

Research

Introducing auto-disable syringes to the national immunization programme in Madagascar

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Objective To evaluate the safety and coverage benefits of auto-disable (AD) syringes, weighed against the financial and logistical costs, and to create appropriate health policies in Madagascar.

Methods Fifteen clinics in Madagascar, trained to use AD syringes, were randomized to implement an AD syringe only, mixed (AD syringes used only on non-routine immunization days), or sterilizable syringe only (control) programme. During a five-week period, data on administered vaccinations were collected, interviews were conducted, and observations were recorded.

Findings The use of AD syringes improved coverage rates by significantly increasing the percentage of vaccines administered on non-routine immunization days (AD-only 4.3%, mixed 5.7%, control 1.1% ($P < 0.05$)). AD-only clinics eliminated sterilization sessions for vaccinations, whereas mixed clinics reduced the number of sterilization sessions by 64%. AD syringes were five times more expensive than sterilizable syringes, which increased AD-only and mixed clinics' projected annual injection costs by 365% and 22%, respectively. However, introducing AD syringes for all vaccinations would only increase the national immunization budget by 2%.

Conclusion The use of AD syringes improved vaccination coverage rates by providing ready-to-use sterile syringes on non-routine immunization days and decreasing the number of sterilization sessions, thereby improving injection safety. The mixed programme was the most beneficial approach to phasing in AD syringes and diminishing logistical complications, and it had minimal costs. AD syringes, although more expensive, can feasibly be introduced into a developing country's immunization programme to improve vaccination safety and coverage.

Keywords Disposable equipment/economics/standards/utilization; Immunization/instrumentation; Immunization programs/economics/organization and administration; Vaccination; Interviews; Syringes/economics/standards; Equipment reuse/economics; Medical waste disposal; Product surveillance, Postmarketing; Sterilization; Injections/economics; Randomized controlled trials; Child; Women; Safety/standards; Health personnel/education; International cooperation; Developing countries; Madagascar (source: MeSH, NLM).

Mots clés Matériel usage unique/économie/normes/utilisation; Immunisation/instrumentation; Programmes de vaccination/économie/organisation et administration; Vaccination; Entretien; Seringues/économie/normes; Réutilisation matériel/économie; Traitement déchets médicaux; Vigilance produits de santé; Stérilisation; Injection/économie; Essai clinique randomisé; Enfant; Femmes; Sécurité/normes; Personnel sanitaire/enseignement; Coopération internationale; Pays en développement; Madagascar (source: MeSH, INSERM).

Palabras clave Equipos desechables/economía/normas/utilización; Inmunización/instrumentación; Programas de inmunización/economía/organización y administración; Vacunación; Entrevistas; Jeringas/economía/normas; Equipo reutilizado/economía; Disposición de residuos médicos; Vigilancia de productos comercializados; Esterilización; Inyecciones/economía; Ensayos controlados aleatorios; Niño; Mujeres; Seguridad/normas; Personal de salud/enseñanza; Cooperación internacional; Países en desarrollo; Madagascar (fuente: DeCS, BIREME).

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Voir page 559 le résumé en français. En la página 559 figura un resumen en español.

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Introduction

National immunization programmes have effectively reduced infant and child mortality rates in developing countries. However, estimates indicate that at least 30% of the approximately one billion vaccine injections administered each year are unsafe (1). These injections, delivered with contaminated disposable syringes or reusable syringes that were not properly sterilized, dramatically propagate the

transmission of hepatitis B, hepatitis C, and human immunodeficiency virus (HIV) (2–4).

In 1986, WHO requested the development of a disposable vaccination syringe, called auto-disable (AD), that could only be used once (5). Since then, AD syringes have been effective in reducing pathogenic transmission and have been generally accepted by immunization workers (6, 7). In

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December 1999, WHO, the United Nations Children's Fund (UNICEF), and the United Nations Population Fund issued a joint statement recommending that all countries use only AD syringes for vaccinations by the end of 2003 (8).

Many developing countries, including Madagascar, currently use sterilizable syringes and face several economical and logistical obstacles to meet the recommended policy for the introduction of AD syringes. These countries generally do not have established guidelines for purchasing, distributing, and managing waste from a large volume of non-reusable syringes. Furthermore, health officials have not determined empirically the most appropriate method of introducing AD syringes into a national immunization programme to maximize benefits while minimizing costs.

Madagascar, like most other developing countries, has poor immunization coverage rates and a relatively small health budget. In 2000, only 44% of children had been fully immunized (as measured by DTP-3 (diphtheria–tetanus–pertussis) coverage), and only 48% of women giving birth during the previous year were protected against tetanus (9). Although clinics have designated immunization days each week to enhance worker efficiency, the problem of missed opportunities to immunize has been ongoing, due primarily to long waiting times for patients on routine days, and unmotivated workers and lack of sterile equipment on non-routine days. The present study was conducted to determine whether the use of AD syringes could increase coverage rates by reducing the number of missed opportunities on non-routine immunization days, and to assess other effects of introducing AD syringes into Madagascar's national immunization programme.

The research objectives were to determine whether and to what extent the introduction of AD syringes might increase the vaccination coverage rates of children and women, reduce the number of sterilization sessions for vaccination equipment, increase the financial costs for an average clinic and the national programme, and to determine whether and to what extent AD syringes might be most successfully introduced into a national immunization programme.

These results are potentially important to national and international health officials seeking to determine and implement appropriate policies for introducing AD syringes into a developing country's national immunization programme and to comply with WHO recommendations.^a

Materials and methods

Setting and design

A randomized study of 15 public clinics was conducted in five districts, within two provinces (Antananarivo and Fianarantsoa), in the central region of Madagascar from September to December 2000. Four of the five districts are located in rural areas. Three relatively small-to-medium clinics, with similar vaccination coverage rates, target populations, and number of health workers, are selected within each district. Together, they were considered to be represen-

Table 1. The three vaccine delivery programmes carried out in central Madagascar, September to December 2000

Study programme	Definition
AD ^a only ^b	Clinics used only AD syringes for administering DTP, ^c measles, and anti-TT ^d vaccines on all days
Mixed	Clinics used sterilizable syringes on routine children's immunization days, and AD syringes for administering DTP, measles, and TT vaccines on non-routine immunization days
Control	Clinics used only sterilizable syringes for all injectable vaccines, as was previously practised

^a AD = auto-disable.

^b Clinics continued to use sterilizable syringes for administering Bacille Calmette–Guérin (BCG) vaccines because a 0.05-ml AD syringe was not available for the study.

^c DTP = diphtheria–tetanus–pertussis.

^d TT = tetanus toxoid.

tative of most clinics in Madagascar. Within each district, the three clinics were randomized to implement one of the three vaccine delivery programmes described in Table 1.

Study materials

SoloShot^b and Destroject^c 0.5-ml AD syringes, which have features to prevent the plunger from being drawn a second time, were used in the study. Both syringes were equipped with permanently attached 23-gauge, 25-mm needles. Five-litre puncture-resistant safe disposal boxes, manufactured by DanaPak Cartons Ltd, were supplied for collecting discarded AD syringes. All other equipment and materials were the same as those previously used by Madagascar's immunization programme. All sterilizable syringes and needles, steam sterilizers, and vaccines used in the study were purchased from UNICEF.

Health worker training

Eight-hour training sessions based on Madagascar's immunization programme guidelines, a comprehensive training manual on AD syringes developed by the Program for Appropriate Technology in Health, and the study's focus were conducted separately for immunization health workers and clinic supervisors. Training sessions described the research protocol, national immunization policies, and system of data collection. The training manual, *Giving safe injections: introducing auto-disable syringes*, was used to review appropriate injection techniques and to introduce AD syringes (10). Participants were shown how to use AD syringes and allowed to practice. Trainers reviewed Madagascar's open vial policy, which states that open vials of poliovirus, DTP, anti-tetanus toxoid (TT), and measles vaccine should be used during subsequent sessions (11). Vaccine delivery programmes were randomized after each district completed the training. Supervisors were given enough data forms, AD syringes, and safe disposal boxes to conduct the study.

^a Preliminary results were presented to Madagascar Ministry of Health and international health officials in Antananarivo, Madagascar, on 8 December 2000, and at the American Public Health Association Conference in Atlanta, GA, USA, on 24 October 2001.

^b SoloShot is a trademark of Becton Dickinson and Company.

^c Destroject is a trademark of Destroject GmbH Medical Devices.

Table 2. Fifteen clinics with target population of children, number of routine immunization days per week, and average number of children vaccinated on routine immunization days during the study period

Programme	Clinic	Target population ^a	No. of routine immunizations	Average no. of children vaccinated
Auto-disable only	Ambohibary	1531	3	46
	Betafo	917	3	36
	Andalater	339	2	18
	Alakamisy Ambo.	770	1	63
	Vohiposa	644	1	56
	<i>Average</i>	<i>840</i>	<i>2.0</i>	<i>44</i>
Mixed	Ambano	1230	1	85
	Ankazomiriotra	794	1	87
	Mahazengy	214	1	16
	Andoharano-maitso	692	2	31
	Ankerana	349	1	17
	<i>Average</i>	<i>656</i>	<i>1.2</i>	<i>47</i>
Control	Andranomanelatra	1039	4	34
	Tritriva	379	2	33
	Antsorokavo	664	3	25
	Mahasoabe	741	1	73
	Befeta	405	1	33
	<i>Average</i>	<i>646</i>	<i>2.2</i>	<i>40</i>
Total average		714	1.8	44

^a Calculated at 4% of the total population. *Politique de Vaccination et Guide PEV Madagascar*, Madagascar Ministry of Health, June 1998.

Data collection and analyses

During the five-week data collection period, each clinic was visited one to three times by study coordinators to interview health workers, conduct qualitative observations, and collect data forms. During the first week, staff in several clinics had difficulty recording data and required further instruction. As a result, the first week of data from all clinics was excluded from the analyses. At the end of the study period, all clinics were revisited to collect the remaining data forms, conduct final interviews, and obtain clinic-specific data. During the initial and final site visits, health workers were asked about sterilization practices preceding and during the study period, respectively.

The 15 clinics maintained data on all vaccinations administered during the study period. Vaccination data were summarized by the number of women and children attending routine and non-routine immunization sessions, adjusted by target populations, and analysed for statistical significance ($P < 0.05$) with χ^2 tests and two-sample t -tests. Measurements on vaccination coverage were not analysed because of widespread variability in the accuracy of demographic data. Vaccination data were also compared with data from the previous month and previous year, but were not informative owing to different data collection methods. Sterilization practices were adjusted by the total number of

immunization sessions and analysed for statistical significance with χ^2 tests.

WHO/UNICEF Product Information Sheets provided all cost information for financial analyses (12). Prices for Destroject syringes, as used in the study, and the most economical 5-litre safe disposal box were used to calculate low AD cost estimates. High AD cost estimates were calculated using prices for SoloShot syringes and DanaPak safety boxes, as used in the study. Low and high estimates for sterilizable syringe costs were based on UNICEF's sterilizable syringe Kit B, assuming that the lifespan of needles was 100 and 75 injections, respectively. Low and high estimates for steam sterilizer costs were based on single- and double-rack sterilizer kits, respectively, which included time, steam, and temperature markers, as sold by UNICEF. The estimated cost per injection for steam sterilizers assumed a lifespan of 4504 injections per year, as projected for an average clinic observed in the study, for 10 years (13), or 45 040 injections total. Low and high estimates of fuel costs were based on US\$ 0.25 for each sterilization session (13), and assumed an average usage of 25 and 15 syringes per sterilization session, respectively. Cost comparisons did not include training, worker efficiency, safe administration, vaccine wastage, transportation, and destruction costs. Information on health workers' technique and logistical indicators, such as distribution, cold chain management, and disposal, was summarized from observations and interviews.

Results

Children's immunization coverage

The three programmes, with varying target populations and number of immunization days, had similar average numbers of children vaccinated on routine immunization days (Table 2). The mixed programme had fewer immunization days (1.2 per week) than AD-only (2.0) and control (2.2) programmes, and vaccinated more children on routine immunization days (47 children per session) than AD-only (44) and control (40) programmes. The 15 clinics conducted an average of 1.8 immunization sessions per week and vaccinated 44 children per session.

AD-only and mixed programmes administered significantly higher percentages of vaccines on non-routine immunization days than the control programme ($P < 0.001$) (Table 3). The AD-only programme vaccinated 277 and 12 children on routine immunization days and non-routine immunization days, respectively; the corresponding numbers for mixed and control programmes were 223/13 and 295/3, respectively. The AD-only programme, despite being used in three clinics that did not vaccinate any children on non-routine immunization days, increased the number of routine vaccinations by 4.3% by vaccinating on non-routine immunization days. Mixed and control programmes increased the number of routine vaccinations by 5.7% and 1.1%, respectively.

The four clinics that offered three or more immunization sessions per week vaccinated significantly more children (311) on routine immunization days than the eight clinics that offered only one immunization session per week (232) ($P = 0.02$). There was no significant difference in the total number of monthly vaccinations of the five clinics that vaccinated more than 50 children on routine immunization

Table 3. Average total number of children vaccinated on routine and non-routine immunization days, and of women vaccinated on routine and non-routine antenatal consultation days during the study period, with percentage increase by vaccinating on non-routine days

Programme	Average no. of children vaccinated on routine and non-routine immunization days ^a				Average no. of women vaccinated on routine and non-routine antenatal consultation days ^b			
	Routine days	Non-routine days	Increase by vaccinating on non-routine days (%)	<i>P</i> -value	Routine days	Non-routine days	Increase by vaccinating on non-routine days (%)	<i>P</i> -value
Auto-disable only	277	12	4.3	<0.001	58	15	26.2	<0.001
Mixed	223	13	5.7	<0.001	55	5	9.1	<0.001
Control	295	3	1.1	Reference	67	0.8	1.1	Reference

^a Rates for each clinic were adjusted to the average target population of 714 children.

^b Rates for each clinic were adjusted to the average target population of 893 pregnant women.

days compared with the five clinics that vaccinated fewer than 32 children. This apparent discrepancy was because the five clinics holding larger sessions also conducted fewer total sessions, averaging 4.0 versus 7.2 sessions per month.

If the observed vaccination rates are extrapolated to a one-year period, an average clinic in the control programme would vaccinate 44 children per year on non-routine immunization days. An average clinic implementing AD-only or mixed programmes would expect to vaccinate 158 or 168 children per year on non-routine immunization days, respectively. Compared with the control, an average clinic would increase the annual number of vaccinations by 114 children with the AD-only programme, and by 124 children with the mixed programme.

Women's immunization coverage

The 15 clinics vaccinated an average of 10 women during 1.7 antenatal consultation (ANC) sessions per week (data not shown). The control programme had slightly more ANC sessions (1.8 per week) than AD-only and mixed programmes (1.6). The mixed programme had similar attendance (eight women) at ANC sessions as AD-only and control programmes (nine women).

The AD-only and mixed programmes administered significantly higher percentages of vaccines on non-routine ANC days than the control programme ($P < 0.001$) (Table 3). The AD-only programme vaccinated 58 and 15 women on routine ANC days and non-routine ANC days, respectively; the corresponding numbers for mixed and control programmes were 55/5 and 67/0.8, respectively. The AD-only programme increased the number of routine vaccinations by 26.2% by vaccinating with AD syringes on non-routine ANC days. The mixed and control programmes increased the number of routine vaccinations by 9.1% and 1.1%, respectively.

The four clinics that vaccinated more than 11 women per session administered significantly more vaccines (95) to women on routine ANC days than the four clinics that vaccinated fewer than six women per session (25) ($P = 0.02$). The 10 clinics that offered two ANC sessions per week did not vaccinate significantly more women than the five clinics that offered only one ANC session per week. Compared with the four clinics that had some overlapping sessions, there was no significant difference in the number of women's vaccinations in the 11 clinics that had no overlapping ANC and children's immunization sessions.

If observed vaccination rates are extrapolated to a one-year period, an average clinic in the control programme would expect to vaccinate 10 women per year on non-routine ANC days. An average clinic implementing AD-only or mixed programmes would expect to vaccinate 201 or 65 women per year on non-routine ANC days, respectively. Compared with the control, an average clinic would increase the annual number of women vaccinated by 191 for the AD-only programme, and by 55 for the mixed programme.

Sterilization safety

Before the study, the 15 clinics sterilized syringes 4.7 times per week on average. After introducing AD syringes, both AD-only and mixed programmes reduced crude sterilization practices by 63%. After adjusting by the total number of routine immunization days per week, the AD-only and mixed programmes significantly reduced the number of sterilization sessions by 68% ($P = 0.02$) and 64% ($P = 0.04$), respectively (Table 4).

If observed sterilization rates were extrapolated to a one-year period, an average clinic in the control programme would expect to sterilize vaccine syringes 211 times per year. After introducing AD syringes on non-routine immunization days, an average clinic would expect to sterilize syringes 83 to 86 times per year. If an average clinic implemented a complete AD syringe programme, including AD syringes for Bacille Calmette–Guérin (BCG), then sterilization sessions for immunization equipment would essentially be eliminated.

Financial costs

The average estimated total cost of one AD injection was US\$ 0.08124, ranging from US\$ 0.078200 to US\$ 0.084273. The average estimated total cost of one sterilizable injection was US\$ 0.01745, ranging from US\$ 0.013606 to US\$ 0.021299. On average, AD syringes were approximately five times (ranging from 3.7 to 6.2) more expensive per injection than sterilizable syringes (data not shown).

The estimated annual injection costs for an average clinic are presented in Table 5, with low, high, and average estimates. An average clinic in the AD-only programme would have administered 4504 injectable vaccines and spent US\$ 366 on AD syringes and safety boxes. Clinics in the mixed and control programmes administering the same number of injectable vaccines would have spent US\$ 96 and

Table 4. Average number of sterilization sessions per week before and during the study, and the percentage decrease in the number of sterilization sessions by introducing auto-disable syringes^a

Programme	Average no. of sessions			P-value
	Before study	During study	Decrease (%)	
Auto-disable only ^b	5.2	1.7	68	<0.02
Mixed	4.5	1.6	64	<0.04
Control	4.1	4.1	0	Reference

^a Rates were adjusted by the total number of routine immunization and prenatal consultation sessions per week, counting overlapping sessions only once.

^b Auto-disable-only clinics were required to sterilize 0.05-ml Bacille Calmette–Guérin (BCG) syringes on children's immunization days.

US\$ 79, respectively. Compared to control, AD-only and mixed programmes would increase costs by 363% and 22%, respectively.

Delivering five injectable vaccines (one BCG, three DTP, one measles) with AD syringes would have added US\$ 0.32 to the price of vaccinating each child. If the total cost to fully immunize one child was approximately US\$ 20, as calculated by the Global Alliance for Vaccines and Immunizations (14, 15), then introducing AD syringes for all vaccinations would have increased a national immunization budget by approximately 2%.

Discussion

Incorporating AD syringes into the immunization programme increased vaccination coverage rates by increasing the number of vaccines administered on non-routine days, and improved injection safety by decreasing the number of sterilization sessions and injections administered by sterilizable syringes. Health workers were 3.6–3.8 times more likely to vaccinate children on non-routine immunization days and 6–20 times more likely to vaccinate women on non-routine ANC days if sterile AD syringes were available and ready to use. A mixed programme reduced the number of sterilization sessions by 64% compared with control, but a complete AD-only programme would eliminate sterilization sessions for immunization injections. Although vaccinations provided by AD syringes were five times more expensive than using sterilizable syringes, an AD-only programme would have increased a national immunization budget by only 2%, assuming that it costs US\$ 20 to fully immunize a child for a schedule with five injectable vaccines. This study indicates that AD syringes could be feasibly introduced into a developing country's national immunization programme to increase immunization coverage and considerably improve vaccination safety.

Limitations of the study

This study was subject to at least three distinct limitations. First, given that all 15 clinics were located in two of Madagascar's six provinces, the results can only be extrapolated to the extent that these clinics represent Madagascar's health system. Second, analysed data were limited to a four-week period, and may have only detected short-term beha-

Table 5. Total number of vaccine injections per year with low, high, and average estimated vaccination injection costs for an average clinic

Programme	Total no. of annual auto-disable/sterilizable injections ^a	Estimated vaccination costs (US\$)		
		Low	High	Average
Auto-disable only	4504/NA ^b	352	380	366
Mixed ^c	270/4234	79	113	96
Control	NA/4504	61	96	79

^a Based on the projected annual total number of administered injectable vaccines after adjusting by target population, the observed average in the study.

^b Not applicable.

^c Proportion based on the observed auto-disable:sterilizable injection ratio (1:15.7) among the "Mixed" clinics.

viour changes among health workers interested in applying new technologies. This study was not able to assess the long-term effects of AD syringes. Third, several important variables were neither quantified nor included in the cost analyses. Although some factors, such as reducing vaccine wastage and improving health worker efficiency, may favour AD syringes, other factors, such as transportation and waste management costs, may not be advantageous for AD syringes. Finally, and perhaps most importantly, the safe administration of vaccine, which greatly favours AD syringes, was not included in the cost analyses.

Despite the limitations, AD syringes appeared to increase a health worker's ability and/or willingness to vaccinate women and children on non-routine, low-volume days, which was probably a result of the convenience and accessibility offered by AD syringes. If health workers had to spend valuable time sterilizing syringes to administer few vaccines for low-volume situations, they were more likely to ask the mother to return on a routine day or, perhaps, administer an unsafe injection. Health workers preferred using AD syringes because they were "ready to use", "fast", and "didn't need to be sterilized". Health workers appeared to spend less time per patient when using AD syringes, which is consistent with other findings (6, 7). In the long term, improvements in efficiency and accessibility might enhance the quality of services, and vaccination coverage rates may increase further because fewer women and children will be lost to follow-up vaccinations.

Coverage rates for women and children

There are several plausible explanations for the larger variation between AD-only and mixed programme vaccination coverage rates for women than for children. First, three clinics did not vaccinate any children on non-routine immunization days in the AD-only programme, whereas all five clinics in the mixed programme vaccinated some children. Therefore, the chances of finding a true difference between the two programmes would be reduced. Second, the number of women vaccinated was smaller than the number of children vaccinated, leading to a greater variability in the women's group. This could have created a spurious difference between the two programmes, when no difference existed. Third, the difference may be due to lower vaccination rates on both routine and non-routine ANC days for the

mixed programme, which would imply that no difference existed between the two programmes. However, this observation did not appear to be related to the number of overlapping sessions. Finally, the data did not give enough evidence to conclude whether there was a real difference in vaccination coverage rates between the AD-only and mixed programmes.

Our data indicate that to improve children's vaccination coverage rates, the study clinics should appropriately increase the number of routine sessions, but to increase those of women they should improve women's attendance at routine ANC sessions. Clinics offering more sessions per week had significantly higher vaccination coverage rates for children, probably because they provided more flexibility and less waiting time. Conversely, higher vaccination coverage rates for women were significantly related to attendance during routine ANC sessions, and not to the number of such sessions. These results suggest that clinics should vaccinate women during all clinical visits and plan to have an adequate number of children's immunization sessions each week.

Effect of introducing AD syringes

Increasing the number of injections administered with AD syringes and reducing sterilization practices would help to strengthen the entire public health system. By decreasing the transmission of infectious organisms, less time and money would be spent treating cases of septicaemia, hepatitis, and HIV infection. However, injection safety is largely dependent on the integrity and technique of health workers. If unsafe injection techniques prevail, then the introduction of AD syringes may not substantially improve injection safety. Health workers would benefit from having periodic training sessions to reinforce injection techniques. AD syringes may also improve efficiency in outreach programmes by eliminating the need to sterilize at the point of administration.

Cost

Estimating the costs of various vaccine injection technologies were based on several assumptions, which can be highly subjective and vary with market prices. The estimated cost for an AD injection, US\$ 0.08124, was consistent with the US\$ 0.08 estimate provided by Aylward et al. (13), but slightly below the US\$ 0.09931 estimate calculated by Battersby et al. (16). The estimated cost for a sterilizable syringe injection, US\$ 0.01647, was consistent with the range provided by Aylward et al. (13), and slightly higher than the range calculated by Battersby et al. (16), which did not account for fuel. The fivefold increase in operational costs from sterilizable to AD syringes was consistent with Aylward et al. (13). However, these estimates will fluctuate with changing market prices and should be adjusted accordingly.

Logistical issues

Although AD syringes may reduce the number of injections administered with contaminated needles, increase vaccination coverage rates, and improve convenience for health workers, they may also complicate logistical issues of supply and distribution, which could cause potential shortages of syringes in stock (if sterilizable syringes were not retained), and increase immediate financial expenditures. Although the mixed programme appeared to minimize costs, while gain-

ing most benefits, the actual increase in cost for implementing a complete AD syringe-only programme was relatively minor in relation to the national immunization budget. Because the injection costs are only a small fraction of the total immunization costs, especially as newer, more expensive vaccines are introduced, the marginal costs of incorporating AD syringes is limited. After adjusting expenses by the medical and social savings of preventing hepatitis and HIV (17, 18), the economics may seem even more favourable for introducing AD syringes.

Waste disposal and training

Waste disposal and health worker training should also be considered before implementing a national AD syringe programme. Proper disposal of contaminated syringes should be a priority for any immunization programme (19), and all clinics will need to have a suitable method to dispose of the large volume of syringes that an AD syringe programme will generate. Because all health workers in this study preferred using AD syringes, they should be well received. However, health workers should be trained in the use and proper disposal of AD syringes as they are introduced into a national immunization programme.

Recommendations

Our recommendations from this study were to first, conduct periodic training sessions to orient health workers to use AD syringes and safety boxes, and to reinforce knowledge and practical skills of the immunization programme; second, establish a micro-planning system for district managers and clinic supervisors to periodically review attendance data to plan each clinic's organization of immunization sessions and outreach strategy; and third, phase in AD syringes antigens to improve vaccination coverage rates and injection safety, while not overburdening the logistics system and national immunization budget.

However, an emphasis should be placed on encouraging national governments to adopt injection policies that are tailored to their particular situation and needs (20). Furthermore, the benefits of AD syringes should not be regarded as a complete solution to addressing the problems of injection safety. Adequate attention should also be given to assuring the quality of injected products and reducing the total number of injections. Improving injection practices in a sustainable manner will reduce the burden of preventable diseases and help to restore public confidence in a national immunization programme. ■

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Résumé

Introduction des seringues autobloquantes dans le programme national de vaccination à Madagascar

Objectif Evaluer, en termes de sécurité et de couverture, les avantages des seringues autobloquantes, par rapport au coût financier et aux difficultés logistiques, et élaborer les politiques de santé appropriées à Madagascar.

Méthodes Quinze dispensaires de Madagascar, dont le personnel avait été formé à utiliser les seringues autobloquantes, ont été répartis en trois groupes pour mener un programme d'évaluation : groupe seringues autobloquantes seules, groupe mixte seringues autobloquantes (utilisées uniquement hors journées de vaccination systématique) et seringues stérilisables, groupe seringues stérilisables seules (groupe témoin). Pendant cinq semaines, les données concernant les vaccinations administrées ont été recueillies, des entretiens ont été réalisés et les observations ont été notées.

Résultats L'utilisation des seringues autobloquantes a amélioré le taux de couverture en augmentant significativement le pourcentage de vaccinations hors journées de vaccination systématique (groupe seringues autobloquantes seules : 4,3 % ; groupe mixte : 5,7 % ; groupe témoin : 1,1 % [$p < 0,05$]). Dans les dispensaires n'employant que des seringues autobloquantes, la stérilisation n'a plus été utilisée pour la vaccination, tandis que

dans les dispensaires utilisant les deux types de seringues, le nombre de stérilisations a été réduit de 64 %. Le coût des seringues autobloquantes est cinq fois plus élevé que celui des seringues stérilisables, ce qui a augmenté le coût annuel projeté des injections de respectivement 365 % et 22 % dans les dispensaires n'utilisant que les seringues autobloquantes et dans ceux utilisant les deux types de seringues. Cependant, l'introduction des seringues autobloquantes pour toutes les vaccinations n'augmenterait le budget du programme national de vaccination que de 2 %.

Conclusion L'utilisation des seringues autobloquantes a amélioré la couverture vaccinale, en permettant d'avoir à disposition des seringues prêtes à l'emploi en dehors des journées de vaccination systématique et en diminuant le nombre de stérilisations, ce qui a augmenté la sécurité des injections. Le programme mixte représente l'approche la plus intéressante pour introduire les seringues autobloquantes et diminue les complications logistiques ; son coût est en outre minimal. L'introduction des seringues autobloquantes dans le programme de vaccination d'un pays en développement pour améliorer la sécurité et la couverture vaccinales apparaît faisable, même si leur coût est plus élevé.

Resumen

Introducción de jeringas autodestruibles en el programa nacional de inmunización de Madagascar

Objetivo Evaluar la seguridad y los beneficios de las jeringas autodestruibles (AD) en términos de cobertura vacunal, contraponiéndolos a los costos financieros y logísticos, y formular políticas sanitarias adecuadas en Madagascar.

Métodos Quince dispensarios de Madagascar entrenados en el uso de las jeringas AD fueron asignados aleatoriamente a un grupo que sólo utilizó jeringas AD, a un grupo mixto que sólo utilizó las jeringas AD fuera de los días de inmunización sistemática o a un grupo que sólo utilizó jeringas esterilizables (control). Durante un periodo de cinco semanas se registraron datos sobre las vacunaciones administradas, se realizaron entrevistas y se registraron las observaciones.

Resultados El uso de las jeringas AD mejoró las tasas de cobertura gracias a un aumento significativo del porcentaje de vacunas administradas fuera de los días de inmunización sistemática (sólo AD: 4,3%; mixto: 5,7%; control: 1,1% [$P < 0,05$]). Los dispensarios que sólo utilizaron AD eliminaron las sesiones de esterilización para las vacunaciones, mientras que los dispensarios "mixtos"

redujeron el número de dichas sesiones en un 64%. Las jeringas AD fueron cinco veces más caras que las esterilizables, lo cual incrementó los costos anuales previstos de las inyecciones en un 365% y un 22%, respectivamente, en los dispensarios que sólo utilizaron AD y en los dispensarios "mixtos". Sin embargo, la utilización de las jeringas AD en todas las vacunaciones sólo habría incrementado el presupuesto nacional de vacunación en un 2%.

Conclusión El uso de las jeringas AD mejoró las tasas de cobertura vacunal, gracias a que permitió proporcionar jeringas estériles fáciles de usar en días no destinados específicamente a la inmunización sistemática y a que redujo el número de sesiones de esterilización, mejorando así la seguridad de las inyecciones. El programa mixto fue el enfoque más beneficioso para introducir paulatinamente las jeringas AD y reducir las complicaciones logísticas, y tuvo costos mínimos. Aunque son más caras, es posible introducir las jeringas AD en un programa de inmunización de un país en desarrollo para mejorar la seguridad y la cobertura de la vacunación.

