Cost effectiveness of a latrine revision programme in Kabul, Afghanistan

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Introduction We assessed a household latrine revision intervention implemented in Kabul, Afghanistan for evidence of a reduction in diarrhoeal disease.

Methods A case–control design involving 1238 cases and 625 controls was used. Logistic regression modelling was performed both for children <5 years and ⩽11 years, and the parameter estimates were later used with results from a stratified cluster sample survey. This survey used a verbal autopsy methodology to enable an estimation of the number of deaths averted over a 1-year period. A cost-effectiveness analysis using direct and indirect costs for the intervention was then conducted and the results compared with primary health care interventions identified from a Medline search.

Findings Conditional logistic regression showed that patients were less likely than controls to live in households with revised latrines (odds ratio (OR) 0.57, 95% confidence interval (CI) = 0.42–0.77 for children <5 years, and OR 0.53, 95% = CI 0.41–0.67 for children ⩽11 years). The results from the survey of cause-specific mortality by verbal autopsy enabled estimation of the number of deaths averted over a 1-year period due to the intervention; these estimations were 235 (95% CI = 109–360) for children <5 years and 285 (95% CI = 180–397) for children ⩽11 years. Estimates of cost effectiveness ranged from approximately US$ 1800 to US$ 4100 per death averted depending on age and payer perspective.

Conclusion These estimates are conservative because only 1 year of effectiveness is considered, yet they compare favourably with a review of other paediatric interventions. These results are important because funding for sanitation interventions is often limited by the belief that the interventions are not cost-effective.

Keywords Toilet facilities/economics; Diarrhea/mortality/prevention and control; Infant mortality; Primary health care; Red Cross; Cost-benefit analysis; Case–control studies; Comparative study; Afghanistan (*source: MeSH, NLM*).

Mots clés Toilettes publiques/économie; Diarrhée/mortalité/prévention et contrôle; Mortalité nourrisson; Programme soins courants/Analyse coût-avantages; Croix-Rouge; Analyse coût bénéfice; Etude cas-témoins; Etude comparative; Afghanistan (*source: MeSH, INSERM*).

Palabras clave Baños públicos/economía; Diarrea/mortalidad/prevención y control; Mortalidad infantil; Atención primaria de salud/economía; Cruz Roja; Análisis de costo-beneficio; Estudios de casos y controles; Estudio comparativo; Afganistán (*fuente: DeCS, BIREME*).

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Introduction

WHO estimates that diarrhoeal diseases are the third leading cause of infectious disease-related mortality, claiming approximately 2.2 million lives annually (*1*). Children under 5 years account for an estimated 2 million deaths and 1.5 billion bouts of diarrhoea annually (*1*).

Numerous studies have examined the impact of improvements in water and sanitation facilities on diarrhoeal disease (*2–6*). Most of them have reported positive effects (*4*), although many of them have encountered methodological problems (*7*). A review from more than 28 countries reported a 26% median reduction in morbidity and a 55% reduction in all-cause child mortality rates among the most rigorous studies. A 65% median reduction in diarrhoeal-specific mortality rates was also reported, although this was based on only three studies. Reductions in morbidity due to other diseases were also observed, suggesting that water and sanitation interventions can improve a range of health outcomes (*4*).

Despite this, funding for these interventions has declined, primarily because the interventions are perceived to be less cost-effective than other primary health care approaches to diarrhoeal disease (*8–10*). Although the health benefits of other primary care interventions are widely acknowledged (*5*, *11*), critics argue that water and sanitation interventions are still appropriate approaches to reducing rates of morbidity and mortality in general (*9*, *12*, *13*). Critics also argue that their cost-effectiveness has

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typically been underestimated because their positive indirect and long-term health effects are generally ignored (*2*, *8*, *9*). Better information on cost-effectiveness can assist policy development with respect to these interventions (*14*).

In August 1996, the International Committee of the Red Cross (ICRC) initiated a sanitary intervention in Kabul, Afghanistan. The intervention involved the construction of a new latrine or renovation of an existing latrine, resulting in both cases in a latrine providing approximately 2.1 m^3 of faecal matter storage, an underground soaking pit for urine, venting with nylon mesh, and a removable door allowing quarterly faecal matter evacuation.

The intervention was limited to 5 of 15 Kabuli districts. These districts comprised a total of 26 "project areas" — areas defined for programme administration. All households in these districts were given the opportunity to participate in the programme. Construction costs were borne by both the ICRC and household owners, with ICRC providing materials and owners providing labour and recycled materials from old latrines whenever possible. By October 1998, 22 211 latrines had been constructed, providing an improved latrine for just over 57% of the five districts' 393 266 inhabitants. Other organizations also conducted latrine interventions in Kabul (such as German Agro Action), but these were generally focused elsewhere in Kabul and not well-represented in these five districts.

We assessed the cost-effectiveness of ICRC's sanitation intervention on paediatric diarrhoeal mortality. A case–control study enabled the impact of the programme on diarrhoeal morbidity to be estimated through multivariate modelling. Inferred reduction in diarrhoeal mortality was estimated from cause-specific mortality data derived from a stratified cluster sample that employed a verbal autopsy methodology. Finally, cost-effectiveness was calculated in terms of direct and indirect intervention costs per death averted. This study provides detailed cost data and contributes to recent demands for cost-effectiveness analyses of humanitarian interventions (*15*).

Methodology

Programme effect

A case–control study design assessed the risk for diarrhoeal disease associated with the intervention. Cases and controls were recruited from five Afghani Red Crescent dispensaries over a 4-week period beginning on 26 September 1998. All children presenting at these dispensaries during this period were eligible for inclusion.

Cases were children presenting with at least three loose stools within the previous 24 hours. Controls were children presenting with acute respiratory illnesses; these conditions were selected as controls because they were generally similar in severity to that of diarrhoeal diseases, they had a similar propensity for being reported, and would probably not be affected by the intervention. The reason for visit as reported by the mother was verified by trained health workers, and subjects were accordingly assigned case or control status. Descriptive data collected from all subjects included sex, age, reason for visit, number of stools per day (for cases only), project area of residence, and whether the child lived in a household where the latrine had been revised.

The association between diarrhoeal morbidity and the presence of a revised latrine was assessed using conditional logistic regression. The project area was used as the grouping variable, which allowed for control of exchangeable correlation within project areas, and all variables referred to above were used for initial univariate analyses. We estimated two models: one restricted to cases and controls under the age of 5 years and another that was not age restricted. Variables reaching statistical significance ($P<0.05$) in univariate modelling were initially offered into the multivariate models; the final models were selected on the basis of ease of interpretability and whether variables were statistically significant ($P<0.05$). Odds ratios and 95% confidence intervals were computed and standard tests for validating the models were carried out.

Preventable fraction and deaths averted

An estimate of lives saved by the programme was made in the following way: first, the preventable fraction was calculated. The preventable fraction was derived from the parameter estimate for the intervention effect by 1–RR (relative risk), where RR was assumed to be approximated by the odds ratio (*16*). Next, the fraction of cases that would not be averted by the programme was obtained by subtracting from 1 the product of the preventable fraction and the degree of programme coverage to which the population was exposed at the time of case–control data collection. The reciprocal of the fraction of cases not averted was then multiplied by the number of diarrhoeal deaths in appropriately aged children estimated to have occurred during a 1-year period beginning 6 months before our case–control data collection and ending 6 months afterwards (9 April 1998 to 9 April 1999). This provided an estimate of deaths expected to occur during this period in the absence of the programme. The difference between this and the number of deaths estimated to have occurred provided our estimate of deaths averted by the programme. The same calculations were repeated with the upper and lower confidence intervals to provide confidence intervals around our estimate of lives saved.

Stratified cluster sample survey and verbal autopsy

Our estimate of the number of children dying of diarrhoeal disease during a 1-year period came from a stratified cluster sample carried out in July 1999. Each project area was designated as a stratum and was further subdivided into several clusters that were proportional to the project area's population size. The estimates of project area populations came from Kabul's municipal sources and ranged from 1653 to 36 140. All project areas were divided into clusters (80 in total), with each cluster comprising up to 5000 individuals. All project areas had at least one cluster included in the sample and the number of clusters within the sample was proportional to the project area population. A random selection process identified which clusters within each project areas were to be sampled. A survey team then selected an initial household within this cluster using a random geographical orientation process and visited the house, along with the nine adjacent households.

The survey team administered a structured questionnaire which, among other things, provided a demographic breakdown of household residents, and asked all women aged 15–49 years who had slept the previous evening in the household to identify the number of children they had given birth to, and the number that had subsequently died. For each death, the date and child's age at the time of death were established. In addition, the women were asked to provide a complete narrative description of the symptoms the child experienced before death.

This description, which conformed to a verbal autopsy methodology (*17*), was recorded and compared by an author

(JFP) with a priori criteria to attribute cause of death to any of the following: diarrhoeal disease, respiratory illnesses, injury, and malnutrition. Deaths among children under 5 years (and up to 11 years for the age-unrestricted model) that occurred between 9 April 1998 and 9 April 1999 and were attributed to diarrhoea were used to estimate the number of deaths due to diarrhoea that occurred among the entire population within this age group.

Cost-effectiveness

As above, this number was next multiplied by the reciprocal of the fraction of cases not averted to estimate the number of deaths that would have been expected to occur in the programme's absence. This enabled the number of deaths averted by the programme over 1 year to be estimated. Cost-effectiveness was computed using data for direct costs of ICRC programme inputs until the end of October 1998. Direct cost data were detailed, as these are regularly tracked by ICRC programme personnel in Kabul. Participating household owners provided some materials and most of the labour; these direct and indirect costs were incorporated into our calculations. Our accounting also differentiated between costs of a new latrine construction versus a revision. Because we only considered cost-effectiveness over a 1-year period we did not apply a discount rate. Also, because construction costs accruing to owners were modest and reflected primarily their labour contribution, and material costs accruing to ICRC were well within ICRC's programme budget, these capital costs were not annualized. Costs for potential savings in health care utilization were not considered.

To compare our cost-effectiveness with other interventions we conducted a Medline search to identify peer-reviewed cost-effectiveness studies assessing interventions aimed at preventing childhood mortality. Estimates of cost-effectiveness per death averted from these interventions were compared with our results. To facilitate direct comparison of these data, costs per death averted were converted to constant 1999 US dollars (*18*).

Results

A total of 1863 children met the criteria for inclusion in the case–control study (1238 cases and 625 controls), 1267 of whom were under 5 years (890 cases and 377 controls). Table 1 provides descriptive data on study population.

Table 2 provides the final models for variables predicting presentation with diarrhoeal disease for children under 5 years and for children up to 11 years. In both models, cases had significantly lower odds of living in households where an ICRC latrine revision had been implemented. For five project areas only cases or controls were present, so these were dropped from our modelling, which used project area as the grouping variable. The model restricted to children under 5 years had one additional project area where only cases or controls were present. Therefore, the under-5 model is based on data from 20 project areas, which are a near-complete subset of the 21 project areas upon which the age-unrestricted model is based.

Table 3 provides data on deaths reported among children of mothers interviewed in our survey. A total of 790 households with a combined population of 8017 were surveyed in all 26 project areas. Table 3 reflects only the relevant subsets of all 26 project areas surveyed. Between 9 April 1998 and 9 April 1999 14 diarrhoeal deaths occurred among children under 5 years within the corresponding 20 project areas, and 15 diarrhoeal deaths among children up to 11 years within the corresponding 21 project areas. From these data we estimated annual deaths within the 20 and 21 project areas at 692 children under 5 years and 744 children aged to 11 years, respectively. These estimated deaths represent expected fatalities in the presence of a level of intervention which was 59% at the period's mid-point (which also corresponds to the mid-point of our case–control data collection). We used this exposure level and parameter estimates and confidence intervals from Table 2 to estimate the number of diarrhoeal deaths averted over this period by the intervention; these estimates were 235 (95% confidence interval (CI) = 109–360) for children under 5 years and 285 (95% CI = 180–397) for children aged to 11 years.

Table 4 summarizes cost data and estimates of the cost per death averted for the two age models. Marginal, purely administrative costs borne by ICRC for this programme are not provided but are unlikely to be substantial, given that labour costs are included and the sanitation department carried out many other programmes. For the under-5 model, estimated cost per death averted was US$ 2144.46 (95% CI = US$ 1399.86–4623.38) from the ICRC perspective and US$ 4085.51 (95% CI = US$ 2669.93–8808.20) from a societal perspective (direct and indirect costs included). For the age-unrestricted model, the estimated cost per death

Table 1. **Descriptive data on the study population**

Characteristic	Cases		Controls		Total	
	Under-5 years of age model[a] (*n* = 890)	Age-unrestricted model[b] (*n* = 1238)	Under-5 years of age model[a] (*n* = 377)	Age-unrestricted model[b] (*n* = 625)	Under-5 years of age model[a] (*n* = 1267)	Age-unrestricted model[b] (*n* = 1863)
Age in years, median (range)	2 (0.02–4.5)	2 (0.02–10)	2 (0.2–4.5)	3 (0.2–11)	2 (0.02–4.5)	3 (0.02–11)
Sex male, *n* (%)	420 (47.2)	574 (46.4)	188 (49.9)	289 (46.3)	608 (48.0%)	863 (46.3%)
No. of stools/day among cases, median (range)	6 (3–12)	6 (3–12)	–	–	–	–
Latrine revision by ICRC, *n* (%)	380 (42.7)	521 (42.1)	240 (63.7)	398 (63.7)	620 (48.9%)	919 (49.3%)
Latrine revision by GAA[c], *n* (%)	12 (1.3)	20 (1.6)	22 (5.8)	31 (5.0)	34 (2.7%)	51 (2.7%)

[a] Children under 5 years of age.
[b] Children up to 11 years of age.
[c] GAA = German Agro Action.

Table 2. **Final multivariate models**

Predictor variables[a]	Odds ratio	95% confidence interval
Children under 5 years of age (age-restricted model)		
ICRC[b] latrine revision	0.57	0.42 to 0.77
GAA[c] latrine revision	0.33	0.15 to 0.74
Children 0–11 years (age-unrestricted model)		
ICRC latrine revision	0.53	0.41 to 0.67
GAA latrine revision	0.40	0.21 to 0.77
Age	0.94	0.90 to 0.97

[a] Models adjusted for age when age was a significant confounder.
[b] ICRC = International Committee of the Red Cross.
[c] GAA = German Agro Action.

averted by the intervention was US$ 1803.61 (95% CI = US$ 1294.79–2855.72) from the ICRC perspective and US$ 3436.14 (95% CI = US$ 2466.75–5440.56) from a societal perspective.

Costs per deaths averted for other primary health interventions are summarized in Table 5, for comparison.

Discussion

The results of this study indicate that the ICRC latrine intervention in Kabul was effective in reducing the risk of childhood diarrhoeal disease morbidity and that the intervention was cost-effective when compared with other primary health care interventions. The results of the two age groups were comparable, but the reduction was slightly greater for children under 5 years than among children under 11 years.

Comparison of cost-effectiveness with other primary health care interventions

A sanitation intervention can be a cost-effective method for reducing mortality among children. The cost-effectiveness was comparable to several immunization programmes, malaria prevention programmes, vitamin A supplementation, breastfeeding promotion, and weaning education. We acknowledge that contextual differences may make direct comparisons of cost-effectiveness difficult. Nevertheless, our findings have policy relevance as several critics maintain that funding for sanitation interventions is often limited because these interventions are perceived to not be cost-effective (*8*, *9*, *12*).

Indirect additional benefits and considerations of biases and limitations

Several issues may have caused us to underestimate the intervention's cost-effectiveness. For example, we considered the impact of the intervention on diarrhoeal disease only. However, Briscoe (*8*) and others (*9*, *13*) have argued that these interventions probably have multiple benefits, such as averting diarrhoea in other age groups and reducing other infectious diseases, and other benefits unrelated to health. Additionally, we limited examination to impact at an individual level, whereas community effects have been shown (*19*). A reduction in excreta on community streets could improve health at the community level, implying another possible source of underestimation of cost-effectiveness. Also, we considered effectiveness over a 1-year period only. Latrines would probably continue to function in the future, biasing our results conservatively towards a further underestimation of cost-effectiveness.

Our verbal autopsy methodology, which should involve three people in making classifications as opposed to one, is a possible limitation of our study. Also, we assumed 100% specificity and sensitivity for diarrhoeal disease. Because no validation study was carried out, the true accuracy is not known. However, in other studies with validation, the sensitivity of verbal autopsy for paediatric diarrhoeal mortality has ranged from 36% to 90% and specificity from 61% to 97%; increasing the detail in the disease description corresponds with an increased specificity and a decreased sensitivity (*20*). Our method used moderate detail to describe disease, and the recall period was short. If we assume a cause-specific mortality fraction of 20% (based on recent reviews (*20*)), a sensitivity of 70%, and a specificity of 90%, we might

Table 3. **Estimated number of diarrhoeal deaths in children and diarrhoeal deaths averted by intervention over a 1-year period**

Characteristic	Under-5 years of age model[a] (20 project areas)	Age-unrestricted model[b] (21 project areas)
No. of individuals sampled, *n*	6674	6768
Total population residing in project areas, *n*	329 826	335 733
No. of deaths in children of mothers sampled, by cause[c]:		
Diarrhoea	14	15
Respiratory disease	11	13
Other	6	9
Malnutrition	2	2
Injury	–	1
No. of estimated diarrhoeal deaths within total population[d]	692	744
Percentage of households with ICRC intervention	59	59
No. of estimated diarrhoeal deaths averted by intervention (95% CI[d])[e]	235 (109 to 360)	285 (180 to 397)

[a] Children under 5 years of age.
[b] Children up to 11 years of age.
[c] All deaths were reported to have occurred between 9 April 1998 and 9 April 1999.
[d] CI = confidence interval.
[e] Estimates of the number of deaths and the number of deaths averted are for the period between 8 April 1998 and 9 April 1999 and are for children under 5 in the under-5 model column, and children to age 11 in the age-unrestricted model column. CI = confidence interval.

Table 4. **Detailed project costs[a] (August 1996 to October 1998)**

Material	Total cost	
	New construction[b]	Rehabilitation[c]
Owner costs/latrine (direct and indirect[d] costs)		
Stone (m^3)	72 000	15 000
Bricks	166 666	–
Clay (m^3)	120 000	–
Straw	30 000	–
Wooden plate (square)	100 000	–
Labour/day	780 000	180 000
Subtotal, owner costs	**1 268 666**	**195 000**
ICRC costs/latrine (direct costs only)		
Stone (m^3)	198 000	–
Sand (m^3)	45 000	45 000
Cement bag	137 250	68 625
Concrete pipe	38 000	114 000
Timber (4 m)	227 500	–
Steel pipe + elbow	211 667	211 667
Clamp + net	9 160	9 160
Concrete slab	27 263	27 263
Mason/day	300 000	60 000
Night soil collection	2 778	2 778
Health education	365	365
Unforeseen cost	139 949	37 443
Subtotal, ICRC costs	**1 336 932**	**576 301**
Total project costs[e]		
Children under 5 years only (age-restricted model):		
Total no. of latrines	15 046	2697
Total costs, ICRC only	US$ 503 948	
Total costs, societal (ICRC and owners)	US$ 960 094	
Cost per death averted (95% CI[f]), ICRC only	US$ 2144.46 (US$ 1399.86–4623.38)	
Cost per death averted (95% CI), societal	US$ 4085.51 (US$ 2669.93–8808.20)	
Children 0–11 years (age-unrestricted model):		
Total no. of latrines	15 347	2751
Total costs, ICRC only	US$ 514 030	
Total costs, societal (ICRC and owners)	US$ 979 301	
Cost per death averted (95% CI), ICRC only	US$ 1803.61 (US$ 1294.79–2855.72)	
Cost per death averted (95% CI), societal	US$ 3436.14 (US$ 2466.75–5440.56)	

[a] All costs quoted in Afghan currency (Afghanis) unless otherwise specified.
[b] New construction = the original latrine is destroyed and a new latrine is constructed.
[c] Rehabilitation = the original latrine is modified and does not need to be destroyed.
[d] Indirect cost for owners = estimated value of volunteer labour by owners.
[e] Total project costs quoted in US dollars, based on an exchange rate of US$ 1 = 43 000 Afghani (May 1999 exchange rate).
[f] CI = confidence interval.

have overestimated the true rate by about 2%. However, if we assume a cause-specific mortality fraction of 30%, this becomes an underestimation by approximately 2% (*20*). Thus, although we do not know the specificity and sensitivity of our method, it is unclear how they may have affected our results.

Possible confounders

There are several possible confounders, related in particular to socioeconomic status, that we could not control for. For example, breastfed infants are less likely to suffer from diarrhoea under similar sanitary conditions (*21*). Similarly, the level of maternal literacy has been shown to modify the impact of sanitation interventions on infant mortality (*22*). Because there were no variables in our models regarding breastfeeding or maternal literacy, we cannot exclude confounding. However, selecting diseases of similar severity and frequency for controls and cases makes the influence of socioeconomic factors less likely to be a major source of confounding. In addition, because cases and controls came from within the same communities, it is unlikely that socioeconomic factors differed drastically.

The installation of a latrine does not necessarily indicate a proper utilization of a latrine, and lack of control for this has been a limitation of several intervention evaluations (*7*). For example, there is evidence to suggest that even in homes with functioning latrines, often mothers do not dispose of faeces from infants and small children in the latrine, but rather use outside (*7*). In our evaluation, no observations were made within homes about utilization patterns of the installed latrines so it is not possible to rule out modification by this factor. However, the assumption used in our evaluation was that all latrines were being

Table 5. **Comparison of cost-effectiveness with other primary health care interventions**

Intervention type	Reference	Country	Cost per death averted[a]	Ages included in deaths averted calculation	Perspective included in cost calculation
Water and sanitation					
Hardware and software[b]	Varley et al., 1998 (*10*)	Theoretical model	US$ 19 676 (hardware and software) US$ 54 833 (hardware only) US$ 2098 (software only) US$ 79–6752 (software added to existing hardware)	Under 5 years	Organization
Latrine construction/ rehabilitation programme	Meddings, 2001	Afghanistan	US$ 4086 (US$ 2670–8808) US$ 3436 (US$ 2467–5441) US$ 2144 (US$ 1400–4623) US$ 1804 (US$ 1295–2856)	Up to 5 years Up to 11 years Up to 5 years Up to 11 years	Societal Organization
Immunization programmes[c]					
EPI immunization programme	Robertson, 1985	Gambia	US$ 68 Measles US$ 169 Pertussis US$ 11 078 Poliomyelitis US$ 18 815 Diphtheria	Up to 9 months Up to 5 years	Organization
EPI immunization programme	Creese, 1986 (*23*)	Summary of programmes in nine countries (Côte d'Ivoire, Brazil, Philippines, Indonesia, Thailand, Gambia, Cameroon, Ghana, Kenya)	Rotavirus US$ 109–5649 Measles US$ 74–2953 Cholera US$ 1285–26 366	0–59 months	Organization
EPI immunization programme, measles vaccination only	Shepard, 1986	Côte d'Ivoire	US$ 887	Up to 9 months	Organization
Routine vaccination and mass immunization programmes	Shepard et al., 1989 (*24*)	Ecuador	Routine vaccination US$ 2965 Vaccination campaign US$ 5936 Combined routine vaccination and campaign US$ 4523	Under 5 years	Organization
EPI Immunization programme, including diphtheria, pertussis, tetanus	Barnum, 1990	Indonesia	US$ 282–987		Organization
Rotavirus immunization	Martines et al., 1993 (*11*)	Combined data from several national programmes	US$ 221–2215, per diarrhoea death	Under 5 years	Organization
Routine cholera immunization	Martines et al., 1993 (*11*)	Bangladesh	US$ 3164, per diarrhoea death	Under 5 years	Organization
Measles immunization	Martines et al., 1993 (*11*)	Combined data from Indonesia and Ghana	US$ 226, per diarrhoea death	Under 5 years	Organization
Malaria prevention					
Mass chemoprophylaxis	Picard et al., 1992 (*25*)	Gambia	US$ 173	3 to 59 months	Societal
Insecticide impregnation of bednets and chemoprophylaxis	Picard et al., 1993 (*26*)	Gambia	US$ 227–410 (bednet impregnation only) US$ 683 (bednet impregnation and chemoprophylaxis)	6 to 59 months	Societal
Permethrin impregnated bednets	Binka et al., 1997 (*27*)	Northern Ghana	US$ 1022–2253	6 to 59 months	Societal

(Table 5, cont.)

Intervention type	Reference	Country	Cost per death averted[a]	Ages included in deaths averted calculation	Perspective included in cost calculation
Malaria vaccines (added to EPI programme) and insecticide impregnation of mosquito nets	Graves, 1998	Gambia	Vaccine US$ 305 Net impregnation US$ 859	Up to 5 years	Organization
Bednet impregnation	Aikens, 1998	Gambia	US$ 537	Under 10 years	Societal
Vitamin A supplementation	Loevinsohn et al., 1997 (*28*)	Phillippines	US$ 73–279	6 to 59 months	Organization
	Fiedler, 2000 (*29*)	Nepal	US$ 302–414	6 to 59 months	Organization
Breastfeeding promotion	Martines et al., 1993 (*11*)		US$ 633–17 005, per per diarrhoea death	Under 5 years	Organization
	Horton, 1996	Brazil, Honduras, and Mexico	US$ 115–625 (Brazil), per diarrhoea death US$ 919 (Honduras), per diarrhoea death US$ 174–216 (Mexico), per diarrhoea death	Up to 6 months	Organization
Weaning education	Martines et al., 1993 (*11*)		US$ 79–3164, per diarrhoea death	Under 5 years	Organization
	Varley, 1998 (*10*)	Theoretical model	US$ 209–835	Under 5 years	Organization

[a] All costs quoted in 1999 US dollars.
[b] Hardware = water and sanitation infrastructure; software = hygiene education.
[c] EPI = Expanded Immunization Programme.

used effectively. Therefore, if some latrines were not being used properly, this would probably act as a conservative bias and would tend to underestimate the true possible reduction of risk (that is, in the case of 100% effectiveness). Also, as there were no major hygiene education campaigns initiated with this project (particularly none directed towards mothers), it is unlikely that utilization patterns would have changed as a result of the intervention.

Strengths of the study

One strength of the ICRC intervention, which probably improved its cost-effectiveness, was the incorporation of the traditional Kabul latrine design into the new ICRC latrine design. By basing the new design around the old one, it was possible to recycle some construction materials from the original latrines (including bricks, which represented the largest per-unit cost of any of the construction materials), resulting in a decrease in the direct organizational costs of the intervention. An additional strength of the intervention was the strong community participation in the project and the good level of cooperation between ICRC and the homeowners who agreed to participate in the intervention. With homeowners agreeing to donate the labour component to complete the latrine construction or rehabilitation (which represented another major cost of the project), direct organizational costs for ICRC were significantly reduced. The decision to adapt the new design to a latrine design that was already familiar to Kabul residents probably also helped to improve community participation in the project.

Conclusion

Our study indicates that the ICRC intervention reduced the risk of diarrhoeal disease morbidity in children and that its cost-effectiveness was comparable to other health care interventions. However, longer-term follow-up is necessary to understand the full impact of the intervention. ■

Conflicts of interest: none declared.

Résumé

Coût-efficacité d'un programme de rénovation des latrines à Kaboul (Afghanistan)

Introduction Nous avons évalué une intervention de rénovation des latrines domestiques à Kaboul (Afghanistan) afin de mettre en évidence une éventuelle réduction des maladies diarrhéiques.

Méthodes Une étude cas-témoins portant sur 1238 cas et 625 témoins a été réalisée. Un modèle de régression logistique a été établi pour les enfants de moins de 5 ans et pour ceux de 0 à 11

ans ; les estimations obtenues ont par la suite été utilisées avec les résultats d'un sondage par grappes stratifié dans lequel on a appliqué la méthode d'autopsie verbale pour estimer le nombre de décès évités sur une période d'un an. On a ensuite effectué une analyse de coût-efficacité en prenant en compte les coûts directs et indirects de l'intervention et comparé les résultats à ceux d'interventions de soins de santé primaires recensées lors d'une recherche sur Medline.

Résultats L'étude de régression logistique conditionnelle a montré que les cas avaient une plus faible probabilité que les témoins d'habiter dans des foyers disposant de latrines rénovées (odds ratio (OR) = 0,57, intervalle de confiance (IC) à 95 % : 0,42-0,77 pour les enfants de moins de 5 ans, et OR = 0,53, IC 95 % : 0,41-0,67 pour les enfants de 0 à 11 ans). Les résultats de l'enquête par autopsie verbale sur la mortalité spécifiquement due à la diarrhée ont permis d'estimer le nombre de décès évités sur une période d'un an grâce à l'intervention, soit 235 (IC 95 % : 109-360) chez les enfants de moins de 5 ans et 285 (IC 95 % : 180-397) chez les 0-11 ans. Les estimations du rapport coût-efficacité allaient d'environ US$ 1800 à US$ 4100 par décès évité, selon l'âge considéré et le point de vue adopté pour le calcul des coûts.

Conclusion Il s'agit ici d'estimations prudentes puisque les calculs ne portent que sur une période d'un an, mais qui se comparent favorablement aux résultats d'autres interventions pédiatriques. Ces résultats sont importants, car le financement des interventions sanitaires est souvent limité par un certain scepticisme quant au rapport coût-efficacité des interventions.

Resumen

Costoeficacia de un programa de renovación de letrinas en Kabul, Afganistán

Objetivo Evaluar una intervención de renovación de letrinas domésticas llevada a cabo en Kabul, Afganistán, para comprobar si efectivamente se habían reducido las enfermedades diarreicas.

Métodos Se hizo un estudio de casos y controles que abarcó a 1238 casos y 625 testigos. Se aplicó un modelo de regresión logística a los niños menores de 5 años y a los niños de 11 años o menos, y los parámetros estimados se emplearon a continuación con los resultados de una encuesta de muestras estratificadas por conglomerados. En dicha encuesta se usó el método de las autopsias verbales para estimar el número de defunciones evitadas durante un periodo de un año. Se realizó un análisis de costoeficacia basado en los costos directos e indirectos de la intervención, y los resultados se compararon con los de otras intervenciones de atención primaria identificadas en una búsqueda en MEDLINE.

Resultados La regresión logística condicional mostró que los pacientes tenían menos probabilidades que los controles de vivir en hogares con letrinas renovadas (razón de posibilidades (OR) = 0,57, intervalo de confianza (IC) del 95% = 0,42 a 0,77 para los niños < 5 años, y OR = 0,53, IC95% = 0,41 - 0,67, para los niños ⩽ 11 años). Los resultados de la encuesta sobre mortalidad por causas específicas mediante autopsias verbales permitieron estimar el número de defunciones evitadas a lo largo de un periodo de un año gracias a la intervención; esas estimaciones fueron de 235 (IC95% = 109 - 360) para los niños < 5 años y de 285 (IC95% = 180 - 397) para los niños ⩽ 11 años. Las estimaciones de la costoeficacia oscilaron entre aproximadamente US$ 1800 y US$ 4100 por muerte evitada, según la edad y la entidad que asumiera los costos.

Conclusión Las estimaciones obtenidas son moderadas porque sólo se considera un periodo de un año de eficacia, pese a lo cual salen favorecidas si se comparan con otras intervenciones pediátricas. Estos resultados son importantes porque la financiación de las intervenciones de saneamiento suele resentirse como consecuencia de la creencia de que esas intervenciones no son costoeficaces.

Arabic

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