Handwashing
“it’s such an easy thing to do…”

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Overview

Measurement

Behavior and behavior change

Health effects
Handwashing measurement
A source of much grief
Challenge: measuring handwashing for various applications

- Research
- Evaluation
- Global monitoring
Measuring handwashing

Behavior at recommended times

- Self-report
- Structured observation
- Video observation

Proxies of handwashing behavior

- Presence of soap anywhere in the home
- Soap and water at a handwashing place
- Soap retrieval in ≤ 60 secs
- Distance to HW place
- Hand microbiology
- Observed hand cleanliness

Use of cleansing agent

- Handwashing demonstration
- Soap consumption
- Accelerometer-embedded soap

Soap consumption
Two measurement questions re: structured observation

1) Do people increase handwashing while under observation?

2) Since observation is time-consuming, can we reduce the duration of observation without reducing the quantity and quality of data?
Opportunity

Accelerometer embedded in bar soap tracks movement
• Patterns consistent with handwashing

Allows measurement of soap use without human observer present

Developed by Unilever

Ram, AJTMH, 2011

Accelerometer

SmartSoap

Photo credit: Unilever GHHP
Study methods: Accelerometers and structured observations (N=50)

Photo credits: Unilever GHHP and Benjamin Nygren

5 – hour observation
Anatomy of a Structured Observation Day

24 hours

4 AM

5 hours preceding SO*

No difference in soap uses between Days 1-3 and SO day

9 AM

Structured observation period

During structured observation period:

Pre-observation days: 3.7 (0.3–10.6)

Structured observation: 5.0 (range: 0 – 18.0)

→ 35% increase, p=.0004

Soap uses increased during observation

• By 20% in 62% of households
• Doubled in 22% of households

2 pm

* SO: Structured observation
In spite of reactivity, only ~20% of people wash hands

<table>
<thead>
<tr>
<th>Region</th>
<th># studies</th>
<th>Prevalence of handwashing with soap (%) (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>13</td>
<td>14 (11,18)</td>
</tr>
<tr>
<td>Americas HI</td>
<td>7</td>
<td>49 (33, 65)</td>
</tr>
<tr>
<td>Americas LMI</td>
<td>2</td>
<td>16 (7, 33)</td>
</tr>
<tr>
<td>Eastern Mediterranean HI</td>
<td>-</td>
<td>44 (34, 57)</td>
</tr>
<tr>
<td>Eastern Mediterranean LMI</td>
<td>-</td>
<td>15 (9, 24)</td>
</tr>
<tr>
<td>Europe HI</td>
<td>5</td>
<td>44 (29, 56)</td>
</tr>
<tr>
<td>Europe LMI</td>
<td>1</td>
<td>15 (6, 30)</td>
</tr>
<tr>
<td>South-East Asia</td>
<td>11</td>
<td>17 (7, 36)</td>
</tr>
<tr>
<td>Western Pacific HI</td>
<td>2</td>
<td>43 (25, 57)</td>
</tr>
<tr>
<td>Western Pacific LMI</td>
<td>2</td>
<td>13 (6, 25)</td>
</tr>
<tr>
<td>World</td>
<td>43</td>
<td>19 (8, 39)</td>
</tr>
</tbody>
</table>

Freeman, TMIH, 2014
Should we chuck out structured observation entirely?

Of currently available methods, it is the optimal way to examine handwashing at particular times of interest.

Challenge: structured observation is time-consuming ➔ expensive
So, should we dismiss structured observation as a handwashing measurement method?

Despite reactivity, only about 20% of toilet use events are followed by handwashing with soap.

Of currently available methods, it is the optimal way to examine handwashing at particular times of interest.

Challenge: structured observation is time-consuming ➔ expensive
Can we do shorter observations to save money and time?

Figure 2 Comparisons of short and long observation groups with respect to observation of critical times, and handwashing behavior at critical times, Bangladesh, 2007.
Disproportionate reductions in events of interest in short duration group:

- **Toilet use** (observed 0.0 events, expected 0.03, \( p = .06 \))
- **Eating** (observed 0.25 events, expected 0.45, \( p < .05 \))

Cannot reduce duration of observation without loss of data
- respondents may have been delaying usual activities out of courtesy
So, we need to do longer duration observations.

Time-consuming... infeasible for large-scale assessments...

How well do rapidly collected measures describe handwashing behavior?
How well do rapidly collected measures describe handwashing behavior?
Measuring handwashing

- Self-report
- Structured observation
- Video observation

Behavior at recommended times

- Handwashing demonstration
- Soap consumption
- Accelerometer-embedded soap
- Use of cleansing agent

Use of cleansing agent

- Presence of soap anywhere in the home
- Soap retrieval in < 60 secs
- Hand microbiology
- Observed hand cleanliness

Proxies of handwashing behavior

- Soap and water at a handwashing place
- Distance to HW place

Scaling up Handwashing: validity of rapidly collected behavior measures

<table>
<thead>
<tr>
<th></th>
<th>Peru</th>
<th>Senegal</th>
<th>Vietnam</th>
</tr>
</thead>
<tbody>
<tr>
<td># structured observations</td>
<td>278</td>
<td>77</td>
<td>199</td>
</tr>
<tr>
<td># events observed among</td>
<td>1467</td>
<td>444</td>
<td>1421</td>
</tr>
<tr>
<td>primary caregivers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of events overall</td>
<td>14%</td>
<td>13%</td>
<td>10%</td>
</tr>
<tr>
<td>at which hands washed with soap</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fecal contact events at</td>
<td>34%</td>
<td>25%</td>
<td>24%</td>
</tr>
<tr>
<td>which hands washed with soap</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food preparation events</td>
<td>7%</td>
<td>7%</td>
<td>8%</td>
</tr>
<tr>
<td>before which hands washed with soap</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Associations between rapidly collected measures and observed handwashing behavior across 3 countries

Observed soap and water at the handwashing place used after defecation
- RR 1.6 to 3.6*

Observed soap and water at the place for handwashing before food preparation
- RR 2.0 to 2.4

No consistent associations
- soap in the home
- self-reported handwashing
- distance of handwashing location to latrine or food preparation place
- soap retrieval in \( \leq 60 \) seconds
- visual inspection of hand cleanliness
The gory details on handwashing measurement and program evaluation


Handwashing measurement for global monitoring: MICS and DHS

Data from 2009-2013 now available and analyzed
Percentage of households observed to have soap for handwashing anywhere in the dwelling, MICS, 2009-2013

Kumar, UNC, 2013
Percentage of households observed to have soap for handwashing anywhere in the dwelling, by wealth quintile, MICS, 2009-2013, Africa and the Middle East

Kumar, UNC, 2013
Percentage of households observed to have a handwashing place with soap and water, MICS and DHS, 2009-2013

Kumar, UNC, 2013
Percentage of households observed to have a handwashing place with soap and water, by wealth quintile, MICS and DHS, 2009-2013, South/East Asia and the Pacific

Kumar, UNC, 2013
The equity case for handwashing is evident.

No excuses for handwashing to be left out of post-2015 Sustainable Development Goals.
Behavior and behavior change
Theoretical framework to explain handwashing behavior of mothers

- Perceived advantages and disadvantages of handwashing
- Normative beliefs and subjective norms
- Perceived risk
- Perceived behavioral control

Intention to wash hands

Desire to nurture

Handwashing behavior

Habit

Actual control

Maternal self-efficacy

Cues to action
Barriers to hand hygiene in the perinatal period

Mothers of newborns are busy

They do not have soap and water where they need them

They cannot tell others to wash hands

Handwashing is not a habit

Shahana Parveen, ASTMH, 2012
Bangladesh Perinatal Handwashing Study

Objectives

Develop an intensive but feasible behaviour change intervention to promote hand cleansing to mothers and other neonatal caregivers

Estimate the effect of intensive perinatal handwashing promotion on handwashing behaviour

1) Mothers
2) Other family members
Methods

Matlab, Bangladesh

Primiparous pregnant women identified during demographic surveillance

Visit to household compound at 28-32 weeks gestation

Eligibility and Consent

Randomization

Control

Intervention: handwashing
Maternal and neonatal health counseling for both arms

Antenatal care
Birth planning
Clean delivery kit
Maternal danger signs
Neonatal danger signs
Hypothermia prevention
Breastfeeding
Umbilical cord care

Danger signs poster adapted from MaMoni project
Number and timing of behavior change communication visits

<table>
<thead>
<tr>
<th>Topic</th>
<th>Arm(s)</th>
<th>Antenatal visit #1</th>
<th>Antenatal visit #2</th>
<th>Postnatal visit #1</th>
<th>Postnatal visit #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal and neonatal health counseling</td>
<td>Both</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Handwashing promotion</td>
<td>Intervention</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Behavior change approach

Iterative and interactive process
To affirm benefits of handwashing
To identify barriers and solutions to those barriers
Motivators of Handwashing: **Convenience**

Provided handwashing materials so that they are available where needed

- Baby’s sleeping area and courtyard
Motivators of Handwashing: Nurture

As a mother, you want to do the best for your child.
You want to protect the vulnerable child.
Motivators of Handwashing: **Cues**

Visual reminders
Verbal reminders

*Reminders can help you remember to wash your hands with soap at important times*

*I will give you reminder cards to post in a visible place*

*You can remind each other to wash hands with soap*
Recommended times for handwashing

After respiratory secretion contact
After fecal contact
Before contact with the umbilical cord

To stay consistent with other handwashing messaging
  Before food preparation or consumption
### Demographic Characteristics at Baseline

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control (N=124)</th>
<th>Intervention (N=125)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother’s mean age (SD)</td>
<td>20.3 (2.4)</td>
<td>19.9 (2.3)</td>
</tr>
<tr>
<td>Mean number of antenatal visits (SD)</td>
<td>0.7 (0.5)</td>
<td>0.8 (0.4)</td>
</tr>
<tr>
<td>Mean number of people in household (SD)</td>
<td>5.7 (2.4)</td>
<td>6.0 (2.9)</td>
</tr>
<tr>
<td>Mean years of education for mother (SD)</td>
<td>7.5 (2.3)</td>
<td>7.6 (2.5)</td>
</tr>
</tbody>
</table>
Percentage of households with at least one handwashing station with soap and water

<table>
<thead>
<tr>
<th># days after birth</th>
<th>Control</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-5</td>
<td>27</td>
<td>77</td>
</tr>
<tr>
<td>10-12</td>
<td>25</td>
<td>83</td>
</tr>
<tr>
<td>13-15</td>
<td>28</td>
<td>87</td>
</tr>
<tr>
<td>20-22</td>
<td>15</td>
<td>81</td>
</tr>
<tr>
<td>27-29</td>
<td>20</td>
<td>73</td>
</tr>
</tbody>
</table>
Percentage of households with soap and water present in a handwashing station in baby's sleeping area

Control
Intervention

4-5  10-12  13-15  20-22  27-29

# days after birth
<table>
<thead>
<tr>
<th></th>
<th>CONTROL (N=106)</th>
<th>INTERVENTION (N=112)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed handwashing with water only</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handwashing with water ≥ 1 time</td>
<td>64%</td>
<td>70%</td>
<td>0.78</td>
</tr>
<tr>
<td>Mean # times (SD)</td>
<td>1.5 (1.5)</td>
<td>1.6 (1.5)</td>
<td>0.32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observed handwashing with soap and water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handwashing with soap and water ≥ 1 time</td>
<td>17%</td>
<td>45%</td>
<td>0.0001</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>0.20 (0.52)</td>
<td>0.82 (1.2)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Intervention increased handwashing with soap 4-fold.

Extrapolated to a 15-hour day, intervention mothers in wash hands with soap ~ 4 times, compared to 1 time by mothers in the control arm.
Handwashing at times of potential pathogen transmission

Soap used to wash hands at recommended
  Intervention mothers: 8%
  Control mothers: 2%

Risk ratio 3.94 (2.08, 7.44)*

*Log binomial regression, accounting for clustering by mother
Implications

Our evidence-based intervention increased

Maintenance of handwashing materials where the newborn spends time with the mother

Handwashing with soap 4-fold among mothers of newborns ➔

~ 4 times during the day

Although higher in the intervention arm, rates of handwashing at “critical times” low in both arms

Only 45% of mothers washed hands with soap at least once during 3-hour observation
Questions remain...

Which critical times are relevant to interrupt pathogen transmission by handwashing in the neonatal period?

Is maternal handwashing with soap 4 times a day sufficient to reduce neonatal infections?

If we can only get mothers of newborns to clean hands 4 times a day, would there be added benefit from
  Promoting handwashing at fixed times?
  Recommending a product with a bacteriostatic effect to delay recontamination?
Handwashing in the Perinatal Period

Literature Review and Synthesis of Qualitative Research Studies from Bangladesh, Indonesia, and Kenya

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State University of New York at Buffalo
Contact: pkram@buffalo.edu

http://www.mchip.net/node/2989
Effects of handwashing promotion in households and schools

Behavior and illness
In a densely populated low-income setting, does intensive handwashing promotion decrease household transmission of respiratory infection?

Bangladesh Interruption of Secondary Transmission of Influenza Study (BISTIS)

Ram, ASTMH, 2011
Index case-patients with influenza-like illness identified at health facilities and pharmacies

Visit to household compound

Randomization

Control: standard practices

Intervention: handwashing promotion

Both groups followed up for 21 days post-resolution of index case-patient symptoms

Study design

Ram, ASTMH, 2011
Intervention
### Impact of intensive handwashing promotion on influenza-like illness

<table>
<thead>
<tr>
<th></th>
<th>Intervention (N=193 compounds 1661 contacts)</th>
<th>Control (N=184 compounds 1498 contacts)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Secondary attack risk (SAR)</strong></td>
<td>9.5%</td>
<td>7.7%</td>
</tr>
<tr>
<td><strong>SAR ratio (95% CI)</strong></td>
<td>1.24 (0.92 – 1.65), p=.14</td>
<td></td>
</tr>
<tr>
<td><strong>Secondary transmission of PCR-confirmed Influenza</strong></td>
<td>Intervention (N=24 compounds 177 contacts)</td>
<td>Control (N=36 compounds 250 contacts)</td>
</tr>
<tr>
<td><strong>Secondary attack risk (SAR)</strong></td>
<td>9.6%</td>
<td>4.0%</td>
</tr>
<tr>
<td><strong>SAR ratio (95% CI)</strong></td>
<td>2.40 (0.68 – 8.47), p=.17</td>
<td></td>
</tr>
</tbody>
</table>

An intervention designed to motivate handwashing on basis of disease prevention had no impact on influenza-like illness or influenza!
Risk factors for influenza-like illness in contacts

Young age of contact

Exposure early during the course of index case-patient’s illness

Report of ‘multiple daily interactions’ with the index case-patient
Behavior may not have changed

Behavior change may not have occurred fast enough to interrupt pathogen transmission
   Intensive handwashing promotion began after onset of symptoms in the index case-patient

In crowded compounds, do droplets contribute to transmission more than direct contact?

Group-level intervention may have increased mixing among compound members
What is the impact of a school-based waterless hand sanitizer intervention on student hand cleaning behavior?

- after toilet use & before eating
Study Site
Kibera, Kenya

0.4 sq km (77,000 people per sq km)

Schools recruited from CDC-Kenya/KEMRI surveillance area
Study Design
6 primary schools
~1600 students, age 5-12

Schools randomly assigned to sanitizer, soap, or control status

Baseline assessment, intervention, follow up for 8 weeks
Interventions

Teacher training

Education kits
  Posters, stickers, video, pencils

Soap/sanitizer installation

Soap and sanitizer replenished daily

No water provided

www.sopo-online.org
Any type of student hand cleaning after toilet use

Proportion of students hand cleaning

week of study

Control
Handwashing
Sanitizer

Intervention

Pickering, AJTMH, 2013
After toilet hand cleaning behavior

Proportion of students cleaning hands after visiting toilet:

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Any hand cleaning</th>
<th>P-value*</th>
<th>Cleaning with product</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitizer</td>
<td>2589</td>
<td>0.82</td>
<td>0.014</td>
<td>0.82</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Soap</td>
<td>3607</td>
<td>0.38</td>
<td>0.954</td>
<td>0.37</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Control</td>
<td>3031</td>
<td>0.37</td>
<td></td>
<td>0.02</td>
<td></td>
</tr>
</tbody>
</table>

*Poisson regression model accounting for clustering & week of follow up

Pickering, AJTMH, 2013
# Self-reported symptoms, by treatment arm

<table>
<thead>
<tr>
<th></th>
<th>Sanitizer vs. control</th>
<th>Soap vs. control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RR (95% CI)</td>
<td>P value</td>
</tr>
<tr>
<td>Diarrhea (defined as three or more loose/watery stools in 24 hours)</td>
<td>0.75 (0.52–1.10)</td>
<td>0.14</td>
</tr>
<tr>
<td>Any loose/watery stool in 24 hours</td>
<td>0.87 (0.72–1.04)</td>
<td>0.12</td>
</tr>
<tr>
<td>Loose/watery stool identified on stool chart</td>
<td>0.87 (0.70–1.08)</td>
<td>0.19</td>
</tr>
<tr>
<td>Vomiting</td>
<td>0.69 (0.44–1.09)</td>
<td>0.11</td>
</tr>
<tr>
<td>Cough</td>
<td>0.89 (0.75–1.05)</td>
<td>0.16</td>
</tr>
<tr>
<td>Observed rhinorrhea</td>
<td>0.77 (0.62–0.95)</td>
<td>0.02*</td>
</tr>
<tr>
<td>Difficulty breathing</td>
<td>0.77 (0.55–1.08)</td>
<td>0.14</td>
</tr>
<tr>
<td>Skin rash</td>
<td>0.79 (0.48–1.29)</td>
<td>0.34</td>
</tr>
</tbody>
</table>

All models control for week of follow-up, child age, sex, and clustering at the student level. All models include 4,636 observations.

*P < 0.05.
Water and soap availability

Soap schools:
- Water present 61% of time at soap schools
- When water available, hand cleaning increased from 0.38 to 0.62

Control schools:
- Water present 71% of time at controls
- When water available, hand cleaning increased from 0.37 to 0.53

Soap use
- 97% in soap schools
- 6% in control schools
Waterless hand cleanser can overcome the substantial hurdle of inconsistent water access

Next steps:
• Larger-scale and longer-term implementation
• Health and absenteeism data
• working towards affordable waterless options
Handwashing

“it’s such an easy thing to do...”?
The path ahead for handwashing

- Changing behavior through feasible, scalable approaches
- Bolstering health efficacy and effectiveness data
- Measuring behavior using credible and feasible methods
- Gaining a foothold post-2015
- Making and addressing the equity case for handwashing
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