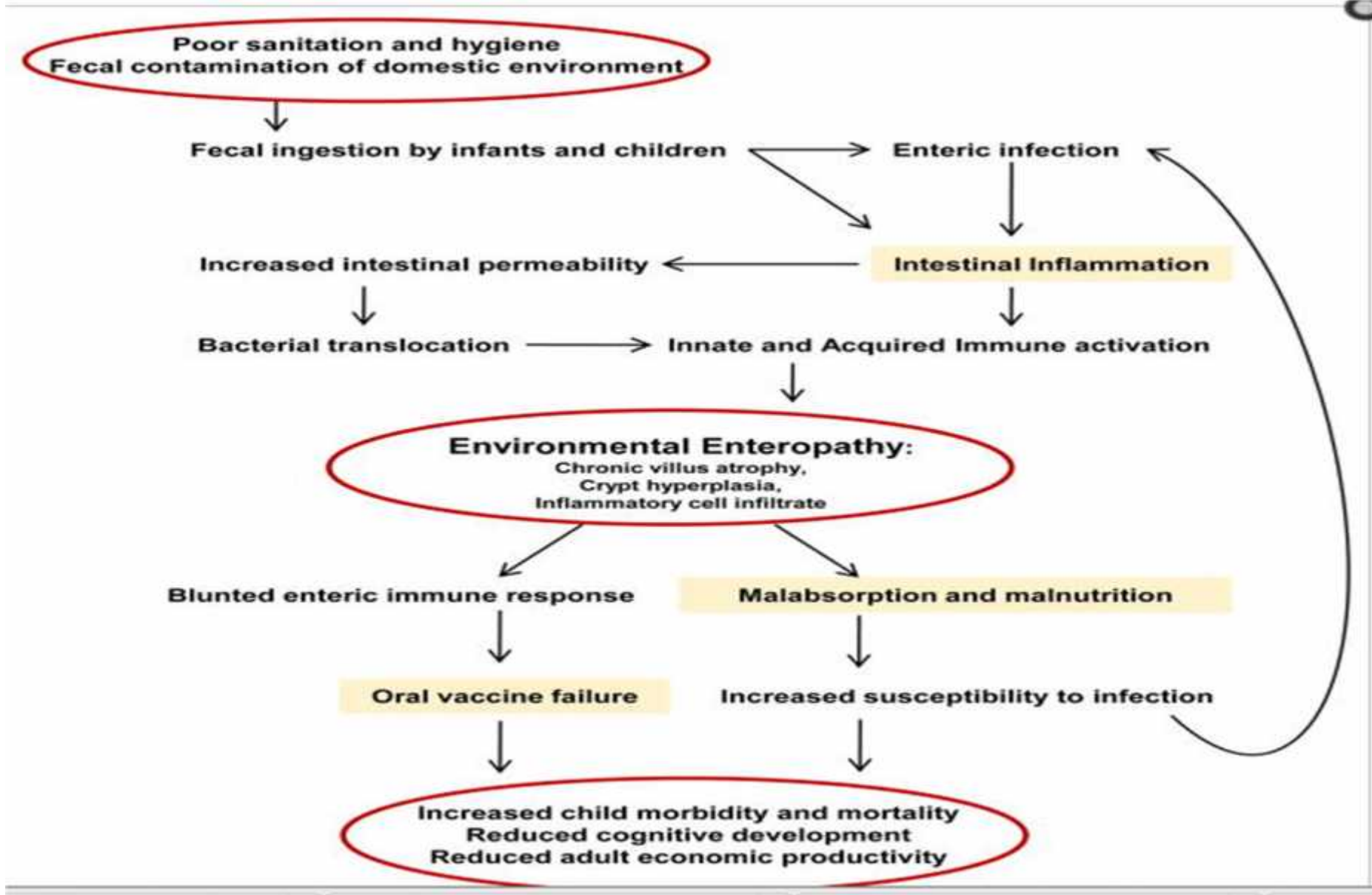
Diarrhea

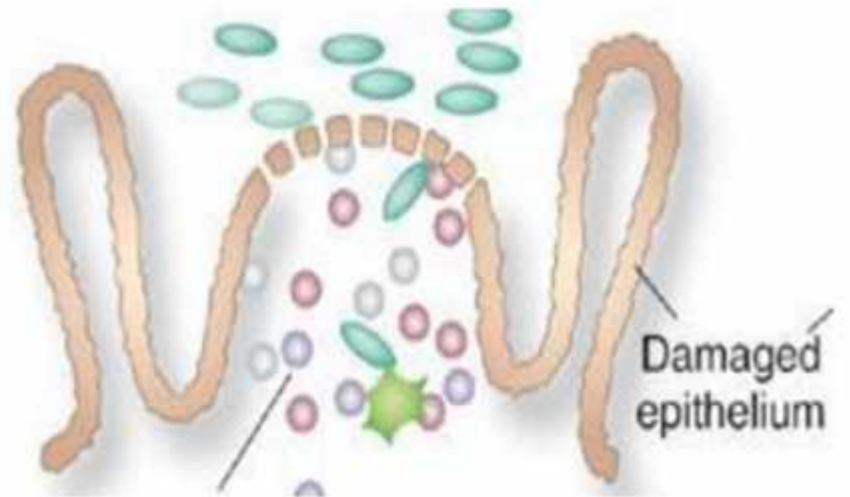
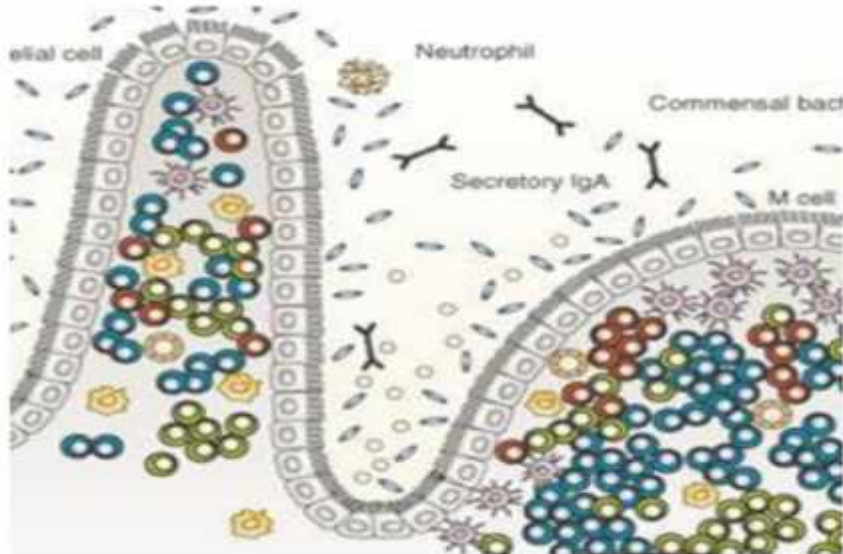
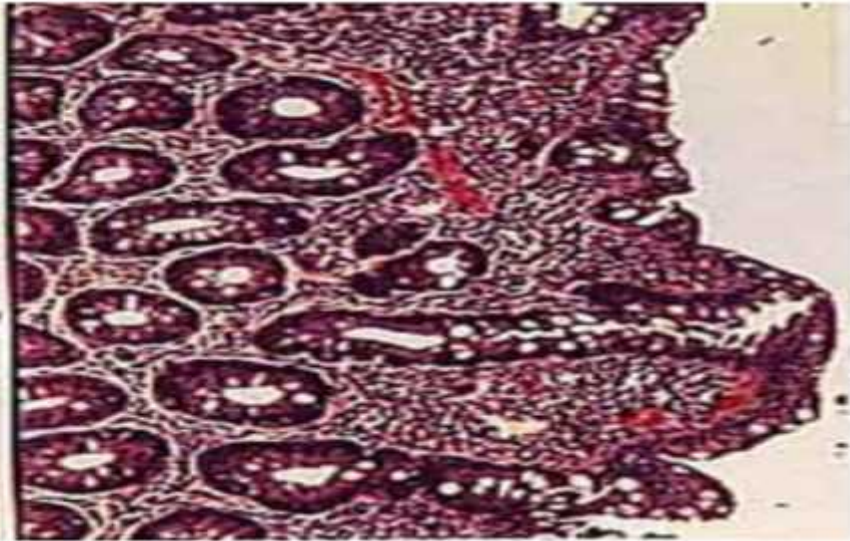
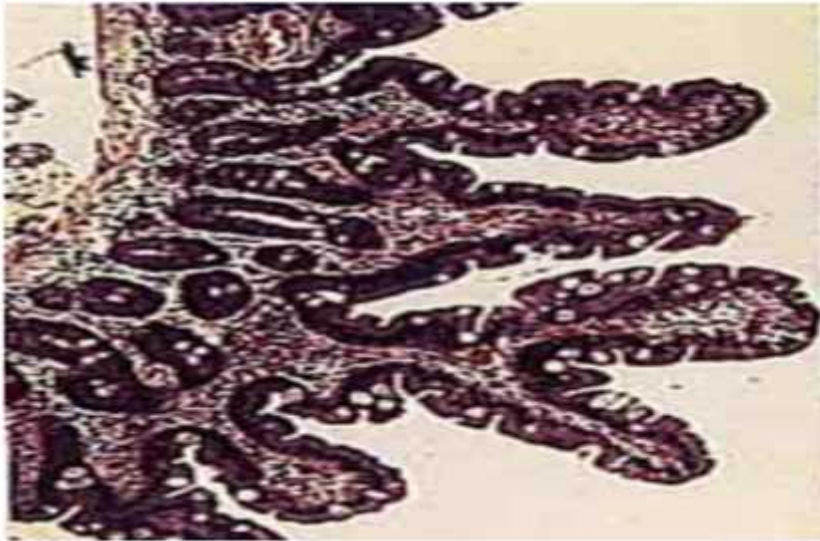
Impaired nutrient absorption

Enhanced microbial translocation

Local and systemic T-cell immune activation

Poor vaccine uptake?





# EE: Vaccines

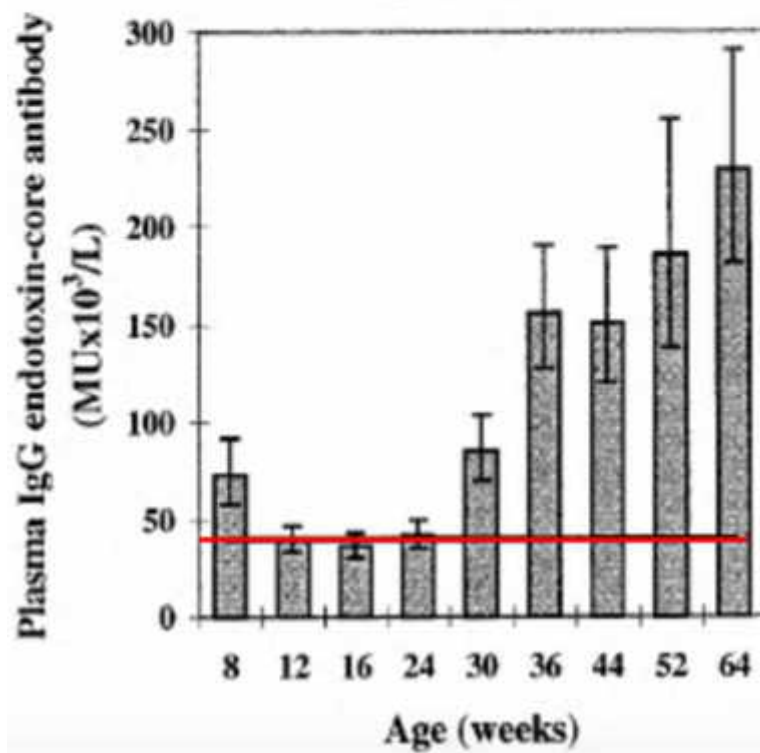
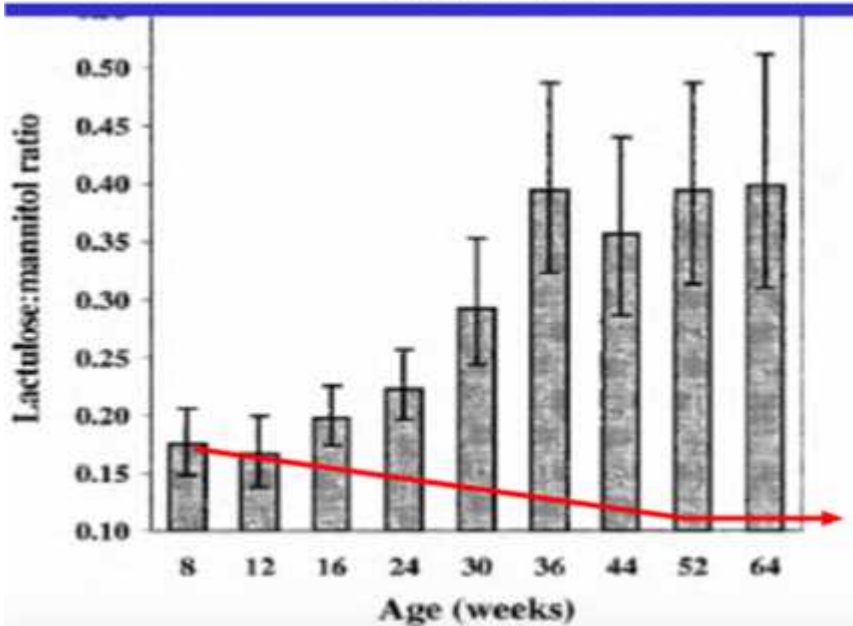
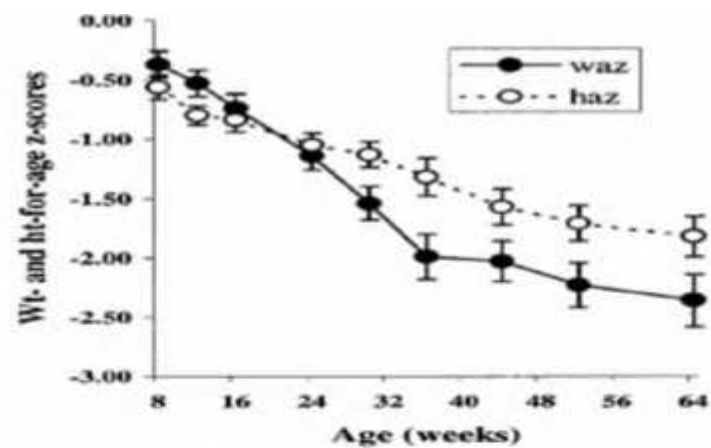
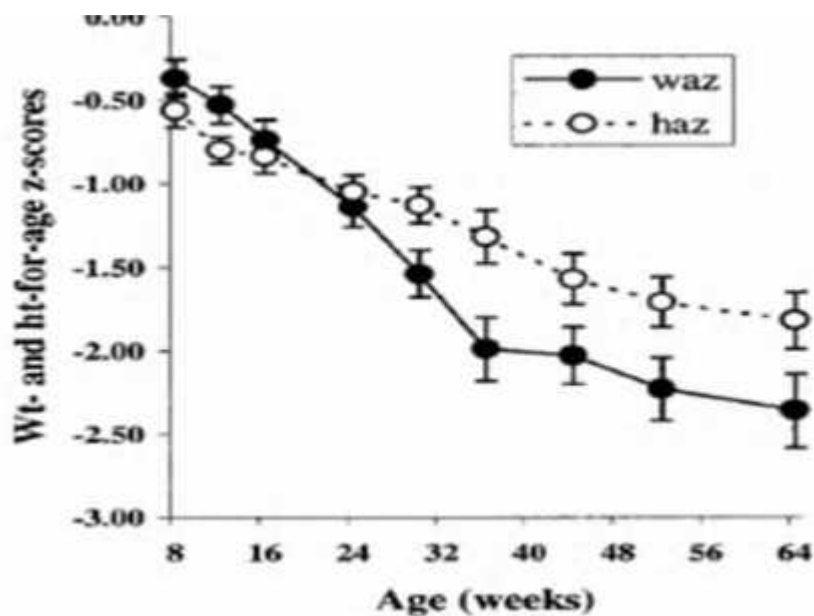
- EE may reduce efficacy of oral vaccines
  - ?Over-vigorous local immune response with destruction of live attenuated vaccines
- Rota virus vaccine:
  - Africa 39.3%
  - Asia 48.3%
  - Europe/America 85-98%
- Stunted Bangladesh children significantly lower OPV response by 1 year compared to non-stunted children

# Diagnosis

- Confirmation: endoscopy and small intestinal biopsy
- Dual sugar absorption test: Lactulose:Mannitol test
  - Lactulose large sugar, not absorbed
  - Mannitol small sugar, absorbed according to GIT surface area
  - Urinary mannitol: index index of absorptive capacity
  - Urinary lactulose: impaired barrier function
- Endotoxin Core Ab (EndoCab)
  - Secreted by gram negative bacteria

# The Gambia study

- Infants 3 months to 14 months
- Malnutrition and stunting despite nutritional intervention
- No diarrhea
- Features of EE (increased L:M ratios, higher EndoCab)





# Treatment Trials

- WASH Trials:
  - Water, Sanitation and Hygiene
  - Modest improvement in stunting
- Supplements:
  - Zinc, Vitamin A: improved L:M ratio, no effect on height
  - LCPUFA: no change
- Antibiotics:
  - Rifaximin, Albendazole: no difference
- Probiotics: no improvement

# Recommendations

- Holistic approach to nutritional rehabilitation
- Minimizing feco-oral contamination
  - Risk of allergic tendency?
- More research!

# Thank You!

