



Managing Sharps Waste in Andhra Pradesh

Introduction and scale-up of a sharps waste management program



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Acknowledgements

This case study report is the culmination of the Partnership Project, a five-year collaboration between PATH and the Government of Andhra Pradesh. The Partnership Project was supported by funding from the Bill & Melinda Gates Foundation through PATH's Children's Vaccine Program and by funding from the Government of Andhra Pradesh.

The case study was made possible by the Bill & Melinda Gates Foundation and by the generous support of the American people through the United States Agency for International Development (USAID) under the terms of the HealthTech Cooperative Agreement #GPH-A-00-01-00005-00. The contents of this document are the responsibility of PATH and do not necessarily reflect the views of USAID, the US Government, or the Bill & Melinda Gates Foundation.

Acronyms

AD	Autodisable
ANM	Auxiliary nurse midwives
BCG	Bacilles Calmette-Guérin (vaccine)
BMDi	Biomedical Devices International
CPCB	Central Pollution Control Board of the Ministry of the Environment and Forestry
DTP	Diphtheria-tetanus-pertussis (vaccine)
GOAP	Government of Andhra Pradesh
IAP	Indian Academy of Pediatrics
IMA	Indian Medical Association
IndiaCLEN	India Clinical Epidemiology Network
PATH	Program for Appropriate Technology in Health
PHC	Primary health center
Rs	Rupees
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization



Executive Summary

Of the more than three billion injections that occur in India each year, over 60 percent are unsafe, potentially exposing millions of health workers and patients to bloodborne pathogens and the infections they cause. The Partnership Project in Andhra Pradesh—a collaborative effort between the Government of Andhra Pradesh and PATH's Children's Vaccine Program—worked to strengthen immunization systems throughout the state. Injection safety was one of its major goals. To improve injection safety, the project introduced and scaled up a practical system for sharps waste management.

Pilot phase (2001–2004)

In the pilot phase, the team identified and evaluated components of an appropriate, legal, and effective solution for disposing of immunization waste from Andhra Pradesh's 1,400 primary health centers (PHCs) and 12,500 health subcenters.

To develop practical, appropriate solutions, the team focused on several strategies, including identifying oral alternatives to injections, assessing current practices and systems, reviewing legislation, and conducting rapid evaluations. As a result of these efforts, the team successfully:

- Reduced the injectable medications list from 181 to 27 drugs.
- Introduced five-liter safety boxes with autodisable syringes in six districts.
- Designed and introduced one-liter safety boxes in all 23 districts.
- Completed a pilot study among 212 health workers using the Balcan Mini-Destructor needle remover (in India needle removers are also known as hub cutters), puncture-proof containers for syringe collection, needle pits, and syringe recycling systems in three divisions with a population of 2 million.



Scale-up phase (2003–2006)

During the project's scale-up phase, the team implemented the sharps waste management system throughout Andhra Pradesh, replicated the system in other sectors, developed a model injection center, and contributed to a national injection safety policy.

Through these activities, the partnership team expanded the comprehensive sharps waste management system to all 1,400 PHCs and 12,500 health subcenters. The system components—needle remover, puncture-proof container for syringe collection, twin bucket for syringe disinfection, sodium hypochlorite, heavy-duty gloves, and disposal bags—were all locally available and bundled to facilitate procurement.

In addition, the team established a model injection center at Niloufer Teaching Hospital in Hyderabad for training clinical staff on best injection practices. In 2005, the center held more than 2,000 demonstration and orientation sessions and gave 23,300 injections without any needlestick injuries.

To leverage these successes, the team worked with the Indian Medical Association, which conducted orientations for 1,600 members in Andhra Pradesh. The team also replicated the comprehensive sharps waste management system in 340 HIV testing centers and assisted the India Clinical Epidemiology Network (IndiaCLEN) with training at model injection centers established in 25 medical college hospitals.

Based on the results of this work as well as the 2003 IndiaCLEN study on injection safety, the Government of India issued a national policy recommendation for autodisable syringes and needle removers to be used for all immunizations.

Impact

The Partnership Project achieved many important successes in Andhra Pradesh, and in India as a whole. Key results include:

- Contributing to a national injection safety policy.
- Reducing by 85 percent the number of injectable medications procured by the state government's procurement agency, which in turn resulted in hundreds of millions fewer injections and greatly reduced medical waste.
- Establishing a comprehensive system of sharps waste management at Andhra Pradesh's PHCs and subcenters.
- Training 30,000 medical officers, supervisors, and health workers in injection safety and proper management of sharps waste.
- Establishing needlestick reporting mechanisms at the PHC and subcenter levels.
- Increasing the effective use of needle removers, which lowered the incidence of syringe reuse among curative injections, reduced reported needlestick injuries, prevented the burning of hundreds of thousands of syringe-filled safety boxes, and enabled safe recycling of thousands of kilograms of plastic syringe barrels.
- Increasing the availability of sharps waste management tools at the local level by bundling a complete sharps waste management kit.
- Replicating the sharps waste management system in HIV testing centers and the private sector.

Lessons learned

- Partner with the government from the start. This project cornerstone built trust and allowed personnel to experiment with innovative technologies and systems.
- Involve health workers at each step. By basing solutions on local realities and needs, the project maximized the chance of success, encouraged new behaviors and practices, and built both trust and respect.
- Conduct a baseline assessment on injection safety. Without a baseline, it would not have been possible to measure progress. Having this information may have led to earlier policy support for sharps waste management.
- Secure sufficient flexible funding. Flexible funding allowed teams to adapt and realign project activities to on-the-ground realities.
- Directly fund the government and appropriate technical assistance partners. Direct funding ensured that decisions were jointly made and solutions were focused on sustainability.
- Bring pilot projects to scale as soon as possible, and share lessons learned. Doing so allowed quick testing of assumptions, sustainability, and incorporation of valuable lessons.

Introduction

The management of sharps waste is an important element of injection safety. This case study describes the sharps waste management component of the Partnership Project in Andhra Pradesh and describes key developments in both the pilot and scale-up phases of the project.

In the pilot phase, elements of an appropriate sharps waste management system were identified, implemented, and evaluated. The scale-up phase focused on:

1. Expanding the sharps waste management system within the immunization sector throughout the state of Andhra Pradesh.
2. Developing a model injection center.
3. Replicating the sharps waste management system beyond the immunization sector.
4. Contributing to a national injection safety policy.

This case study also describes the overall impact of this project and identifies key lessons learned to guide the development and scale-up of other injection safety programs. The process and tools used in Andhra Pradesh may provide practical and useful information for others considering similar projects in India and other countries.

Background

According to the World Health Organization (WHO), over 16 billion injections are administered each year, of which 4.2 billion are given in India alone. Because needles and syringes are often exposed to bloodborne pathogens, they carry the risk of transmitting infection if they are reused or discarded in an unsafe manner that can cause injury. This risk creates a significant public health burden—an estimated 12 million hepatitis B infections, 2 million hepatitis C infections, and 260,000 HIV infections are inadvertently caused by infectious sharps waste each year.¹ Data from the 2003 India Clinical Epidemiology Network (IndiaCLEN) and Government of India Injection Safety Study showed that there were 3 to 6 billion injections in India in 2003, and

of these, 60.5 percent were unsafe.² Unsafe injections resulted from unsafe handling of injection equipment or from unsafe waste disposal practices.

As in many countries, injections are an ingrained part of Indian medical practice and culture. Recent studies on injection practices showed that every third patient in a government facility and every second patient visiting a private facility received an injection. Furthermore, 70 percent of prescribed injections—mostly vitamins, nutrients, and pain killers—could be administered orally.

The national Injection Safety Study also indicated that sharps waste disposal was unacceptable at more than half of all government and private health facilities and immunization clinics surveyed—only 47.1 percent of facilities maintained acceptable practices. Some facilities discarded used needles and syringes in unsecured dumps near hospitals and health centers. Scavengers would then collect the used needles and syringes intended for single use, repackage, and resell them without sterilization, exposing the community to a serious health hazard. After immunization outreach efforts, injection providers routinely recapped, manually removed, or bent needles after use and transported them back to health centers in plastic bags, posing a high risk of needlestick injuries and reuse.

Partnership Project overview

The Partnership Project in Andhra Pradesh was a collaborative effort between the Government of Andhra Pradesh (GOAP) and PATH. Started in 2001, with funding from the Bill & Melinda Gates Foundation, the Partnership Project was completed in 2006. The project introduced hepatitis B vaccine to 1.6 million newborns annually as part of routine immunization practices and influenced similar expansion in ten other Indian states. Improving injection safety was an additional goal of the Partnership Project. The five-year combined budget for the GOAP and PATH was US\$24 million and funded the Partnership Project and a second project to develop a new rotavirus vaccine in Andhra Pradesh. The Partnership Project provided the GOAP with

¹ Simonsen L, Kane A, Lloyd J, Zaffran M, Kane M. Unsafe injections in the developing world and transmission of bloodborne pathogens: a review. *Bulletin of the World Health Organization*. 1999; 77 (10): 789–800.

² IndiaCLEN (India Clinical Epidemiology Network) Injection Safety Study, 2003.



US\$11 million for hepatitis B vaccine, autodisable (AD) syringes, cold chain equipment, and training, as well as information, education, and communication materials and nonrecurrent expenditures. The GOAP contributed US\$4 million through an incremental, cost-sharing funding approach whereby over the five years of the project, the level of funding gradually increased until the final year when the project activities were fully funded.

The Partnership Project was managed jointly by the department of Health and Family Welfare of Andhra Pradesh in consultation with the other parts of the Government of India Ministry of Health in Delhi. The Department of Health and Family Welfare appointed a special officer to serve as a full-time counterpart to PATH staff. PATH provided dedicated technical and financial assistance through staff based in Hyderabad, with additional assistance provided by PATH staff in Delhi and in other PATH offices. Participatory decision-making from the highest levels of government to rural health workers was a key element of the project management.

At the national level, PATH served as the Secretariat for the India Injection Safety Coalition based in Delhi. Other members of the coalition included WHO, United Nations Children's Fund (UNICEF), Indian Medical

Association (IMA), Indian Academy of Pediatrics (IAP), the Nursing Council, and Toxics Link (formerly Srishti), a nongovernmental, environmental organization.

As part of introducing hepatitis B vaccine, the Partnership Project focused on strengthening key systems related to the safe and effective delivery of immunizations. These systems were supportive supervision, developing an effective supply chain for vaccines and other supplies, measuring progress, developing new record-keeping forms, initiating a major public information campaign, retraining health workers—principally auxiliary nurse midwives (ANM) and physicians—to support the state-level procurement administration, and supporting injection safety including the pilot and scale-up of a practical sharps waste management system.

Pilot Phase: Sharps Waste Management Solutions

From 2003 through 2006, the Partnership Project immunized a total of 4.8 million infants in Andhra Pradesh (1.6 million infants each year) with three doses of hepatitis B vaccine, as well as diphtheria, tetanus, and pertussis (DTP); polio; and a single dose of both Bacille Calmette Guerin (BCG) and measles vaccines.³ This increased level of immunization coverage would result in approximately 30 million additional AD needles and syringes needing safe disposal each year. To prepare for an increased volume of sharps waste, the Partnership Project team began identifying appropriate disposal solutions in 2001. While rolling out AD syringe use, the Partnership Project introduced five-liter safety boxes following current WHO recommendations. However, the Indian biomedical waste management policy that took effect soon after the project began prohibited the burning of plastics. Thus, it was imperative to find an alternative solution for disposal of immunization waste that was appropriate, legal, and effective for use in the 1,400 primary health centers (PHCs) and 12,500 health subcenters throughout Andhra Pradesh. The key steps to determine an alternative sharps waste disposal solution included:

³ Immunization coverage with tetanus toxoid vaccine among women of child-bearing age was already high at the start of the project and was not identified as an area for further improvement

1. Identifying drugs that could be given orally instead of by injection.
2. Identifying current sharps waste management practices and systems.
3. Reviewing legislation and guidelines.
4. Conducting rapid evaluations.
5. Determining appropriate solutions.

Oral alternatives to injections

At the start of the Partnership Project, the GOAP procurement agency—Andhra Pradesh Health, Medical, Housing, and Infrastructure Development Corporation—reviewed all medicines given by injection in Andhra Pradesh. The Partnership Project worked with the procurement agency to determine which drugs purchased in injection form could be given orally. A new procurement list was developed that reduced the number of injected drugs from 181 to 27, preventing the delivery of over five hundred million injections in one year in Andhra Pradesh.

Current sharps waste management practices and systems

In 2000, the project team researched numerous methods of sharps waste disposal in Andhra Pradesh ranging from well-managed systems to extremely unsafe practices. For example, following WHO recommendations some health care workers used cardboard safety boxes for syringe collection and transport and burned them at the subcenter or the PHC. The remaining plastic and sharps were buried on site. Many hospitals used well-organized sharps waste standard operating procedures, but in poorly supervised PHCs, practices ranged from emptying boxes of used sharps into a shallow pit or burning and burying waste in a shallow pit. Scavengers often collected and sold used disposable syringes that were not properly discarded.

Before the inception of the Partnership Project, some PHCs used electric needle burners, but these devices were often problematic because of unreliable electricity and the burners' inability to separate the entire needle (a sharp stub usually remained). This led some health care workers to use the unsafe practice of batching syringes for later processing. The electric needle burner

devices were time consuming to use, caused sparks and odors, and frequently malfunctioned.

The project provided five-liter cardboard safety boxes but observation and discussion with ANMs—primary health workers delivering immunizations—revealed the boxes were cumbersome and rarely taken on outreach visits.

Current legislation and guidelines

In 1998, the national Central Pollution Control Board of the Ministry of the Environment and Forestry (CPCB) issued a new policy for proper medical waste disposal. The policy stipulated that health care workers must mutilate used syringes and needles to prevent reuse, disinfect syringes, and discard plastic waste without burning or incineration.

While WHO recommends using five-liter cardboard safety boxes for sharps waste disposal, in many countries, safety boxes are burned or incinerated on site. Therefore, when new guidelines were enacted in 2004 including a CPCB immunization waste policy, sharps waste management solutions in Andhra Pradesh needed to comply with these guidelines and had to find alternatives to safety boxes for syringe disposal.

Rapid evaluations

The project team conducted rapid evaluations to identify and evaluate solutions for improving sharps waste management. Because the project would eventually transfer full responsibility to the Government of Andhra Pradesh at the end of the project, the affordability, appropriateness, and sustainability of each solution was carefully considered. Locally available solutions were given priority consideration because of cost—products were less expensive to make locally, and the import tax was eliminated. In 2003, the project team evaluated the use of one-liter safety boxes (reduced from the five-liter generic size). Following the enactment of the CPCB guidelines on immunization waste, the team also conducted a pilot study examining the use of needle removers and syringe disinfection.

Based on the challenges of using and transporting the five-liter safety box, the Partnership Project team developed and field tested a one-liter safety box. They



One-liter safety box

solicited bids from three Indian companies to produce the one-liter safety box. The team spent approximately Rs. 20,000 (US\$450) to develop the small safety box and an additional Rs. 30,000 (US\$670) to conduct the

acceptability study. These boxes held 20 to 25 used syringes, more than are typically used in a single session. Having these smaller boxes made locally was far less expensive, Rs. 7 or US\$0.16 compared to US\$1 for the recommended five-liter box (excluding import taxes). Local production also allowed for assembly and use instructions to be written in Telegu, the local language.

The Partnership Project introduced 750,000 one-liter safety boxes throughout all 23 districts in Andhra Pradesh. Through observation and focus group discussions, health workers reported the smaller safety boxes were more acceptable and easier to use than the larger ones. Barriers to their use still existed, however. Health workers did not always use the boxes, particularly during outreach visits to subcenters. Some health workers did not burn boxes after the session out of concern about “wasting” the box if it was not yet $\frac{3}{4}$ full—the recommended maximum capacity.

After the smaller boxes were introduced, the CPCB began enforcing the “no burn” policy for all plastic waste from health centers. The project had to devise another way to safely dispose of contaminated needles and syringes. The Ministry of Health can be credited with negotiating a second policy change only one year after introducing the small one-liter safety box policy, introducing needle removers for disabling and disposal of sharps waste.

Needle-remover pilot implementation trial

Project team members identified needle removers as an option that complied with the national policy directing needle and syringe disabling and the use of burn-free

disposal methods. Needle removers are manually operated devices used by health workers immediately after each injection to separate and isolate the needle from the syringe. The needle is then contained in a small plastic container and no longer poses a needlestick risk. The syringe barrel must also be properly treated and disposed. In 2004, the Partnership Project team conducted a pilot implementation trial to demonstrate use of needle removers to separate the needle from the syringe, empty the needle container into concrete-lined needle pits at PHCs, and disinfect plastic syringe barrels for final disposal and collection by informal plastic recyclers. A description of each component of the pilot trial follows.

Although using needle removers complies with national policies, a key consideration was whether they would be acceptable for use by health workers. From October 2003



Balcan Mini-Destructor

to April 2004, the Partnership Project team assessed the Balcan Mini-Destructor, a commercially available needle remover device listed in the WHO Product Information Sheet (PIS) catalogue. The Balcan Mini-Destructor and two needle containers were imported from Balcan Engineering Ltd., UK, at a cost of approximately US\$100 per device (excluding import taxes). The study objectives were to evaluate the needle remover’s acceptability and performance among health workers and to assess the feasibility of introducing a needle-remover sharps disposal system, as well as the feasibility of collecting revenue from recycled syringe plastic.

The assessment was conducted in a population of 1.5 million in the Mehbubnagar District of Andhra Pradesh—one of the most poorly performing districts in terms of immunization coverage. The Partnership Project team trained 212 health workers and periodically observed needle-remover use. The team also conducted focus group discussions before, during, and after the intervention.

Comprehensive Sharps Waste Management System



During the trial period, 47,800 syringes were cut with no reported needlestick injuries related to needle-remover use.⁴ A total of 98 percent of participating health workers rated needle removers as excellent. Use of needle removers reduced the volume of sharps waste at the health centers and was seen as feasible and appropriate for both urban and rural settings in Andhra Pradesh. Although some health workers took the needle remover on outreach visits, most felt it was too heavy to transport. Training and supportive supervision were critical components to ensure proper needle-remover use and maintenance; when health workers did not perform routine maintenance, the cutting surfaces of the Balcan devices began to rust, making the cutting process more difficult.

Prior to this study, no formal needlestick reporting system existed in Andhra Pradesh. The Partnership Project team began collecting this data using a daily tally sheet completed by injection providers. The WHO Occupational Health Program and the Training for Development of Innovative Control Technologies Project provided technical guidance to develop this form. Five needlestick injuries were reported during the study,

⁴ Satish Kaipilyawar. Needle Remover Implementation Trial, Mehbubnagar, Andhra Pradesh. Presentation made March 28, 2004.

although none of these injuries was related to use of the needle remover. Although health workers were generally reluctant to discuss needlestick injury both before and after the intervention, 56 percent of health workers reported that using the needle remover decreased needlestick injuries. Unfortunately, no baseline data existed to provide an accurate comparison.

The main reported advantages of needle-remover use were:

- Significant reduction in the volume of dangerous sharps waste entering the disposal stream.
- Elimination of needlestick injuries among rag pickers and the community living close to the health center.

Because burning safety boxes was prohibited and outreach workers preferred not to transport needle removers on outreach visits, a need emerged for a safe, practical means of transporting used syringes from outreach visits to the PHC or subcenter for cutting. Based on input from health workers, the team identified a locally available, puncture- and leak-proof container and lid with a sufficiently narrow diameter to prevent syringes from inverting during transport (syringes were placed needle facing down in these containers).



Puncture-proof container

convenient option for collecting and transporting used needles from outreach visits to the PHC for needle removal. Observation and discussions with health workers showed that nearly 95 percent of health care workers used the PPC and found it to be convenient and easy to transport back to the PHC. Health care workers also reported no needlestick injuries using the PPC. The lid closed firmly, and pressure had to be applied to open it.

Based on study results, the team recommended several design changes to improve the PPC. The PPC needed to be translucent and marked with a biohazard sticker to ensure others knew it contained used syringes. A stronger, more robust plastic was needed to prevent rodents from chewing the edges. As an extra precaution, a modified lid was needed to stay firmly attached if dropped. Although the diameter of the PPC ensured the correct orientation of all used syringes, the next generation of PPC was tapered at the bottom (8 cm at the top and 6 cm diameter on the bottom).

The GOAP had already constructed needle pits at more than 1,100 of the 1,400 PHC's in the state. The



Needle pit

The opaque, reusable container was 16.5 cm tall and 8 cm in diameter and cost Rs. 20 (US\$0.45). Ten to fifteen syringes fit in each container. Each health worker received two puncture-proof containers (PPC) during the study.

Health workers reported the PPC to be a safe, acceptable, and

Partnership Project successfully lobbied the government to complete the construction of pits at the remaining 300 PHCs. The pits had a cement bottom and top

with a pipe embedded in the top for emptying needles into. Construction of each pit cost approximately Rs. 5,000 (US\$110). Initial site visits revealed that health workers were often unaware of the pits or how to use them; waste was often seen scattered near the site.

Feasibility of recycling

As part of the needle-remover implementation trial, the Partnership Project team conducted an economic feasibility study on establishing a collection and transport system to recycle plastic syringe barrels. After separating the needle from the plastic syringe barrel for the 47,800 syringes cut during the implementation trial, health centers collected the syringe barrels in plastic bags and delivered bags to a centralized location for weighing and disinfecting. The plastic collected weighed 276 kilograms. The study results showed that in the rural areas—where about half of the plastic waste is produced—the volume of plastic was too small to provide an economic incentive for establishing a separate system for syringe recycling. Similarly, in urban areas, where distances and transportation costs were lower, it was minimally economical to set up a system to collect and recycle the disinfected plastic.

Although setting up a syringe recycling system was not economical, the study team found that every village and small town had its own informal recycling system where vendors collected a variety of used goods, including plastics for shredding and resale. The study concluded that recycling syringes could be safe and economically feasible, as long as the syringe barrels were properly disinfected at the PHC and collected by an existing recycler.

Table 1 provides detailed information about the costs of the recycling feasibility study. The total cost of collection and transport was Rs. 14,260 (US\$316) while the income generated was Rs. 4,416 (US\$98) leaving Rs.8,844 (US\$197) as system costs that were not covered. Based on this data from the 96 participating health centers, establishing a dedicated syringe recycling process would have cost each health center Rs. 92 (US\$2.04) over the six-month period in which this recycling study took place.

Table 1. Feasibility of recycling: Costs

Item	Details	Cost in Rupees
Transportation	4,400 Kms to collect from 96 centers	9,600
Human resources	2 people	1,960
Sodium hypochlorite solution	100 Liters X Rs. 7/-	700
Miscellaneous	Heavy-duty gloves, twin buckets, etc.	1,000
Total Cost of Collection and Transport		13,260
Commercial value of the plastic syringe barrel	276 kgs. X Rs. 17/-	4,416
Remaining Costs for Health System		8,844

Appropriate solutions

Based on the positive results of the pilot trial, the Partnership Project team and the GOAP jointly decided to roll out a needle remover-based sharps disposal system for the entire state of Andhra Pradesh. However, in order for this sharps waste system to be sustainable and appropriate, changes were needed: purchasing or construction of needle removers, needle pits, puncture-proof containers, and a syringe disinfection system for the PHC.



Twin-bucket system

One essential task in scaling up the project included procuring a high-quality, locally available, affordable needle-cutting device through a reliable supply system. The GOAP and PATH began talking with two manufacturers of high-quality needle removers: eventually, Australia-based Biomedical Devices International (BMDi) established a local manufacturing plant in India.

To respond to other findings in the pilot trial, in addition to the construction of the needle pits, health workers received training in the disposal of needles from needle containers. To make syringe barrel plastic recycling economically feasible, the team developed a twin-bucket system to serve PHC-level facilities with a simple, low-cost system for disinfecting syringe barrels. A sieve and bucket system provided a convenient mechanism for disinfecting syringe barrels in sodium hypochlorite solution and draining and emptying syringes into a plastic bag for recycling.

Scale-Up Phase: Program Expansion

By 2005, the project team had expanded the safe injection and sharps waste disposal system to all PHCs and subcenters throughout Andhra Pradesh. The system focused on using the BMDi Nomoresharps® devices used by 30,000 staff in Andhra Pradesh (24,000 health workers at the PHC and subcenter level as well as the 6,000 medical officers and supervisors). The needle containers were emptied into needle pits at each PHC. Diluted (2%) sodium hypochlorite solution was used to disinfect the removed syringe barrels contained in the twin-bucket system. After soaking for at least two hours, health care workers transferred the syringe barrels from the mesh inner bucket into a white plastic bag collected by informal recyclers. Because recycling is a way of life in India, most disinfected syringe barrels get collected and sold to an informal recycler. Those disinfected syringes which are not collected are disposed of along with municipal trash.

This same needle remover-based system, with adaptations, is now used for both outreach immunization visits and within the private sector. ANMs conducting outreach visits used the puncture-proof container with a secure lid to safely collect and transport syringes back to the subcenter or PHC where syringe hubs were then cut with the needle remover.

Recognizing the importance of supportive supervision in the Partnership Project—including ensuring proper use and maintenance of the needle-remover system—the team experimented with a strategy to increase the sustainability of external supervision. The project contracted with local medical schools to place supervisors in PHCs to assist staff. Medical school supervisors shared recent medical

information and gained valuable field experience to pass to their students. The government trained and paid external supervisors from an additional five medical schools to work with existing project supervisors to gain first-hand experience with supportive supervision techniques.

Bundling supplies and building capacity

To facilitate the procurement, distribution, training, and use of the needle remover-based system, the project team assembled two kits: a needle-remover kit and a waste management (waste disposal) kit. The two kits were later merged into one streamlined kit.

The needle-remover kit contained the locally produced needle remover with two needle containers and a local-language instructional poster highlighting needle-remover use and maintenance. Bundling BMDi devices (US\$17) with training posters cost Rs. 900 (US\$20) including delivery to the districts. The waste management kit contained twin buckets, two puncture-proof containers, a liter of sodium hypochlorite, heavy-duty gloves, and 15 plastic bags for syringe barrels. Training CDs were sent separately to all 1,400 PHCs. The bundled waste kit sold for Rs. 495 (approx US\$11) including delivery to the districts.

In 2005, the GOAP and PATH provided training to all 23 district immunization officers from each district in Andhra Pradesh. These officers later trained their 1,400 medical officers from all PHCs, and the medical officers later trained 14,000 health workers. Each health worker received the kits and training in using the supplies. Representatives from the GOAP and/or PATH attended all trainings to ensure high quality and consistency.

PATH worked with BMDi to promote local production of an appropriate needle remover. Upon setting up production in India, BMDi agreed to conduct rigorous quality control. The company worked closely with the project team and made refinements to the device to improve durability and prevent rust. After 18 months of use, all needle-remover devices continued working properly. PATH also worked closely with an Indian company, AV Ulco, to develop a high-quality needle remover that may be added to the UNICEF catalog in the future.



Waste disposal kit

Scale-Up Phase: Model Injection Center

In 2003 the project conducted a study on injection practices in Hyderabad that revealed that medical officers and paramedics were not trained to deliver injections. The project team advocated with government partners, members of the Indian Academy of Pediatrics, and public hospital administrators to provide injection training. To accelerate the uptake of safe injection and disposal practices throughout Andhra Pradesh, the project established a model injection center at Niloufer Hospital for Women and Children, a 360-bed teaching hospital in the state's capital of Hyderabad.

The model injection center aimed to:

- Rationalize and reduce the number of curative injections (and promote oral medications as an alternative to injections).
- Increase access to safe injections.
- Demonstrate safe injections including safe sharps disposal practices.
- Prevent and reduce needlestick injuries to providers.
- Educate nursing and medical professionals and students on the importance of safe injections.
- Create a permanent learning center.
- Build awareness of injection safety within the community.

The model injection center serves as an ongoing training facility for medical and nursing students as well as visiting physicians and private providers. Hospital patients receiving injections at the center also learn about the importance of injection safety. The facility includes a training room, waiting area, and injection room. Since its inception in early 2005, 1,400 student nurses and doctors received training at the center. As of May 2006, health workers safely administered 16,000 injections with no needlestick injuries reported. The total cost to set up the model injection center at the hospital was approximately Rs. 5.74 lakh (US\$12,755). Building the physical infrastructure cost Rs. 3.77 lakh (US\$8,378), interior design cost Rs. 1.25 lakh (US\$2,778), and the salary for the part-time center coordinator was Rs.

0.72 lakh (US\$1,600). PATH supported the center coordinator's salary for the first nine months, and Niloufer Hospital now supports the ongoing costs, primarily for staff salaries.

Scale-Up Phase: Program Replication

Model injection center

The model injection center is now replicated in two other locations—Andhra Pradesh Guntur Medical College and Sadhu Ram LIONS Eye Hospital in Hyderabad. IndiaCLEN, with support from USAID, has replicated model injection centers in 25 Medical College hospitals in India and received training assistance from PATH in Andhra Pradesh. Lessons learned from the Niloufer model injection center were shared with the Trained Nurses Association of the Indian Nursing Council and the India Medical Association (IMA). These institutions incorporated injection safety components into their national trainings as part of their continuing medical education program.

Replication in HIV/AIDS programs

After validating the sharps waste management system, sectors outside of the immunization arena expressed interest in replicating the program to support their own facilities. To facilitate this, the project team conducted rapid pilot studies to test assumptions and identify specific needs. In Andhra Pradesh, PATH partnered with Lepra India—an international nongovernmental organization focusing on leprosy, tuberculosis, and HIV/AIDS treatment—to conduct a pilot sharps waste management project at 13 HIV testing centers. The focus of the pilot was to identify how the sharps waste disposal system could be adapted for HIV testing centers and how health care workers could better monitor needlestick injuries. HIV testing center laboratory technicians received training in the new sharps waste management system. The centers introduced a daily record-keeping system complementary with the routine reporting system to state and district health offices. Training also instructed laboratory technicians to notify supervisors immediately about needlestick injuries and treatment of post-exposure prophylaxis.



Sharps barrel with recessed funnel

Based on the pilot study findings, the project team recommended several modifications to the sharps waste management system: (1) soaking needles overnight in the needle container with 2% sodium hypochlorite solution, (2) adapting the needle container lid with two small holes for draining the disinfectant, (3) storing disinfected syringes in blue plastic bags to be sent to recycling, and (4) emptying disinfected needles into a sharps barrel with a recessed funnel.

Based on the success of this pilot project in the HIV testing centers, PATH received funding from the GOAP AIDS Control Society to expand the sharps waste management program to all 340 HIV testing centers in Andhra Pradesh.

Replication in the curative sector

PATH partnered with the IMA—the largest professional body of medical practitioners in India with nearly 170,000 members—to promote injection safety in the curative sector through IMA orientation meetings in districts throughout Andhra Pradesh. Over 1,600 members attended 20 seminars by the end of 2005. IMA district branches capitalized on this opportunity to also train nursing professionals, and this approach is being replicated in Gujarat and Maharashtra states in collaboration with BD—the current supplier of AD syringes.

Scale-Up Phase: Policy

The project team, in conjunction with the national Injection Safety Coalition partners, advocated at the state and national level to improve injection safety and safe waste management practices, both in the preventive and curative sectors. In 2004, the team presented findings from the pilot implementation trial at a national injection safety workshop sponsored by the Indian Academy of Pediatrics and BD. Secretary Hota, the national secretary for health, was present and expressed interest in injection safety. The Partnership Project continued to advocate with both the Government of India and the IMA, and both organizations issued press releases supporting injection safety policies. In 2005, the Indian Parliament endorsed the use of AD syringes for all immunizations, syringe disposal by using needle removers, and the construction of secure disposal pits at each PHC.

In response to the proven efficacy of needle removers in Andhra Pradesh, the Government of India is now procuring 217,000 needle removers annually for national use. Based on the results of the Partnership Project, UNICEF/India committed to purchasing durable needle-remover devices, such as those used in the project.

One remaining challenge to this system is the lack of a clear WHO position on the use of needle removers in immunization programs. WHO plans to conduct additional studies in order to assess the effect of needle removers on needlestick injury. A WHO recommendation is a prerequisite for the Performance, Quality, and Safety Unit of the department of Immunization, Vaccines, and Biologicals in Geneva to prepare and agree on performance standards for needle-remover devices. Until these standards are solidified, purchasing needle removers will remain problematic for procurement agencies since many low-quality, low-cost devices are available.

Program Impact

The impact of a sharps waste management system in Andhra Pradesh is demonstrated by the following outcomes:

- Indian policy on injection safety is based on Partnership Project findings and achievements.
- Number of injectable medications stocked by the government procurement agency (reduced from 181 to 27) resulted in hundreds of millions fewer injections and less syringe and needle waste.
- A comprehensive sharps waste management system introduced at PHCs and subcenters level throughout a state of 75 million people.
- 30,000 medical officers, supervisors, and health workers received training in injection safety and proper sharps waste management.
- Needlestick injury reporting tools were developed and utilized at the PHC and subcenter facilities.
- Use of needle-removers.
- Lowered the incidence of syringe reuse among curative injections.
- Reduced reported needlestick injuries to health workers and waste handlers.
- Prevented the burning of millions of cardboard safety boxes.
- Allowed for recycling thousands of kilograms of disinfected, mutilated plastic syringe barrels, and kept them out of the waste stream.
- Local availability of sharps waste management tools were developed including high-quality needle removers, training and education tools, and bundled components of a sharps waste management system.
- Sharps waste management system replicated in HIV testing centers and in the private sector.

Lessons Learned

Partner with the government from the start. This project cornerstone built trust and allowed personnel to experiment with innovative technologies and systems in a way that otherwise would have been difficult.

Involve health workers at each step. By basing solutions on local realities and needs, the project maximized the chance of success, encouraged new behaviors and practices, and built both trust and respect between health workers and the government.

Conduct a baseline assessment on injection safety. Without baseline data, the project lacked state-specific evidence that would have allowed quantitative measures of progress. Having this information may have led to earlier policy support for sharps waste management.

Secure sufficient flexible funding. Flexible funding allowed teams to adapt and realign project activities to on-the-ground realities.

Directly fund the government and appropriate technical assistance partners. Direct funding ensured that decisions were jointly made and solutions were focused on sustainability.

Bring pilot projects to scale as soon as possible and share lessons learned. Doing so allows quick testing of sustainability assumptions and use of valuable lessons.



Annex A

Sharps Waste Management: Key Activities and Results

The Partnership Project achieved the following sharps waste management results in the state of Andhra Pradesh:

Pilot Phase: 2001–2004

Practical sharps waste management solutions and activities:

- Injectable medications list reduced from 181 to 27 (2001).
- Five-liter safety boxes distributed with autodisable (AD) syringes in six initial districts (2002).
- One-liter safety box introduced to all 23 districts in Andhra Pradesh (2003).
- Balcan Mini-Destructor (needle-remover) study conducted in Mehbubnagar District. Primary health workers and private practitioners provided usability and safety data on 250 Balcan devices (2004).

Scale-Up Phase: 2003 – 2006

The sharps waste management system was expanded to all 1,400 PHCs and 12,500 health subcenters in all 23 districts of Andhra Pradesh. This system included routine use of the needle remover for safe disposal of used syringes (2004–2006).

Model injection center

Niloufer Teaching Hospital in Hyderabad was established as a center for training clinical staff on best practices for administering safe injections. In 2005, over 2,000 demonstration and orientation sessions were held and 23,300 injections given without any reports of needlestick injuries (2004-2005).

Program replication

The Indian Medical Association (IMA) conducted sharps waste management orientation sessions for 1,600 members in Andhra Pradesh state in 2005. With project technical assistance, model injection centers were established in 25 additional medical college hospitals. PATH and Lepra/India (an international NGO whose focus includes leprosy treatment, TB, and HIV/AIDS) were funded by the Government of Andhra Pradesh to replicate the sharps waste management system in 340 HIV Testing Centers (2004–2006).

Policy

Based on the India Clinical Epidemiology Network National Injection Safety Study done in 2003 and the results of the Partnership Project's efforts in the pilot phase, the Government of India issued a national policy recommendation for AD syringes and needle removers to be used for all immunizations throughout India (2003–2004).

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