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People in Need
Prague, Czech Republic
London, UK
www.clovekvtisni.cz/en

Towards linking infection, WASH and child health outcomes

Evidence for action

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Undernutrition, infection, EED and WASH



Infants and WASH

- Safe WASH is required to sustain life, prepare food, maintain personal and domestic hygiene
- Huge knock-on benefit for infants and young children

The ‘first 1000 days’

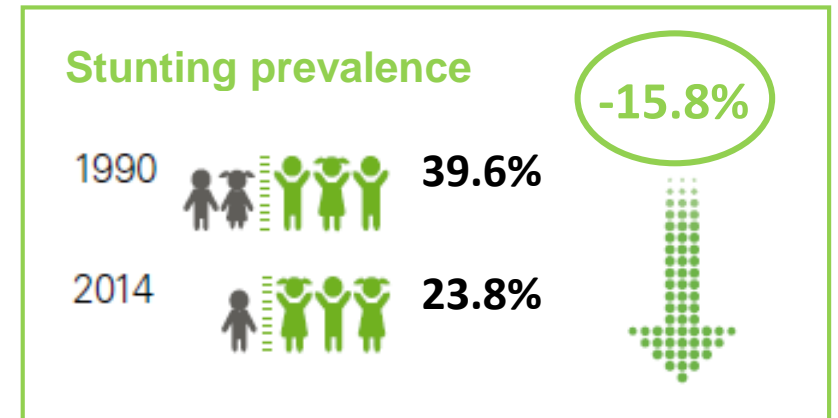
- Period from conception → 2 years of age
- Proper nutrition crucial for growth and development
- Establishes foundations for lifetime brain function

It’s not just about stunting:

- Improving even **basic** sanitation responsible for **10%** decline in child mortality 1990–2015¹
- Impacts on child **development** too (maternal caregiving / time spent with child)



2



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What links WASH and undernutrition?

WASH affects **all four pillars** of nutrition and food security:

1. Food availability
2. Food access
3. Food stability
4. **Utilisation of nutrients**

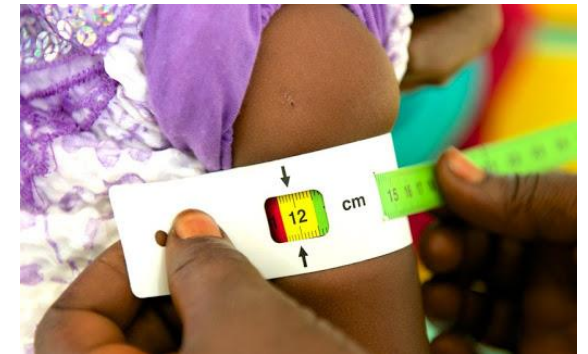
The three main causes of undernutrition:

1. A lack of food quality and quantity
2. Poor care practices
3. Infectious disease

...are directly or indirectly related to poor WASH
... including poor WASH access, quality, and related behaviours

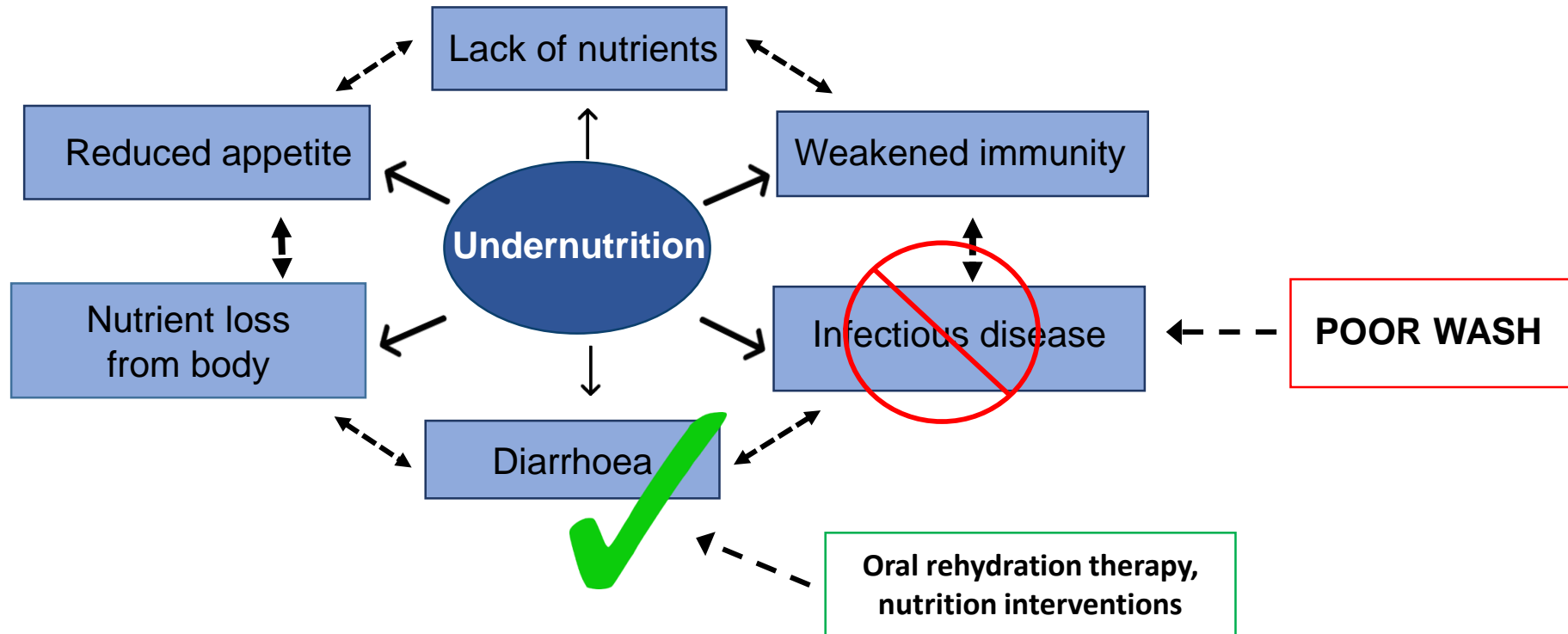


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Stunting, WASH and infectious disease



- Diarrhoea deaths dropped by > half 2000–2015...³
... but diarrhoeal **episodes** have not similarly decreased⁴



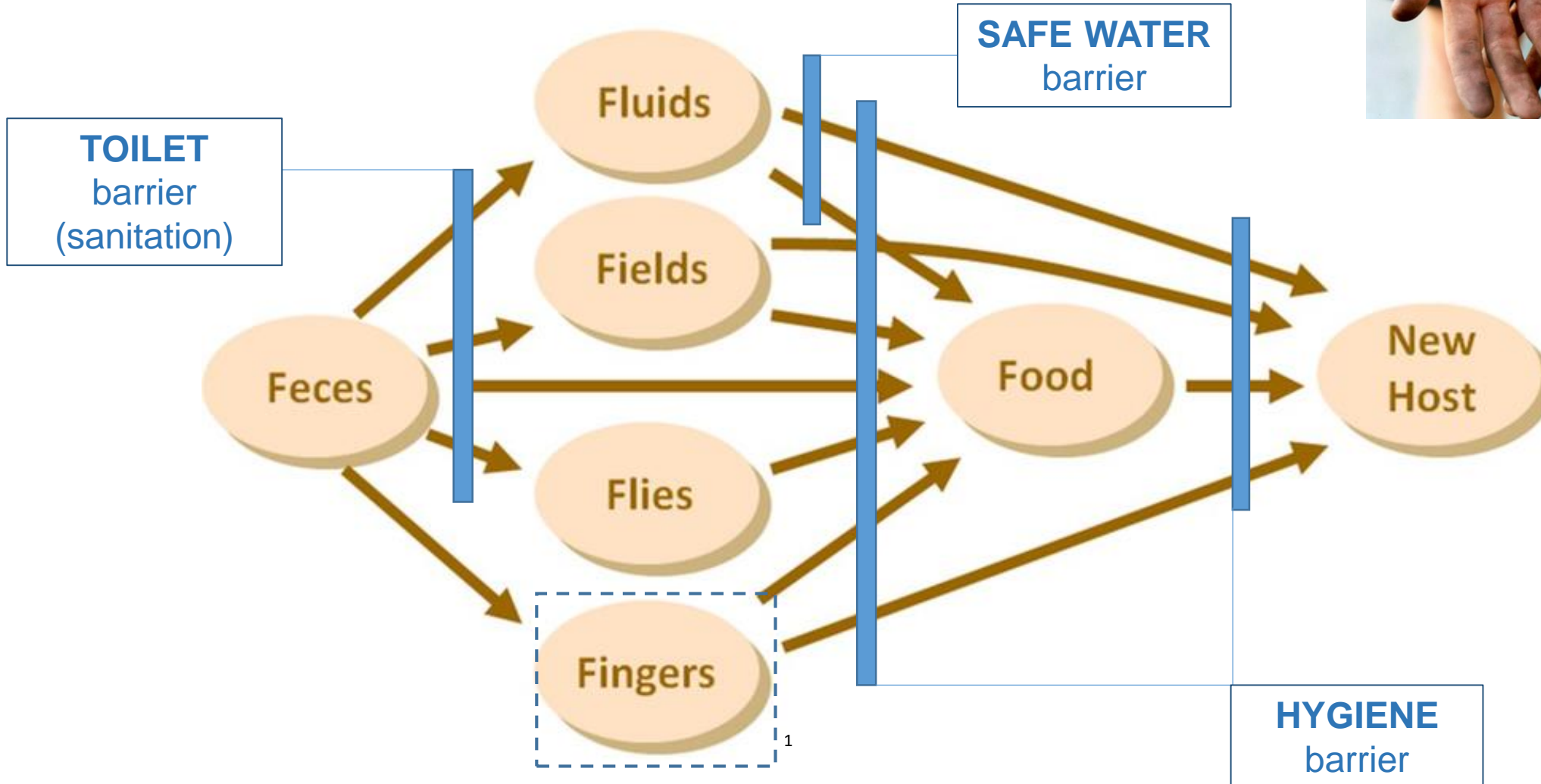
**A reduction in mortality from diarrhoea but NOT
in episodes...**

**...means we are preventing infants
from dying from diarrhoea...**

**but less at preventing the infection in the first
place**



The 'F' diagram



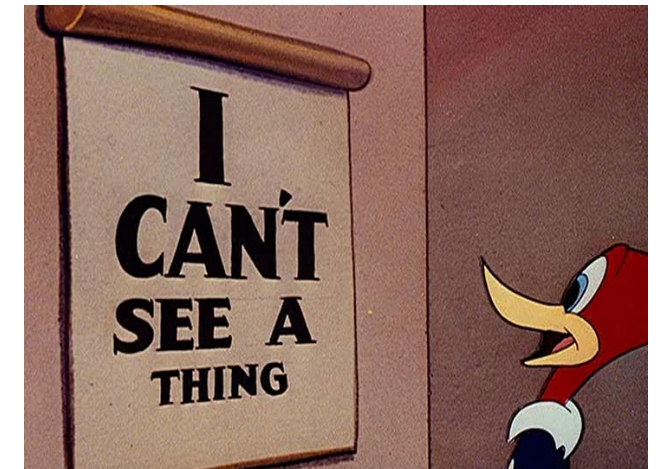


Infection without the signs (that we can see)

Infection with enteric (gut) pathogens is common, often without clinical signs (e.g. diarrhoea)¹

- In infants who experience frequent exposure to pathogens from **faecal-oral transmission** there is a **change in gut structure and function²**
- This subclinical pathology is termed environmental enteric dysfunction (EED)

It has been argued that EED may be a more important pathway to stunting than diarrhoea³





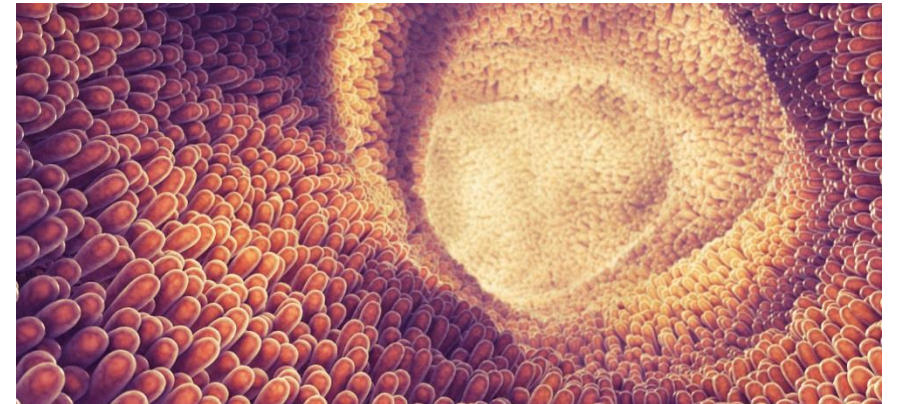
EED: An old issue in need of new evidence

Environmental enteric dysfunction (or enteric dysfunction, or environmental enteropathy, or tropical enteropathy)

- Generalised state of **subclinical** chronic intestinal inflammation¹
- Result of **chronic exposure to faecal pathogens**
- Documented as far back as mid 1700s in European expats in Barbados²
- Peace Corps volunteers³

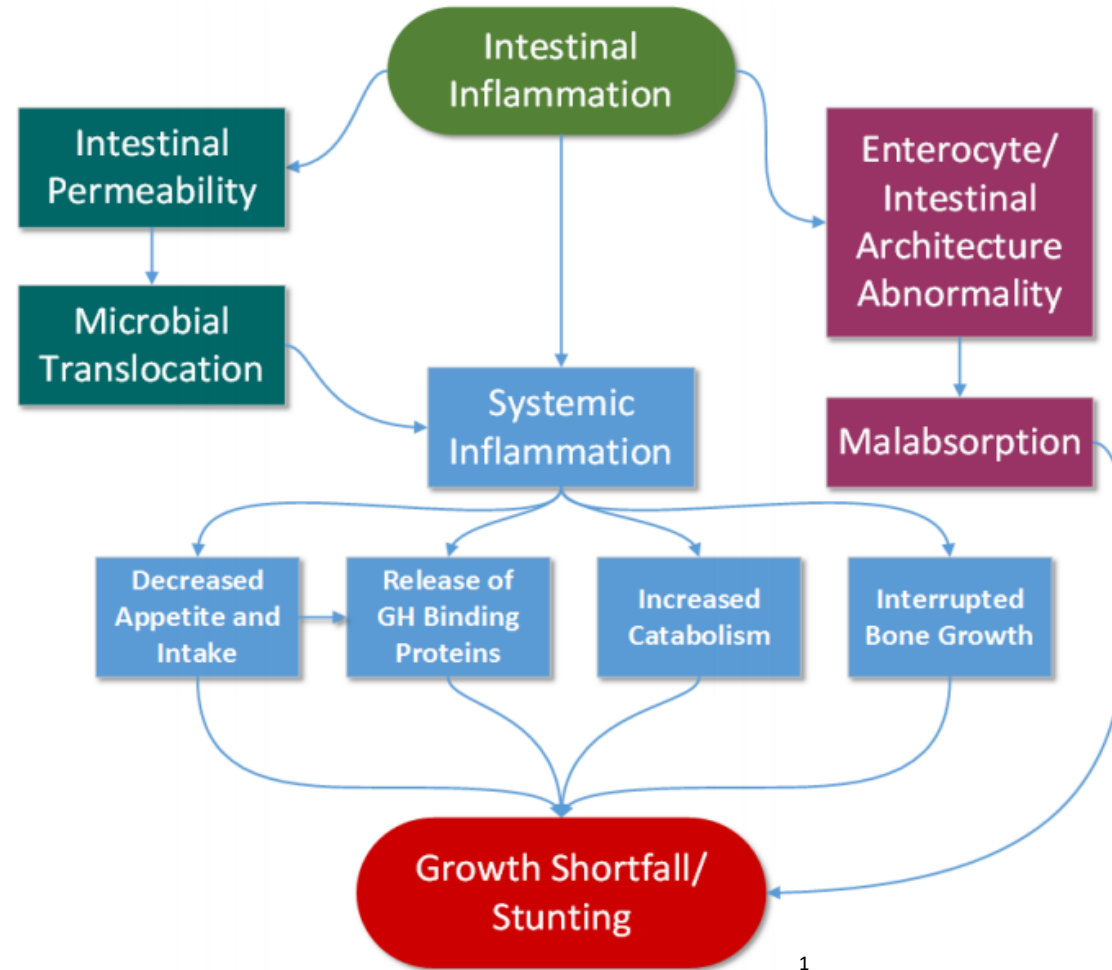
Why environmental?

- Reversible³
- Closely related to GDP not latitude⁴
- Expats with enteropathy showed moderately reduced absorption of carbohydrates, fat and B12⁵
- ‘**Subclinical malabsorption**’





Repeated infection and EED pathophysiological processes leading to growth failure



Effects variable and dependent on the immune status of the host²

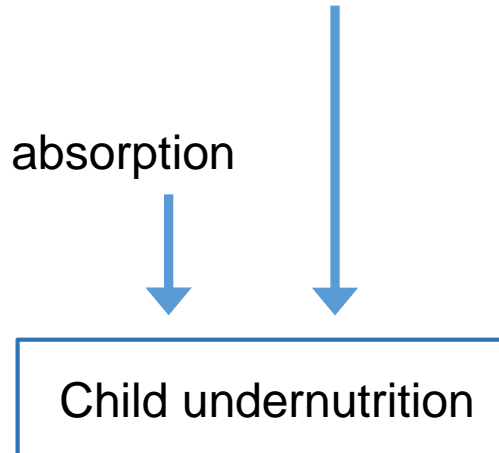


Relationship between poor WASH, infection and undernutrition

To summarise:

Poor WASH and a contaminated environment increase the risk of **faecal ingestion** by infants (and → **pathogen infection**)

1. High bacterial (pathogen) ingestion overwhelms the gut, resulting in high concentration in the small intestines → EED
2. Intermittent diarrhoea, anorexia → reduced nutrient absorption





Checking in:

What do you see as the main causes of malnutrition in infants, youth and children?

What is going down in child diarrhoea – mortality or cases?



Undernutrition, infection and animal pathogens

How have WASH interventions been designed?

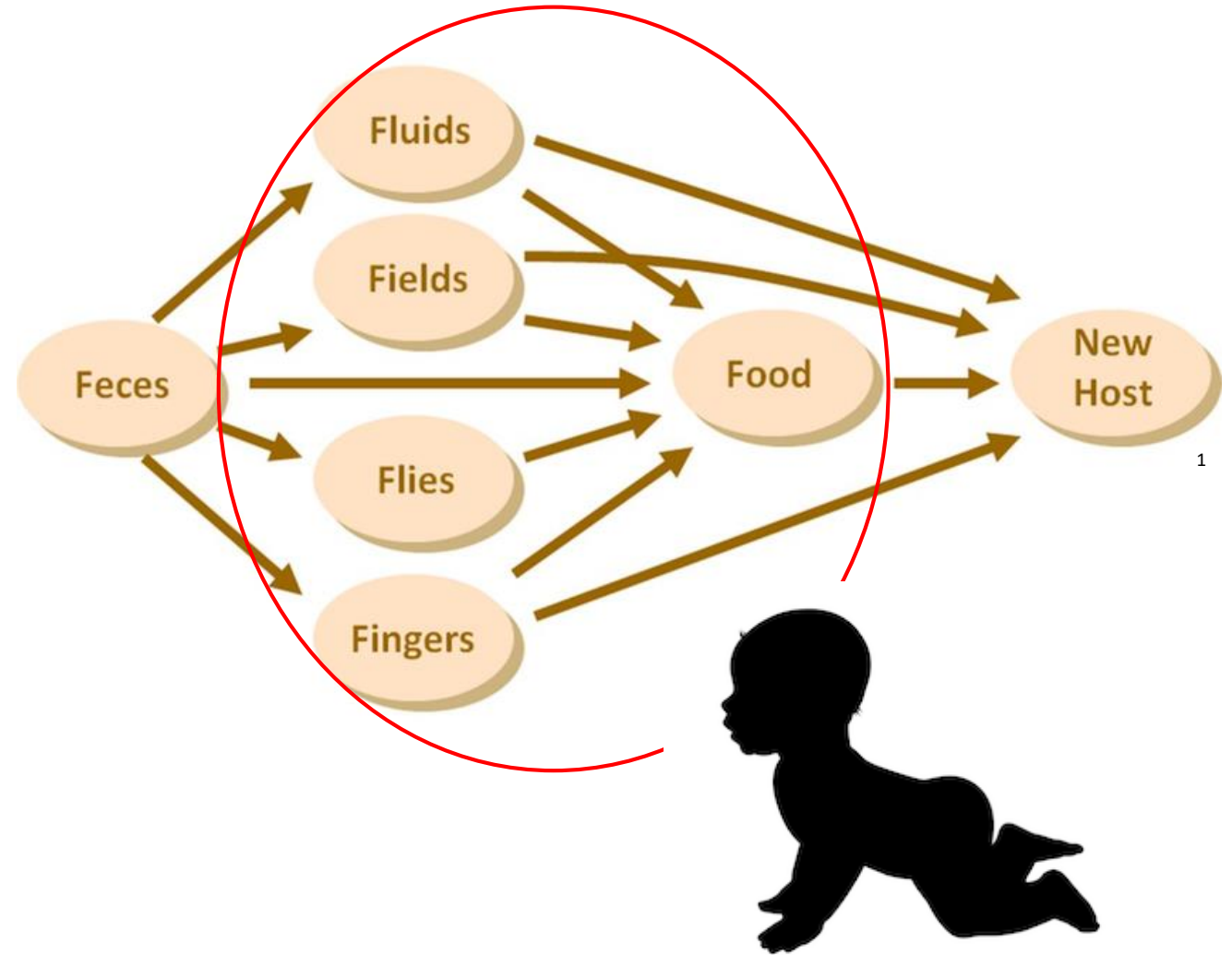
Back to the F Diagram...

- The traditional F-diagram focuses on **human** excreta

However...

- To understand how WASH might improve infant health outcomes...

...we must understand how **each of 5 x 'Fs'** relate specifically to infants





We want to hear from you:

**How are your programmes
currently addressing infant-
specific pathways?**



Risk factors for infant infection



Floors/Fields/Fingers ¹



Fingers/Fomites ²



Fluids/Fields ³



Fluids/Fields ⁴



Food/Fomites/Fluids ⁵



Food/Fomites/Fluids/Fingers/Flies ⁶

1. Online at <https://www.alamy.com/stock-photo-african-baby-ghana-africa-76980545.html>; 2. Online at <https://bestalbuquerque dentists.com/baby-teeth-care/>; 3. Online at <https://www.flickr.com/photos/duniaduara/7518037570/sizes//>; 4. Online at <https://www.flickr.com/photos/littlebigafrica/12459790705/sizes//>; 5. Online at <https://www.alamy.com/stock-photo-black-mother-spoon-feeding-baby-daughter-11419712.html>; 6. Online at <https://www.flickr.com/photos/unicefethiopia/17603098604/sizes//>



Infant behaviours and pathogen transmission

Infant behaviours are often not considered:

- Households are where infants spend a lot of time
- Infants often crawl and play on the bare (dirt) floor
- Play with contaminated objects, directly eat faeces from the floor
- Given water from **unprotected** sources
- Given food which is not reheated properly (bacteria multiplies)
- Fed using dirty utensils

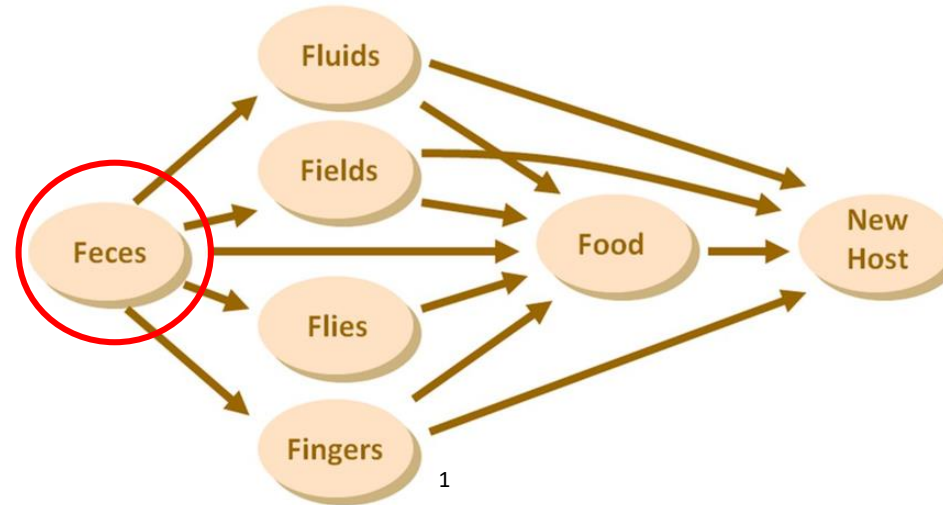


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All of these risk factors increase exposure to pathogens during critical periods of growth

Back to the F Diagram again...

- The traditional F-diagram focuses on **human excreta**



However...

- In many low-income countries, people live closely with their animals
- Animals often share living and sleeping quarters and are not separated at all
- Here, animals **increase contamination across multiple transmission pathways** inside the home

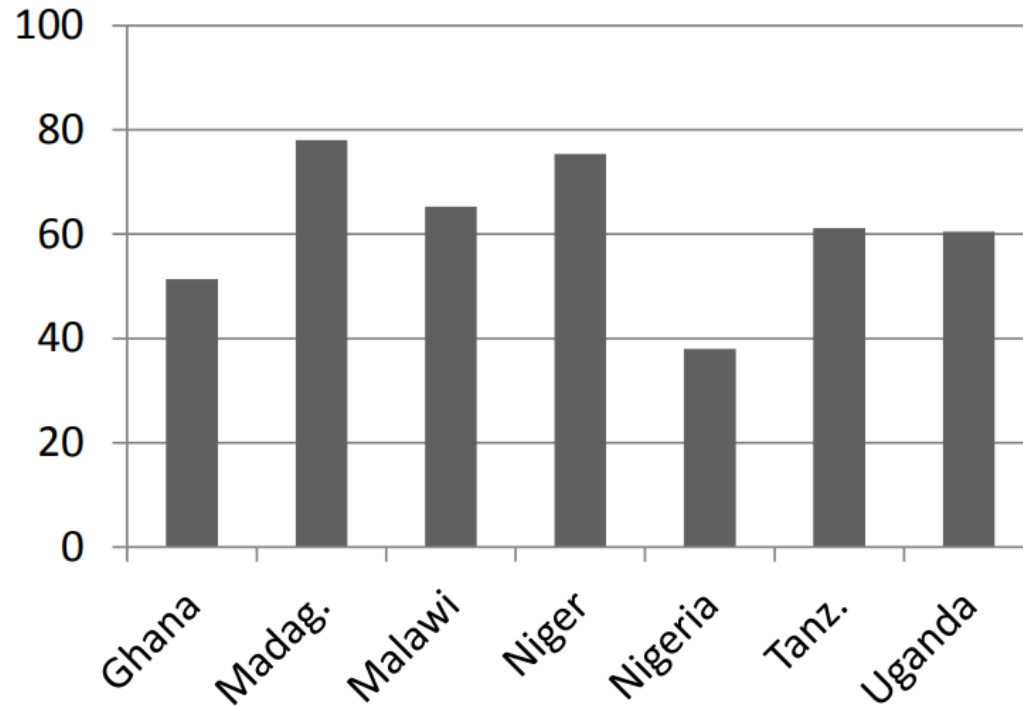




Overlooked risk factors



% of rural households keeping livestock¹



“

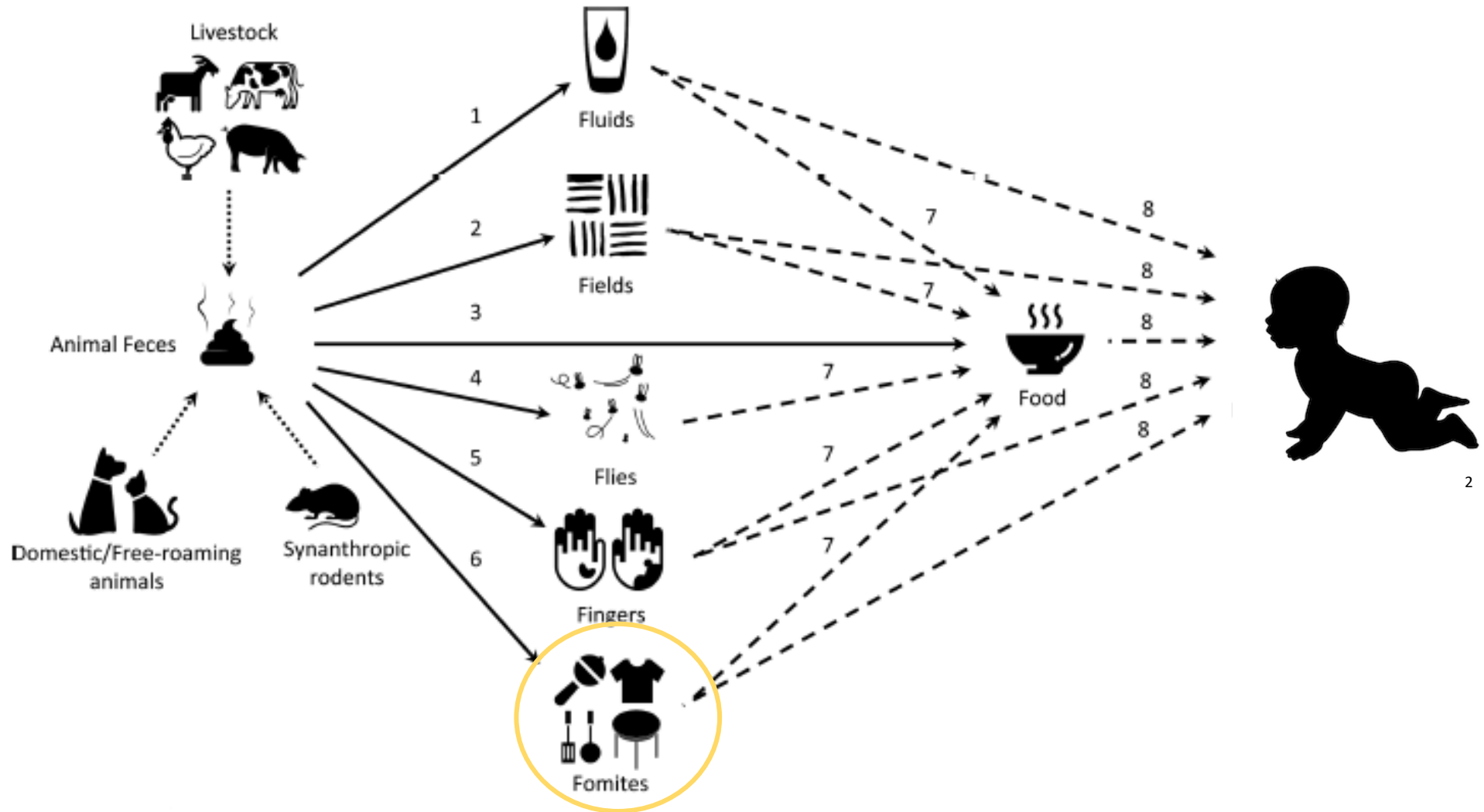
Domestic animals such as poultry, cattle, sheep, and pigs generate **85%** of the world's animal **faecal waste**, proportionally **a far greater amount** than the contribution by the human population.

”





Animals increase contamination across multiple transmission pathways inside the home





What's the common factor?



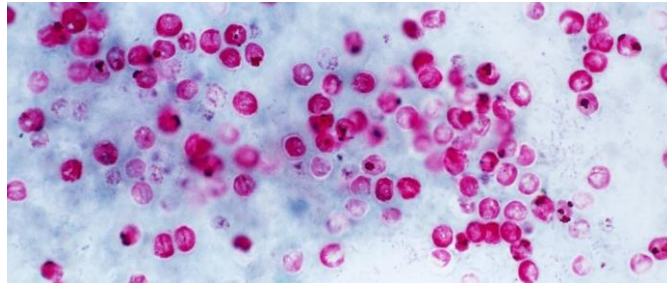
Pathogen	Evidence for correlation with infant health	Source
Campylobacter	Reduced growth ^{1,2} and weight ^{2,3}	Primarily in poultry and cattle; others include dogs and cats, pigs, rodents, and bird
Norovirus*	Reduced growth ¹ and weight ³	Pathogen of livestock. The excreta from infected cattle, pigs and sheep contains large numbers of infectious particles
Shigella	Reduced growth ^{1,3,4} and weight ³	Found in poultry, shed in the faeces of livestock such as cows and goats
Cryptosporidium	Reduced growth ⁵ and weight ⁶	Most common species are generally considered dog, avian, cat, and rodent species
Enteropathogenic/ Enterotoxigenic E. coli	Reduced growth ³ and weight ^{3,4}	Animal reservoirs include dogs, sheep, rabbits, pigs, cattle
Giardia	Reduced growth ^{1,3,7} and weight ³	Commonly isolated in animals such as livestock, dogs, and cats**

*Authors speculated that increased detection of norovirus in cases may be a sequela of impaired mucosal immunity
 **However evidence lacking that zoonotic transmission significantly contributes to overall burden of disease

Several pathogens of zoonotic origin are associated with acute gastrointestinal symptoms arising from contact with animal faeces



Approximately one third of deaths among under-fives are attributed to pathogens found in animal faeces¹



Cryptosporidium

2



Campylobacter

3



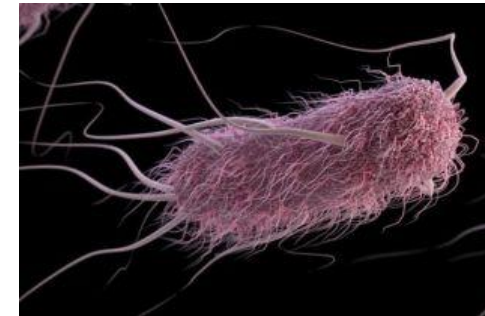
Giardia

4



Shigella

5



Enterotoxigenic E. coli
Enterotoxigenic E. coli

6

... and infections are associated with markers of EED¹

1. Wang, H et al. Lancet. 2015, 388 (10053), 1459-1544; 2. Online at: <https://abcnews.go.com/Health/cdc-warns-pool-parasite-summer/story?id=32060444>; 3. Online at https://www.hygiene-in-practice.com/pathogen/campylobacter-jejuni-coli_en/; 4. Online at https://en.wikipedia.org/wiki/Giardia_lamblia; 5. Online at <https://news.psu.edu/story/582818/2019/08/06/research/whole-genome-sequencing-may-help-officials-get-handle-disease>; 6. Online at <https://www.livescience.com/62600-ecoli-diarrhea-blood-type.html>.



To sum a complicated story



WASH



1



2



3



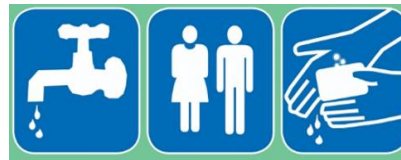
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5



7



WASH

1



6



Review:

What are your programmes currently addressing infant-specific pathways?



The dangers of a single story



“ ~50% of undernutrition is associated with infections caused by poor WASH¹ ”



2

“

...an alternative explanation...
Is that faltering growth occurs as a
consequence of **chronic
or recurrent infection...**

brought about by **living
in an unhygienic
and unsanitary environment...**¹

”



“ ...The problem of stunting is not going to be easily fixed by a little bit of attention to WASH.

Modest efforts to marginally improve environments are not sufficient.

If we want children in the lowest-income environments to thrive, **[we] need to make environments radically cleaner.** ”



1

Prof Steve Luby, WASH Benefits Bangladesh

Household Environmental Conditions Are Associated with Enteropathy and Impaired Growth in Rural Bangladesh

Audrie Lin,^{*†} Benjamin F. Arnold,[†] Sadia Afreen, Rie Goto, Tarique Mohammad Nurul Huda

Am. J. Trop. Med. Hyg., 93(2), 2015, pp. 269–275
doi:10.4269/ajtmh.14-0694
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Enteropathogens and Gut Inflammation in Asymptomatic Infants and Children in Different Environments in Southern India

Ira Praharaj,^{1,†} R. Revathy,¹ Rini Bandyopadhyay,¹ Blossom Benny,¹ Mohammed Azharuddin KO,¹ Jie Liu, Eric R. Houpt,² and Gagandeep Kang¹

Fecal Markers of Environmental Enteropathy Are Associated with Animal Exposure and Caregiver Hygiene in Bangladesh

Christine Marie George,^{*} Lauren Oldja, Shwapon K. Biswas, Jamie Perin, Gwenyth O. Lee, Shahnawaz Ahmed,

Rashidul Haque, R. Bradley Sack, Tahmidul Karim, and Kaiser A. Talukder

Environmental Contamination and Early Childhood Morbidity in Kenya, Tanzania, and Uganda

Assata Zerai, Rebecca L. Morrow, and

Animal-related factors associated with moderate-to-severe diarrhea in children younger than five years in western Kenya: A matched case-control study

Anne Conan¹, Ciara E. O'Reilly², Eric Ogola³, J. Benjamin Ochieng⁴, Anna J. Blackstock²,

Fecal Contamination of Shanty Town Toddlers in Households with Non-corralled Poultry, Lima, Peru

GRACE S. MARQUIS, MS, GLADYS VENTURA, BS, ROBERT H. GILMAN, MD, ESPERANZA PORRAS, BS,

Poultry husbandry, water, sanitation, and hygiene practices, and child anthropometry in rural Burkina Faso

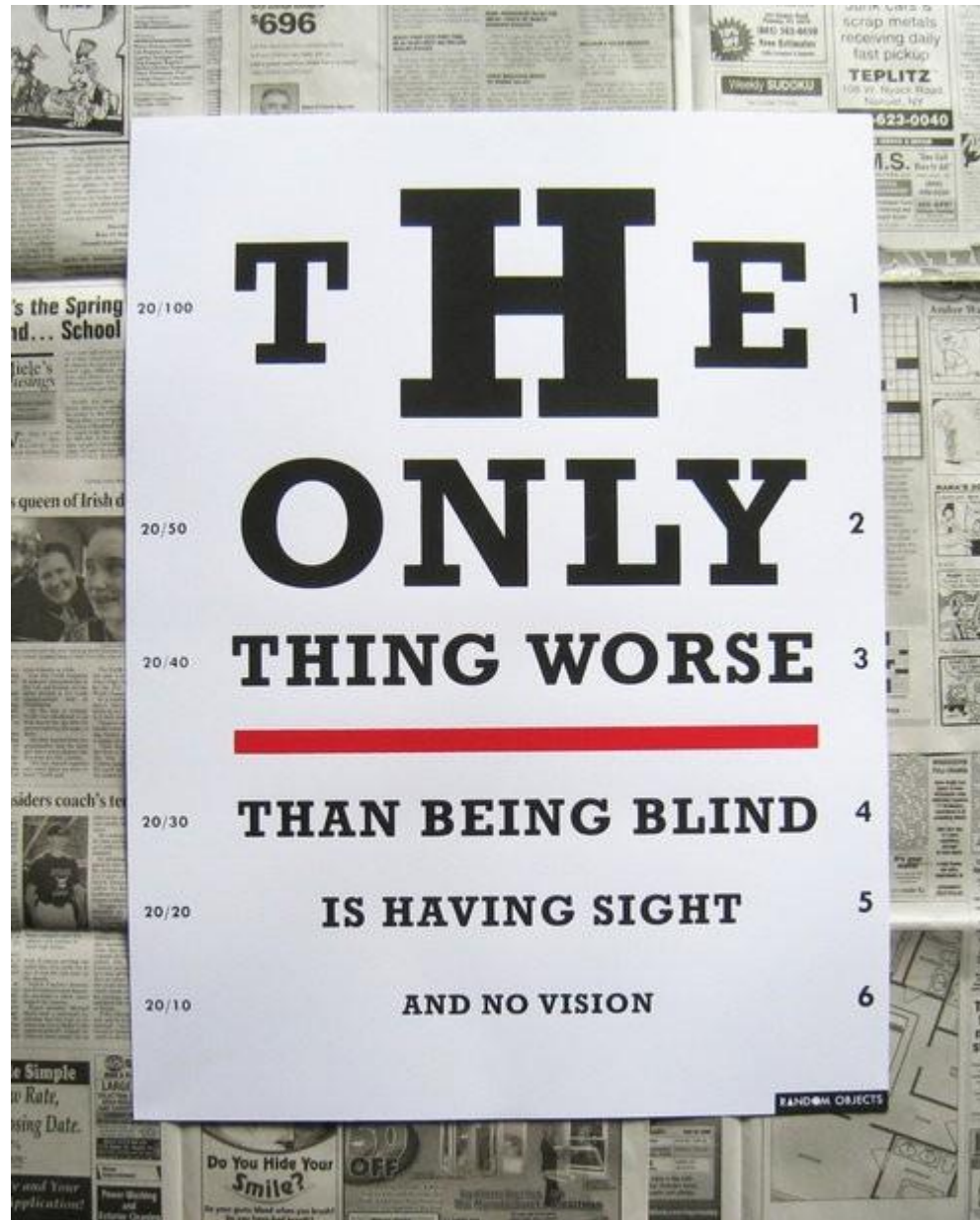
Aulo Gelli¹ | Derek Headey²

Paediatric campylobacter diarrhoea from household exposure to live chickens in Lima, Peru

O. GRADOS¹ N. BRAVO² R. E. BLACK³ & I. P. BUTZLER⁴

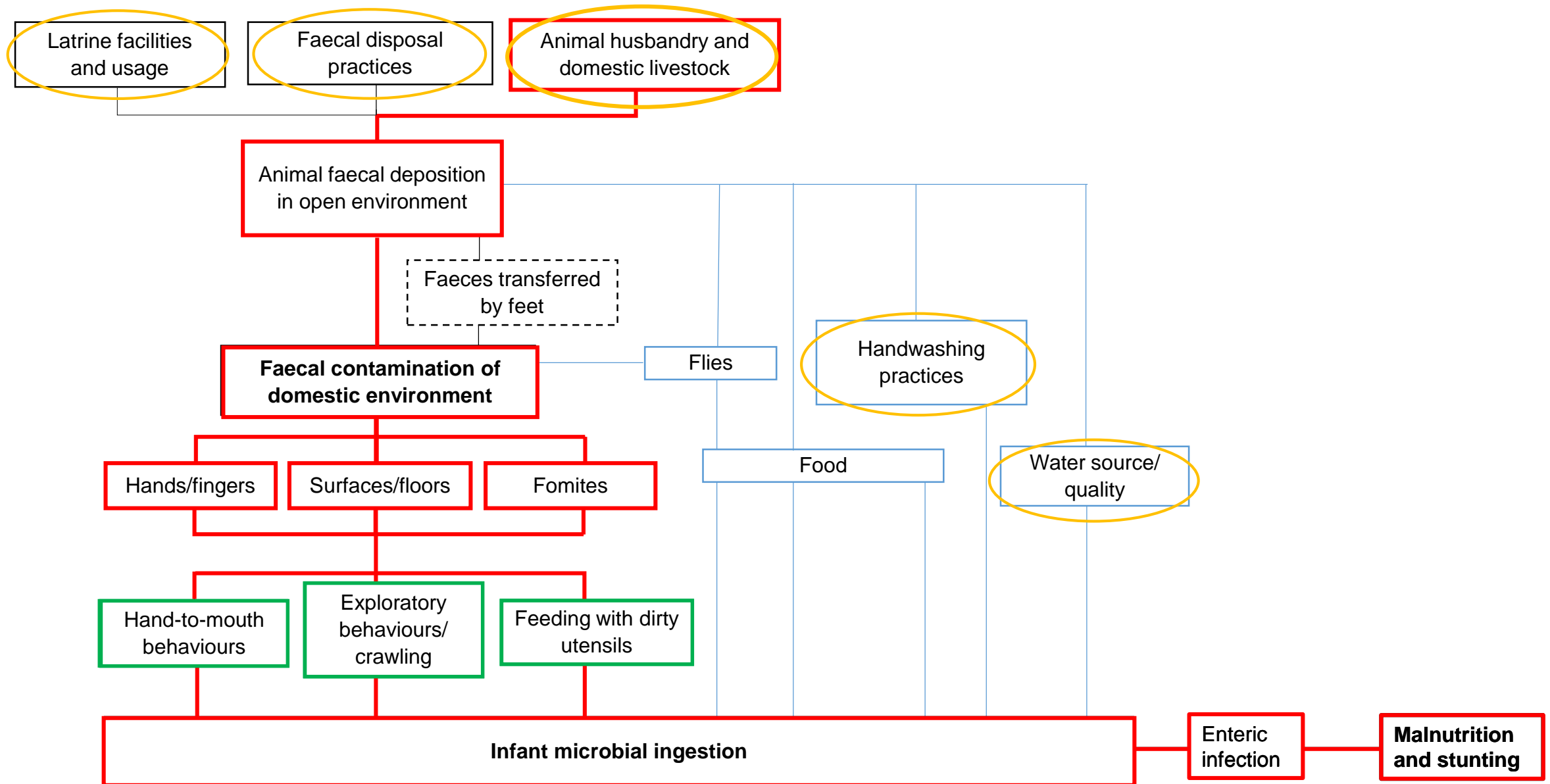
Exposure to Livestock Feces and Water Quality, Sanitation, and Hygiene (WASH) Conditions among Caregivers and Young Children: Formative Research in Rural Burkina Faso

Francis Nguire,^{1*} Aulo Gelli,² Elodie Becquey,² Rasmané Ganaba,³ Derek Headey,² Lieven Huybregts,²



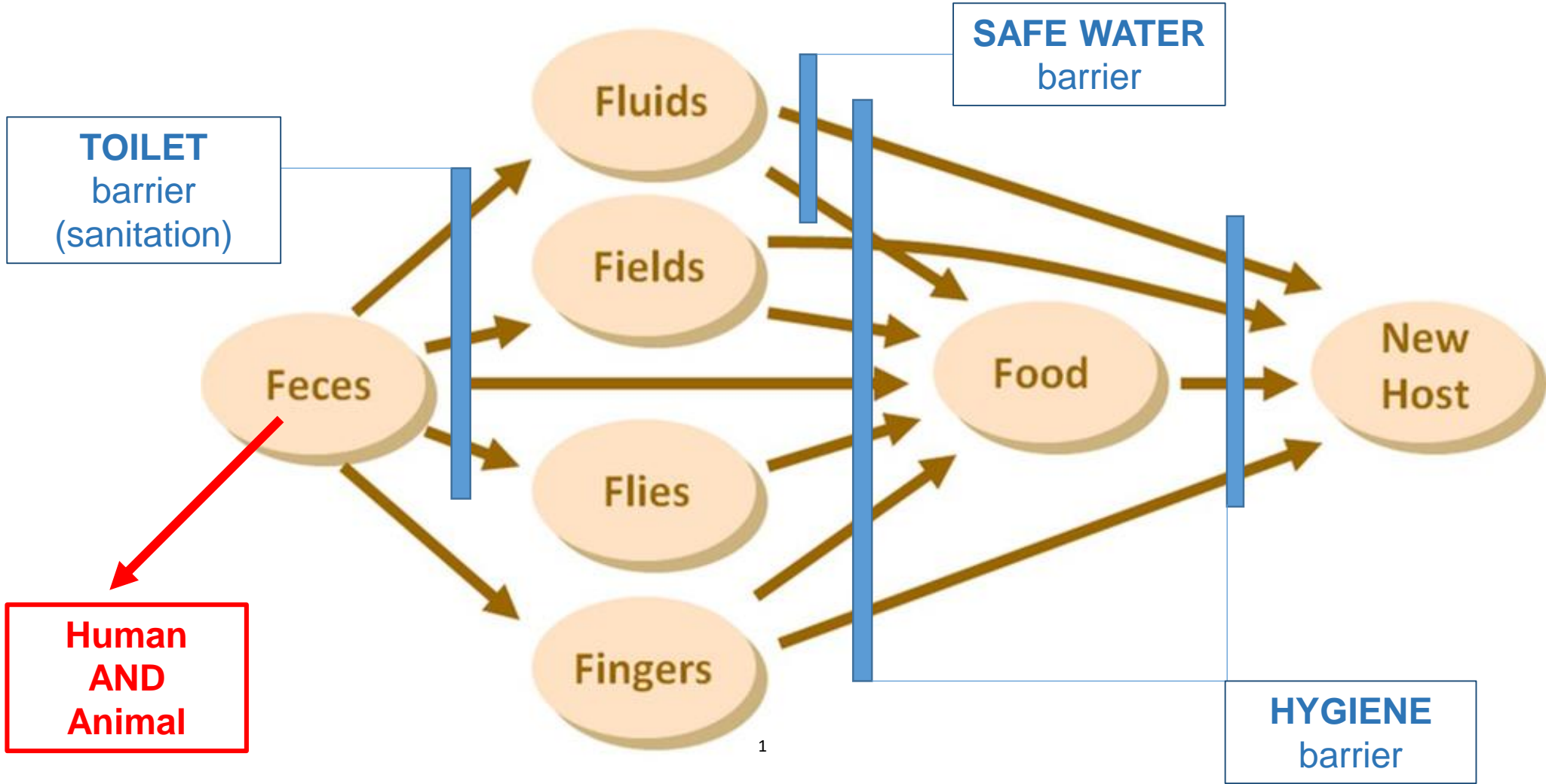


**What does this mean for WASH interventions
aiming to improve child health?**





Infection spreads through multiple pathways



1



Transformative WASH

Transformative WASH:

- An approach to delivering WASH that is **'radical'** and fully comprehensive
- **Interventions** or **changes** that may be structural, technical, behavioural...
- Aims to address **each possible transmission route**

Interventions must consider every aspect of WASH AND environmental hygiene

- Water, sanitation and hygiene are **ALL linked** together
- Good infant health depends on each factor individually...
... As well as the **many interactions** between them





BabyWASH intervention components

BabyWASH interventions aim to:¹

1. Improve household sanitary and hygienic conditions
2. Improve personal hygiene practices
3. Avoid ingestion of faeces and contaminated objects during infant play
4. Achieve the safe storage and use of water
5. Maintain good hygiene practices in the preparation and storage of infant foods (food safety)





Moving forward with WASH intervention design, we need to remember...

1. We need **transformative WASH** but also **BABYWASH** components:

- Safe feeding practices
- Adequate separation from animals
- Environmental hygiene

2. We need to think **bigger**, more **long term** and more **comprehensive**...

- Reducing exposure to bacteria within the home can only be tackled through a **truly integrated approach**

3. Infection and undernutrition cross issues and sectors – and so must the solutions.





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