

Final Report

Evaluation of a Needle-Remover Device and Sharps Barrel in Health Posts in Senegal

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Table of Contents

Table of Contents	ii
Introduction	1
Methods	2
Study Materials	2
Study Design	2
Study Participants	4
Data Collection	4
Results	4
Acceptability of Needle-Remover Devices	4
Acceptability of Sharps Barrels	5
Impact on Volume of Waste	7
Maintenance of Balcan Needle Removers	7
Discussion	8
Acknowledgements	8

Appendices

- A. Building a Sharps Barrel and Using a Sharps Barrel
- B. Injection Provider's Daily Log
- C. Manager's Weekly Log
- D. Study Facilitator Report: Data Clarification

Evaluation of a Needle Remover Device and Sharps Barrel in Health Posts in Senegal

Introduction

Each year, more than 16 billion injections are administered worldwide.¹ In some regions, 17% to 75% are estimated to be with reused, unsterilized injection equipment.² Unsafe reuse is estimated to cause 20 million hepatitis B infections, 2 million hepatitis C infections, and 250,000 HIV infections annually.³ The main tools to prevent reuse of unsterile syringes and needles are auto-disable (AD) syringes and safety needles and syringes. Appropriate sharps and syringe disposal also play a role in safe injection and reuse prevention. World Health Organization (WHO) guidelines recommend disposal of used syringes and needles in puncture-resistant, impermeable cardboard safety boxes. In developing countries, where reuse is most prevalent, safe sharps disposal policies and practices are often inadequate. Assessments in China, India, and six African countries showed that health workers often mix sharps waste into other waste streams, dispose of waste haphazardly in and around their clinics, and do not have regulated systems for safe disposal of sharps waste for all injections.^{4,5,6}

In an effort to improve the safety of injections in Senegal, AD syringes are increasingly being used by the Senegalese National Expanded Programme on Immunization (EPI). Recognizing the sharps waste disposal issues associated with AD use, in 2002 the Senegalese government approved the procurement and use of manual needle-remover devices manufactured by Balcan Engineering for use in all health posts in several districts in Senegal.

In many of the Senegalese sites that are presently using needle removers, Médecins sans Frontières-designed sharps pits have been installed for disposal of the removed needles. These pits are dug into the ground, lined with cement, and accessed by a 10 cm pipe that stands above ground. PATH has developed an alternative disposal option—a sharps barrel with funnel—for locations where digging a pit is not feasible, such as urban hospitals and rural settings where the water table is too high or other geographical features preclude digging.

¹ World Health Organization [homepage on the Internet]. Geneva, Switzerland: World Health Organization; c2004 [cited 2004 June 16]. Injection Safety; [about 2 screens]. Available from: http://www.who.int/injection_safety/en/.

² Hutin YJ, Hauri AM, Armstrong GL. Use of injections in healthcare settings worldwide, 2000: literature review and regional estimates. *British Medical Journal*. 2003;327(7423):1075.

³ Hutin Y, Hauri A, Chiarello L, Catlin M, Stilwell B, Ghebrehiwet T, et al. Best infection control practices for intradermal, subcutaneous, and intramuscular needle injections. *Bull World Health Organ*. 2003;81(7):491–500.

⁴ Dicko M, Oni AQ, Ganivet S, Kone S, Pierre L, Jacquet B. Safety of immunization injections in Africa: not simply a problem of logistics. *Bull World Health Organ*. 2000;78(2):163–169.

⁵ Lei J. Rapid assessment of injection practices in China. Final Report. Ministry of Health of China and the Secretariat of SIGN; 2002.

⁶ Rajasekaran M, Sivagnanam G, Thirumalaikolundusubramanian P, Namasivayam K, Ravindranath C. Injection practices in southern part of India. *Public Health*. 2003;117(3):208–213.

In December 2004, PATH initiated an evaluation of needle-remover devices and sharps barrels in health posts in Senegal.

The objectives of the study were to:

1. Assess the acceptability of the needle-remover devices (Figure 1) in sites where they have been in use for more than one year.
2. Assess the acceptability of the sharps barrel for needle disposal.
3. Assess the impact of needle remover devices on the volume of needle and syringe waste.



Figure 1. Balcan Needle Remover

Methods

Study Materials

Balcan Needle Remover

The needle remover used in this evaluation is manufactured by Balcan Engineering, Ltd., in the United Kingdom (Figure 1). The used needle is inserted into the opening at the top. When the handle is pulled down, the circular blade makes two concurrent cuts—one through the syringe hub, thus separating the needle from the syringe and rendering the syringe nonreusable, and one through the needle itself, rendering it nonreusable. The needle remnants fall into the plastic container below, which can either be completely disposed of or emptied and reused. The container holds approximately 250–400 needles depending on the size of the needle and hub.

Sharps Barrel

The sharps barrel consists of a large empty plastic barrel fitted with a specially designed funnel (Figures 2 and 3). The funnel screws into the barrel at the bunghole to allow easy and safe emptying of the contents of needle-remover containers. For this study, the plastic barrels were purchased in the capital (Dakar) and transported to St. Louis by study personnel. The funnels were manufactured in Seattle, United States, under contract to PATH. The funnels were installed on the barrels by study personnel in St. Louis then distributed to the study sites. See Appendix A for more detailed drawings of the barrel funnel system.



Figure 2. Funnel on Sharps Barrel

Study Design

The study was conducted over a two-month period in 15 health posts in Senegal where vaccine is delivered. The protocol was reviewed and approved by ethical review boards for PATH and the Government of Senegal. The 15 sites were evenly divided into the following three different intervention groups:

1. Sites with Needle Removers

Collection and disposal of needle waste was facilitated by use of a Balcan needle-remover device that separates the syringe from the needle at the point of use (see Figure 1). Each health post had at least three devices, one for each individual injection site. Staff received refresher training in needle-remover use and in management of the needle container.

2. Sites with Needle Removers and Sharps Barrel

The Balcan needle removers were used similar to the above group. In addition, a sharps barrel was introduced for the disposal of needle remnants from the needle remover (see Figures 2 and 3). Staff received refresher training in needle-remover use and in management of the needle container.



Figure 3. Sharps Barrel Installation

3. Sites with Safety Boxes Only

Sharps waste was collected in a safety box.

Supply, Training, and Supervision—All Sites

Study interventions included assurance of adequate syringe and safety box supply, safe injection and waste management training, supervision, and a system of management of safety boxes that allowed them to be counted before disposal.

Table 1. Description of Study Sites

Setting Type	Site Number	# of Participants	
		Injection Providers	Waste Handlers
Needle removers with sharps pit, safety boxes	10	2	1
	11	4	
	9	3	
	13	2	1
	3	5	
Needle removers with sharps barrel, safety boxes	8	2	1
	15	2	1
	14	7	
	2	7	
	4	2	1
Safety boxes only	12	3	1
	5	3	1
	6	3	1
	1	4	
	7	3	1

The health posts that were chosen for the sharps barrel group were sites that previously had not installed sharps pits because of problems with high water tables. The control sites were located in Louga, a district that had not received needle removers when they were distributed in 2002. All sites were selected with some consideration to the convenience of the location to the primary study monitor who visited the sites weekly.

Study Participants

The study population included all the health workers giving injections, both curative and preventive, in the selected health posts; the waste handlers; and the supervisors. The participation of injection providers and waste handlers was formally requested, and they signed consent forms. No one refused to participate. The number of participants (nonsupervisor) from each clinic is listed in Table 1.

Data Collection

Data collection took place between December 20, 2004, and February 13, 2005. The injection providers in each health post were responsible for collecting information on numbers of injections and device performance using a daily one-page log (Appendix B). The supervisor was responsible for reporting the number of safety boxes and needle containers filled during the week by completing a weekly log (Appendix C). Study facilitators collected the daily and weekly sheets from the health posts on a weekly basis. In addition, at the end of the study, study facilitators collected information about how many partially full safety boxes and needle containers remained in each health post and the fill level of each. All of these data were entered into an Excel workbook for electronic storage and data manipulation.

In the needle remover intervention groups, focus group discussions (FGDs) with injection providers and individual interviews with supervisors and waste managers were conducted at the end of the study to collect qualitative information about the acceptability of needle removers and sharps barrels. FGDs took place at several locations in February 2005.

After data collection had ended and the data were initially evaluated, the reported numbers of filled safety boxes and needle containers from two sites seemed low compared to the number of syringes and needles that were processed. The study facilitator returned to these two sites to clarify the data. His findings were reported back and added into the database, and the modified numbers appear in the final data in Table 3. The study facilitator's report is attached as Appendix D.

Results

A total of 16,730 syringes were used during the study, and 94 safety boxes and 44 needle containers were filled.

Acceptability of Needle-Remover Devices

The first objective of the study was to assess the acceptability of the needle-remover devices in sites where they have been in use for over one year. Small FGDs were conducted with two to four health workers from each of the sites that were using needle removers. The needle-remover devices had been in place at each site for an average of 24 months. All participants responded that the devices are easy to use. Advantages and disadvantages of needle removers

cited by participants are listed below in Table 2. Although all sites had received needle removers on average of 24 months before, needle removers were not in regular use in one site.

Table 2. Advantages and Disadvantages of Needle Removers (Reported in FGDs)

Advantage	# of times cited	Disadvantage	# of times cited
Prevents injuries	8	None	8
Removes needles from the waste stream	5	Increases time required for injection	1
Ensures syringes/needles not reused	3	Risk of needlestick (sticking your hand that's holding the device)	1
Reduces number of safety boxes needed	1	Additional required activities (transport, cleaning)	1
		Jamming of the device	1

In nine of ten study sites with needle removers, health workers reported using the device immediately after the injection took place. In the tenth site, the regional hospital, the health workers reported that sometimes when the emergency department was very busy, the needles were not removed immediately. No splatter was observed from use of the device, but there were two reports of cut needle and plastic parts escaping from the device when the handle was brought back to the starting position.

Four of ten sites reported using the device during outreach journeys. Two of these reported that the device worked very well, and two reported that the device worked satisfactorily. All four sites reported that there were no problems with transporting the device.

All ten sites stated that they preferred the use of the needle remover plus safety box for syringes compared to the use of safety boxes alone. The reasons for this preference are listed below:

- Increased safety when the needle is removed.
- The safety box is no longer dangerous (no needles inside it).
- Reduces number of safety boxes needed.
- Use of needle removers avoids risk of accidental needlestick while managing waste.
- Needle remover plus safety box provides greater safety than the safety box alone.

In the 1241 daily report forms completed by study participants, 15 included reports of device malfunction during the day (1.2%). Twelve reported the device did not completely cut the syringe on the first try. One reported the device entrance was blocked, one reported the device could not cut the needle, and one reported the cut needle did not fall immediately into the container. Only one report indicated that the device was not returned to working order. It was noted by the study facilitator that many of the needle removers were in poor condition at the start of the evaluation. Rust, residue from syringes, dirt, and grime were hindering the smooth operation of some of the needle removers.

Acceptability of Sharps Barrels

The second objective of this study was to assess the acceptability of the sharps barrel for needle disposal. To collect this information, two FGDs were conducted. The first session

included nine participants from four health posts. The second included seven participants from the regional hospital site.

Both groups stated that there was no problem with the installation of the barrel and funnel. The barrels at the health posts were placed inside the building and were therefore not exposed to the elements. At the hospital, the barrel was placed outside, near the incinerator. In the two months of the study, there was not any problem with the barrel placed outside, but group participants stated that they would expect problems with rust of the metal funnels on the barrels as time went on.

Operation was smooth, and no repair or maintenance was required for the barrels, but participants thought that was due in part to the short period of the study—“Dysfunction often only occurs after long use of equipment.”

No participants knew of any needles falling on the ground during the emptying of the needle containers into the barrel. The supervisor in charge of medical waste at the hospital reported, “I take care to close the container before going to the barrel, and I take care while I empty the needles into the funnel.” As a general rule, the passage of the needles through the funnel worked without a problem. However, once at each of two different health facilities, the waste handler had to use a stick to help the needles pass through the funnel—the needles jammed at the neck of the funnel upon emptying the container.

In all four of the health posts using the barrel, only syringe needles were dropped into the barrels. However, the barrel at the hospital was used also for blades, suture needles and infusion needles. These were collected in spare containers from the Balcan needle-remover devices (each device comes with two containers).

At all sites, the fill level of the sharps barrels at the end of the study was low, far below one-tenth of the volume. One participant declared, “The bottom surface of the barrel is not yet entirely covered.” Another stated, “We will retire, and still the barrel will not be full.”

At each FGD there was a discussion about what to do with the sharps barrel when it became full. Ideas suggested by the participants were recycling and incineration.

The following advantages of using the sharps barrel were listed in the two FGDs:

- Useful in areas where the local geology prevents digging a pit (water table too high, soil rocky or difficult to dig).
- More flexible choice of placement than a pit.
- Easier to move than a pit.

The only disadvantage that participants in both groups identified was the large size of the barrel—when it becomes full, it may be too heavy to carry out to the elimination site if needed.

In both FGDs, the participants agreed that the barrel presented an acceptable approach for dealing with the problem of sharps waste in the health facilities. They reiterated the advantage of its use where one could not dig a pit.

The following suggestions were made for improving the barrel and funnel system:

- Secure the barrel so that it cannot be stolen when it is outside the health facility.
- Equip the funnel with a padlock for limiting access only to the waste handlers.

- Make it clear that only needles should be emptied there.
- Make the barrel smaller.

Impact on Volume of Waste

The third objective of this study was to assess the impact of needle-remover devices on the volume of needle and syringe waste in health posts in Senegal. Using the number of syringes reported by the health care workers and the number of safety boxes and needle containers reported by the supervisors and study facilitators, we calculated the average number of syringes per safety box or per needle container. These numbers are shown for each study site in Table 3 below.

Table 3. Syringes, Safety Boxes, and Needle Containers Counted During Study

Site #	Syringes Used	Safety Boxes Filled	Needle Containers Filled	Avg # of Syringes in Filled Safety Box	Avg # of Needles in Filled Needle Container
2	3227	12	8	269	403
3	1399	6.5	3.75	215	373
4	1196	6	6	199	199
8	416	2.25	2.75	185	151
9	1397	6.75	6.75	207	207
10	1237	4.5	2.75	275	450
11	743	3	1.42	248	523
13	1233	6.5	4	190	308
14	852	8.75	6	97	142
15	643	4.25	3	151	214
1*	411	4.75	0	87	
5*	1457	11	0	133	
6*	936	7	0	134	
7*	872	4	0	218	
12*	711	6.67	0	107	
Total	16730	93.92	44.42		

*Sites with safety boxes only

The average number of syringes collected per safety box in sites using needle removers (204) was 50% higher than in sites without needle removers (135). More syringes fit in a safety box when the needle is removed; therefore the use of needle removers can reduce the number of safety boxes required. An increase of 50% in the number of needles per safety box corresponds to a decrease of 33% in the number of safety boxes used.

Maintenance of Balcan Needle Removers

Due to the significant maintenance issues that were discovered with many of the needle-remover devices, PATH followed the study with a series of workshops to train health care workers about how to perform maintenance and repair procedures and the importance of regular maintenance to improve device performance. This training was conducted not only for the participants in this study, but for health care workers in all the districts that received needle removers as part of the 2002 procurement by the Senegal Ministry of Health.

194 health workers from seven districts in the two medical regions of Saint Louis and Matam participated in the training workshops. Training reiterated safe injection practices and safe use of the needle removers, along with comprehensive information and demonstration of maintenance procedures. Participants received a supply of lubrication oil to take back to their clinic.

Information was collected about how many needle-remover devices are in use in health centers, and of these, how many currently require maintenance in order to work properly—only two of a total of 326 devices were reported as being broken beyond repair, while 13 were currently in need of maintenance.

Discussion

The results of the study show that needle removers are acceptable and could bring about a 33% savings in safety box supply costs. Sharps barrels, the only equipment intervention in this study, were acceptable and served to provide a needle disposal alternative to pits.

Two areas of concern were identified. First was the practice of batching the syringes for needle removal at a later time, as observed at the busy hospital. Batching results in increased handling of contaminated needles and extends the time that health workers are exposed to infectious sharps. The second area is the lack of maintenance on the needle-remover devices. Therefore, training on correct use and maintenance of needle-remover devices must be a priority where they are provided.

Results from the maintenance workshop indicate that despite some issues with upkeep, the Balcan devices are holding up well after two years of deployment. It is difficult to project the expected lifetime of one of these devices, but given the volume of needle removal reported in this study, and the claims of the UK-based manufacturer, most of these devices may have a useful lifetime well beyond ten years. Misplacement of the plastic needle containers was not raised as an issue during this study nor in the maintenance workshops.

Acknowledgements

The study was conducted in collaboration with the Government of Senegal, Department of Health. We gratefully acknowledge the efforts of the study facilitators, Mr. Diallo and Dr. Mutombo, and participating observers from the Senegalese Programme Élargi de Vaccination for their diligence in monitoring the study and collecting the data. We are thankful to the health workers and clinic supervisors for their participation and commitment to this study.

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Jrrp24027

Building a Sharps Barrel

**1. Manufacture a funnel.**

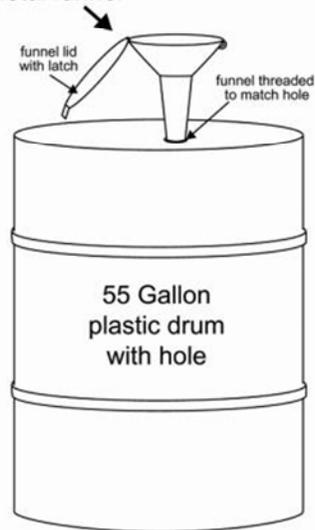
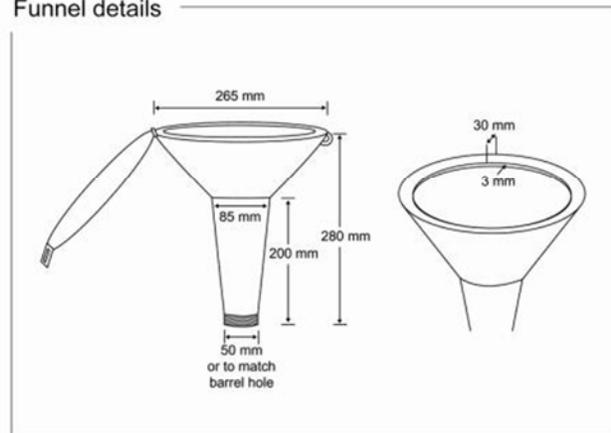
Identify a sheet metal manufacturer to make the funnel according to the design drawings below.

2. Select a barrel and identify an appropriate location.

Barrels should be plastic, as metal barrels could rust over time. Health facility supervisors and waste handlers should decide together on a site for the barrel. It should be dry, secure, and convenient.

3. Attach the funnel to the sharps barrel.

Screw the metal funnel into the hole on top of barrel. Rubber cement or other sealant may be used to help secure connection if needed.

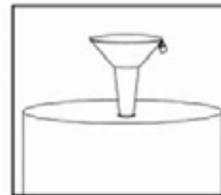
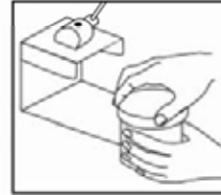
Metal funnel**Funnel details**

Using a Sharps Barrel



General use for disposal of needles

1. Remove the filled needle container from needle remover and immediately secure lid.
2. Keep the lid on the container when transporting the filled container to the sharps barrel.
3. Unlock and lift funnel lid.
4. Empty needle container into funnel with care to avoid spilling.
Do not use the barrel for any other type of waste.
5. Funnel lid should be kept closed and locked when not in use.
6. Occasionally the barrel may be gently rocked to settle the contents evenly inside.
Needles will tend to stack directly underneath the funnel opening; rocking helps to ensure that the entire barrel volume will be used.
7. Wearing plastic gloves, clean the container with bleach and hot water before reuse.



Cleaning needle spills

1. Put on protective gloves.
2. Pour bleach solution over needles and allow to sit for 15 minutes.
3. Using a dustpan and broom, carefully brush the needles off the ground and empty them into the sharps barrel through the funnel. Do not allow fingers or hands to come in contact with needles. Take special care to ensure that no needle fragments remain embedded in the broom.
4. After the needles have been removed, mop the area with a bleach solution.

Final disposal of barrel

The barrel is expected to hold approximately 150,000 needles before it is full. The fill level of the barrel can be examined by looking directly down into the barrel through the funnel. When it is full, the following steps should be followed:

1. Remove funnel. The funnel can be saved and used again for another barrel.
2. Fill the barrel with cement to safely encapsulate the loose needles.
3. Cap the hole and transfer the cemented barrel to landfill disposal.

Manager's Weekly Log

1. Date: __/__/____

2. Facility ID: _____

3. Total number of safety boxes filled during this week: _____

4. How were safety boxes disposed of?

- a. _____ Bury
- b. _____ Incinerate
- c. _____ Waste collection service
- d. _____ Burn
- e. _____ Other (describe) _____

NOTE: The remaining questions are only for managers in sites using needle removers.

5. Total number of needle containers filled this week: _____

6. How were needles disposed of?

- a. _____ Emptied into sharps barrel
- b. _____ Other (describe) _____

Study Facilitator Report: Data Clarification

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I visited Site #3 and Site #11 to verify the data which seemed incorrect.

Site #11

At Site #11 I held a work meeting with the chief nurse (ICP) and others health workers who participated in the study. There were three injection sites and we asked everyone to check how many boxes were filled in his site during the study. We found that there were two boxes missed in the weekly reports that were completed by the ICP. We were able to verify that these boxes existed since the filled boxes were still in the facility. We also found that there was a needle container which is estimated filled at $\frac{3}{4}$ at the end of the study. This estimation is done by the nurse of the maternity department.

Site #3

At Site # 3 we did the same exercises as at Site # 11. There were five injection sites and we found that the supervision report of the end of the study had not been done. The last filled boxes and needle containers were kept by the ICP and waiting for the final supervision report to be completed.

I recommend the following data corrections:

Site #11

1-Add

- One (1) filled safety box during the week of January 3, 2005
- One (1) filled safety box during the week of February 2, 2005

2-Add

- One (1) needle container filled at $\frac{3}{4}$ at the end of the study

Site #3

1-Add

- One (1) filled safety box at $\frac{1}{4}$
- One (1) filled safety box at $\frac{3}{4}$
- Two (2) filled safety boxes at $\frac{3}{4}$

2-Add

- Five (5) needle containers filled at $\frac{3}{4}$