

Structured Observations and the Competing Hazards Model – Lessons from SaniPath in Ghana

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Overview

1 Introduction

- SaniPath
- Structured Observation

2 Method

- Data Collected
- Competing Hazard Model

3 Results

- Primary Results
- Simulation Results

4 Lessons Learned

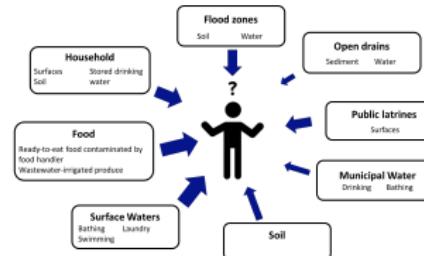
- Application
- Considerations for Future Studies

SaniPath

SaniPath is a **multi-pathway exposure assessment** that quantifies exposure to fecal contamination from different environmental sources through multiple pathways.

The two main **objectives** of the SaniPath study are:

- to characterize relevant exposure pathways due to poor sanitation
- to provide evidence to guide intervention strategies.



Content Adapted by Jessica Lusk, KfW Nexus Project

Structured Observation

- Ages 0-1 years, 1-2 years, and 2-5 years
- Private domain (household)
- 5 hours observation
- 6 categories of behavior of children
- 5 categories of compartments (location where behaviors are observed)

Data Collected

Basic information, including age, gender, mobility, and teething or not, were collected for children in four urban low-income slum neighborhoods in Accra, Ghana.



Children Under Five Structured Observation- Identification

Date (DD/MM/YYYY) / /

Child ID <input type="text"/>	Age:	Sex:	Mobility:	Teething:
	<1 year <input type="checkbox"/>	F <input type="checkbox"/> M <input checked="" type="checkbox"/>	Can crawl <input type="checkbox"/>	Yes <input type="checkbox"/>
	1-2 years <input type="checkbox"/>		Can walk <input type="checkbox"/>	No <input type="checkbox"/>
	> 2 years <input type="checkbox"/>		Can sit on ground independently <input type="checkbox"/>	

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	> 2 years <input type="checkbox"/>		Can sit on ground independently <input type="checkbox"/>	

Data Collected

Compartment	Behavior
1. Unimproved ground (dirt)	1. Playing/sitting
2. Improved ground (floor)	2. Sleeping
3. Off ground (Caregiver, chair)	3. Handwashing
4. SWAT (Wet trash area)	4. Bathing
5. Open drain	5. Defecating
	6. Eating

Children Under Five

page ____ /

Structured Observation- Behavior Events

Child ID Start Time :

Child Location	1) On unimproved ground (dirt) <input type="checkbox"/>	2) On improved ground (floor) <input type="checkbox"/>	3) Off ground (with caregiver/on chair, etc) <input type="checkbox"/>	4) In SWAT <input type="checkbox"/>	5) In drain <input type="checkbox"/>	6) Out of view <input type="checkbox"/>
A) Touching location with hands:	1) Yes <input type="checkbox"/>	2) No <input type="checkbox"/>	B) Wearing shoes in location:	1) Yes <input type="checkbox"/>	2) No <input type="checkbox"/>	3) N/A <input type="checkbox"/>

Child Behavior

- | | |
|--|--|
| A) Playing/sitting <input type="checkbox"/> | E) Defecating: 1) On ground <input type="checkbox"/> 2) In latrine <input type="checkbox"/> 3) In bag <input type="checkbox"/> 4) In potty <input type="checkbox"/> 5) In drain <input type="checkbox"/> |
| B) Sleeping <input type="checkbox"/> | * Child's bottom is: 1) Cleaned <input type="checkbox"/> 2) Not cleaned <input type="checkbox"/> |
| C) Handwashing <input type="checkbox"/> 1) With soap <input type="checkbox"/> 2) Without soap <input type="checkbox"/> | * Feces are: 1) Put in latrine <input type="checkbox"/> 2) Put in drain <input type="checkbox"/> 3) Put in trash <input type="checkbox"/> 4) Left on ground <input type="checkbox"/> |
| D) Bathing: 1) With soap <input type="checkbox"/> 2) Without soap <input type="checkbox"/> | F) Eating: 1) Prepared food <input type="checkbox"/> 2) Bought food <input type="checkbox"/> 3) Fresh fruit <input type="checkbox"/>
* Eating with: 1) Cutlery <input type="checkbox"/> 2) Hands <input type="checkbox"/> |

Notes 

Data Collected

These observations were recorded in the following format for each individual child*:

Observation	1	2	3	4	5	6	...	N-1	N
Compartment	3	3	2	5	1	2	...	2	1
Behavior	1	6	3	1	5	1	...	2	1
Duration (min)	12	23	3	13	5	8	...	31	10

*Note that on any given day only one child is observed in the selected household, even if there are other children present.

Data Collected

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Data Collected

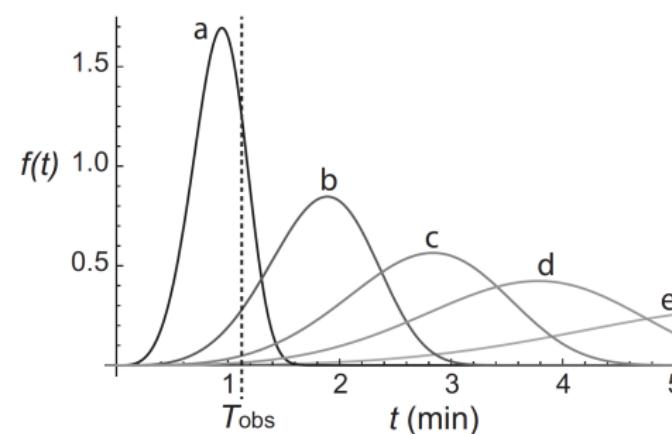
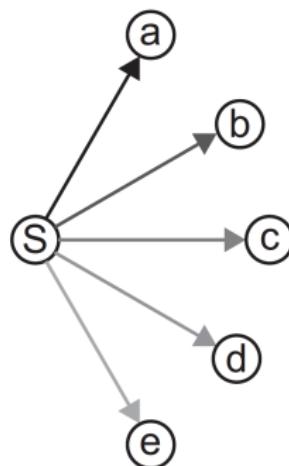
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*Note that on any given day only one child is observed in the selected household, even if there are other children present.

Competing Hazard Model

Behavior is a sequence of states that consists of a series of transitions between states. Each transition has its own (probability) distribution of time until the next transition.



Potential transitions with unequal probabilities will compete with each other.

Primary Results

Some descriptive statistics...

Neighborhood	# subjects	# obs. per subj.	time obs. (min)
Alajo	35	3–22	117–330
Bukom	23	8–31	230–320
Old Fadama	37	1–26	21–321
Shiabu	34	6–28	132–330

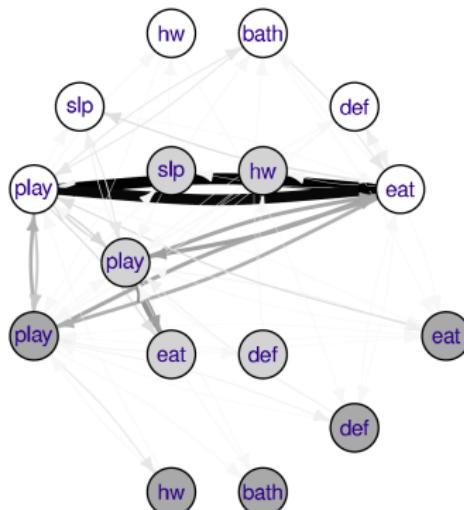
Over 500 hours of structured observations were collected for 129 children.

Primary Results

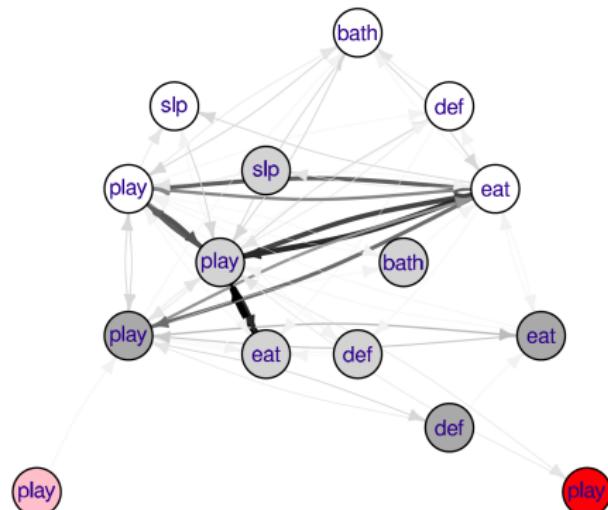
- Not all states occur (e.g. sleeping in open drains)
- Transition between states are not random or all equally likely
- It is useful to study behavior as sequences instead of frequencies and durations
- Transitions can be visualized as a network

Primary Results

Observed states and transitions:



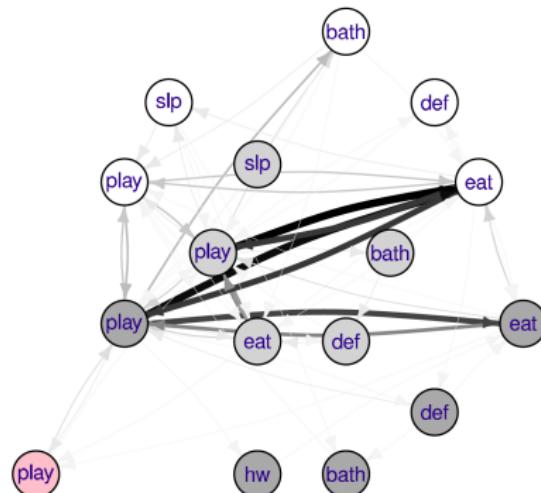
Alajo



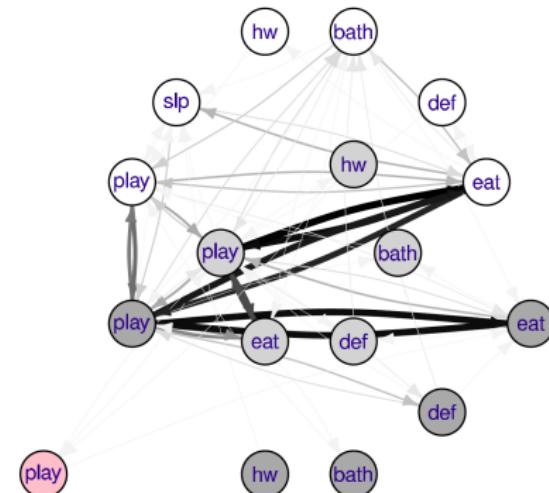
Bukom

Primary Results

Observed states and transitions:



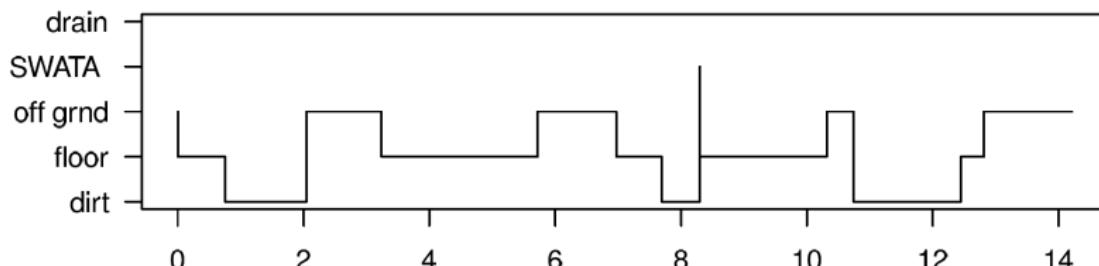
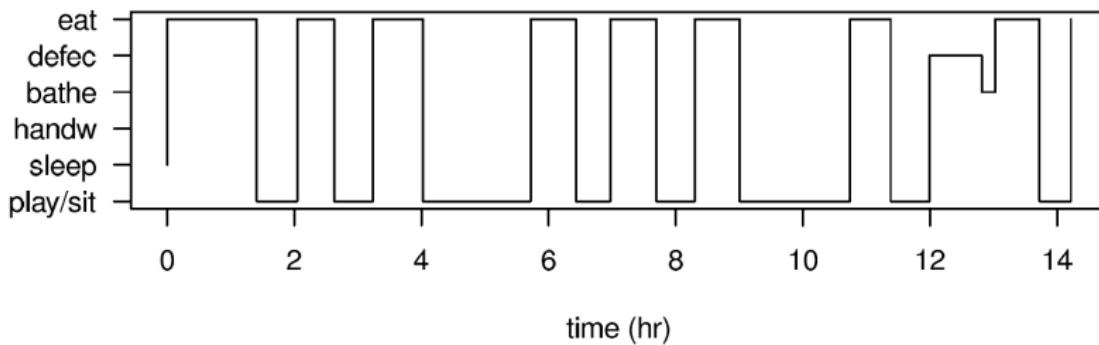
Old Fadama



Shiabu

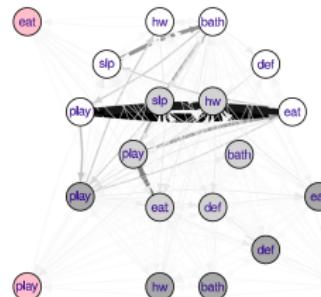
Simulation Results

Simulated sequences of states (behavior and compartment combinations):

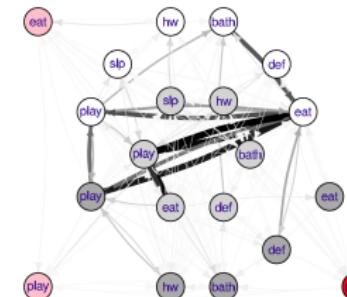


Simulation Results

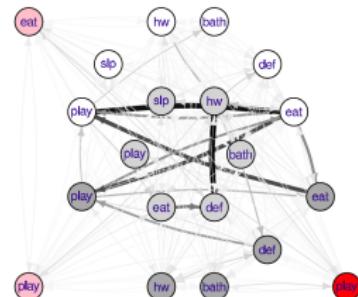
Simulated behaviors by age group and neighborhood:



Alajo 0 – 1 yr



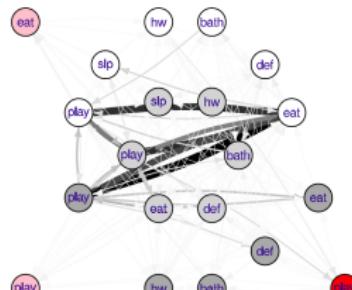
Alajo 1 – 2 yr



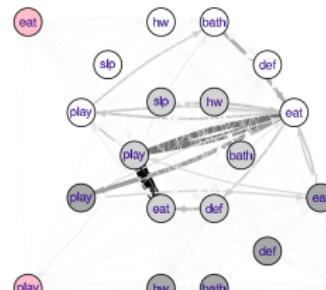
Alajo > 2 yr

Simulation Results

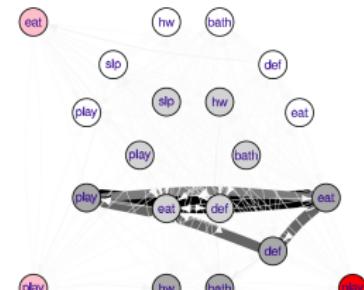
Simulated behaviors by age group and neighborhood:



Bukom 0 – 1 yr



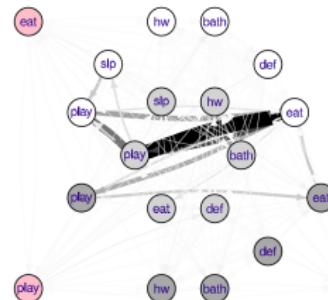
Bukom 1 – 2 yr



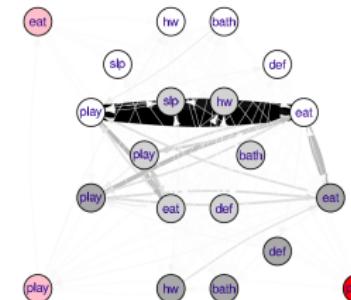
Bukom > 2 yr

Simulation Results

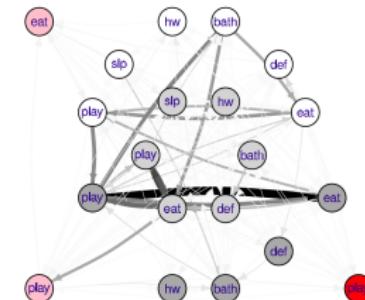
Simulated behaviors by age group and neighborhood:



Old Fadama 0 – 1 yr



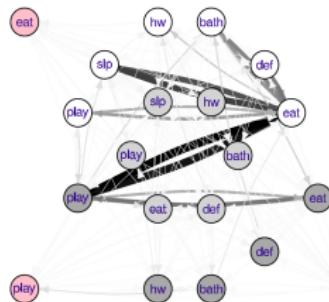
Old Fadama 1 – 2 yr



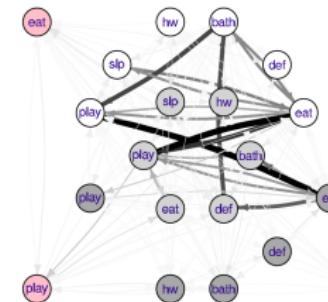
Old Fadama > 2 yr

Simulation Results

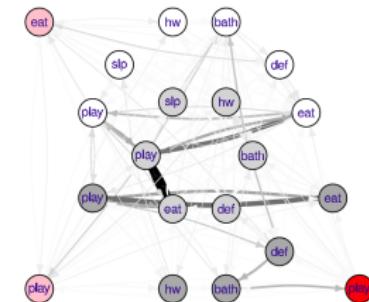
Simulated behaviors by age group and neighborhood:



Shiabu 0 – 1 yr



Shiabu 1 – 2 yr



Shiabu > 2 yr

Rare behavior may happen



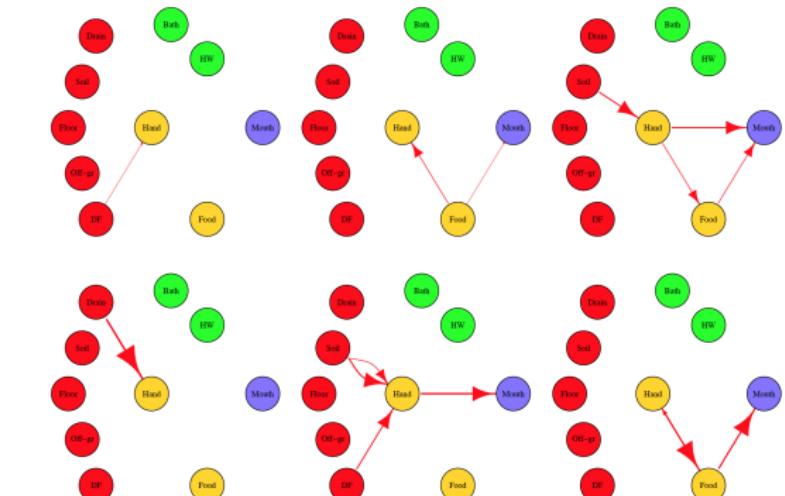
this may not seem to happen frequently, but when it happens,
exposure is certain...

Lessons Learned

- When time series of behavior is taken into account, even those small dataset can provide rich information about frequency and/or duration of behavior, and most importantly, sequences of behavior.
- Child behavior patterns vary by age group.
- No strong differences in child behavior between different neighborhoods in Accra.

Application to SaniPath Exposure Assessment

Combined with environmental microbial contamination data, simulated behavior sequences can be used to quantify microbes transfer from environment to ingestion through different pathways. The results of SaniPath exposure assessment* has been accepted and will be published in AJTMH.



*Multi-pathway quantitative assessment of exposure to fecal contamination for young children in low-income urban environments in Accra, Ghana: The SaniPath analytical approach

Scenario to apply

In the following scenarios, this structured observation and modeling method can be considered:

- when subjects can be observed in a defined area for a specific amount of time and all their behaviors can be captured.
- when exposure through vehicles plays a crucial role.
- when the order of behavior make a difference.

Considerations for Future Studies

- Include drinking (e.g. breastfeeding) as a behavior category
- Conduct video recording for a small number of households to provide more details about exposure behaviors
- Record physical contact with caregivers, other adults, or other children

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Data collection team: Carol Adjei, Manuela Agorku, Alfred Amoako, Gloria Annan, and Reginald Botchway.

References

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Wang Y, Moe CL, Null C, Raj SJ, Baker KK, Robb K, Yakubu H, Ampofo JA, Wellington N, Freeman MC, Armah G, Reese HE, Peprah D, Teunis PFM. Multi-pathway quantitative assessment of exposure to fecal contamination for young children in low-income urban environments in Accra, Ghana: The SaniPath analytical approach. *American Journal of Tropical Medicine and Hygiene*. Accepted May 2017.

Robb K, Null C, Teunis PFM, Yakubu H, Armah G, Moe CL. Assessment of Fecal Exposure Pathways in Low-Income Urban Neighborhoods in Accra, Ghana: Rationale, Design, Methods and Key Findings of the SaniPath Study. *American Journal of Tropical Medicine and Hygiene*. Accepted August 2016.