

A Bibliography of Selected Articles on Handwashing/Hygiene, July 2009

This bibliography contains citations and abstracts to 17 journal articles published from January – July 2009. The bibliography will be updated on a periodic basis and posted to the Environmental Health at USAID website at: http://www.ehproject.org/eh/eh_topics.html.

Entries are arranged alphabetically by first author.

1 - Arnold B, Arana B, Mäusezahl D, Hubbard A, Colford JM Jr.

Evaluation of a pre-existing, 3-year household water treatment and handwashing intervention in rural Guatemala. *Int J Epidemiol.* 2009 Jul 2.

Division of Epidemiology, University of California, Berkeley, CA, USA.

BACKGROUND: The promotion of household water treatment and handwashing with soap has led to large reductions in child diarrhoea in randomized efficacy trials. Currently, we know little about the health effectiveness of behaviour-based water and hygiene interventions after the conclusion of intervention activities.

METHODS: We present an extension of previously published design (propensity score matching) and analysis (targeted maximum likelihood estimation) methods to evaluate the behavioural and health impacts of a pre-existing but non-randomized intervention (a 3-year, combined household water treatment and handwashing campaign in rural Guatemala). Six months after the intervention, we conducted a cross-sectional cohort study in 30 villages (15 intervention and 15 control) that included 600 households, and 929 children <5 years of age.

RESULTS: The study design created a sample of intervention and control villages that were comparable across more than 30 potentially confounding characteristics. The intervention led to modest gains in confirmed water treatment behaviour [risk difference = 0.05, 95% confidence interval (CI) 0.02-0.09]. We found, however, no difference between the intervention and control villages in self-reported handwashing behaviour, spot-check hygiene conditions, or the prevalence of child diarrhoea, clinical acute lower respiratory infections or child growth.

CONCLUSIONS: To our knowledge this is the first post-intervention follow-up study of a combined household water treatment and handwashing behaviour change intervention, and the first post-intervention follow-up of either intervention type to include child health measurement. The lack of child health impacts is consistent with unsustainable behaviour adoption. Our findings highlight the difficulty of implementing behaviour-based household water treatment and handwashing outside of intensive efficacy trials.

2 - Braun BI, Kusek L, Larson E.

Measuring adherence to hand hygiene guidelines: a field survey for examples of effective practices. *Am J Infect Control.* 2009 May; 37(4):282-8.

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BACKGROUND: Measuring adherence to hand hygiene guidelines is resource intensive and complicated by lack of standardized methodology. The multiplicity of approaches in use makes it difficult to meaningfully compare performance across health care organizations. The goal of this project was to identify promising and effective practices for measuring adherence with hand hygiene guidelines across a variety of settings.

METHODS: A cross-sectional survey was conducted electronically in February 2007 to collect information on aspects of hand hygiene measured (eg, frequency, thoroughness of technique, glove use, product consumption), data collection approaches, training and resources, reports, and others. Invitations to respond were widely distributed through Web site announcements and list-serve messages of The Joint Commission and collaborating organizations. A panel of national experts developed and applied criteria for evaluating the methods.

RESULTS: Two hundred forty-two responses were submitted from a variety of settings and countries. Most (approximately 75%) measured frequency of hand hygiene; approximately 50% measured thoroughness, glove use, product usage, patient and provider satisfaction, or other aspects. Seventy-two percent relied exclusively on manual data collection, and most methods (80%) had been in use for less than 3 years. Most (65%) spent less than 1 hour in training data collectors, and few had evidence of reliability or validity. Forty submissions met most criteria for inclusion in an educational monograph.

CONCLUSION: Among respondents who considered their approach to be an example of an effective practice, there was substantial variation in methods and little evidence of reliability. Standardization of methods is needed to compare performance across organizations or within an organization over time.

3 - Campos AKC, Angela Maria Soares Cardonha, et al.

Assessment of personal hygiene and practices of food handlers in municipal public schools of Natal, Brazil. *Food Control, Volume 20, Issue 9, September 2009, Pages 807-810.*

The aim of this study was to assess the hygiene practices of food handlers in municipal schools of Natal, Brazil, where 27 public schools were evaluated, using a checklist and microbiological analysis of hands. It was found that 74.1% of the handlers did not receive periodic training, 51.9% did not undergo annual health examinations and 100% did not practice proper hand hygiene, a situation that reflected significantly ($p < 0.05$) in hand contamination, in which fecal coliforms were detected on 55.6% of the hands analyzed. It was concluded that the schools studied did not have appropriate hygienic conditions, suggesting the need for interventions that ensure the quality of school food served to the children.

4 - Curtis VA, Danquah LO, Aunger RV.

Planned, motivated and habitual hygiene behaviour: an eleven country review. *Health Educ Res. 2009 Aug;24(4):655-73.*

Hygiene Centre, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK.

Handwashing with soap (HWWS) may be one of the most cost-effective means of preventing infection in developing countries. However, HWWS is rare in these settings. We reviewed the results of formative research studies from 11 countries so as to understand the planned, motivated and habitual factors involved in HWWS. On average, only 17% of child caretakers HWWS after the toilet. Handwash 'habits' were generally not inculcated at an early age. Key 'motivations' for handwashing were disgust, nurture, comfort and affiliation. Fear of disease generally did not motivate handwashing, except transiently in the case of epidemics such as cholera. 'Plans' involving handwashing included to improve family health and to teach children good manners. Environmental barriers were few as soap was available in almost every household, as was water. Because much handwashing is habitual, self-report of the factors determining it is unreliable. Candidate strategies for promoting HWWS include creating social norms, highlighting disgust of dirty hands and teaching children HWWS as good manners. Dividing the factors that determine health-related behaviour into planned, motivated and habitual categories provides a simple, but comprehensive conceptual model. The habitual aspects of many health-relevant behaviours require further study.

5 - Dia Sanou, Huguette Turgeon-O'Brien, Therese Desrosiers,

Nutrition intervention and adequate hygiene practices to improve iron status of vulnerable preschool Burkinabe children. *Nutrition, In Press, 22 July 2009.*

Objective: To determine the impact of an intervention that combined an increase in dietary and bioavailable iron intakes and an improvement in hygiene behaviors on the iron status of preschool children from Burkina Faso.

Methods: Thirty-three orphans and vulnerable children from 11 families who were 1-6 y old, were non-anemic, or had mild to moderate anemia were enrolled in an 18-wk trial. Using the probability approach for planning diets in an assisted-living facility, bioavailable iron intake was increased from 0.4 to 0.9 mg/d by increasing the amounts of meat and citrus fruits and by adding iron-rich condiments to the diet, for an estimated cost of U.S. \$0.59/mo. Hygiene behaviors were modified by implementing hand-washing before meals and by the use of individual plates for meals. Iron status indicators were measured twice and means at enrollment and after intervention were compared.

Results: After intervention, hemoglobin concentration increased from 98.7 to 103.8 g/L ($P = 0.006$). There was a decrease in total iron binding capacity (107 to 91 $\mu\text{mol/L}$, $P = 0.05$) and a marginal increase in transferrin saturation (13% to 17%, $P = 0.06$). Significant improvement was not observed for serum ferritin concentration or prevalence of depleted iron stores, likely due to the confounding effect of infection. Anemia and iron-deficiency anemia were decreased from 64% to 30% and from 61% to 30%, respectively.

Conclusion: Dietary modification associated with adequate hygiene behaviors could be a relevant strategy to control iron deficiency and anemia in areas where infection is a major health problem.

Keywords: Bioavailable iron; Dietary intervention; Hygiene behaviors; Infection; Iron-deficiency anemia; Preschool children

6 - Fung IC, Cairncross S.

Ascariasis and handwashing. *Trans R Soc Trop Med Hyg.* 2009 Mar; 103(3):215-22.

Department of Infectious Disease Epidemiology, Imperial College London, St Mary's campus, Norfolk Place, London W2 1PG, UK.

This review summarises evidence of the effectiveness of handwashing and the use of soap as a public health intervention against *Ascaris* infection, in terms of both prevalence and intensity. Literature in five major languages was searched and data were retrieved from 15 papers. The evidence of the effect of handwashing in general upon both prevalence and intensity of *Ascaris* infection is inconclusive. However, the use of soap in handwashing is protective against *Ascaris* infection with respect to prevalence. There is no direct evidence that it reduces the intensity of infection.

7 - Lopez-Quintero C, Freeman P, Neumark Y.

Hand washing among school children in Bogotá, Colombia. *Am J Public Health.* 2009 Jan; 99(1):94-101.

Braun School of Public Health & Community Medicine, Hebrew University, Hadassah, PO Box 12272, Jerusalem, Israel.

OBJECTIVES: We assessed hand-washing behaviors and intentions among school children in Bogotá, Colombia, to help identify and overcome barriers to proper hygiene practices.

METHODS: Data on hand-washing behavior and intentions and individual and contextual factors were collected from 2042 sixth- through eighth-grade students in 25 schools in Bogotá via anonymous questionnaires. A member of the school administration or teaching staff completed a questionnaire about the school environment. Site inspections of bathroom facilities were conducted.

RESULTS: Only 33.6% of the sample reported always or very often washing hands with soap and clean water before eating and after using the toilet. About 7% of students reported regular access to soap and clean water at school. A high level of perceived control was the strongest predictor of positive hand-washing intentions (adjusted odds ratio [AOR]=6.0; 95% confidence interval [CI]=4.8, 7.5). Students with proper hand-washing behavior were less likely to report previous-month gastrointestinal symptoms (OR=0.8; 95% CI=0.6, 0.9) or previous-year school absenteeism (OR=0.7; 95% CI=0.6, 0.9).

CONCLUSIONS: Scarcity of adequate facilities in most schools in Bogotá prevents children from adopting proper hygienic behavior and thwarts health promotion efforts. The current renovation program of public schools in Bogotá provides a unique opportunity to meet the challenges of providing a supportive environment for adoption of healthy behaviors.

8 - Luby SP, Agboatwalla M, Bowen A, Kenah E, Sharker Y, Hoekstra RM.

Difficulties in maintaining improved handwashing behavior, Karachi, Pakistan. *Am J Trop Med Hyg.* 2009 Jul;81(1):140-5.

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In an earlier study in Karachi, Pakistan, households that received free soap and handwashing promotion for 9 months reported 53% less diarrhea than controls. Eighteen months after the intervention ended, these households were enrolled in a follow-up study to assess sustainability of handwashing behavior. Upon re-enrollment, mothers in households originally assigned to the intervention were 1.5 times more likely to have a place with soap and water to wash hands (79% versus 53%, $P = 0.001$) and when asked to wash hands were 2.2 times more likely to rub their hands together at least three times (50% versus 23%, $P = 0.002$) compared with controls. In the ensuing 14 months, former intervention households reported a similar proportion of person-days with diarrhea (1.59% versus 1.88%, $P = 0.66$) as controls. Although intervention households showed better handwashing technique after 2 years without intervention, their soap purchases and diarrhea experience was not significantly different from controls.

9 - Nicol PW, Watkins RE, Donovan RJ, Wynaden D, Cadwallader H.

The power of vivid experience in hand hygiene compliance. *Hosp Infect.* 2009 May;72(1):36-42.

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In recent years, explicit behavioural theories have been used in some research into hand hygiene behaviour. One of the most prominent of these has been the theory of planned behaviour (TPB). In this qualitative study aimed at increasing understanding of infection prevention practice in the acute care setting, TPB was identified as a suitable framework for the emergence of new insights that have the potential to improve the power of existing education and training. The theory emerging from the research was based on a finding that individual experience is of greater import than formal education in explaining hand hygiene behaviour. This indicated that exposure to vivid vicarious experience is a potential means to improving the power of existing training methods and increasing the propensity for instilling sustainable adequate hand hygiene habits.

10 - Park Aeri, Seung Ju Lee,

Fault tree analysis on handwashing for hygiene management,

Food Control, Volume 20, Issue 3, March 2009, Pages 223-229, ISSN 0956-7135, DOI: 10.1016/j.foodcont.2008.05.001.

FTA (fault tree analysis) of the handwashing process was performed to investigate the causes for faults in hygiene management. The causes were deductively identified as the events causing every possible hazard by constructing a fault tree. The fault tree was constructed in a hierarchical structure with a single top event (occurrence of

faults in hand washing), seven intermediate events, and fifteen basic events connected by a Boolean operator AND gate, or an OR gate. Qualitative analysis on the fault tree yielded minimal cut sets, structural importance, and common cause vulnerability. Quantitative analysis yielded simulation of the final top event fault, cut set importance, item importance, and sensitivity. Those factors are basically a measure to represent the priority order of the basic events causing the top event. The critical basic events turned out to be human errors in hand manipulation in terms of scrubbing the palms, backs, fingers, and fingertips of the hands, as well as failure to use hygienic towels for hand drying due to not using disposable paper towels and unhygienic storage of the towels. The priority order of the basic events was consistent between the qualitative and quantitative analyses. Consequently, we found that FTA, with qualitative and quantitative analyses, was a good alternative approach to hazard analysis in HACCP system implementation.

11- Porzig-Drummond R, Stevenson R, Case T, Oaten M.

Can the emotion of disgust be harnessed to promote hand hygiene?

Experimental and field-based tests. *Soc Sci Med.* 2009 Mar;68(6):1006-12.

Two studies carried out in Sydney, Australia explored whether inducing disgust may be a useful addition to hand-hygiene interventions. Experiment 1 employed a novel laboratory measure of hand hygiene, and tested whether a brief (3-min) video-based intervention using disgust/education, improved hand hygiene relative to education alone and a control condition. On test, a week later, the disgust intervention significantly exceeded the education and control condition combined, although the effect size was modest. Experiment 2 examined the generality of this effect in a field study. During a baseline period, soap and paper towel use in a series of washrooms were covertly monitored. This was followed by an intervention period, in which two washrooms received disgust/education-based posters and a further two, educational posters, exhorting participants to wash their hands. A follow-up period, after the posters were removed, was also monitored. The disgust-based intervention was significantly better at promoting hand hygiene. These findings suggest that even brief disgust-based interventions may be successful and that these can be tested and developed under laboratory conditions.

12 - Rosen, Laura, Orly Manor, David L. Brody, Dan Engelhard, Rony A. Shtarkshall, David Zucker,

From pills to programs: Lessons from medicine for developing effective lifestyle interventions. *Preventive Medicine, 13 March 2009, ISSN 0091-7435.*

Objective: To propose a scheme for comprehensive development and evaluation of lifestyle interventions.

Methods: We adapted the four-phase system used in drug development, the engine of progress in medicine for decades, to construct a system for developing lifestyle intervention programs.

Results: Phase I: The intervention is constructed and tested with a small number of individuals. Acceptability and feasibility are assessed. Evaluation is primarily qualitative. Phase II: Effectiveness on intermediate endpoints (e.g. behavior) is tested in a real field setting, with a limited number of individuals, using a before-and-after design. An iterative process of testing and refinement may be necessary.

Phase III: The effectiveness of the intervention on health-related outcomes is tested, using, where possible, a randomized design. Phase IV: Large-scale implementation and penetration are assessed in other populations. Process variables and local and national health indicators are studied. The development and evaluation of our hygiene intervention, which took place in Jerusalem from 1999 to 2001, is presented as a case study.

Conclusions: Adaptation of the phased system of drug development to lifestyle interventions is a conceptually simple approach to building effective, sustainable programs for community-based public health.

13 - Rosen L, Zucker D, Brody D, Engelhard D, Manor O.

The effect of a handwashing intervention on preschool educator beliefs, attitudes, knowledge and self-efficacy. *Health Educ Res.* 2009 Aug;24(4):686-98.

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This paper describes the effect of a preschool hygiene intervention program on psychosocial measures of educators regarding handwashing and communicable pediatric disease. A cluster-randomized trial, with randomization at the level of the preschool, was run in 40 Jerusalem preschool classrooms. Eighty preschool educators participated. The program used a multipronged approach which included elements aimed at staff, children, parents, school nurses and the classroom environment. Frontal lectures by medical, epidemiological and educational experts, along with printed materials and experiential learning, were provided to staff. Responses from a validated survey instrument were used to build four scales for each respondent regarding beliefs, attitudes, self-efficacy and knowledge. The scales were built on a Likert-type 1-7 scale (1 = minimum, 7 = maximum). The effect of the intervention was tested using mixed model analysis of variance. Response was received from 92.5% of educators. Educators believed that handwashing could affect health (mean = 5.5, SD = 1.1), had high levels of self-efficacy (mean = 6.1, SD = 0.9) and had positive attitudes toward handwashing (mean = 5.7, SD = 1.2). Knowledge was affected by the intervention (intervention: mean = 6.2, SD = 0.7; control: mean = 5.8, SD = 0.8). The combination of positive attitudes toward handwashing among educators and the program's effectiveness in imparting knowledge helped to create a sustained social norm of handwashing among many children in disparate locations.

14 - Stevenson RJ, Case TI, Hodgson D, Porzig-Drummond R, Barouei J, Oaten MJ.

A scale for measuring hygiene behavior: Development, reliability and validity. *Am J Infect Control.* 2009 Apr 9.

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BACKGROUND: There is currently no general self-report measure for assessing hygiene behavior. This article details the development and testing of such a measure.

METHODS: In studies 1 to 4, a total of 855 participants were used for scale and subscale development and for reliability and validity testing. The latter involved establishing the relationships between self-reported hygiene behavior and existing measures, hand hygiene behavior, illness rates, and a physiological marker of immune function. In study 5, a total of 507 participants were used to assess the psychometric properties of the final revised version of the scale.

RESULTS: The final 23-item scale comprised 5 subscales: general, household, food-related, handwashing technique, and personal hygiene. Studies 1 to 4 confirmed the scale's reliability and validity, and study 5 confirmed the scale's 5-factor structure.

CONCLUSIONS: The scale is potentially suitable for multiple uses, in various settings, and for experimental and correlational approaches.

15 - Ugbomoiko US, V. Dalumo, I.E. Ofoezie, R.N.N. Obiezue,

Socio-environmental factors and ascariasis infection among school-aged children in Ilobu, Osun State, Nigeria. *Transactions of the Royal Society of Tropical Medicine and Hygiene, Volume 103, Issue 3, March 2009.*

The risk factors predisposing children to ascariasis transmission in a rural community of Osun State, Nigeria were investigated from November 2005 to April 2006. Children below 16 years of age were examined at the household level after information on biodata, access to water supply and sanitation, socio-economic status of their parents and degree of cohabitation with their parents was collected using a questionnaire. Of 440 children examined, overall prevalence was 60% and median intensity was 1548 eggs per gram (epg) (min. 48 epg; max. 55 464 epg). Infection patterns were gender comparable and age dependent, with peak prevalence (67.8%) occurring in children aged 5-9 years and peak median intensity (4368 epg) in children aged ≥ 15 years. Logistic regression analysis revealed that prevalence was influenced by patterns of water supply and sanitation, parents' educational background, number of biological parents living with a child and number of playmates a child has. These findings suggest that socio-environmental risk factors which play a role in disease transmission need to be taken into account when formulating sustainable control strategies for ascariasis and other intestinal parasites in Nigeria and elsewhere.

16 - Yajima A, Pascal Jouquet, Dung Do Trung, Thach Dang Thi Cam, et al.

High latrine coverage is not reducing the prevalence of soil-transmitted helminthiasis in Hoa Binh province, Vietnam. *Transactions of the Royal Society of Tropical Medicine and Hygiene, Volume 103, Issue 3, March 2009, Pages 237-241.*

A baseline epidemiological survey for parasite infections was conducted between December 2007 and January 2008 in 155 villagers in a rural commune in Hoa Binh province, Vietnam. The prevalence of *Ascaris lumbricoides*, *Trichuris trichiura* and hookworm infection was 13.5%, 45.2% and 58.1%, respectively. At least one of the parasites was detected in 72.3% of the samples. We found no association between infection with *A. lumbricoides* or *T. trichiura* and engagement in agriculture, while hookworm infection was more prevalent in populations having frequent contact with soil. Agricultural use of human faeces was not correlated with any of the infections. We suggest that the consumption of vegetables that are commonly fertilized with human faeces in the community has led to the high infection rates with

A. lumbricoides and T. trichiura, rather than the manipulation of faeces in farming activity. This also explains the high infection prevalence, despite high latrine coverage (98.1%) in the study population. The presence of latrines alone is not sufficient to reduce the prevalence of helminthiasis in a rural agricultural community if fresh faeces are used as fertilizer.

17 - Yang C, Sangthong R, Chongsuvivatwong V, McNeil E, Lu L.

Effect of village income and household income on sanitation facilities, hygiene behaviours and child undernutrition during rapid economic growth in a rural cross-border area, Yunnan, China. *Epidemiol Community Health.* 2009 May; 63(5):403-7.

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BACKGROUND: The study aimed to examine the effects of village income and household income on child nutrition status through basic sanitation and hygiene behaviours.

METHODS: A survey was conducted in a rural cross-border area of Yunnan, China. Data on village income in 2002-2006 and household income in 2002-2007 were obtained from an official report and a household survey respectively. Anthropometric measurement of the children aged 6 months to 5 years (n = 1801) was used to determine their nutrition status. Child caretakers were interviewed about household sanitation facilities and their hygiene behaviours using a structured questionnaire.

RESULTS: Households with incomes below the national poverty line decreased from 22% in 2002 to less than 8% in 2007. The coverage of safe drinking water and water-sealed latrines gradually increased, but was still inadequate. The prevalence of stunting and underweight in children was 37% and 17.5% respectively. Village income had a greater positive effect than household income on exclusive breastfeeding, drinking boiled water, handwashing with soap, as well as reducing the prevalence of stunting. Village income at one lag year had the greatest effect on the availability of basic sanitation compared with other lag years, while household income had a small but significant effect through all lag years.

CONCLUSIONS: Rapid economic growth is not always followed by improved child nutrition status. Village income has a greater effect than household income on sanitation facilities, hygiene behaviours of caretakers and child nutrition status.