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A Glance at the World

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This column comprises notes and info not subjected to peer-review focusing on waste management issues in different corners of the world. Its aim is to open a window onto the solid waste management situation in any given country, major city or significant geographic area that may be of interest to the scientific and technical community.

Implementation of WHO healthcare waste management (HCWM) approach in an Algerian hospital

The WHO estimates that only 20% of wastes produced by hospitals are hazardous (chemicals, infectious and toxic wastes, sharp instruments, etc.), requiring special handling and disposal. Almost 80% of wastes are considered general wastes, including paper, cardboard, packaging, food, etc. The WHO has reported that between 18% and 64% of health facilities in developing countries do not apply proper waste removal methods (Pruss et al., 1999). In order to reduce the numerous risks associated with mismanagement of Healthcare Waste (HCW), WHO has established a practical approach to improve HCWM by assessing currently applied waste management systems, staff training, estimation of waste production and waste segregation, storage, transportation and disposal (Pruss et al., 1999; Rushbrook et al., 2000; Zghondi, 2000). The assessment is aimed to reduce occupational hazards, essentially needle injuries related to poor HCWM and to set up a waste segregation system at the source of production.

The WHO approach has been implemented at the "Doctor HASSANI Abdelkader" University Hospital, in Sidi Bel Abbes.

This town, with a population of 603,369 inhabitants, is located in the North West part of Algeria. The hospital provides a total of 774 beds with an average occupancy rate of 67% and employs 1646 people.

First step in the HCWM plan implementation

As an initial step in the implementation of the WHO approach, an HCWM committee was set up based on the "Hygiene and Security Commission", comprising the hospital Manager, the head of staff administration, an engineer and two environmental technicians, a nurse and an occupational physician. An HCWM review was subsequently performed to identify current conditions and ascertain the need for improvements.

General and infectious wastes were disposed of without any segregation. Garbage and artificial colour-coding was rejected by the majority of staff members. Sharp items were generally collected in the form of plastic or glass bottles and cans. Only four wards had rigid yellow containers for sharp items. The conferment of wastes from the units to the storage site was taken care of by housekeepers using plastic bags or bins. Five premises devoid of standard conditions were available for waste storage. Wastes were frequently deposited on bulk soil in view of the scarcity of bins. Daily transportation of waste to municipal landfill was carried out by the hospital truck and a municipality dumper truck. A portion of unsegregated wastes was incinerated in a single-chamber oven inside the hospital.

Monitoring of the HCWM plan

A three-bin system was distributed throughout the hospital wards (black plastic bags for general waste, yellow plastic bags for infectious waste and rigid containers for sharp instruments). Hazardous solid and general wastes were weighed daily for one week. An educational and training program was carried out with the aim of establishing waste separation. Staff compliance was controlled each month. This HCWM plan continued over a three-year period, from January 2005 to December 2007. Injuries caused by sharp items and needles, as reported by healthcare workers, were analysed at the same time to specifically identify those related to mismanagement of needles and sharp instruments, thus representing an indicator of efficiency of the implemented HCWM plan.

Staff training and implementing the necessary means for waste collection (black and yellow plastic bag, and sharps containers) were conducted simultaneously. The three-bin system was distributed throughout all wards at the end of 2005. Waste production was assessed in June 2006. The total weight of waste produced by 12 units (448 beds) was estimated in 417 kg/d. The average weight of infectious waste was 0.303 kg/bed/d and general waste 0.627 kg/bed/d. During the same period, the laboratory produced 35 kg/d of infectious waste and 11 kg/d of general waste. Therefore, an average of approximately 8100 yellow bags and 3120 sharps' containers were incinerated per year.

Inspections were carried out on a monthly basis to check for irregularities in the waste disposal system and to certify compliance with recommendations. By the end of 2007, all services had implemented the three-bin container-system. However, waste segregation was of medium quality.

A percentage of 68.7% of paramedics and 80% of menial staff underwent specific training. Since the start of the 2005 academic year a course on exposure to blood and an overview on waste segregation had been introduced in the 6th year medical program studies. Posters were hung in the wards, operating rooms, and laboratories, recommending disposal of sharp items in rigid yellow containers. Written and standard recommendations were distributed to nursing staff during training sessions.

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Table 1
Frequency of injury by sharp items and needles according to occupation, observed from January 1st 2005 to December 31st 2007, at the "Doctor HASSANI Abdelkader" University Hospital, in Sidi Bel Abbes, Algeria.

Position	Year				
	2005	2006	2007	Total	%
Paramedic staff	19	28	31	78	43.5
Housekeepers	15	13	18	46	25.7
Physicians	5	10	16	31	16.8
Waste collectors	2	7	0	9	5
Linen-maids	1	2	0	3	1.7
Others	2	4	6	12	6.7
Total	44	64	71	179	100

Sharps and needle injuries surveillance

A monitoring survey aimed at determining the rate of harm caused to professional staff by needles or mismanagement of wastes was carried out and the evolution of the latter over time calculated. Table 1 shows the frequency of injury caused by needles and sharp items reported by professional staff over a three-year period. An increase in the number of accidents reported by doctors, paramedics and housekeepers, was observed, although not for incidents referred by waste collectors. The rate of needle injuries reported by housekeepers remained unchanged during the monitoring period. The average incidence of needle injuries in housekeepers and paramedics was respectively 0.16/housekeeper/year ($n = 96$) and 0.04/nurse/year ($n = 600$). The difference was statistically significant ($p = 0.000; \alpha = 5\%$). Fifty-five exposures (30.7%) recorded over a three-year period were referred by staff directly assigned to waste handling (46 housekeepers and nine waste personnel collectors). Eleven needle injuries (6.14%) were recorded among individuals who should not have been in contact with sharps or needles: three linen-maids, two maintenance engineers, two secretaries, one maintenance technician, heating technician, security guard and gardener. A total of 66 exposures (36.87%) were directly related to waste misconduct, estimated in 2005, 2006 and 2007 at 45.45%, 40.6% and 28%, respectively. The decrease (−17% in 2007) was not statistically significant compared with 2005. 25.7% of injuries caused by sharp items occurred among housekeepers during floor cleaning and handling of waste containers. The care rooms (18 cases) and operating rooms (five cases) were the most frequent places implicated in injury to housekeepers.

Final remarks

The study revealed how waste management in the facility examined was very basic and at high risk for handling of wastes by staff, particularly housekeepers, for whom the highest incidence of needle injuries was reported. Waste segregation is a major step to be implemented by healthcare workers, and staff compliance with the HCWM system should be ensured. Staff training in waste handling, together with the distribution of specially adapted household gloves should contribute towards reducing these accidents.

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Composting of municipal solid waste: Indian experience

Composting is regarded as an environmentally benign option for treating source segregated Municipal Solid Waste (MSW) practiced traditionally in India, particularly in rural areas. Anaerobic composting, in which mainly vegetable and food waste is dumped in pits and closed for a certain time, is the preferred method in rural areas. On completion of a six-month maturation time, the compost is excavated and used as manure for agricultural purposes.

The Government of India initiated a program in 1974 to stimulate MSW composting in cities with a population of over 300,000. Later, in the 1980s, centralized, large-scale and mechanized MSW composting plants were promoted in urban areas. Most of them turned out to be a failure with the exception of Delhi and Bangalore, mainly due to inadequate waste collection, poor design of composting facility, lack of odor control measures, poor compost quality and low market value.

During the 1990s, several small, manually operated composting plants at community level, initiated primarily by community based organizations and nongovernmental organizations with national and international funding were set up. These "decentralized composting" facilities receive source segregated organic fraction of MSW mainly containing food and vegetable waste from the neighborhood where the composting site is located. At present, various composting systems of different scales and types are operating in the urban centers of India. These operating facilities not only solve the problem of waste disposal but also support the underprivileged in the society by providing employment opportunities.

Windrow-composting and vermi-composting are the two most common composting methods in use in India. In windrow-composting, organic fraction of MSW is formed as a heap or windrow and turned periodically with moisture addition. Vermi-composting uses earthworms to convert the organic substrate into compost. Composting technologies are undergoing continuous development. However, vermi-composting is still considered more an art than a science, particularly due to the difficulties in maintaining appropriate conditions for the growth of worms.

Selecting the right composting method involves a number of factors such as receiving source segregated biodegradable organic waste for composting, investment capacity to establish, operate and maintain the composting facility and finally ensure a market

at suitable prices for the compost. Often, rising land costs represent a major obstacle in the setting up of a successful composting plant in Indian urban centers.

It is foreseen that the solid waste generation in India will peak up to 150 million Mg/year by 2025, of which 50–60% will be of biodegradable organic such as food, vegetable and fruit waste. Therefore, it is important to introduce improved composting methods to reduce maturation time, thus providing the opportunity to handle more waste in a shorter time and produce a better quality compost. In recent times, researchers have accepted the challenging task of improving composting technologies to get good quality compost from source segregated organic fraction of MSW. As a result, a number of new initiatives such as forced aeration of windrow piles, static in-vessel composting and use of effective microorganisms are experimented and being implemented in the field. Nevertheless, the cost-effectiveness of these initiatives is still questionable.

Proper source segregation and collection is important for the success of any composting technologies and lacking these, even the best treatment system could fail. The most common system of garbage collection is through community bins and in some cases, door-to-door collection. Generally, urban local bodies contract the collection and transport of this garbage to private partners, most of which are not professionally managed service providers. Often, they are paid with the tipping fee based on weight of the garbage transported. This attracts them to transport larger quantities of inert materials such as construction and demolition debris along with the biodegradable organic waste.

Around 70% of the generated waste is collected on a daily basis by urban local bodies, and the presence of inert materials up to 30–40% along with the plastics, paper and metal causes the problem of waste handling and processing. Hence, segregating biodegradable and non-biodegradable waste at the source for composting and controlled landfilling, respectively, has been made mandatory since 2000 (MoEF, 2000). But in reality enforcement of source segregation is lacking in the country and hence the obtaining of source segregated waste for composting has turned out to be difficult. Though various pressure groups have been advocating for source segregation, India has still a long way to go. Raising public awareness through campaigning, providing technical guidance,training to the officials and sanitary workers are some areas requiring attention to foster source segregation and composting.

Composting is an environmentally attractive process for getting rid of waste and at the same time producing useful manure. However, efforts to commercialize composting have achieved poor success rates in India. There are few exceptions where composting has succeeded commercially and socially. The decentralized composting model adopted in Bangladesh is exemplary. Referred as "Designer Fertilizer", composts produced in these decentralized facilities are enriched with additional nutrients depending on the target application, type of soil, vegetation etc. Heavy subsidies for chemical fertilizers, supported by strong distribution networks, and pressure from large-scale fertilizer industries pose a stiff competition to compost. Often, composting is carried out in a decentralized manner by means of small plants which is not able to withstand this competition. The Ministry of Urban Development in co-ordination with Ministry of Agriculture has been trying to create a market for compost by requiring fertilizer companies to sell a mixed product of fertilizer and compost in the ratio 70:30. Several other measures such as 50% subsidy on capital for proposed compost plants in Public–Private Partnership, free leasehold land provision by Urban Local Bodies (ULBs), no royalty on waste, exemption of local taxes, transport subsidy for compost have also been proposed to encourage composting across the country. However, the realization of these promotional efforts may take some time. Even though compost may not be able fully replace chemical fertilizers it could be used as soil conditioner, thus reducing the amount of chemical fertilizers.

Inarguably, encouraging composting alone will not suffice to solve the waste disposal challenge. Other essential alternative technologies including landfill bioreactors, and anaerobic digestion should also be taken into consideration. The brighter side of composting is its social linkage, ability to reduce consumption of synthetic fertilizers and above all mitigate greenhouse gas emissions from the infamous open dumps in India. Hence, it is time to stimulate integrated waste management approach in India to reap multidimensional benefits from MSW.

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