

Low-cost on-the-job peer training of nurses improved immunization coverage in Indonesia

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In Indonesia responsibility for immunizations is placed on local government health centres and on the nurses who provide the immunizations at each centre. An on-the-job peer training programme for these nurses, which was designed to improve the immunization performance of poorly performing health centres in terms of coverage and practice in Maluku province, was evaluated. Experienced immunization nurses were sent to health centres where nurses were inexperienced or performing poorly; the experienced nurses spent 1–2 weeks providing on-the-job training for the less experienced ones. An evaluation of the 13 centres that participated in the programme and the 95 that did not found that the programme increased both immunization coverage and the quality of practice. Coverage of diphtheria/pertussis/tetanus (DPT), polio, and measles vaccinations rose by about 39% in all 13 participating centres when compared with non-participating centres, and by about 54% in the 11 centres that had a functioning transportation system during the year after training. These results reflect increases in the actual number of doses given and improvements in the accuracy of reports. Potential threats to the study's validity were examined and found not to be significant. The out-of-pocket cost of the training programme was about US\$ 53 per trainee or about US\$ 0.05 per additional vaccine reported to have been given. The marginal cost per additional fully immunized child was estimated to be US\$ 0.50.

Keywords: immunization; vaccination, nursing; public health nursing, education; peer group; diphtheria-tetanus-pertussis vaccine; poliovirus vaccine; measles vaccine; cost-benefit analysis; Indonesia.

Mots clés: vaccination; vaccination, soins infirmiers; santé publique, soins infirmiers, enseignement; formation par les pairs; vaccin diphtérie-tétanos-coqueluche; vaccin antipoliomyélique; vaccin antirougeoleux; analyse coût-avantage; Indonésie.

Palabras clave: inmunización; vacunación, enfermería; enfermería en salud pública educación; grupo par; vacuna difteria-tétanos-pertussis; vacuna antipolio, vacuna antisarampión; análisis de costo-beneficio; Indonesia.

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Introduction

Training by peers has been proposed as an efficient, effective, and sustainable training strategy (1–3). Many studies have shown that peer-based programmes can deal effectively with social and psychological problems, and that peers can function as counsellors, trainers, mediators between professionals and clients, or leaders of self-help groups (4–6). For example, a meta-analysis of 240 evaluations of substance abuse prevention programmes found that programmes using peer-based strategies were consistently more effective than programmes using other approaches (7).

Although immunizing children is one of the most successful strategies for reducing child mortality and sickness, substantial work remains to be done to eliminate the effects of vaccine-preventable diseases in developing countries. Several barriers to achieving this have been identified, including, for example, an inadequate understanding of and demand for immunizations by families and communities (8), hierarchical structures and other organizational styles that hinder the flow of information and prevent learning (9), and inconsistent and inadequate performance by health workers (10, 11).

This paper reports on the evaluation of a programme in which experienced immunization nurses provided on-the-job training to less experienced immunization nurses. This programme, which was implemented in 1993 in the Maluku province of Indonesia by the Provincial Department of Health and Project Concern International, a private, voluntary organization, was part of a more comprehensive effort by these two organizations to increase immunization coverage and improve practice (12).

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The evaluation analyses the effect of the programme on immunization coverage and on the knowledge and practices of the immunization nurse, as well as analysing the costs of the programme.

The programme

Indonesia's preventive health care services are largely delivered through government health centres; within the hierarchy of provinces, districts, sub-districts, health service areas, and sub-health service areas, the health centres are the next-to-smallest service areas. Health centres use several strategies to immunize women and children in their catchment areas, including making monthly visits to villages (*posyandu*) and appointing an immunization nurse at each centre to manage the immunization programme. The immunization nurses, who typically have several years of nursing experience gained after three years of hospital-based nursing training and a one-week course on immunization techniques, manage the cold chain, give vaccinations at the centre and during *posyandu*, help organize the *posyandu*, and report data. In Maluku the immunization nurses from each district meet quarterly for several days.

The immunizer-training-immunizer peer-training programme provides on-the-job training to immunization nurses (the hosts) who are not performing well or who are inexperienced. Poor performance is determined from poorly reported immunization data or from data indicating that coverage is low. The training programme was first implemented in 15 health centres in Maluku province during 1993 and 1994. Each of the five district health offices in Maluku selected 2–4 health centres to participate in the programme (host health centres), and selected the immunization nurses who would act as trainers. Most of the trainers worked with hosts at nearby health centres to reduce travel costs and to ensure that the two health centres were similar. Training was held at the host health centre for 1–2 weeks. In most cases the trainer and the host had met before training began, usually through the quarterly district meetings, and sometimes the visiting trainer stayed in the home of the host. Although neither the trainer nor the host received additional remuneration for this activity, the trainer received recognition, a paid trip to the host health centre, and formal credit towards advancement.

The training provided instruction on techniques for maintaining the quality of vaccines (for example, information was given on how to operate and maintain the refrigerator and on the proper storage of vaccines) as well as practical advice (for example, on injection techniques); there was also instruction on operating the information system and discussion of ways to increase coverage. Strategies for increasing coverage included reinforcing the idea that it is appropriate to vaccinate even when a child is ill with fever or diarrhoea, using the record book at the *posyandu* to identify no-shows who were due for a

vaccination and tracking them down that day, giving public presentations at *posyandu* to inform and motivate mothers about immunizations, increasing attendance at *posyandu* by better scheduling, and using village volunteers more effectively and building closer ties with community leaders and sub-district officials.

Methods

Of the 116 health centres in Maluku province during 1993–94, 15 completed the training programme; one began the training but discontinued almost immediately; and 100 health centres did not begin. The participating group included the 15 health centres that completed the programme, and the non-participating group included the remaining 101 health centres.

Data were obtained to assess the impact and cost of the programme. The immunization information system operated by the Maluku Province Department of Health yielded retrospective data on the number of age-appropriate doses of the diphtheria/pertussis/tetanus vaccinations (DPT 1), complete courses of polio vaccine (polio 3), and measles vaccine given and reported monthly by the health centres. DPT 1 and polio 3 vaccinations are defined as age-appropriate when given before the child's first birthday, and measles when given after 9 months of age and before the first birthday. The information system also provided official estimates of the size of the target population for immunization by health centre catchment area for the corresponding time periods (13).

Two province-wide surveys, using WHO cluster sampling methodology, were completed by Project Concern and the Department of Health in 1994 and 1995, capturing vaccinations given in the two years before the surveys (14). These surveys provided more reliable estimates of actual immunization coverage in the province than the provincial administrative immunization information system. An analysis comparing the estimates from the cluster surveys and the information system produced adjustments that were used to correct for over-reporting of coverage by the information system.

Project Concern and the Department of Health also completed a field survey of immunization management practices in a sample of 90 health centres around the time of the training activities. Twelve of the participating health centres were surveyed before training, and nine of these were also surveyed a second time within a year of training. The remaining three were surveyed by the authors in 1996. Although not originally designed to contribute to the evaluation of the programme, these surveys provided serendipitous and independent information on changes in key immunization practices. Additional information on practices was obtained from assessments that trainers completed at the start and end of each training. These assessments were available for 11 of the training programmes. In early 1996, the

authors carried out interviews with several trainers, hosts, and district disease control officers, paying particular attention to the special conditions that surrounded each of the 15 participating health centres and training sessions and possible confounding factors that might threaten the validity of the results. Finally, cost data were obtained from the accounting records of Project Concern.

For this study, the numbers of age-appropriate doses of vaccine given monthly as reported to the provincial information system by the health centres are called the reported doses; the size of the target population was the estimate made by the Department of Health of the number of children living in a health centre's catchment area who should be immunized in a particular year; and the ratio of reported doses to target population is the reported coverage. Reported coverage was calculated using administrative data to estimate both the numerator (reported doses) and the denominator (target population) and it is distinguished from coverage estimates based on card and recall data obtained from a survey of a representative sample of children aged 12–23 months. The term "survey coverage" refers to coverage obtained by the 1994 and 1995 household surveys, and "adjusted coverage" is the reported coverage corrected for overestimation by applying adjustments obtained from the 1994 and 1995 household surveys.

Complete data on reported doses were available for only 13 of the 15 participating health centres. Additionally, one participating centre split into two centres, and both hosted trainers six months after the split. These two centres were treated as a single case for the analysis of coverage. Thus, in the analysis of coverage the participating group contains 13 health centres consolidated into 12 cases in the tables. No data on coverage were reported for 6 of the 101 non-participating health centres, leaving 95 non-participants. Although monthly data on reported doses were obtained for each participating health centre, only an aggregate figure was available for the 95 non-participating centres; this was obtained by subtracting

the reported doses in the 13 participating centres from the corresponding province-wide figure for all 108 reporting health centres. The number of reported doses was obtained from the immunization information system for the year before and after training. The period before training included the 11-month period immediately preceding the month when training occurred; the period after training included the 11 months immediately after the month that training occurred. Most of the training occurred around September 1993. Because of this, for non-participants the period before was assumed to be the 11 months ending 31 August 1993 and the period after was the 11 months ending 31 August 1994.

Results

In the 13 participating health centres for which complete data were available, the reported doses of DPT 1 increased by 34%, polio 3 increased by 38%, and measles by 40% when the period after training was compared with the period before. The corresponding figures for the 95 non-participating health centres showed little or no change (0% increase for DPT 1, -2% for polio 3, and -2% for measles). A composite indicator obtained by summing the reported doses for all three vaccines showed that there was a net gain of 37% in the participating group compared with a 1% drop in the non-participating group. Thus the net increase in reported doses is 34% for DPT 1, 40% for polio 3, 42% for measles, and 38% for the composite indicator (Table 1).

Province-wide coverage from the 1994 and 1995 household surveys is about 23 percentage points lower for all antigens than the corresponding coverage reported by the immunization information system. The reasons for this difference are unknown but could include inappropriate reporting of doses given to children over 1 year of age, inconsistent reporting and over-reporting, missed immunizations in the coverage survey and, possibly most impor-

Table 1. **Increase in reported doses. Number of reported age-appropriate doses given in 13 programmes and 95 non-programme health centres in the 11-month periods before and after the ITI training.** Significance was computed using a χ^2 test with children as the unit of analysis.

Vaccination	Group	Number of reported doses		11 months before ITI (%)	11 months after ITI (%)	Significance
		11 months before ITI	11 months after ITI			
DPT 1	Programme	4051	5421	34		<0.001
	Non-programme	41 222	41 135	0	34	
Polio 3	Programme	3626	4996	38		<0.001
	Non-programme	38 765	38 064	-2	40	
Measles	Programme	3276	4593	40		<0.001
	Non-programme	34 189	33 402	-2	41	
Composite: sum of all vaccinations	Programme	10 953	15 010	37		<0.001
	Non-programme	114 176	112 607	-1	38	

ITI = immunizer-training-immunizer.

tantly, underestimating of the target population. Adjusted estimates of coverage are obtained by combining the survey results with the number of reported doses and the target population from the information system (Table 2). Adjusted coverage in the participating health centres rises dramatically when compared with non-participating centres. For example, measles coverage increased from 35% to 61% in the participating centres but only from 50% to 51% in the non-participating centres. The composite indicator of coverage showed a net gain of 39%. These differences between participating and non-participating health centres in doses reported and coverage are all highly significant (<0.001) for all three antigens, but the difference between antigens is not significant.

All but two of the participating centres had large increases in coverage after training. The two that did not had transport problems: a broken boat at one centre and a burnt out vehicle and heavy flooding at the other. In both cases the result was a drastic reduction in the number of immunization nurses attending at *posyandu* and a decrease in coverage in the year after training. When these two centres are removed from the analysis, the remaining participating health centres show a net gain in coverage of about 54%. This represents what is possible under ideal circumstances (Fig. 1).

In addition to a consistent improvement in absolute scores, the participating centres also had a consistent improvement in their ranking relative to other health centres in terms of coverage. The ranking of each participating centre in terms of coverage in comparison with other health centres in the district both before and after training was calculated using a six-month composite coverage

score of all three antigens. All 15 participating health centres improved their rank within their own district; 10 of the 15 moved from the bottom half of the ranking to the top half, with an average rise in the district's ranking from the 23rd percentile just before training to the 58th percentile 6 months later, an increase of 35 percentage points.

Immunization practices improved in participating centres as well. In the field survey of management practices, data were obtained on 12 key practices from 12 of the participating centres (Table 3). The average number of practices that were performed correctly rose from 7.4 before training to 10.2 after training, an increase of about 30%. The before and after assessments by the trainers are similar to the results from the field survey. According to the trainers, the average number of the 7 practices assessed that were performed correctly rose from 5.1 at the start of training to 6.6 at the end, a gain of 29%.

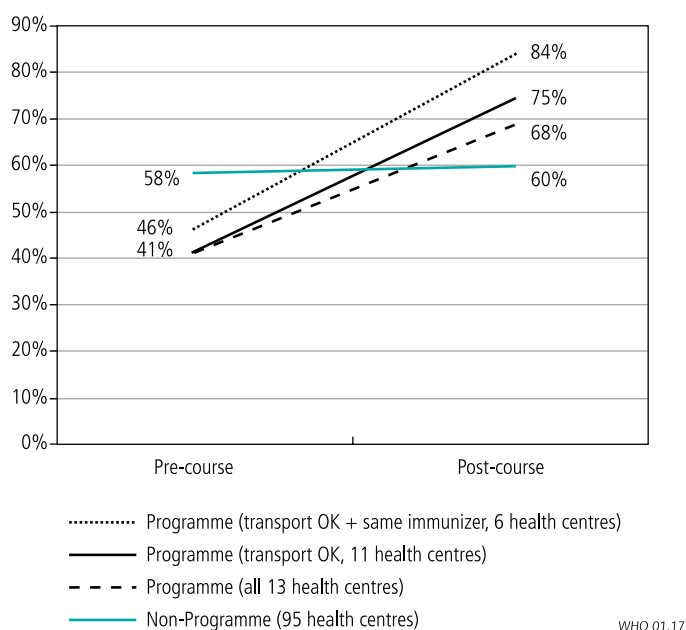
Several potential threats to the validity of the results were examined to determine if they were significant (13). Seasonal patterns associated with weather or effects associated with the end of the fiscal year were controlled for by including data from exactly the same months of the year for the before and after measurements. There was no evidence of data accumulating at the limits of the time periods because of delayed reporting or for any other reason. An observed increase in doses given by participating centres during training was controlled for by eliminating that month from the analysis and comparing the 11 months preceding training with the 11 months immediately following. Some participating centres reassigned, replaced, or changed the number of immunization nurses after

Table 2. **Increase in adjusted coverage. Adjusted coverage in 13 programme and 95 non-programme health centres in the 11-month periods before and after the ITI training.** Percentage point gain is calculated rather than percent gain before coverage is adjusted for over-reporting by adding a fixed number of percentage points to the raw estimate of coverage. Significance was calculated using a χ^2 test with children as the unit of analysis.

Vaccination	Group	Target population		Adjusted coverage		Percentage point gain	Net percentage point gain	Significance
		11 months before ITI	11 months after ITI	11 months before ITI (%)	11 months after ITI (%)			
DPT 1	Programme	5651	5495	49	76	27	24	<0.001
	Non-programme	47 044	45 366	65	68	3		
Polio 3	Programme	5651	5495	41	68	27	28	<0.001
	Non-programme	47 044	45 366	59	60	1		
Measles	Programme	5651	5495	35	61	26	25	<0.001
	Non-programme	47 044	45 366	50	51	1		
Composite: sum of all 3 vaccinations	Programme	5651	5495	42	68	26	24	<0.001
	Non-programme	47 044	45 366	58	60	1		

ITI = immunizer-training-immunizer.

Fig. 1. Immunization coverage in the year before and the year after the training programme. The calculation of immunization coverage is the composite of DPT 1, polio 3 and measles vaccinations adjusted for over-reporting. The adjusted coverage figures cannot be used to compute the percentage gain in coverage because of the procedure used to compute the adjustment.



had larger increases in coverage than participating centres that replaced their trained immunization nurse (Fig. 1). Regression towards the mean is a potential threat to our analysis because the members of the participating group were selected from the lower part of the performance distribution; this regression was ruled out as an important factor because the participating group included only chronically poor performers.

A major confounding issue is the extent to which the observed increases in reported doses and coverage are the result of an improvement in reporting rather than an increase in the number of age-appropriate doses actually given. In fact, the programme has both objectives: to increase the actual coverage and to improve reporting. The data available do not permit these two factors to be disentangled. However, there is strong anecdotal evidence that both factors contributed to the increase. For example, two health centres were selected for the programme specifically for the purpose of improving their reporting. After training, another participating centre started counting the doses that were being given by a nearby hospital to children living in the centre's catchment area. Both of these examples support the conclusion that some of the increase in reported doses was the result of changes in reporting. However, to support the idea that there was an actual increase in the number of doses given, several hosts recounted specific strategies that they had learnt through training, which they then used and which, in their opinion, substantially increased the number of doses they gave. For example, they mentioned following up no-shows and working with village volunteers to increase *posyandu* attendance. These observations were confirmed by physicians at the health centres and by district health officers. In addition, the field survey of immunization practices (Table 3) and the pre-training and post-training assessments by the trainers provided objective evidence of improvements that are likely to have increased coverage. For instance, the field survey found that the proportion of participating health centres vaccinating children with fever, diarrhoea, and colds more than doubled after training, and the proportion of participating health centres that opened a new pack of vaccine when only one child showed up for a *posyandu* increased by about 40%. The trainers' assessments identified a substantial increase in the number of hosts who noted which children were due for a vaccination at a *posyandu* and went to get them if they did not show up.

Table 3. Correct management practices. Results from the field survey of management practices in 12 ITI programme health centres, showing the number of centres performing each immunization practice correctly, before and after the ITI training.

Type of practice	Number of programme health centres with correct practice		
	Before	After	Gain
1. Refrigerator temperature OK (2-8 C)	11	11	0
2. Refrigerator temperature recorded	6	11	5
3. No damaged vaccine	12	11	-1
4. All vaccine stored correctly	10	11	1
5. Shake test OK	11	12	1
6. Information recorded past 3 months	5	9	4
7. Information sent to sub-district	3	5	2
8. Immunize when child > 12 months	10	11	1
9. Immunize when child has fever	4	9	5
10. Immunize when child has diarrhoea	4	10	6
11. Immunize when child has cold	5	11	6
12. If only one child, still open pack and vaccinate	8	11	3
Average number of correct practices per health centre	7.4	10.2	2.8

ITI = immunizer-training-immunizer.

training, but an analysis found that although these factors may have influenced coverage in the centres where they occurred, their positive effects in some centres and negative effects in others tended to cancel each other out, thus resulting in no net effect on the study's conclusions. Participating centres that kept their trained immunization nurse in the same immunization job throughout the year after training

Case example

Many of our observations are illustrated in the following case example of a trainer (MR) and host (JA). JA had worked as an immunization nurse for more than a year at clinic X on the west coast of Halmahera Island. The immunization coverage for the women and children in his area was among the

lowest in the district. JA did not have a particularly difficult area to cover. Although embarrassed when the district's medical director pointed this out, JA was glad to learn that a more experienced immunization nurse from the Kalumbang clinic would be visiting him as part of a new training programme.

After JA arranged for accommodation and board for the trainer, MR spent 10 days working side-by-side with the immunization nurse. The first few days were spent reviewing and re-learning how to keep the vaccine stock-books and complete the local area monitoring reports. When JA had started as an immunization nurse at the clinic, he had attended a course in the district capital on using the monitoring reports. However, the training had been difficult to follow as it was delivered by lecture and lasted late into the night for several consecutive days. JA was too timid to admit that he did not understand parts of the monitoring training and so he returned to his clinic ill-equipped to prepare the reports. In addition, he was unable to use the data as a management tool to target priority areas for immunization. During the sessions with MR, JA admitted that he had not understood the monitoring report but indicated that he was receptive to spending time to learn to really understand it. This was easily accomplished by working one-to-one in a non-threatening atmosphere.

JA was also having trouble with attendance at his monthly mobile immunization clinics. MR showed him how to approach local village health workers beforehand to ask for their cooperation in seeking out the mothers whose children needed vaccinations. This strategy proved to be effective.

During the ensuing 12 months (September 1993–August 1994) the vaccination coverage at JA's clinic improved significantly. The proportion of children receiving measles vaccine increased by 67%. Additionally, the clinic moved up in the district's coverage rankings from last place to fourth (out of 24) one year later.

Cost and cost-effectiveness

The average out-of-pocket cost per immunization nurse trained was about US\$ 53. This included all expenses for travel and per diem, but not the salaries of the trainer or the host, which would have been paid anyway. The cost of training an individual in this way ranged from US\$ 16 to US\$ 134, depending on the duration of the training (which ranged from 3 to 12 days) and cost of travel. This works out to about US\$ 2.12 for each percentage point increase in adjusted coverage.

Each health centre provides eight different childhood vaccinations (BCG, DPT x 3, polio x 3, and measles). We estimate that the number of reported doses of all vaccines increased by 12 745 in the 13 participating health centres in the year after training as a direct result of the programme. This is about US\$ 0.05 for each additional dose reported and US\$ 0.40 to provide eight additional vaccinations,

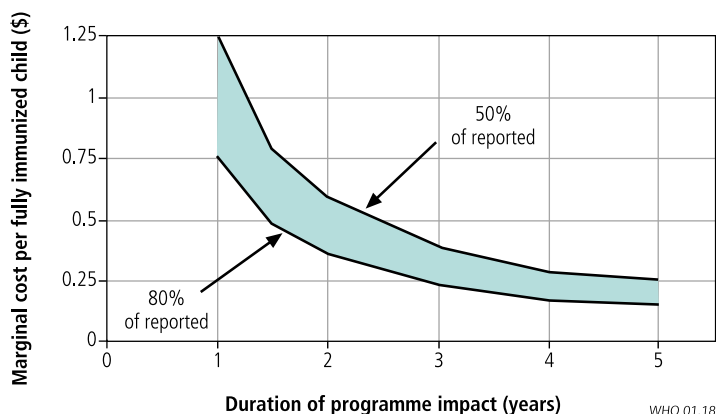
the number required to complete all immunizations for one child. If only half of this increase is due to an increase in the actual number of doses given, as opposed to an improvement in reporting, then the training cost per additional dose given in the following year is about US\$ 0.10 and it costs about US\$ 0.80 to provide all required vaccinations. These estimates would, of course, be halved if the impact of the programme continued for two years instead of one. These estimates do not account for the increase in vaccinations for tetanus that the programme might also achieve.

Another way to present the costs is by fully immunized child. Assuming that the programme increased by 40% the number of fully immunized children reported by participating centres, this would raise the number from 2898 in the year before the training to 4057 in the year after. The Maluku Baseline Survey (14) estimated that measles coverage by a child's first birthday was 57% and complete coverage by the first birthday was 47%, which is 10 percentage points below measles coverage. When this information is combined with the target population of 6165, which was identified before the programme, it yields a training cost of US\$ 0.59 per additional child reported to have been fully immunized assuming that the programme has an impact for one year. The estimated cost for each additional child who is actually fully immunized (rather than just reported) depends on the amount of the reported increase that comes from an actual increase rather than improved reporting and on the number of years that the impact of the programme is sustained. The marginal out-of-pocket cost per additional fully immunized child ranges from US\$ 0.15 to US\$ 1.18 when the duration of impact ranges from one to five years, and the actual increase ranges from 50% to 80% of the reported increase, indicating a marginal out-of-pocket cost per additional fully immunized child of roughly US\$ 0.50 when the impact lasts about two years (Fig. 2).

Discussion

This evaluation concluded that the immunizer-training-immunizer programme significantly improved both the practice of vaccination and the coverage among the participating health centres. The evaluation compared the increase in coverage in 13 participating centres with data from the 95 centres in Maluku province that did not participate in the programme and for which immunization data were available. To estimate the change in coverage over a two-year period, the evaluation used the number of doses of DPT 1, polio 3, and measles vaccine given to children at the appropriate age as reported by the provincial health department's administrative information system. The results show that a net increase in coverage of about 39% was achieved by the participating health centres when compared with the non-participating centres; this was about 54%

Fig. 2. **Marginal cost per additional fully immunized child (FIC) achieved by the training programme.** The marginal cost per fully immunized child is US\$ 0.59 / (RxT), where R is the ratio of actual to reported improvement and T is the duration of the programme's effect in years.



when the two participating centres whose transportation systems stopped functioning in the year after training are excluded from the analysis. Furthermore, the increase is consistent across antigens and, with the two exceptions noted above, positive across health centres.

An independent field survey of immunization management practices in 90 health centres in Maluku and pre-training and post-training assessments by the trainers provided strong anecdotal evidence that the quality of immunization practices improved as a result of training. For example, improvements in adherence to cold-chain protocols, use of sterilization, reporting, administering immunizations to sick children, and in using more energetic, problem-solving approaches to find and vaccinate children in villages were observed and reported in many of the participating centres. The success of on-the-job peer training of health workers in teaching cognitive strategies for problem solving (as opposed to routine technical procedures) has previously been observed by Godwin (1), and the results reported here support the conclusion that such training is a good way to teach problem solving. However, contrary to Godwin's findings, this programme also improved routine technical skills, such as sterilization and the proper arrangement of vaccines in the refrigerator.

Factors other than the training programme might have contributed to the observed improvement; these other factors might include better reporting, changes in personnel responsible for immunizations, seasonal effects, other components of the immunization programme, data accumulating as the result of delayed reporting, one-time campaigning or drop-off effects during the training period, and regression to the mean. However, the evaluation concluded that, except for improved reporting, these other potential confounding factors did not contribute significantly to the positive effect of the programme, and in some cases it may have contributed to an underestimation of the effect of the programme. The observed increase in coverage was

due to the combined effect of improved reporting and an increase in actual coverage. Although the data available did not allow us to disentangle the relative contributions of these two factors, there is convincing evidence from interviews and behavioural observations that the number of doses actually given increased substantially in most cases and reporting improved in a few cases as a direct result of training. Because the provincial health department's goals for the programme included both improving actual coverage and improving reporting, the confounding of the two is not a problem from the department's perspective.

In theory, coverage is a more valid indicator of immunization than reported doses. However, in Maluku coverage may be unreliable at the health centre level because the estimates of the target population for each health centre are made at the national and provincial levels using standard procedures for allocating national population projections to health centre catchment areas; these often produce inaccurate estimates. This does not affect the results reported here because the coverage figures are aggregated for participating and non-participating centres, and the estimated net changes at this aggregated level are similar for coverage and reported doses.

Improvements in performance occurred in poorly performing health centres, as indicated by the lower adjusted figures for coverage for the participating centres in the year before training (41%); the figure for non-participating centres was 58%. The programme is not likely to produce a similar improvement in all health centres. Additional experience is needed to estimate the value of the programme in health centres already performing well.

The data available through the provincial immunization information system is a vital component of this programme. The data reported on coverage by each health centre was used to identify the immunization nurses who needed training and the nurses who were capable of providing the training. The subsequent changes in reported doses were used to determine if training had been successful. The importance of objective performance data to the success of peer training has been observed by other authors (6), as has the importance of monitoring systems for the success of prevention and promotion programmes (11).

This programme has been very popular with the participants and the managers at the host health centres. The hosts have talked enthusiastically about their experience. Several noted that it is much easier to learn in this programme than in "official" training courses because the training is practical and tackles the real problems that immunization nurses face, and because they can admit what they don't know to a colleague, which they would very often not do in a formal classroom setting. The weaknesses of the government's classroom-style training in Indonesia have been discussed elsewhere (11).

The out-of-pocket cost of the programme was very low, averaging US\$ 53 per nurse trained, not including the wages of either the trainer or the host or costs associated with higher coverage. This works out to about US\$ 0.05 per additional reported dose and about US\$ 0.50 per additional fully immunized child. As a result of the low cost and apparent success of the programme, some of the district and provincial governments have made plans to continue the programme and fund it from their own budgets.

Using cost data from immunization programmes in eight countries, Brenzel & Claquin (15) estimated that the average cost per fully immunized child was about US\$ 15 in 1987 dollars, with about 10% of this being the cost of vaccines. However, they noted two weaknesses in this result. Firstly, the use of the fully immunized child as a unit of effectiveness does not reflect the value of partial immunization, the value of vaccinations after the first birthday, or the relative importance of the different diseases vaccinated against. Secondly, the use of an average cost provides no information about marginal costs, which are important considerations in designing and managing programmes. Further, there is a paucity of information about the marginal costs of immunization programmes. Both of these weaknesses limit our ability to compare the cost-effectiveness of this programme with other interventions. It is not clear whether our rough estimate of US\$ 0.50 for the marginal out-of-pocket cost represents the full marginal cost of an additional fully immunized child or whether other factors, such as the cost of vaccines, should be included. In any case, the marginal cost of each additional fully immunized child obtained by this programme is very small when compared with the average cost estimated by Brenzel & Claquin, regardless of whether vaccines are included in the marginal cost.

The immunizer-training-immunizer programme, although successful, has made only a limited contribution towards building a cost-effective, affordable, and sustainable system for preventing diseases. Other input is required. A monitoring system, such as that in Maluku, would be beneficial. It is also necessary to know and understand the practices of the communities being immunized. Nichter has shown that misunderstandings by clients

lead to a low demand for immunization, which in turn hinders the long-term sustainability of immunization programmes (8). This study did not address our clients' knowledge nor the effects interacting between the community and the immunization nurse and the nurse's performance. However, in view of Nichter's findings in Indonesia, this would be a valuable next step.

Any extension of the training programme to other parts of Indonesia or to other countries must address the differences between the cultural and organizational contexts in Maluku and other sites. For example, Sciortino (11) has detailed the context in which nurses work in central Java, and Streefland (9) has pointed out the ways that different organizational structures and styles can influence immunization programmes. The government health structure in Maluku is very hierarchical, with the attendant advantages and disadvantages. In terms of the structure-process-outcome paradigm articulated by Donabedian (16), the training programme improved outcomes (coverage, quality) by changing a training process, but there was a high degree of reliance on certain structures, such as the local area monitoring system, the structure of responsibility of the health centres and immunization nurses, and *posyandu*. These particular supporting structures may not be available in other contexts, which means that the transfer of this training programme to other contexts may require extra care or it may not be successful. ■

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Résumé

Amélioration de la couverture vaccinale en Indonésie : formation à coût modique et en cours d'emploi des infirmières par leurs pairs

En Indonésie, la responsabilité de la vaccination repose sur les centres de santé publics locaux et sur les infirmières qui y pratiquent les vaccinations. Un programme de formation en cours d'emploi et par leurs pairs de ces infirmières, conçu pour améliorer la vaccination dans les centres de santé de la province de Maluku où les résultats étaient médiocres, tant en termes de couverture que de pratique, a été évalué. Du personnel infirmier ayant une longue expérience de la

vaccination a été envoyé dans les centres de santé où les infirmières étaient inexpérimentées et la qualité de leur pratique mauvaise; le personnel infirmier expérimenté a passé une à deux semaines à former sur le tas le personnel infirmier moins expérimenté. Les résultats ont été évalués dans les 13 centres ayant participé au programme et les 95 autres qui n'ont pas estimé que le programme améliorerait à la fois la couverture vaccinale et la qualité de la pratique. La couverture vaccinale

contre la diphtérie/le tétanos/la coqueluche (DTC), la poliomyélite et la rougeole a augmenté d'environ 39 % dans les 13 centres participants comparé aux centres non participants, et de près de 54 % dans les 11 centres qui ont disposé d'un système opérationnel de transport pendant l'année qui a suivi la formation. Ces résultats concordent avec l'augmentation du nombre réel de doses administrées et l'amélioration des enregistre-

ments. La validité de l'étude a été examinée et les causes potentielles d'erreur ont été estimées non significatives. Le coût effectif du programme de formation était d'environ US \$53 par personne formée et de US \$0,05 par vaccin supplémentaire administré inscrit dans les enregistrements. Le coût marginal par enfant supplémentaire entièrement vacciné a été estimé à US \$0,50.

Resumen

La formación inter pares de enfermeras en el servicio, una opción de bajo costo que mejoró la cobertura inmunitaria en Indonesia

En Indonesia, las actividades de inmunización incumben a los centros de salud de los gobiernos locales y a las enfermeras de cada centro que administran las vacunas. Se procedió a evaluar un programa de formación inter pares en el servicio para esas enfermeras, destinado a mejorar las actividades de inmunización de los centros de salud de desempeño deficiente en lo relativo a la cobertura y la práctica en la provincia de Maluku. Se envió a enfermeras con experiencia en la inmunización a centros de salud donde sus homólogas carecían de esa preparación o realizaban de forma deficiente esas tareas; las enfermeras experimentadas pasaron 1-2 semanas formando en el servicio a las menos experimentadas. La evaluación de los 13 centros que participaron en el programa y los 95 que no lo hicieron reveló que el programa aumentó tanto la cobertura inmunitaria como

la calidad de las prácticas de inmunización. La cobertura vacunal contra la difteria/tos ferina/tétanos (DPT), la poliomiélitis y el sarampión aumentó aproximadamente en un 39% en el conjunto de los 13 centros participantes en comparación con los que no participaron, y en un 54% en los 11 que contaron con un sistema de transporte operativo durante el año posterior a la capacitación. Estos resultados reflejan el aumento del número real de dosis administradas, así como la mayor precisión de los informes. Se analizaron las posibles objeciones a la validez del estudio, concluyéndose que eran irrelevantes. El costo directo del programa de formación fue de aproximadamente US\$ 53 por persona capacitada, o de unos US\$ 0,05 por vacuna adicional administrada. El costo marginal por cada niño adicional plenamente inmunizado se estimó en US\$ 0,50.

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