
Missed opportunities for immunization during visits for curative care: a randomized cross-over trial in Sudan

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Infants who come to health facilities for curative care in developing countries are usually not vaccinated at the same time. To assess what could be done a randomized cross-over study was carried out in twelve urban health centres in Sudan where two approaches were investigated: (1) the place for vaccination was moved very close to the consulting room, and (2) the doctor seeing the infant wrote a prescription recommending vaccination for the child. On average, 55% of the infants needing immunization were vaccinated when either of these approaches was followed. No difference was found between the two interventions in terms of the proportion of eligible children who were immunized (mean difference, 2%; 95% CI, -4% to +7%). The more sick an infant appeared to be to the mother, the more likely she was to refuse vaccination. Older infants and infants not previously vaccinated were also less likely to be immunized.

The number of missed opportunities can thus be reduced using these simple approaches. However, to immunize infants who are sick, unvaccinated, or have limited access to health facilities will require more social mobilization, health education, and outreach activities.

Introduction

Children in developing countries who come to health facilities for treatment could receive preventive care, such as immunizations, at the same time. These services could be provided at little additional expense, but at present most of these opportunities are missed. A previous study in Khartoum indicated that 58% of infants coming for medical services to government health centres needed to be vaccinated but were not immunized on the day they attended (1). Similar findings were noted in southern India where 57% of children attending a hospital outpatient department could have been vaccinated (2). The frequent occurrence of missed opportunities for vaccination is regarded as one of the major outstanding problems in the delivery of immunization services (3).

The potential benefits from the immunization of children who come for medical care indicated the need for an intervention study to test suitable interventions. The earlier study in Khartoum suggested

that failure to immunize these children was because the place where vaccinations were given was often far or hidden from the consulting rooms, or because the mothers were afraid of vaccinating a sick child, or because health workers were not very familiar with the immunization programme (1). This article describes a randomized cross-over study comparing two approaches for vaccinating children who are brought to urban health centres.

Methods

Two interventions

Intervention A: more accessible site of vaccination.

In order to make the available vaccination service more visible to mothers who bring their children to the health centre, we moved the immunization table to the area directly in front of the room where consultations were carried out. The vaccinator and his/her equipment (such as record books, vaccine carrier, and syringes) were now clearly visible to the mothers as they came out of the consulting rooms. These mothers were then asked a standard set of questions regarding their children's vaccination history by a supervisor who worked with the vaccinator. Those children who required one or more vaccinations were offered the service then and there.

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Intervention B: referral for vaccination. In a few health centres, the doctor gave a prescription recommending immunization to every mother to take to the regular vaccination site. This approach, although endorsed by the Ministry of Health, was not practised on a large scale. To implement it, discussions were held with the medical assistants and doctors on the importance of, and contra-indications to, immunization. The clinicians were specifically asked to give all mothers a prescription and to refer their infants to the vaccination site. There, the mothers were questioned by the supervisor about the child's immunization history and vaccination was offered if the infant had missed one or more antigens.

Study design and location

Twelve large, government health centres where between 75 and 300 patients of all ages were seen in a day were randomly selected for this study. Six of these centres were in Khartoum and the rest in El Obeid (population 200 000), a city lying south-west of Khartoum. A cross-over design was employed in which each health centre carried out one intervention on one day and the other intervention on the same day of the following week. For example, a health centre that carried out intervention A on Tuesday of week 1 would carry out intervention B on Tuesday of week 2. The six health centres in each city were randomly allocated, using random permuted blocks to achieve balance, to carry out intervention A followed by intervention B or vice versa.

Entry criteria and outcome assessment. Every mother who came with a child of less than one year, but had *not* brought the child specifically to be immunized, was interviewed as she was leaving the health centre. The interviews took place as close to the exit of the health centre as possible. If there was more than one exit the director was asked to lock all but one of them so that all the mothers could be interviewed.

Mothers were interviewed in colloquial Arabic using a printed form. They were asked first about the vaccination history of their child. A previous study in Sudan (4) showed that mothers of infants were accurate in remembering their children's vaccination status. Mothers were asked a series of questions on their socioeconomic status and whether they were satisfied with the care given to the children that day. They were also asked a closed-ended question about whether they thought their child was mildly, moderately or very sick. No clinical records existed to see whether the child had any contraindications to vaccination or whether the mother's perception agreed with the clinician's impression of how sick the child was.

Using the records kept by the vaccinators it was easy to determine whether a child had been immunized on that day. These records were also used to obtain the number of infants who had been immunized in the health centre on the same day of the week preceding the beginning of the study (week 0).

Statistical analysis

Each health centre was treated as an experimental unit and the number of children who had been immunized was expressed as a percentage of those who were eligible to be vaccinated on that particular day. Hence, for each health centre the proportion of children immunized using intervention A could be compared with the percentage vaccinated using intervention B.

The percentages were transformed using a modification of the Freeman and Tukey Arcsine transformation (5). The transformed data were then analysed using paired *t*-tests following the method suggested by Hills & Armitage (6), in which period effects and treatment-period interactions were assessed. The untransformed data were also analysed using the non-parametric Wilcoxon rank sum test.

In the case of two health centres no infants needing immunization attended on one of the two days in which the study was carried out. The data from these centres were not included in the above-mentioned analysis, but they were used in the multivariate analysis described below.

Multivariate analysis. A multivariate analysis was carried out using logistic regression. The outcome variable was whether the mother accepted immunization for her child (yes, no) and the explanatory variables examined were: mother's perception of how sick her child was (mildly, moderately, or very sick), prior immunization status (previously vaccinated, never vaccinated), maternal literacy (yes, no), type of intervention (A, B), age of the child (in months), and the health centre which the child attended. The latter was included in the model to take into account the fact that children were not randomly selected for entry into the study but were part of a cluster, i.e., all infants attending that particular health centre.

Results

The mothers of 270 children who met the inclusion criteria were interviewed as they were leaving the 12 health centres. Of these children, 64% (172) needed to be vaccinated. Only 33% (90) of the mothers

brought their children's vaccination card with them to the health centre. The infants who were exposed to either of the two interventions had similar characteristics (Table 1).

Overall, 55% (94) of the 172 children who needed vaccination were actually immunized on the day they attended. The difference between intervention A and intervention B in the proportion of infants immunized was not significant (mean difference, 2%; 95% confidence interval, -4% to +7%). The same result was obtained when the non-parametric Wilcoxon rank sum test was used ($P = 0.37$).

In any cross-over study it is possible that the effectiveness of either treatment is dependent on whether it is given first or second. This is known as a "period" effect. For example, in this study it could be argued that whichever strategy was used during the second "period" (week 2) would be more effective because the health centre staff had become used to the idea of immunizing sick children or were more at ease in the presence of the supervisors. However, we found no evidence of a "period effect" (mean difference, -4%; 95% CI, -9% to +2%; the non-parametric test yielded the same result ($P = 0.59$)). No treatment-period interaction was found ($P = 0.22$).

A review of the health centre's registration books showed that 32% (95% CI, 24% to 40%) more infants had been vaccinated during the first week of the study than had been immunized on the same day of the week preceding the first intervention.

Multivariate analysis. Mothers who thought that their children were "very" sick or "moderately" sick were much less likely to allow them to be immunized.

The more sick a child was perceived to be, the less likely was the mother to allow the child to be immunized that day (Table 2).

Mothers whose children had never before been immunized appeared to be less likely to accept immunization. Children who had not previously been vaccinated were younger (mean, 5.4 months) than those who had (mean, 6.9 months). None the less, the mothers of older children were, on the whole, less likely to accept immunization when it was offered. The odds of being vaccinated decreased by 15% (95% CI, 1% to 27%) for every additional month of age.

Maternal literacy did not affect the likelihood of a child being immunized once other factors were controlled for.

Satisfaction with services. Overall 80% of the mothers were satisfied with the services they received at the health centres studied. There was no difference in levels of satisfaction between intervention A (79%) and intervention B (81%). Mothers whose children had been vaccinated on the day they attended were slightly more satisfied with the services than mothers who had refused to have their children immunized (85% vs 73%, difference = 12% (95% CI, -1% to +24%)).

Discussion

There was no practical or statistical difference between moving the vaccination site close to the consulting room (intervention A) and having the

Table 1: Characteristics of 270 eligible infants included in the study

Intervention ^a	A ^b	B ^b	Total
No. of eligible infants	129	141	270
No. needing immunization that day	79 (61) ^c	93 (66)	172 (64)
Average age (months)	6.6	6.7	6.7
No. previously immunized	98 (76)	110 (78)	208 (77)
No. "very sick" ^d	41 (32)	32 (23)	73 (27)
No. "moderately sick" ^d	25 (19)	27 (19)	52 (19)
No. with literate mothers	64 (50)	78 (55)	142 (53)

^a See the Methods section for a description of the two interventions.

^b None of the differences between A and B were statistically significant at the 5% level.

^c Figures in parentheses are percentages.

^d Mother's perception of how sick her child was.

Table 2: Characteristics of children whose mothers refused immunization and the associated relative risk (RR) (*n* = 172 children needing vaccination)

Characteristic	No. of children needing vaccination	No. of children whose mothers refused vaccination	No. of children without the characteristic whose mothers refused vaccination	Crude relative risk	Adjusted relative risk ^a
Child "very sick" (compared to "mildly sick")	44 (26) ^b	36 (82)	25 (25)	3.2 (2.2–4.6) ^b	5.1 (1.6–16)
Child "moderately sick" (compared to "mildly sick")	27 (16)	17 (63)	25 (25)	2.5 (1.6–3.9)	2.3 (0.7–7.4)
No prior vaccination	62 (36)	39 (63)	39 (35)	1.8 (1.3–2.4)	2.8 (0.9–8.1)
Mother illiterate	78 (45)	46 (59)	40 (43)	1.4 (1.0–1.9)	1.1 (0.4–2.8)
Intervention "A" vs "B"	79 (46)	41 (52)	37 (40)	1.3 (0.9–1.8)	1.1 (0.5–2.8)

^a See the Methods section for a description of the model used in calculating the adjusted relative risk.

^b Figures in parentheses are percentages; those describing a range are 95% confidence intervals of the relative risk.

medical staff refer the child for immunization by writing a prescription (intervention B). Each of these approaches was better than doing nothing and both were, on average, able to immunize 55% of the children who were missing at least one antigen. This led to a 32% overall increase in the number of children vaccinated in the health centres studied. These findings are consistent with previous experience (1) in the same setting, which showed that when no intervention was carried out none of the children needing vaccination was immunized when they attended for treatment.

Despite the attractive possibility of using visits for curative care to immunize children there are some obstacles to be overcome. Firstly, the children who were not immunized, although offered the service, tended to be the ones who were most sick, or had not been immunized before, or were older and hence at greater risk of catching measles. These infants are precisely the ones who need to be vaccinated.

Secondly, the results we obtained could have been influenced by the close supervision provided. In regular programmes such careful supervision may not be possible.

Thirdly, other practical problems need to be resolved, e.g., how to record vaccinations given to the 67% of children who came without their immunization cards. A proliferation of new cards could cause confusion during subsequent coverage surveys as well as with the routine vaccination reporting system. Or there may be increased vaccine wastage if immunization services are provided on a daily basis. This could raise the costs although expenditures on vaccine typically account for only 5–20% of immunization budgets (7).

Finally, would the immunization of children who come for curative services make a large difference to the overall coverage in the community? This question turns critically on how often unimmunized children are brought to health centres and hospitals.

Visits by children to health centres for curative care should be exploited to carry out disease prevention by immunizing them on the same occasion. Energetic social mobilization, health education, and, where needed, outreach activities are also required to ensure that all children can benefit from immunization and other preventive programmes.

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Résumé

Occasions manquées de vaccination lors des consultations pour traitement: étude croisée au Soudan.

Dans les pays en développement, les nourrissons qui sont conduits dans un centre de santé pour traitement ne sont généralement pas vaccinés lors de cette visite. Une étude croisée randomisée a été menée dans 12 centres de santé urbains du Soudan pour comparer deux méthodes susceptibles d'améliorer la situation: 1) la salle de vaccination était installée à proximi-

té immédiate de la salle de consultation, 2) après avoir examiné l'enfant, le médecin rédigeait une ordonnance recommandant la vaccination. En moyenne, chacune de ces méthodes a permis de vacciner 55% des enfants qui devaient l'être, sans que l'on puisse détecter de différence significative sur ce point entre les deux méthodes (différence moyenne, 2%; intervalle de confiance à 95%, -4% à +7%). Les mères avaient d'autant plus tendance à refuser la vaccination que leur enfant leur paraissait plus malade. Le taux de vaccination était également plus faible chez les enfants plus âgés et chez ceux qui n'avaient jamais été vaccinés auparavant.

Ces méthodes simples peuvent donc réduire le nombre d'occasions manquées de vaccination. Toutefois, si l'on veut toucher également les enfants malades, qui n'ont jamais été vaccinés ou qui ont difficilement accès aux centres de santé, il faudra développer la participation sociale, l'éducation pour la santé et les interventions sur le terrain.

References

1. **Loevinsohn, B.P.** Missed opportunities for immunization during visits for curative care: practical reasons for their occurrence. *American journal of tropical medicine and hygiene*, **41**: 255-258 (1989).
2. **Steinhoff, M.C. et al.** Evaluation of the opportunities for and contraindications to immunizations in a tropical paediatric clinic. *Bulletin of the World Health Organization*, **63**: 915-918 (1985).
3. **Moxon, E.R.** The scope of immunisation. *Lancet*, **335**: 448-451 (1990).
4. **Gareaballah, E.T. & Loevinsohn, B.P.** The accuracy of mothers' reports regarding their children's vaccination status. *Bulletin of the World Health Organization*, **67**: 669-674 (1989).
5. **Zar, J. H.** *Biostatistical analysis*, 2nd edition. Englewood Cliffs, NJ, Prentice Hall, 1984, pp. 239-241.
6. **Hills, M. & Armitage, P.** The two-period cross-over clinical trial. *British journal of clinical pharmacology*, **8**: 7-20 (1979).
7. Immunizing the world's children. Costs of immunization. *Population reports*, **14**(1): 181-182 (1986, March-April).