Citations and abstracts of recently published journal articles summarizing studies of household water treatment & sanitation, hygiene, & diarrheal diseases

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Hutton¹, Guy; Haller², Laurence

**EVALUATION OF THE COSTS AND BENEFITS OF WATER AND SANITATION IMPROVEMENTS AT THE GLOBAL LEVEL.**

**WORLD HEALTH ORGANIZATION,** Geneva, Switzerland. 2004. [PHEDOC@WHO.INT](mailto:PHEDOC@WHO.INT).

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Order a copy of this report from: Marketing and Dissemination, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland; Tel: +41 22 791 2476; Fax: +41 22 791 4857; email: [BOOKORDERS@WHO.INT](mailto:BOOKORDERS@WHO.INT).

The aim of this study was to estimate the economic costs and benefits of a range of selected interventions to improve water and sanitation services, with results presented for 17 WHO sub-regions and at the global level. Interventions evaluated include (1) improvements required to meet the millennium development goals (MDG) for water supply (by halving by 2015 the proportion of those without access to safe drinking water), (2) meet the water MDG plus halving by 2015 the proportion of those without access to adequate sanitation, (3) increasing access to improved water and sanitation for everyone, (4) providing disinfection at point-of-use over and above increasing access to improved water supply and sanitation (5) providing regulated piped water supply in house and sewage connection with partial sewerage for everyone.

Predicted reductions in the incidence of diarrhoeal disease were calculated for each intervention based on the expected population receiving these interventions. The costs
of the interventions included the full investment and annual running costs. The benefits of the interventions included time savings associated with better access to water and sanitation facilities, the gain in productive time due to less time spent ill, health sector and patients costs saved due to less treatment of diarrhoeal diseases, and the value of prevented deaths.

The results show that all water and sanitation improvements were found to be cost-beneficial, and this applied to all world regions. In developing regions, the return on a US$1 investment was in the range US$5 to US$28 for intervention 1, remaining at similar levels for interventions 2, 3 and 4. The main contributor to benefits was the saving of time associated with better access to water supply and sanitation services. When different cost and benefit assumptions were used, the cost-benefit ratios changed considerably, but even under pessimistic scenarios the potential economic benefits generally outweighed the costs. Due to uncertainties in many of the data inputs, it is recommended to conduct detailed country case studies as a follow-up to this global analysis. (Author abstract)

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Rijsberman, Frank

**The Water Challenge.**


Lack of access to basic water supply and sanitation services has a broad range of impacts at the household level for what are generally referred to as “the unserved”. These range from the high costs the urban unserved pay to water vendors for minimal amounts of water, to large amounts of time spent carrying water in rural areas, or time not spent by adults on productive activities while caring for sick children suffering from water-related diseases. The water-related health impacts are well established. They can be divided into three classes:

1. Some diseases are closely correlated with the lack of access to water supply and sanitation combined with unhygienic behavior, particularly diarrhoeal diseases.

2. Other diseases are water-related because the habitat for the vector transmitting the disease is closely linked to water or live in water, e.g. malaria, filariasis, schistosomiasis, guinea worm.

3. Finally, health impacts can also be caused by natural or anthropogenic low quality water or pollutants, e.g. arsenic, fluoride, heavy metals, persistent organic pollutants or endocrine disruptors. (Excerpt, p. 7)

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Evans, Barbara; Edited by Karen Ciceri

**THE SANITATION CHALLENGE: TURNING COMMITMENT INTO REALITY.**


Order a copy of this report from: Marketing and Dissemination, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland; Tel: +41 22 791 2476; Fax: +41 22 791 4857; email: BOOKORDERS@WHO.INT.

The provision of sanitation is a key development intervention – without it, ill-health dominates a life without dignity. Simply having access to sanitation increases health, well-being and economic productivity. Inadequate sanitation impacts individuals, households, communities and countries. Despite its importance, achieving real gains in sanitation coverage has been slow. Scaling up and increasing the effectiveness of investments in sanitation need to be accelerated to meet the ambitious targets agreed at Johannesburg.

In response to global demand, this document summarises the key thinking about how these targets can be met. It suggests actions that can be taken at different levels and by different actors to change the pace of sanitation improvement. Achieving the internationally agreed targets for sanitation and hygiene poses a significant challenge to the global community and can only be accomplished if action is taken now. Low-cost, appropriate technologies are available. Effective programme management approaches have been developed. Political will and concerted actions by all stakeholders can improve the lives of millions of people in the immediate future.

Nearly 40% of the world’s population (2.4 billion) have no access to hygienic means of personal sanitation (Figure 1).1 Globally, WHO estimates that 1.8 million people die each year from diarrhoeal diseases, 200 million people are infected with schistosomiasis and more than 1 billion people suffer from soil-transmitted helminth infections. A Special Session on Children of the United Nations General Assembly (2002) reported that nearly 5,500 children die every day from diseases caused by contaminated food and water.

Increasing access to sanitation and improving hygienic behaviours are key to reducing this enormous disease burden. In addition, such changes would increase school attendance, especially for girls, and help school children to learn better. They could also have a major effect on the economies of many countries – both rich and poor – and on the empowerment of women. Most of these benefits would accrue in developing nations. *Author abstract*

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Mahalanabis, Dilip

**ROLE OF MICRONUTRIENTS IN THE CASE MANAGEMENT STRATEGY OF CHILDHOOD ILLNESSES.**
Improving Child Health and Nutrition, 10th Asian Conference on Diarrhoeal Diseases and Nutrition (ASCODD), December 7-9, 2003, Dhaka, Bangladesh.

Society for Applied Studies, 108 Manicktala Main Road, Flat 3/21, Kolkata 700 054, India.

The role of micronutrients, namely zinc, vitamin A, and folate, as adjunct therapy of illness episodes in children in developing countries will be discussed in the light of health policy. This is based on a selective review and some of our attempts to statistically combine results of relevant studies to address policy issues. Many studies in this subcontinent and other developing countries reported the use of zinc supplements to treat acute diarrhoea along with oral rehydration therapy. These studies clearly show benefit in reducing the duration and severity of the episodes. In some trials in children with acute diarrhoea, when zinc was given daily for 7 to 14 days beyond recovery, diarrhoeal and respiratory morbidity was reduced over 4 to 8 weeks following recovery. The reported follow-up impact has substantial implication for health policy.

Before zinc is considered in primary healthcare programme for treating acute diarrhoea, we need additional effectiveness trials on reduction of hospitalization or deaths due to diarrhoea, impact on oral rehydration solution (ORS) use and on use of antimicrobials and probiotics commonly prescribed in developing countries. While competition with antibiotics and probiotics is desirable that with ORS is not, large ongoing field trials could provide essential information on these policy issues. Concerning policy, zinc supplementation as a component of a micronutrient mixture is recommended in the rehabilitation of severely-malnourished children and in persistent diarrhoea. Present evidence suggests that use of zinc in diarrhoea may be an effective intervention to reduce hospitalization and child mortality if one could reach the most vulnerable children in the community. In an unpublished study, authors have found that zinc as adjunct therapy of pneumonia in infants and young children render benefit in boys but not in girls. Studies are needed to evaluate the role of zinc in the treatment of childhood pneumonia. In developing-country children, vitamin A supplementation during illness has a profound effect in reducing mortality from measles, a significant effect in reducing persistent episodes in children with acute diarrhoea but no benefit in the treatment of non-measles pneumonia.

Several studies reported adverse effect of large-dose vitamin A in children with pneumonia and, it is, therefore, not recommended. Use of large-dose vitamin A is, however, recommended during measles episodes. Its use in acute diarrhoea is debatable but recommended in persistent diarrhoea and in severe malnutrition as a component of a micronutrient mixture. Large-dose vitamin A supplementation should be used with caution in young infants, as there are unresolved concerns about its safety, particularly bulging fontanelle observed in infants when co-administered at immunization. In two randomized controlled trials, folic acid has been evaluated in acute and persistent diarrhoea and found to have no beneficial effect. Folate is, therefore, not recommended as adjunct therapy of diarrhoea. Role of folate, however, in preventing severe disease and/or death from diarrhoea or pneumonia deserves further evaluation. The latter is based on an elegant animal study conducted at ICDDR,B. (Author abstract)

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J. Sobel1; T. A. T. Gomes2; R. T. S. Ramos2; M. Hoekstra1; D. Rodrigue1,3; V. Rassi2; P. M. Griffin1

PATHOGEN-SPECIFIC RISK FACTORS AND PROTECTIVE FACTORS FOR ACUTE DIARRHEAL ILLNESS IN CHILDREN AGED 12-59 MONTHS IN SÃO PAULO, BRAZIL.

Clinical Infectious Diseases: June 1, 2004; 38(11): 1545-1551. PMID: 15156440

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2 Escola Paulista de Medicina, São Paulo, Brazil.
3 Present affiliation: Lexington Infectious Diseases Consultants, Lexington, Kentucky, USA.

Diarrheal diseases are a leading cause of childhood morbidity and mortality in Latin America. Most studies have focused on infants but not on older children. We enrolled 505 children (age, 12-59 months) with diarrhea and age-matched controls in a case-control study in São Paulo, Brazil. Independent risk factors for diarrhea included another household member with diarrhea (matched odds ratio [mOR], 8.1; attributable fraction [AF], 0.17; \( P < .001 \)) and consumption of homemade juice (mOR, 1.8; AF, 0.10; \( P = .01 \)); protective factors included boiling of the baby bottle or nipple (mOR, 0.60; AF, 0.19; \( P = .026 \)), childcare at home (mOR, 0.58; AF, 0.12; \( P = .004 \)), and piped sewage (mOR, 0.58; AF, 0.05; \( P = .047 \)). Hand washing by the caretaker after helping the child defecate protected against \textit{Shigella} infection (mOR, 0.35; \( P < .05 \)). Preparation of rice, beans, or soup in the morning and serving it to children after noon were associated with enterotoxigenic \textit{Escherichia coli} infection (mOR, 8.0; \( P < .05 \)). In these poor households, 28% of cases of diarrhea in 1-4-year-old children was attributable to easily modifiable exposures. (Author abstract)

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Burgess S.; Onyonge C.

SOLAR DISINFECTION OF WATER - A CASE STUDY FROM KENYA.


The women in this rural Kenyan project asked, 'Does SODIS work?' This article describes the bacteriological tests that they undertook, comparing raw water from various sources with the same water treated by SODIS, and also their reactions and questions regarding the technique. (Author abstract)

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Price S.; Rudge L.; Prades E.C.

PROMOTING SODIS IN GUATEMALAN VILLAGES.
Experience in Guatemalan villages shows that SODIS is most successfully adopted in rural areas where other purification methods are less affordable, and where promotion is directed at the whole family and accompanied by health and hygiene messages. (Author abstract)

* * *

Rukunga G.; Mutethia D.; Odhiambo F.

INTEGRATING KNOWLEDGE MANAGEMENT INTO WATER AND SANITATION PROGRAMMES IN KENYA.

Introducing knowledge management into an organization is best done one department at a time. This article describes how AMREF was helped to introduce knowledge management into its water and sanitation programme. (Author abstract)

* * *

Wegelin-Schuringa M.; Kamminga E.

WATER SUPPLY, SANITATION, HYGIENE AND HIV/AIDS - THE UNRECOGNIZED LINKS.

People with HIV/AIDS need better access to clean water and sanitation so that they can fight infection better. But the prevalence of the illness in many parts of the world means that community-based water supply systems are less well managed, and there is a high turnover of staff in government agencies. (Author abstract)

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Mintz, Eric

IMPROVING HEALTH BY IMPROVING WATER QUALITY: DISTRIBUTED TECHNOLOGIES FOR HOUSEHOLD WATER TREATMENT AND STORAGE.

Improving Child Health and Nutrition, 10th Asian Conference on Diarrhoeal Diseases and Nutrition (ASCODD), December 7-9, 2003, Dhaka, Bangladesh.

CENTERS FOR DISEASE CONTROL AND PREVENTION, Atlanta, GA 30333, USA.
Over 1.1 billion persons lack access to safe drinking-water, and an estimated 2 million children die from waterborne diseases each year. Efforts to prevent these deaths have largely focused on improvements in water sources, sanitation facilities, and hygiene practices. While these are essential long-term goals, recent studies have suggested that health gains can be greatly accelerated through improvements in water quality achievable by point-of-use water treatment and safe storage. Four point-of-use treatment methods have been field-tested: chlorination; flocculation plus chlorination; solar disinfection; and filtration. Each has proven safe, acceptable, inexpensive, and effective at reducing episodes of diarrhoeal diseases among users by approximately 50%. This presentation will review current scientific data on point-of-use water treatment and safe storage methods and consider why observed health gains far surpass those predicted by the dominant water and sanitation paradigm. Emerging technologies and new implementation strategies for improving water management at the point-of-use and the major challenges this approach faces in the future will be discussed. The role that the recently-created International Network to Promote Household Water Treatment and Safe Storage can play in meeting these challenges will also be described. (Author abstract)

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Vargas1, Martha; Gascon2, Joaquim; Casals1, Climent; Schellenberg3,4, David; Urassa5, Honorati; Kahigwa5, Eliseus; Ruiz2, Joaquim; Vila1,6, Jordi

ETIOLOGY OF DIARRHEA IN CHILDREN LESS THAN FIVE YEARS OF AGE IN IFAKARA, TANZANIA.


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6 Reprint requests: Jordi Vila, Department of Microbiology, ICII, Institut d’Investigacions Biomediques August Pi i Sunyer, Hospital Clinic, Villarroel 170, 08036 Barcelona, Spain. Telephone: 34-93-227-5522, Fax: 34-93-227-9372, E-mail: VILA@MEDICINA.UB.ES.

A total of 451 stool specimens were collected from children less than five years of age with acute diarrhea from Ifakara, Tanzania and processed to detect bacterial enteropathogens, parasites, and rotaviruses. These specimens were divided into 348 from the dry season and 103 from the rainy season. Overall, diarrheogenic *Escherichia coli* (35.7%) were the predominant enteropathogens, with enterotoxigenic *E. coli*, enteroaggregative *E. coli*, and enteropathogenic *E. coli* being the most prevalent. Moreover, enteroaggregative *E. coli* (63% versus 35.5%; $P < 0.05$), *Shigella* spp. (24%
versus 12%; $P < 0.05$), and rotavirus (23% versus 4%; $P < 0.05$) were more prevalent in the dry season than in the rainy season and enterotoxigenic *E. coli* (51.6% versus 20%; $P < 0.05$) and *Giardia lamblia* (14% versus 1%; $P < 0.05$) were more prevalent in the rainy season. *(Author abstract)*

**Efficacy and Safety of a Modified Oral Rehydration Solution (ReSoMal) in the Treatment of Severely Malnourished Children with Watery Diarrhea.**


1 ICDDR,B, Centre for Health and Population Research, Dhaka, Bangladesh.

2 Correspondence and reprint requests to: George J. Fuchs, MD, University of Arkansas for Medical Sciences, Department of Pediatrics, Mail Slot 512-7, Little Rock, AR 72205, USA; gjfuchs@usa.net.

Supported by a grant from the World Health Organization (grant no. C6/181/377.)

**Objectives** Efficacy, development of overhydration, and correction of electrolyte disturbances of severely malnourished children with acute diarrhea using a modified oral rehydration solution for malnourished children (termed ReSoMal and recommended by the World Health Organization [WHO]) were evaluated and compared with standard WHO-oral rehydration solution (ORS).

**Study design** Children age 6 to 36 months with severe malnutrition and acute watery diarrhea were randomized to ReSoMal ($n=65$) or standard WHO-ORS ($n=65$). Major outcome measures included the number of children who developed overhydration and the number who corrected hypokalemia.

**Results** The numbers of children who developed overhydration were not significantly different (ReSoMal vs WHO-ORS, 5% vs 12%, $P=.2$). ReSoMal corrected basal hypokalemia in a greater proportion of children by 24 hours (36% vs 5%, $P=.0006$) and 48 hours (46% vs 16%, $P=.004$) compared with WHO-ORS. More children on ReSoMal than WHO-ORS remained hyponatremic at 48 hours (29% vs 10%, $P=.017$). Three children in the ReSoMal group developed severe hyponatremia by 24 hours, with one experiencing hyponatremic convulsions (serum sodium, 108 mmol/L).

**Conclusions** ReSoMal has a large beneficial effect on potassium status compared with standard ORS. However, ReSoMal therapy may result in symptomatic hyponatremia and seizures in patients with severe diarrhea. *(Author abstract)*
P. Roslev; L.A. Bjergbæk; M. Hesselsoe

**EFFECT OF OXYGEN ON SURVIVAL OF FAECAL POLLUTION INDICATORS IN DRINKING WATER.**

**SECTION OF ENVIRONMENTAL ENGINEERING, DEPARTMENT OF LIFE SCIENCES, AALBORG UNIVERSITY,**
Sohngaardsholmsvej 57, DK-9000 Aalborg, Denmark; Correspondence to: P. Roslev, PR@BIO.AUC.DK.

**Aims:** The aim of this study was to determine the effect of oxygen on the survival of faecal pollution indicators including Escherichia coli in nondisinfected drinking water.

**Methods and Results:** Aerobic and anaerobic drinking water microcosms were inoculated with *E. coli* ATCC 25922 or raw sewage. Survival of *E. coli* was monitored by membrane filtration combined with cultivation on standard media, and by in situ hybridization with 16S rRNA-targeted fluorescent oligonucleotide probes. Anaerobic conditions significantly increased the survival of *E. coli* in drinking water compared with aerobic conditions. *Escherichia coli* ATCC 25922 showed a biphasic decrease in survival under aerobic conditions with an initial first-order decay rate of $\approx 0.11 \text{ day}^{-1}$ followed by a more rapid rate of $\approx 0.35 \text{ day}^{-1}$. In contrast, the first-order decay rate under anaerobic conditions was only $\approx 0.02 \text{ day}^{-1}$. After 35 days, <0.01% of the initial *E. coli* ATCC 25922 population remained detectable in aerobic microcosms compared with 48% in anaerobic microcosms. A poor survival was observed under aerobic conditions regardless of whether *E. coli* ATCC 25922 or sewage-derived *E. coli* was examined, and regardless of the detection method used (CFU or fluorescent in situ hybridization). Aerobic conditions in drinking water also appeared to decrease the survival of faecal enterococci, somatic coliphages and coliforms other than *E. coli*.

**Conclusions:** The results indicate that oxygen is a major regulator of the survival of *E. coli* in nondisinfected drinking water. The results also suggest that faecal pollution indicators other than *E. coli* may persist longer in drinking water under anaerobic conditions.

**Significance and Impact of the Study:** The effect of oxygen should be considered when evaluating the survival potential of enteric pathogens in oligotrophic environments. *(Author abstract)*

**Jon Lane**

**PERSPECTIVE: POSITIVE EXPERIENCES FROM AFRICA IN WATER, SANITATION AND HYGIENE.**


Consultant in Water and Sanitation for Developing Countries, PO Box 2270, Blantyre, Malawi.
Nowhere in the world is poverty more visible, more destructive and more pervasive than in Africa. Too often, Africa is associated with stories of failure and pessimism, of wars and famines, floods and unrest. Africa appears to be slipping back on many development indicators, even as other parts of the world move ahead. In 2003, however, there are prospects of achieving progress in water, sanitation and hygiene in Africa. Across the continent, there is a strong sense of the need for peace, democracy and cooperation. Through the Highly Indebted Poor Countries initiative, industrialised countries are finally proposing to write off a significant part of the debt into which the poorest countries have fallen. Many African countries have written Poverty Reduction Strategy Papers, which give clarity and direction to the development work in those countries. Within the water sector itself, the African Ministerial Conference on Water (AMCOW) has been formed to share ideas and lessons and to provide mutual support and active direction. Recent meetings, especially the World Summit on Sustainable Development (August 2002), are giving fresh political impetus to this work. This paper suggests five priorities for achieving the water and sanitation Millennium Development Goals in Africa. It relates them to practical examples of inspiring and positive initiatives in water and sanitation from across the continent. These examples have worked, or have the potential to work, at a large scale, are demonstrably sustainable, and do not benefit from too many unique local conditions. These characteristics enable the lessons from these examples to be useful for other people in, and indeed outside, Africa. (Author abstract)

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V.C.C. Cheng¹; I.F.N. Hung¹; B.S.F. Tang¹; C.M. Chu²; M.M.L. Wong³; K.H. Chan¹; A.K.L. Wu⁴; D.M.W. Tse³; K.S. Chan²; B.J. Zheng¹; J.S.M. Peiris¹; J.J.Y. Sung⁴; K.Y. Yuen¹

**VIRAL REPLICATION IN THE NASOPHARYNX IS ASSOCIATED WITH DIARRHEA IN PATIENTS WITH SEVERE ACUTE RESPIRATORY SYNDROME.**


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² Department of Medicine, United Christian Hospital, Hong Kong, SAR, China.
³ Department of Medicine and Geriatrics, Caritas Medical Centre, Hong Kong, SAR, China.
⁴ Department of Medicine and Therapeutics, Prince of Wales Hospital, Hong Kong SAR, China.

The role of severe acute respiratory syndrome (SARS) coronavirus as an enteric pathogen was investigated in a cohort of 142 patients with SARS who were treated with a standard treatment protocol. Data from daily hematological, biochemical, radiological, and microbiological investigations were prospectively collected, and the correlation of these findings with diarrhea was retrospectively analyzed. Sixty-nine patients (48.6%) developed diarrhea at a mean (± standard deviation [SD]) of 7.6 ± 2.6 days after the onset of symptoms. The diarrhea was most severe at a mean (±SD) of 8.8 ± 2.4 days after onset, with a maximum frequency of 24 episodes per day (median, 5 episodes; range, 324 episodes). A higher mean virus load in nasopharyngeal specimens obtained on day 10 after the onset of symptoms was significantly associated with the occurrence of diarrhea (3.1 log10 vs. 1.8 log10 copies/mL; \(P = .01\)) and mortality (6.2 vs. 1.7 log10)
copies/mL; \( P < .01 \). However, diarrhea was not associated with mortality. The lung and the gastrointestinal tract may react differently to SARS coronavirus infection. Additional investigation of the role of SARS coronavirus in the pathogenesis of diarrhea in patients with SARS should be conducted. (Author abstract)

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Mark E. Beatty\(^1,2,5\); Tom Jack\(^3\); Sumathi Sivapalasingam\(^1,2\); Sandra S. Yao\(^3\); Irene Pau\(^3\); Bill Bibb\(^2\); Kathy D. Greene\(^2\); Kristy Kubota\(^2\); Eric D. Mintz\(^2\); John T. Brooks\(^2,6\)

**AN OUTBREAK OF VIBRIO CHOLERAE O1 INFECTIONS ON EBEYE ISLAND, REPUBLIC OF THE MARSHALL ISLANDS, ASSOCIATED WITH USE OF AN ADEQUATELY CHLORINATED WATER SOURCE.**


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\(^6\) *Present affiliation*: Epidemiology Branch, **DIVISION OF HIV/AIDS PREVENTION**, National Center for HIV, STD and TB Prevention, Centers for Disease Control and Prevention, Atlanta, GA USA.

In December 2000, physicians in the Republic of the Marshall Islands reported the first known outbreak of *Vibrio cholerae* O1 infection (biotype El Tor, serotype Ogawa) from this country. In a matched case-control study on Ebeye Island, patients with cholera (\( n = 53 \)) had greater odds than persons without cholera (\( n = 104 \)) to have drunk adequately chlorinated water collected from a US military installation on neighboring Kwajalein Island and transported back to Ebeye (matched odds ratio [MOR], 8.0; \( P = .01 \)). Transporting or storing drinking water in a water cooler with a spout and a tight-fitting lid was associated with reduced odds of illness (MOR, 0.24; \( P < .01 \)), as was drinking bottled water (MOR, 0.08; \( P < .01 \)), boiled water (MOR, 0.47; \( P = .02 \)), or water flavored with powdered drink mixes (MOR, 0.18; \( P < .01 \)). No cases of cholera were reported among Kwajalein residents. This outbreak highlights the critical importance of handling and storing drinking water safely, especially during outbreaks of gastrointestinal illness. (Author abstract)

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Bakker, Karen

ARCHIPELAGOS AND NETWORKS: URBANIZATION AND WATER PRIVATIZATION IN THE SOUTH.


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The author examines the interrelationship between urbanization and water supply privatization in cities in the global South. The purpose of the article is not to evaluate the impacts of privatization; rather, the author analyses the differences in pathways and modes of water supply privatization, focusing on urban and contrasting with rural areas. A distinction is drawn between Privatization (organizational change) is distinguished from commercialization (institutional change) of water supply. Emphasis is placed upon the interrelationship between regulatory change (a shift from public to private management of water supply systems), human use of and access to water, and urban waterscapes. In contrast to metaphors of ‘networks’ so often applied in analyses of water management, the ‘archipelago’ is posited as a metaphor which better captures the complex overlapping strategies of water supply provision in urban areas in the South. Building on this metaphor, and in response to the ‘public-private’ dualism often invoked in studies of privatization, the author outlines an alternative typology of water management in urban areas in the South. This typology foregrounds the concepts of the territorialization of corporate power as a means of understanding the articulation between privatization and urbanization processes in the South. (Author abstract)

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Abul Hasnat Milton; Ziaul Hasan; S M Shahidullah; Sinthia Sharmin, M D Jakariya; Mahfuzar Rahman; Keith Dear; Wayne Smith

ASSOCIATION BETWEEN NUTRITIONAL STATUS AND ARSENICOSIS DUE TO CHRONIC ARSENIC EXPOSURE IN BANGLADESH.


1 National Centre for Epidemiology & Population Health (NCEPH), The Australian National University, Canberra, ACT 0200, Australia.
2 NGO Forum for Drinking Water Supply & Sanitation 4/6, Block-E Lalmatia, Dhaka-1207, Bangladesh.
3 Research and Evaluation Division BRAC, BRAC Centre 75, Mohakhali, Dhaka 1212, Bangladesh.
4 Public Health Sciences Division ICDDR,B - THE CENTRE FOR HEALTH AND POPULATION RESEARCH, GPO Box 128, Mohakhali CA, Dhaka 1000, Bangladesh.
5 Centre for Clinical Epidemiology & Biostatistics, University of Newcastle, NSW, Australia.

The role of nutritional factors in arsenic metabolism and toxicity is not clear. Provision of certain low protein diets resulted in decreased excretion of DMA and increased tissue
retention of arsenic in experimental studies. This paper reports a prevalence comparison study conducted in Bangladesh to assess the nutritional status among the chronic arsenic exposed and unexposed population.

138 exposed individuals diagnosed as arsenicosis patients were selected from three known arsenic endemic villages of Bangladesh and age, sex matched 144 unexposed subjects were randomly selected from three arsenic free villages. The mean arsenic concentration in drinking water for the exposed and unexposed population was 641.15 and 13.5 μg L\(^{-1}\) respectively. Body Mass Index was found to be lower than 18.5, the cut off point for malnutrition, in 57 (41.31%) out of 138 exposed arsenicosis cases and 31 (21.53%) out of 144 unexposed individuals. The crude prevalence ratio (or risk) was 1.92 (95% CI = 1.33 - 2.78) for poor nutritional status among the arsenicosis cases compared to the unexposed population.

The findings of this study add to the evidence that poor nutritional status may increase an individual's susceptibility to chronic arsenic toxicity, or alternatively that arsenicosis may contribute to poor nutritional status. (Author abstract)

* * *

Chris Greenaway

**DRACUNCULIASIS (GUINEA WORM DISEASE)**


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Dr. Greenaway performed research on fellowship for a year at the Medical Research Council Laboratories, Gambia, West Africa.

*Dracunculiasis* (Guinea worm disease) is a parasitic disease that is limited to remote, rural villages in 13 sub-Saharan African countries that do not have access to safe drinking water. It is one the next diseases targeted for eradication by the World Health Organization. Guinea worm disease is transmitted by drinking water containing copepods (water fleas) that are infected with *Dracunculiasis medinensis* larvae. One year after human ingestion of infected water a female adult worm emerges, typically from a lower extremity, producing painful ulcers that can impair mobility for up to several weeks. This disease occurs annually when agricultural activities are at their peak. Large proportions of economically productive individuals of a village are usually affected simultaneously, resulting in decreased agricultural productivity and economic hardship. Eradication of guinea worm disease depends on prevention, as there is no effective treatment or vaccine. Since 1986, there has been a 98% reduction in guinea worm disease worldwide, achieved primarily through community-based programs. These programs have educated local populations on how to filter drinking water to remove the parasite and how to prevent those with ulcers from infecting drinking-water sources.
Complete eradication will require sustained high-level political, financial and community support. (Author abstract)

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RG Hughes¹; DS Sharp²; MC Hughes³; S 'Akau'ola⁴; P Heinsbroek⁵; R Velayudhan⁶; D Schulz⁷; K Palmer⁸; T Cavalli-Sforza⁸; G Galea⁸

ENVIRONMENTAL INFLUENCES ON HELMINTHIASIS AND NUTRITIONAL STATUS AMONG PACIFIC SCHOOLCHILDREN.


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This paper describes a study undertaken to: (1) determine the prevalence of Ascaris lumbricoides, Trichuris trichiura and hookworm infections and nutritional status among Pacific Island school children; (2) identify factors influencing helminthiasis; (3) identify interventions to improve school health.

A total of 3,683 children aged 5-12 years attending 27 primary schools in 13 Pacific Island countries were surveyed along with school environmental data. Stool samples were collected from 1996 children (54.2%) and analysed for ova and helminths. Total prevalence of helminthiasis was 32.8%. Anaemia prevalence was 12.4%. Children with helminthiasis and anaemia were found to be 8.7 times more likely to be stunted and 4.3 times more likely to be underweight than non-anaemic and non-infected children.

Four significant environmental influences on helminthiasis were identified: (1) an inadequate water supply; (2); availability of a school canteen; (3) regular water/sanitation maintenance regimes; and (4) overcrowded classrooms. Helminthiasis was found to be strongly associated with anaemia, stunting and underweight and environmental influences identified. Although mass anti-helminthic drug administrations (MDA) have been taking place, reinfestation is common as drug therapy alone is not enough. Programme effectiveness depends upon upgrading school environments to include an adequate water supply, controlled food preparation/provision, well-maintained water/sanitation facilities and class sizes of 30 students or less. (Author abstract)

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Mary Quirk

**DIARRHOEAL GASES EMIT CHEMICAL FINGERPRINTS.**


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Using equipment more familiar to the organic chemist than to the microbiologist, researchers capture the volatile chemicals emitted from stool samples to identify diarrhoeal pathogens (Gut 2004; 53: 58–61 [next abstract]). “Specific volatile chemicals are associated with particular infections, thus these volatiles could be used to identify the type of organism causing the diarrhoea”, Christopher Probert (Bristol Royal Infirmary, Bristol, UK) told THE LANCET Infectious Diseases. (Excerpt)

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C.S.J. Probert¹, P.R.H. Jones², N.M. Ratcliffe²

**A NOVEL METHOD FOR RAPIDLY DIAGNOSING THE CAUSES OF DIARRHOEA.**


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² Faculty of Applied Sciences, Centre for Research in Analytical, Materials, and Sensor Sciences, University of the West of England, Coldharbour Lane, Bristol BS16 1QY, UK

**Background:** The microbiological diagnosis of infectious diarrhoea may take several days using conventional techniques. In order to determine whether flatus can be used to make a rapid diagnosis, the volatile organic compounds associated with diarrhoea were analysed.

**Methods:** Stool samples were collected from 35 patients with infectious diarrhoea and from six healthy controls. Gaseous compounds were extracted from a headspace using solid phase microextraction and analysed using gas chromatography and mass spectroscopy.

**Results:** Characteristic patterns of volatile gases were found for the main causes of infectious diarrhoea in hospitals. Furan species without indoles indicated Clostridium difficile, ethyl dodecanoate indicated rotavirus, ammonia without ethyl dodecanoate suggested other enteric viruses, and the absence of hydrocarbons and terpenes indicated Campylobacter infection.

**Conclusion:** These results could be the basis of rapid near patient diagnosis of infectious diarrhoea. (Author abstract)

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John A. Crump1; Peter O. Otieno2; Laurence Slutsker2; Bruce H. Keswick3; Daniel H. Rosen2; John M. Vulule2; Stephen P. Luby1

TRIAL OF HOUSEHOLD-BASED FLOCCULANT-DISINFECTANT DRINKING WATER TREATMENT FOR DIARRHEA PREVENTION IN THE SETTING OF HIGHLY TURBID SOURCE WATER IN RURAL KENYA.

Presented at: The International Conference on Emerging Infectious Diseases (ICEID) February 29 - March 3, 2004, Atlanta, Georgia, USA.

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Background: More than one billion persons lack access to improved water. The addition of dilute sodium hypochlorite to drinking water in the home reduces diarrhea, but it does not mitigate turbidity. Its effectiveness as a disinfectant is reduced in highly turbid water. We conducted a study to compare a new flocculant-disinfectant home water treatment with sodium hypochlorite in an area where source waters were highly turbid.

Methods: Six hundred family compounds representing 6,650 persons using highly turbid pond or river water for drinking were identified in rural Western Kenya. Compound were randomized to receive either the new flocculant-disinfectant or sodium hypochlorite for water treatment, or to continue traditional water handling practices (control). All persons were visited weekly for 20 weeks to monitor diarrhea prevalence. Turbidity was measured in household drinking water.

Results: Compared to control compounds, diarrhea prevalence was 16% lower in flocculant-disinfectant compound (2.6 versus 2.2 percent of weeks with diarrhea, P=0.037) and 21% lower in sodium hypochlorite compounds (2.6 versus 2.1 of percent of weeks with diarrhea, P<0.001). The difference in diarrhea prevalence between persons receiving flocculant-disinfectant versus sodium hypochlorite was not significant (p=0.007). The turbidity of drinking water was 7 nephelometric turbidity units (NTU) in flocculant-disinfectant compounds, compared to 55 NTU in control and sodium hypochlorite compounds (p<0.001). Persons using flocculant-disinfectant were 1.3 times more likely to report that their drinking water looked better compared with those using sodium hypochlorite.

Conclusions: Flocculant-disinfectant and sodium hypochlorite both reduced diarrhea among persons using highly turbid source water, while only the flocculant-disinfectant significantly reduced turbidity. In a market-based approach with comparable cost, high product acceptability of flocculant-disinfectant associated with turbidity mitigation could stimulate use and potentially achieve even greater reductions in diarrheal disease compared with interventions that do not reduce turbidity. (Author abstract)
**Laurie F. Caslake\(^1\); Daniel J. Connolly\(^2\); Vilas Menon\(^2\); Catriona M. Duncanson\(^2\); Ricardo Rojas\(^3\); Javad Tavakoli\(^2\)**

**DISINFECTION OF CONTAMINATED WATER BY USING SOLAR IRRADIATION.**

Applied and Environmental Microbiology, February 2004; 70(2): 1145-50. PMID: 14766599

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Contaminated water causes an estimated 6 to 60 billion cases of gastrointestinal illness annually. The majority of these cases occur in rural areas of developing nations where the water supply remains polluted and adequate sanitation is unavailable. A portable, low-cost, and low-maintenance solar unit to disinfect unpotable water has been designed and tested. The solar disinfection unit was tested with both river water and partially processed water from two wastewater treatment plants. In less than 30 minutes in midday sunlight, the unit eradicated more than 4 log10 U (99.99%) of bacteria contained in highly contaminated water samples. The solar disinfection unit has been field tested by Centro Panamericano de Ingenieria Sanitaria y Ciencias del Ambiente in Lima, Peru. At moderate light intensity, the solar disinfection unit was capable of reducing the bacterial load in a controlled contaminated water sample by 4 log10 U and disinfected approximately 1 liter of water in 30 minutes. *(Author abstract)*

**Kehoe, S.C.; Barer, M.R.; Devlin, L.O.; McGuigan, K.G.**

**BATCH PROCESS SOLAR DISINFECTION IS AN EFFICIENT MEANS OF DISINFECTING DRINKING WATER CONTAMINATED WITH *SHIGELLA DYSENTERIAE* TYPE I.**


Department of Surgery, Royal College of Surgeons in Ireland, Dublin, Ireland.

**Aims:** The mortality and morbidity rate caused by *Shigella dysenteriae* type I infection is increasing in the developing world each year. In this paper, the authors investigate the possibility of using batch process solar disinfection (SODIS) as an effective means of disinfecting drinking water contaminated with *Sh. dysenteriae* type I.
Methods: Phosphate-buffered saline contaminated with *Sh. dysenteriae* type I was exposed to simulated solar conditions and the inactivation kinetics of this organism was compared with that of *Sh. flexneri*, *Vibrio cholerae* and *Salmonella typhimurium*.

Significance: Recovery of injured *Sh. dysenteriae* type I may be improved by plating on medium supplemented with catalase or pyruvate. *Sh. dysenteriae* type I is very sensitive to batch process SODIS and is easily inactivated even during overcast conditions. Batch process SODIS is an appropriate intervention for use in developing countries during *Sh. dysenteriae* type I epidemics. *(Author abstract)*

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Tim Donaldson

**GUT REACTION: SIMPLE STEPS TO IMPROVE FOOD SAFETY AND SANITATION.**

ID21 RESEARCH HIGHLIGHT: MAY 14, 2004

Crop Post-Harvest Programme, NATURAL RESOURCES INTERNATIONAL LTD., Park House, Bradbourne Lane, Aylesford, Kent ME20 6SN, UK; Email: T.DONALDSON@NRINT.CO.UK.

Funded by the UK DEPARTMENT FOR INTERNATIONAL DEVELOPMENT.

Food safety and sanitation, and the methods by which to improve them, must be recognised by policy-makers as significant tools in the prevention of ill health and the subsequent pressure that it places on a country's health system and economy. Policy-makers should continue, or begin to:

- reduce toxin and pesticide residue levels for indigenous and introduced fruit and vegetables for city-dwellers to ensure access to a safe diet as well as improving the health and income of rural and peri-urban growers and processors
- improve the hygiene of street-vended food by providing vendors with access to clean water, proper means to dispose of sewage, regular refuse collection and access to refrigeration
- encourage more hygienic practice in food production to reduce the dangers of contamination to the consumer.

Development of simple measures to improve post-harvest handling of crops/crop residues and agro-industrial by-products will reduce contamination by mycotoxigenic fungi, thus preventing harm to human and animal health. *(Excerpt)*

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Marco Albonico; Quentin Bickle; Mahdi Ransan; Antonio Montresor; Lorenzo Savioli; Martin Taylor

**Are two better than one? Combining drugs for intestinal infections in Zanzibar.**
**ID21 RESEARCH HIGHLIGHT**

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How can we combat the intestinal infections caused by roundworms (nematodes), *Ascaris*, whipworms and hookworms in children and women of childbearing age? A study carried out by the London School of Hygiene and Tropical Medicine, the Ivo de Carneri Foundation and the World Health Organisation evaluated the effectiveness of the drug mebendazole and its combined effect with a second drug, levamisole, in school children in Zanzibar, Tanzania.

Around one thousand children took part in the study that involved a stool test before and three weeks after treatment. The treatment consisted of four possibilities that were assigned at random among participants: 500 mg of mebendazole; 40 or 80 mg of levamisole (depending on the child’s weight); both drugs combined; a placebo. The research found that:

- The prevalence of intestinal worm infection was very high among children. On average, more that 65% of those who took part were infected with *Ascaris* and more than 90% had whipworm, hookworm or both.

- The effectiveness of mebendazole and levamisole against intestinal worm infection was comparable with those in previous trials. *(Excerpt)*

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John Hodges; Ian Curtis

**Water resources management and access to safe water and basic sanitation.**


**Department for International Development**, 1 Palace Street, London SW1E 5HE, UK; Tel: +44 (0)20 7023 0016; Fax: +44 (0)20 7917 0072; Email: J-HODGES@DFID.GOV.UK.

Funded by: Department for International Development, UK.

Over a billion people still lack access to safe water, and another 2.4 billion people lack adequate sanitation, as water resources become increasingly stressed. What are the links between water resources management and economic development and security, and between water and sanitation services and health and livelihoods outcomes?

A report from the UK’s Department for International Development reminds us that water contributes to economic development through its use in agriculture, industry and transport; to human development through improved health arising from the provision of
safe water supplies, appropriate sanitation and improved hygiene practice; and to environmental sustainability through fresh water provision for ecosystems and reduced levels of pollution. Sketching the role played by bilateral and multilateral support agencies and national governments, it calls for the greater co-ordination and involvement of people, communities and the private sector.

Human consumption of freshwater threatens to push to the limit the capacity of nature to supply its benefits to mankind. The extreme levels of abstraction of groundwater in India means that in the future, in many situations water may not be available for irrigation purposes. Water, rather than land availability, is set to become the major constraint on agricultural production. The report warns that: Global freshwater consumption rose six-fold in the twentieth century – more than twice the rate of population growth. (*Excerpt edited*)

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Suzanne Hanchett; Mohidul Hoque Kha; Shireen Akhter

**Access for all: the delivery of water and sanitation in urban Bangladesh.**

**ID21 RESEARCH HIGHLIGHT:** February 5, 2003.

_Funded by: WATERAID, Prince Consort House, 27-29 Albert Embankment, London, SE1 7UB, UK; Tel: +44 020 7793 4500; Fax: +44 020 7793 4545; Email: INFORMATION@WATERAID.ORG.UK._

A study by Planning Alternatives for Change and Pathway, Ltd. assesses whether WATERAID Bangladesh’s Urban Programme benefits the urban poor of slums in Dhaka and Chittagong.

The programme began in 1996 with WATERAID funding and with one partner non-governmental organisation (NGO). Since 1998 seven partner NGOs have run the programme in over 160 slums. It is estimated that 27 per cent of approximately 92000 slum households have used at least one of the services including water points to access safe water, community latrines and hygiene education.

Findings include:

- Water sources provided by the project have helped 98 per cent of households.
- The construction of water and sanitation facilities and the opportunity to pay for their water supply gives slum dwellers a sense of ‘citizenship’.
- The poorest of the slum dwellers still cannot gain access to programme facilities because they are unable to pay. They continue to lack status and influence.

The study highlights the need for more opportunities for the poorest people to be involved in programme planning and management. It points to further steps that could enhance programme delivery and outcomes. (*Excerpt*)

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Amaka Obika; Marion Jenkins; Guy Howard; Valerie Curtis

CAN SOCIAL MARKETING INCREASE DEMAND AND UPTAKE OF SANITATION?


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Despite the gains made in increasing sanitation coverage during the United Nations water and sanitation decade of 1981-1990, over 2.4 billion people still do not have access to improved sanitation. Why is the uptake of sanitation low? Is a new approach to promoting sanitation needed?

Research from WEDC, UK, in conjunction with the London School of Hygiene and Tropical Medicine, TREND Group, Kumasi and WaterAid Tanzania, considers the use of social marketing to increase demand and uptake of improved sanitation. The research is taking place in Nkawie, a small town in the Kumasi Metropolis, Ghana and in Dar es Salaam, Tanzania.

Among other research methods, in-depth interviews have been used to understand the factors that motivate or constrain households from installing household latrines and the attributes that people desire in latrines. The private sector, in the form of local informal latrine providers including diggers, masons and carpenters, was also interviewed to investigate its role in latrine provision and its perspective on the demand and uptake of latrines.

The findings so far suggest that the reason for the low uptake of household sanitation facilities is that sanitation programmes do not sufficiently understand users and what they want before starting projects. It is time for latrine programmes to treat users as consumers who have a say in what products they buy to meet their needs rather than as beneficiaries who receive gifts. (Author abstract)

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