

Community intervention to promote rational treatment of acute respiratory infection in rural Nepal

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Summary

OBJECTIVE To evaluate a community education program about treatment of acute respiratory infection (ARI).

METHODS First, community case definitions for severe and mild ARI were developed. The intervention was then evaluated using a controlled before-and-after design. Household surveys collected data about ARI treatment in 20 clusters, each based around a school and health facility. Treatment indicators included percentages of cases attending health facilities and receiving antibiotics. The intervention consisted of an education program in schools culminating in street theater performances, discussions with mothers after performances and training for community leaders and drug retailers by paramedics. The intervention was conducted in mid-2003. Indicators were measured before the intervention in Nov/Dec 2002 and again in Dec 2003/Jan 2004.

RESULTS Two thousand and seven hundred and nineteen households were surveyed and 3654 under-fives were identified, of whom 377 had severe ARI. After implementing the intervention, health post (HP) attendance rose by 13% in under-fives with severe ARI and fell by 9% in under-fives with mild ARI (test of interaction, $P = 0.01$). Use of prescribed antibiotics increased in under-fives with severe ARI by 21% but only by 1% in under-fives with mild ARI (test of interaction, $P = 0.38$). Irrespective of ARI severity, the use of non-prescribed antibiotics dropped by 5% ($P = 0.002$), and consultation with female community health volunteers (FCHVs) and use of safe home remedies increased by 6.7% (P not estimated) and 5.7% ($P = 0.008$) respectively.

CONCLUSION The intervention was implemented using local structures and in difficult circumstances, yet had a moderate impact. Thus it has the potential to effect large scale changes in behaviour and merits replication elsewhere.

keywords acute respiratory infection, under-fives, education intervention, use of antibiotics, Nepal

Introduction

Acute respiratory infection (ARI) is a common health problem in children under 5 years of age (under-fives) and pneumonia is a major cause of childhood mortality in developing countries. Several studies focusing on understanding community perception and practices related to ARI have shown that community members can be involved in developing effective interventions on treatment and case management in the community (Mtango & Neuvians 1986; Gadomski *et al.* 1993; Kundi *et al.* 1993; Bang *et al.* 1994; Hudelson *et al.* 1995).

In Nepal, it has been estimated that, on average, each under-five child suffers 5–6 episodes of ARI every year (Ministry of Health 1996) and that only 20–35% of such cases are treated at health posts (HPs) (Management Sciences for Health 1998, WHO 2008). Many children still die from ARI, under-five mortality rate in 2000 being 86/1000 live births, 18.5% due to pneumonia (WHO 2008). About 30–35% of all deaths among under-fives attending health facilities with ARI are related to pneumonia (Dawson & Ware 1997) which accounted for 40% in 1998/99 and 44% in 1999/2000 of cases with ARI (Department of Health Services,

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MOH/HMG 2000). High mortality from severe ARI indicates that there is lack of access to adequate treatment with antibiotics for cases of childhood pneumonia.

Distinguishing between pneumonia and mild viral upper respiratory tract infection is a major challenge when treating ARI in infants, both for health workers (despite training), parents and caretakers. This is particularly so in communities which lack access to adequate health care. A study in primary health care showed that only 14.3% of under-fives with ARIs involving pneumonia were treated appropriately with antibiotics, and that antibiotics were prescribed for $\approx 70\%$ of under-fives with ARIs who did not have pneumonia (Kafle *et al.* 2001). In another study, $\approx 23\%$ of carers of under-fives with signs of pneumonia received cough-cold preparations and 21% received antibacterials from drug retailers (Kafle *et al.* 1998). These practices demonstrate inappropriate and under use of antibiotics.

Mortality in under fives has been reduced through more effective treatment of ARI in the community, by training and supervising community members to treat pneumonia and refer severely affected infants (Pandey *et al.* 1989, 1991). In a community-based ARI programme operating in half of the country in 2007, it was estimated that about 24% of expected pneumonia cases were being treated in health facilities and 32% in the community by female community health volunteers (FCHVs) (Dawson *et al.* 2008). However, current data suggest that many children continue to die from ARI (Greenwood *et al.* 2007). The objective of the present study was to design and evaluate a relatively inexpensive, pragmatic intervention to improve community knowledge and treatment practices for children with ARI.

Methods and materials

Setting

The study took place in four hill districts of Eastern Nepal (Khotang, Panchthar, Sankhuwasabha and Taplejung) where the Britain Nepal Medical Trust (BNMT) operates cost-sharing drug schemes. Patients were charged a small fee (40% of cost price) for drugs at government health posts; the fees were used to purchase more drugs. Each district has a hospital and 9 to 10 health posts, each covering a population represented by 2-3 village development committees. HPs are staffed by paramedical personnel, most of whom have had 1 year's training or less. A doctor should be present at a district hospital but, in the absence of a doctor, paramedical staff undertake prescribing.

The districts (populations 134 000-232 000) are remote and mostly without roads. Agriculture is the major source of living. Most households have no electricity or ventilation and use kerosene lamps and pine wood for lighting. Less than a third of the population visits government health facilities, which are often several hours walk away. FCHVs trained to treat or refer cases of childhood pneumonia (Dawson *et al.* 2008) were not treating patients in the study area. Therefore, drug retailers, traditional healers and home remedies were the main sources of health care. Retailers operate with little control, selling medicines mostly without prescriptions.

Descriptive study to inform the household survey

A descriptive (formative) study was conducted in 2002 in two districts similar to those proposed for the evaluation study. The aim was to understand the concepts of ARI and its treatment among community members. A method was devised to distinguish between mild and severe ARI in under-fives, based on caretakers' responses during household interviews. A sample of under-fives, diagnosed in HPs or hospitals (inpatients and outpatients) by health workers as having an ARI (on the basis of symptoms and signs), was identified. Each child was classified as having a severe ARI (which could be potentially fatal and required antibiotics) or not by the senior author (KAH) on the basis of health workers' diagnoses. Severe ARI included diagnoses of pneumonia, bronchopneumonia, severe chest infection, severe bronchitis and bronchiolitis. Non-severe ARI included diagnoses of common cold, runny nose, cough and cold without fever or only very mild fever. Mothers of the children were interviewed and their responses about the symptoms experienced by the children during their illnesses were recorded. Their responses were used to estimate the sensitivity and specificity of the reported symptoms for severe ARI/pneumonia, using the health workers' diagnoses as the reference standard [analogous to verbal autopsy (Anker *et al.* 1999)]. Symptoms associated with ARIs classified as severe were incorporated in the subsequent household surveys. Data collection tools and training materials, using local terms for ARI and its treatment, were also developed.

Intervention and materials

The intervention used methods for spreading health messages successfully implemented previously. It was developed after discussion between BNMT, government officials and community members during the descriptive study. It consisted of:

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- Training the people involved in the intervention (3 days for teachers and district health staff who then conducted 10 day workshops for students, retailers and community leaders in order to develop community plans of action);
- A child-to-child education program administered by teachers in schools, whereby children in selected classes were encouraged to spread key messages to other children and their families;
- Street theater performances based on the education program, performed by children to mothers' groups;
- Interactive group discussions with mothers following street theater performances, run by local female community health volunteers (FCHVs);
- Design and distribution in intervention districts of posters communicating the key messages.

Figure 1 summarises how the intervention was cascaded using the method of 'training-the-trainers', allowing the program to be delivered efficiently and widely with locally available resources. Ten core study team staff cascaded the training of 419 people (district staff, teachers, community members, performing students), drawing on information from the descriptive study and using packages developed in Nepali. The training packages, and the components of the

intervention itself, were field-tested outside the study districts and were revised as necessary.

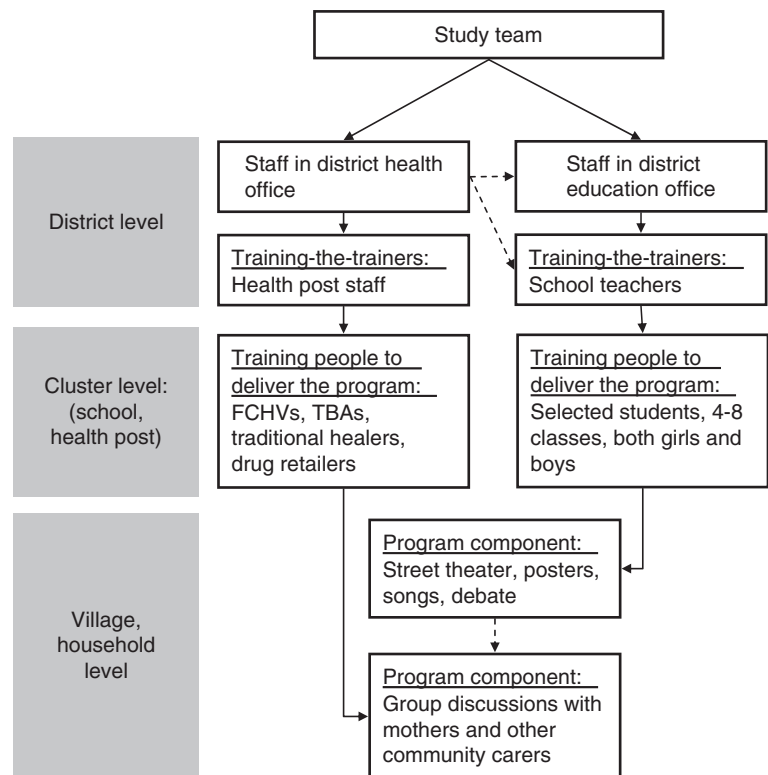
Table 1 summarises the key messages which were delivered during street theatre performances and mothers' group discussions. Training in the community discussions focused on the symptoms and signs of severe ARI, as recognized and used by mothers, and recommended treatments for severe (including antibiotics and referral) and mild (including safe local home remedies) ARI.

Study design for evaluation, and sampling strategy for household surveys

The evaluation study used a controlled before-and-after design (Shadish *et al.* 2002). Two of the four districts (Taplejung and Khotang) were randomly assigned to receive the intervention.

The sampling structure was as follows. First, in consultation with local leaders, all possible intervention sites in study districts were listed; each had to have a secondary school, a health post and at least one private drug seller/retailer. Five of ≈ 10 sites/district were randomly selected to be the study areas. In each site, five villages with >60 households, within 2 h' walking distance from the

Figure 1 Diagram showing how responsibility for training and delivery of the intervention was cascaded from district to cluster to village levels. Dotted lines at district level represent the fact that staff in the district health office helped to train staff in the education office and school teachers. The dotted line between program components represents the fact that group discussions took place immediately after street theatre performances. FCHV, Female Community Health Volunteer; TBA, Traditional Birth Attendant.



K. A Holloway *et al.* **Community intervention on treatment of acute respiratory infection in Nepal****Table 1** Key messages on ARI given to the communities

Condition	Signs/symptoms*	Messages**
Child under five with 'Pneumonia/severe pneumonia'	Fast breathing Chest in-drawing Unable to eat/drink/suck Difficulty breathing/grunting 'Severely ill'	Refer immediately to the health post the same day. Get the advice of a health worker immediately. Only use drugs on advice of health worker. Follow advised dosing schedules and ask health workers to write the medicine name and dosing instructions clearly on prescriptions.
All ages with 'No pneumonia'	Common cold No fever No dangerous sign	No need to treat with drugs. Keep patient's nose clean. Use home remedies (give plenty of boiled and warm water with tulsi leaf, turmeric, juice of ginger, lemon and honey, etc.). Do not give cough syrup except on advice of health worker.

*The signs/symptoms described in the table represent lay terms recognized and used by mothers which were identified in the qualitative study.

**Carers of all cases with or without pneumonia/severe ARI were advised to increase fluids and frequency of breast feeding and revisit the health post if the condition worsens or continues for more than 2 weeks.

school, were randomly selected. In each village, after reaching a public place (e.g. school or lane or play ground), the first household was sampled randomly by spinning a bottle. Additional households were selected in a clockwise direction until 16 households were identified in which one or more under-fives had had an ARI in the last 2 weeks. The household surveys were carried out in November-December 2002 pre-intervention and in December-January 2003/4 post-intervention. For each household, the main respondent was asked whether a child under five had had an ARI in the last two weeks. If the answer was 'yes', the full survey was administered and details collected about all children with ARI; if the answer was 'no', the research team progressed to the next household.

In each village, we aimed to survey 16 households with an under-five who had had an ARI, i.e. 20 sites \times 5 villages \times 16 households = a total of 1600 households in each survey. This target sample size was estimated as follows. Assuming statistical independence, with 400 under-fives with ARI in the control and intervention groups, the study would have had 80% power to detect an increase in the frequency of an outcome from 40% to 50%. A design effect of two was assumed to take into account clustering, giving a sample size of 800 per group; for both groups, and the surveys before and after implementation, the overall target was 3200.

Data collection

Household interviews included questions, developed in the descriptive study, about the symptoms of any under-five who had an ARI and about the drugs and other treatments

given. HP prescriptions and drug availability were monitored during 2002-3 for changes in the health care system as described elsewhere (Holloway *et al.* 2008). Ten supervisors and 10 enumerators were recruited and trained to carry out household interviews. In addition, 20 teachers from the study sites also participated, acting as local guides and providing logistical support for data collection, eighteen of them participating in both pre-and post-intervention surveys.

Outcome indicators and data analysis

Survey data about community treatments for ARI were used to evaluate the intervention. Data were entered into an Epi-Info database (version 6.04). Outcome indicators specified in the protocol were:

- % consulting at a health post (CHP);
- % prescribed and treated with an antibiotic of any class (PAb);
- % prescribed and treated with cotrimoxazole (PCt);
- % prescribed and treated with amoxicillin (PAX);
- % treated with an antibiotic obtained over-the-counter (AOTC, i.e. obtained without a prescription from a drug retailer rather than a health post);
- % consulting a FCHV;
- % treated with a safe home remedy (SAFE).

Outcome frequencies in the intervention and the control districts were compared before and after implementation by logistic regression modelling. For outcomes (a) to (d), we hypothesised that the effect of the intervention would depend on ARI severity, i.e. the outcomes would increase in frequency in intervention

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districts for severe ARIs (e.g. CHP more likely) and decrease for mild ARIs (e.g. CHP less likely). (Statistically, this is a 3-way interaction of intervention *vs.* control district, before *vs.* after implementation, and ARI severity.) For outcomes (e) to (g), we hypothesised that the effect of the intervention should be the same direction for all ARIs, i.e. the outcome frequency should decrease for AOTC and increase for FCHV and SAFE, irrespective of ARI severity. Odds ratios were estimated for each outcome variable with robust confidence intervals to take into account multiple ARIs in some households. All analyses were carried out in STATA version 9.2 (Stata Corporation, Texas).

Research governance

This research was planned under the aegis of the WHO Joint Research Initiative to improve the use of medicines. A protocol was approved by international reviewers before the research started. Research ethics approval was given by the national research ethics committee for Nepal and by Boston University (delegated to take on this role by the committee organising the Initiative).

Results**Descriptive study to inform the household survey**

The caretakers of 274 under-fives with ARI were interviewed. We investigated the ability of the following symptoms reported by caretakers to predict ARIs classified as severe/pneumonia:

- Pneumonia (i.e. a mother reported that the child had 'sannepat', the local word for pneumonia)
- 'Severely ill' (i.e. mother reported that the child was severely ill)
- Unable to eat/drink/suck
- Unconsciousness
- Difficulty in breathing
- Fast breathing
- Chest indrawing

The prevalences of symptoms are shown in Table 2. Sensitivities and specificities were calculated for multiple symptoms. Adding more symptoms increased sensitivity but decreased specificity for the first five symptoms but adding fast breathing and chest indrawing did not improve the diagnostic accuracy. Two combinations were considered (Table 3): (a) the first five symptoms combined ('c' statistic = 0.55, $P = 0.10$), giving a sensitivity of 81% (95% CI 69% to 90%) and a specificity of 30% (95% CI 24% to 37%); (b) the first three symptoms combined ('c' statistic = 0.57, $P = 0.05$), giving a sensitivity of 61%

Table 2 Prevalence of symptoms of severe ARI in the descriptive study

Symptom	Prevalence		
	Severe ARI/pneumonia ($n = 62$)	Non-severe ARI ($n = 212$)	Total ($n = 274$)
'Sannepat' (pneumonia)	58%	42%	46%
Severely ill	11%	5%	7%
Unable to eat/drink/suck	16%	7%	9%
Unconsciousness	10%	11%	11%
Difficulty in breathing	48%	47%	47%
Fast breathing	53%	42%	44%
Chest indrawing	10%	6%	7%

- Chest indrawing did appear to distinguish between severe and non-severe ARIs in the descriptive study but was not reliably reported in the subsequent household surveys either because it was not recognised by mothers or not adequately explained by data collectors.
- Unconsciousness and difficulty breathing did not appear to distinguish between severe and non-severe ARIs in the descriptive study and were reported very infrequently in the subsequent household surveys. Therefore, inclusion/omission of these two symptoms distinguished between rules (a) and (b) in table 3.

(95% CI 48% to 73%) and a specificity of 53% (95% CI 46% to 60%).

Effect of intervention (analysis of household survey data)

In August and September 2003, trained students performed 5 street theatres to convey the ARI key messages in each intervention site. About 7500 people, including about 1000 mothers, of approximately 30 000 people living around the intervention sites, observed the performances. Immediately after each street theatre performance, the trained members of the community (FCHVs, TBAs, etc.) carried out interactive discussions, mostly in the form of questions-and-answers, with mothers who had watched a performance. A trained teacher or health worker also attended each discussion to answer questions.

Field workers surveyed a total of 2231 households in both pre and post surveys and identified 4850 persons with an ARI; 3654 were under-fives. In the pre-implementation survey, 907 and 947 under-fives with ARI were identified in intervention and control villages respectively; in the post-implementation survey, the corresponding numbers were 915 and 885.

Before analysing the data, we decided to classify non-severe ARIs into mild and moderate categories, on the basis of the symptom of fast-breathing. This decision was taken because, although fast breathing did not predict severe ARI

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Rule (a)*	Reference diagnosis: severe ARI			Rule (b)†	Reference diagnosis: severe ARI		
	Yes	No	Total		Yes	No	Total
Severe ARI: yes	50	148	198	Severe ARI: yes	38	100	138
Severe ARI: no	12	64	76	Severe ARI: no	24	112	136
Total	62	212	274	Total	62	212	274

*Rule (a): severe ARI = Yes if caretaker reported pneumonia, *or* severely ill, *or* unable to eat/drink/suck, *or* unconsciousness, *or* difficulty breathing.

†Rule (b): severe ARI = Yes if caretaker reported pneumonia, *or* severely ill, *or* unable to eat/drink/suck.

Table 3 Descriptive data for sensitivity and specificity of classifying ARIs in children under-five as severe/pneumonia or not; reference diagnosis was the classification of health workers' diagnoses

in the descriptive study, it is accepted to be a very important sign of severe ARI/pneumonia. Although rules (a) and (b) had quite different sensitivities and specificities in the descriptive study, they identified similar percentages of severe, moderate and mild ARIs in the household surveys, i.e. 10% (377), 21% (771), and 69% (2506) respectively with rule (a), and 9% (325), 22% (794), and 69% (2535) with rule (b).

Table 4a summarises treatment practices for under-fives with *severe* ARI rule (a); pre-post changes in the intervention and control groups show that, as hypothesised, the

intervention was associated with increases in CHP, PAb, PCt, PAx and FCHV, and a decrease in the use of AOTC. Table 4b summarises the treatment of under-fives with *mild* ARI; here, pre-post changes in the intervention and control groups show that the intervention was associated with a decrease in CHP, as hypothesised, but no increase in FCHV.

Figure 2 summarises the effect of the intervention on CHP, PAb, PCt, and PAx by ARI severity. Data points (ratios of two odds ratios, RORs) represent the comparison between intervention and control districts during the

Table 4 Treatment indicators pre- and post-implementation and impact of the intervention in under-fives with (a) severe and (b) mild ARI, using rule (a)

Indicator	Control			Intervention			Intervention impact
	Pre (<i>n</i> = 94)	Post (<i>n</i> = 93)	Change	Pre (<i>n</i> = 102)	Post (<i>n</i> = 88)	Change	Intervention - Control
(a) Severe ARI							
% CHP	30.9	41.9	+11.1	55.9	79.5	+23.7	+12.6
% PAb	23.4	20.4	-3.0	37.3	55.7	+18.4	+21.4
% PCt	11.7	7.5	-4.2	14.7	25.0	+10.3	+14.5
% PAx	11.7	11.8	+0.1	19.6	33.0	+13.3	+13.2
% AOTC	2.1	6.5	+4.3	10.8	5.7	-5.1	-9.4
% FCHV	0.0	0.0	+0.0	1.0	25.0	+24.0	+24.0
% SAFE	57.4	63.4	+6.0	75.5	79.5	+4.1	-1.9
<hr/>							
	Pre (<i>n</i> = 667)	Post (<i>n</i> = 508)	Change	Pre (<i>n</i> = 650)	Post (<i>n</i> = 681)	Change	Intervention - Control
(b) Mild ARI							
% CHP	14.5	16.9	+2.4	23.5	16.4	-7.1	-9.5
% PAb	8.7	8.1	-0.6	9.1	9.5	+0.5	+1.1
% PCt	3.9	4.3	+0.4	5.7	5.6	-0.1	-0.5
% PAx	4.2	3.3	-0.9	3.1	3.7	+0.6	+1.4
% AOTC	1.8	3.0	+1.2	7.8	2.6	-5.2	-6.4
% FCHV	0.1	0.0	-0.1	0.6	2.9	+2.3	+2.5
% SAFE	48.0	64.0	+16.0	57.5	79.4	+21.9	+5.9

CHP, consultation at a health post; PAb, prescribed and treated with an antibiotic (of any class); PCt, prescribed and treated with cotrimoxazole; PAx, prescribed and treated with amoxicillin; AOTC, treated with an antibiotic obtained over-the-counter; FCHV, consultation with a female community health volunteer; SAFE, treated with a safe home remedy (SAFE).

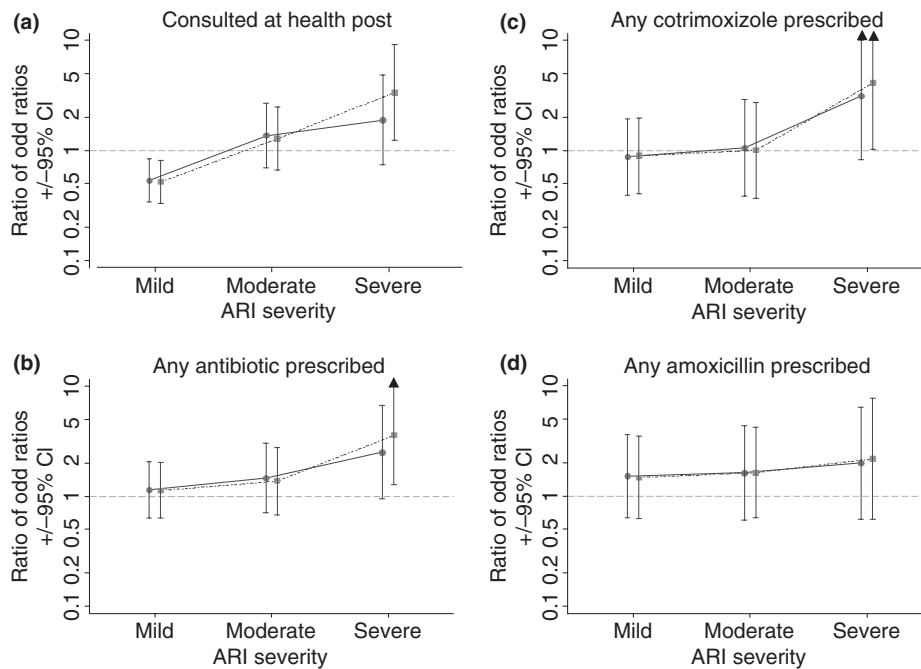


Figure 2 Graphs showing the effect of the intervention for consultations at health posts and indicators of antibiotic prescribing (a,b,c,d) by ARI severity. Solid and dotted-dashed lines show the results for rules (a) and (b), respectively. The grey dashed line (ratio of odds ratios = 1) represents the null hypothesis, i.e. no effect of the intervention.

Footnote: The graphs show the results for mild, moderate and severe ARIs equally spaced on the X-axes. This has been done to make the graphs simple and clear. It is not intended to imply that the differences in severity between mild and moderate ARIs, and between moderate and severe ARIs, are equivalent.

post-intervention survey (when we expected a difference) divided by the comparison between intervention and control districts during the pre-intervention survey (when we did not expect a difference). RORs >1 imply that the frequency of the outcome increased in intervention districts after the intervention compared to before; RORs <1 imply that the frequency of the outcome reduced in intervention districts after the intervention compared to before. Each outcome showed the hypothesised positive gradient across ARI severity, although only CHP showed a decrease in mild ARIs. For ARIs classified using rule (a), the ratio for the three-way interaction of intervention, period and ARI severity CHP was statistically significant for CHP ($P = 0.01$) but not for PAb ($P = 0.38$), PCt ($P = 0.26$) and PAX ($P = 0.93$). Based on these models, after implementing the intervention, health post attendance increased by 13% in under-fives with severe ARI and fell by 9% in under-fives with mild ARI; use of prescribed antibiotics increased in under-fives with severe ARI by 21% but only by 1% in under-fives with mild ARI.

In analyses that did not distinguish ARI severity (because our hypotheses for these variables did not depend on ARI severity), statistically significant decreases

and increases in AOTC and SAFE (two-way interactions of intervention and period) were also observed as hypothesised; odds ratios were 0.28 (95% CI 0.12 to 0.63, $P = 0.002$) for AOTC and 1.54 (95% CI 1.12 to 2.13, $P = 0.009$) for SAFE. These relative changes represented a decrease of 5% in AOTC and an increase of 7% in SAFE. All results were very similar using rule (b). Data for FCHV could not be modelled because almost no mothers and carers consulted FCHVs before the intervention; nevertheless, this indicator showed the equal largest increase in frequency for under-fives with severe ARI, from 1 to >25% after the intervention (see Table 4a), equivalent to an overall increase in FCHV of 6.7%.

Discussion

This study has six important findings:

- The intervention was associated with better utilisation of the health workers who staff HPs. Parents and carers consulted them more often for severe ARIs but less often for mild ones.

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- Before the intervention, parents and carers almost never consulted FCHVs. Assuming that this baseline reflects the prevailing situation more widely, FCHVs appear to be under-utilised resource, as evidenced by the dramatic increase in FCHV consultations after the intervention.
- The intervention was associated with improved antibiotic prescribing. The changes were in the hypothesised direction, although not statistically significant, and the size of the effects represented potentially important improvements in the use of antibiotics to treat ARI (e.g. two-fold increases in the prescription of recommended antibiotics for severe ARI).
- Safe home treatments increased for all ARIs, irrespective of severity.
- Use of AOTC decreased for all ARIs, irrespective of severity.
- The intervention itself was feasible and used only locally available resources.

A key strength of this study is that it evaluated a pragmatic, inexpensive intervention, designed to be delivered by local people in a local context without the need for medical or other highly skilled personnel. Apart from core activities (coordination, supervision, training of trainers) carried out by a team of 10 Nepali BNMT staff, all of whom were also involved in other health activities, the entire intervention was implemented by paramedical HP staff, school teachers, and local people. As well as evaluating the intervention, the study shows that the intervention itself engaged the local communities and is completely feasible. A second strength is that local people carried out the household surveys. In developing country settings, district level commitment for the investment required to sustain an intervention in the long term (even if the investment is modest) depends on continuing sentinel surveillance showing health gains. This study shows that with minimal external support local people can provide such surveillance.

The most serious limitation was the relatively poor ability of the household survey questions to discriminate ARIs of differing severity. The questions showed some discrimination, but inevitably many ARIs identified in the household surveys will have been misclassified in a non-differential manner. It is very important to note that *non-differential* misclassification would have biased the estimated effect sizes towards the null hypotheses, i.e. this limitation would have reduced the ability of the evaluation to show an impact of the intervention. Therefore, the effects reported are a conservative estimate of the true impact of the intervention.

The sample size of the study was chosen to allow the study to detect important changes in the overall frequency of outcomes after implementing the intervention, not changes within groups of varying ARI severity. Therefore, it is not surprising that the changes in antibiotic prescribing did not reach statistical significance, even though they were large and in the hypothesised direction. Unfortunately, a very large study indeed would be required to yield sufficient severe ARIs to have adequate power to investigate three way interactions.

The intervention was limited to villages within reasonable distance of a secondary school, HP and ≥ 1 private drug retailer; also, for logistical reasons, only villages with >60 households were included. Therefore, the findings should not be applied to communities even more isolated than those studied. A final limitation is that the 'post' survey was carried out only 4 months after delivering the intervention. It is likely that, without follow-up interventions, the impact would decrease over time. We propose that the intervention should be a standard part of school and wider community life, providing at least an annual reminder of the key messages.

There have been very few other studies in developing countries evaluating the impact of child-to-child or school-based educational interventions to improve drug treatment of any illness. Such interventions have many advantages: they build on the existing educational infrastructure, do not require medical input and are potentially inexpensive and self-sustaining. A school-based intervention study in Moldova to improve the treatment of ARI showed an improvement of 25–30% in treatment practices; however, the intervention was implemented in a health system which provided better access to treatment and hence greater coverage of the targeted population than in Nepal (Cebotarenco & Bush 2008). A study in Ghana used school teachers to treat cases of childhood malaria at school and improved treatment by more than 30% (Afenyadu *et al.* 2005). Community intervention studies to improve ARI treatment, by training and supervising community members to treat children in their own communities, have resulted in significant reduction in mortality from ARI in Nepal (Pandey *et al.* 1991; Dawson *et al.* 2008), Bangladesh (Fauveau *et al.* 1992) and India (Reddaiah & Kapoor 1991). The Moldova study findings are difficult to apply to an Asian setting and the other interventions in the India sub-continent have not been implemented widely possibly due to resource constraints. Our intervention focused on children as a channel for behaviour change and was found to be both feasible and effective. Such an intervention should therefore be considered in areas where there is poor access to health care.

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Our results show that the intervention was associated with improved ARI treatment in the community. For severe ARI, consultations at HPs and with FCHVs increased by about 20%; use of first-line, prescribed antibiotics increased by about 13–15%, and use of unprescribed antibiotics to treat mild cases of ARI decreased by about 5%. These modest changes in ARI treatment were exactly in accordance with the messages disseminated in the intervention.

The robustness of the intervention is evidenced by the circumstances of the study. At the time, there was virtual civil war between the Maoist insurgency and the Nepali government, which resulted in some of the intervention activities being delayed, reduced in scale and occurring unsupervised in some villages. Despite these challenges, the interventions were implemented with the support and co-ordination of partners and the communities themselves. The interventions, used local structures involving local communities and government (health and education departments). Thus, it should be possible to replicate the intervention relatively easily.

Our findings need replicating in other developing countries. New studies would benefit from a household survey instrument which discriminated ARI severity better. Sensitivities and specificities of symptoms were estimated in a sample of under fives attending health facilities (including a disproportionate number of hospital attendees to ensure sufficient severe ARIs were included), which was not identical to the one surveyed during the evaluation. Thus, chest indrawing was an important sign when an affected child could be observed by a health worker, but could not be communicated effectively to mothers in the household survey; unconsciousness *due to* ARI is an important sign of severity, but only if it can be reasonably attributed to an ARI; fast breathing and difficulty breathing tended to be non-specific in the household survey. Nevertheless, the rules that we applied did distinguish between ARIs of varying severity; if they had not, it would have been impossible to show effects in the hypothesised direction. In view of this experience, we believe that research to develop a household survey instrument that better discriminates ARI severity in developing country settings, and which can be administered by lay people in local communities, is an important priority.

Conclusion

A multi-faceted community-based intervention on ARI treatment was modestly effective. This modest impact on a very important disease was observed despite implementing the intervention in difficult circumstances using local structures. Serious consideration should be given to

replicating our findings, which should be within the capacity of a poor country like Nepal to do. In any replication, provision of the intervention and measurement of behaviour should be continued for 1–2 years to evaluate the sustained longer term impact.

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References

- Afenyadu G, Agyepong I, Barnish G & Adje S (2005) Improving access to early treatment of malaria: a trial with primary school teachers as care providers. *Tropical Medicine and International Health* 10, 1065–1072.
- Anker M, Black RE, Coldham C *et al.* (1999) *A Standard Verbal Autopsy Method for Investigating Causes of Death in Infants and Children*. WHO, Geneva. WHO/CDS/CSR/ISR/99.4 http://www.who.int/csr/resources/publications/surveillance/WHO_CDS_CSR_ISR_99_4/en/index.html (last accessed 27 Feb 2008).
- Bang AT, Bang RA, Sontakke PG & Search Team (1994) Management of childhood pneumonia by traditional birth attendants. *Bulletin of the World Health Organisation* 72, 897–905.
- Cebotarencu N & Bush PJ (2008) Reducing antibiotics for cold and flu: a student taught program. *Health Educ Res.* 23, 146–157.
- Dawson P & Ware JN (1997) *A Situation Study on ARI in Chitwan and Morang (in Nepal)*. JSI/Nepal and CDD-ARI Section, Child Health Division, Ministry of Health, Kathmandu, Nepal.
- Dawson P, Pradhan YV, Houston R, Karki S, Poudel D & Hodgins S (2008) From research to national expansion: 20 years' experience of community-based management of childhood pneumonia in Nepal. *Bulletin of the World Health Organisation* 86, 339–343.
- Department of Health Services, MOH/HMG (2000) *Annual Report 1999/2000*. MoH, MoH, Kathmandu.
- Fauveau V, Stewart MK, Chakraborty J & Khan SA (1992) Impact on mortality of a community-based programme to control acute lower respiratory tract infections. *Bulletin of the World Health Organization* 70, 109–116.

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- Gadomski AM, Aref GH, Hassanien F *et al.* (1993) Caretaker recognition of respiratory signs in children: correlation with physical examination findings, x-ray diagnosis and pulse oximetry. *Int J Epidemiol* **22**, 1166–1173.
- Greenwood BM, Weber MW & Mulholland K (2007) Childhood pneumonia - preventing the world's biggest killer of children. *Bulletin of the World Health Organisation* **85**, 501–568.
- Holloway KA, Karkee S, Tamang A, Gurung YB, Pradhan R & Reeves BC (2008) The effects of user fees on prescribing quality in rural Nepal: two controlled pre-post studies to compare a fee per drug unit vs. a fee per drug item. *Tropical Medicines and International Health* **13**, 1–7.
- Hudelson P, Huanca T, Charaly D & Cirpa V (1995) Ethnographic studies of ARI in Bolivia and their use by the national ARI programme. *Social Science and Medicine* **41**, 1677–1683.
- Kafle KK, Shrestha AD, Karkee SB *et al.* (1998) Impact of action-orientated training and/or mailed print material on retailer practices: safe dispensing, correct advice and appropriate referral for diarrhoea, ARI and pregnancy. Report Submitted to WHO/MSH/WFPMM, INRUD Nepal, July 1998.
- Kafle KK, Shrestha AD, Shrestha N *et al.* (2001) *Test of Strategies for Implementing STS in Improving use of Drugs*. Report Submitted to Rational Pharmaceutical Management Project (RPM), INRUD Nepal, March 2001.
- Kundi MZM, Anjum M, Mull DS & Mull JD (1993) Maternal perceptions of pneumonia and pneumonia signs in Pakistani children. *Social Science and Medicine* **37**, 649–660.
- Management Sciences for Health (1998) *Child Survival Pharmaceuticals in Nepal*. Management Sciences for Health, Kathmandu.
- Ministry of Health (1996) *A Training and Work Manual on ARI for Maternal and Child Health Workers and Village Health Workers (in Nepal)*. HMG, UNICEF, USAID, Kathmandu.
- Mtango FDE & Neuvians D (1986) Acute respiratory infections in children under five years. Control project in Bagamoyo District, Tanzania. *Transactions of the Royal Society of Tropical Medicines and Hygiene* **80**, 851–858.
- Pandey MR, Gubhaju BB, Shakya GM *et al.* (1989) Impact of a pilot acute respiratory tract infection (ARI) control programme in a rural community of the hill region of Nepal. *Annals of Tropical Paediatrics* **9**, 212–220.
- Pandey MR, Daulaire NMP, Starbuck ES, Houston RM & McPherson K (1991) Reduction in total under-five mortality in western Nepal through community-based antimicrobial treatment of pneumonia. *Lancet* **338**, 993–997.
- Reddaiah VP & Kapoor SK (1991) Effectiveness of ARI control strategy on underfive mortality: Indian. *Journal of Pediatrics* **58**, 123–130.
- Shadish WR, Cook TD & Campbell DT (2002) Quasi-experimental designs that use both control groups and pretests – matching through cohort controls. In: *Experimental and Quasi-Experimental Designs for Generalized Causal Inference*. (ed. Kathi Prancan) Houghton Mifflin, Boston, pp. 148–152.
- WHO (2008) *Health Statistics*. <http://www.who.int/whosis/whostat/2008/en/index.htm>.

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