From the Backyard to the Frontline:
Initiatives of Philippine Hospital Workers on Best Environmental Practices

JULY 2013

Metro Manila, Philippines
From the Backyard to the Frontline:
Initiatives of Philippine Hospital Workers on Best Environmental Practices
Health Care Without Harm (HCWH) is an international coalition of over 500 member organizations in 53 countries, working to transform the health care sector world-wide, without compromising patient safety or care, so that it becomes ecologically sustainable and a leading advocate for environmental health and justice.

In the Philippines, HCWH-Asia has laid the groundwork for promoting its three main campaigns on environmental responsibility in health care: Safer Chemicals, Medical Waste, and the Global Green and Healthy Hospitals (GGHH) agenda and network.

In the ten years that HCWH-Asia has been in the country, it has done high profile projects such as the documentation of the proper disposal of needles and syringes for the country-wide vaccination program, the Philippine Measles Elimination Campaign of the Department of Health, without resorting to open burning or incineration. In 2006, HCWH-Asia hosted the first Southeast Asian Conference on Mercury in Health Care which led to the drafting of an Administrative Order mandating the gradual phase-out of mercury in all Philippine health care facilities and institutions, the first of its kind in the region. HCWH-Asia also launched the Health Care Waste Assessment Programs (HWAP) with different hospitals in the country to draw up baseline data on good health care waste management practices and develop a health care waste assessment procedure appropriate in the Philippine health care setting and for adaptation in other Asian countries. With support from the Strategic Approach to International Chemicals Management’s (SAICM) Quick Start Program and Swedish Chemicals Agency (KemI), HCWH-Asia is currently working on substitution and management of chemicals in two pilot hospitals in the country.

HCWH-Asia has been visibly promoting its causes through seminars, conferences, and training programs, and has made several contributions to various published material concerning its key environmental issues.

For more information, visit www.noharm.org or email info@no-harm.org.
The Global Environment Facility unites 183 countries in partnership with international institutions, civil society organizations (CSOs), and the private sector to address global environmental issues while supporting national sustainable development initiatives. Today, the GEF is the largest public funder of projects to improve the global environment. An independently operating financial organization, the GEF provides grants for projects related to biodiversity, climate change, international waters, land degradation, the ozone layer, and persistent organic pollutants.

Since 1991, GEF has achieved a strong track record with developing countries and countries with economies in transition, providing US$11.5 billion in grants and leveraging US$57 billion in co-financing for over 3,215 projects in over 165 countries. Through its Small Grants Programme (SGP), the GEF has also made more than 16,030 small grants directly to civil society and community based organizations, totalling US$653.2 million.

The GEF also serves as financial mechanism for the following conventions:

- Convention on Biological Diversity (CBD)
- United Nations Framework Convention on Climate Change (UNFCCC)
- Stockholm Convention on Persistent Organic Pollutants (POPs)
- UN Convention to Combat Desertification (UNCCD)
- The GEF, although not linked formally to the Montreal Protocol on Substances that Deplete the Ozone Layer (MP), supports implementation of the Protocol in countries with economies in transition.

For more information, visit [www.thegef.org](http://www.thegef.org).
UNDP partners with people at all levels of society to help build nations that can withstand crisis, and drive and sustain the kind of growth that improves the quality of life for everyone. On the ground in 177 countries and territories, UNDP offers global perspective and local insight to help empower lives and build resilient nations.

World leaders have pledged to achieve the Millennium Development Goals, including the overarching goal of cutting poverty in half by 2015. UNDP’s network links and coordinates global and national efforts to reach these Goals. Their focus is helping countries build and share solutions to the challenges of:

- Poverty Reduction and Achievement of the MDGs
- Democratic Governance
- Crisis Prevention and Recovery
- Environment and Energy for Sustainable Development

UNDP helps developing countries attract and use aid effectively. In all their activities, they encourage the protection of human rights, capacity development and the empowerment of women.

The annual Human Development Report, commissioned by UNDP, focuses the global debate on key development issues, providing new measurement tools, innovative analysis and often controversial policy proposals. The global Report’s analytical framework and inclusive approach carry over into regional, national and local Human Development Reports, also supported by UNDP.

For more information, visit www.undp.org.
Acknowledgements

Health Care Without Harm would like to express its gratitude to the seven hospitals who shared their valuable time, knowledge, and experiences for the completion of this documentation. We are thankful to the hospital administrators for their willingness to be involved in this project. Likewise, we are grateful to the doctors, nurses, dentists, engineers, architects, medical technologists, radiologists, human resources personnel, housekeeping staff, biomedical waste staff, security guards and kitchen staff of the participating hospitals, who have shown us passion and dedication in working towards healthier hospitals.

ST. PAUL DE CHARTRES HEALTH CARE MINISTRY

Sr. Arcelita Sarnillo, Provincial Assistant for Health Care

GENERAL SANTOS DOCTORS HOSPITAL

Sr. Estelle Marie Camagan, SPC, Administrator
Dr. Daniel G. Yap Sr., Medical Director

GSDH’S RADIOLOGY TEAM
Aries Ada, Nuclear Medicine Orderly
Charlestone Buenaflor, Radiology Health Safety Assistant Officer
Marion Deo A. Sunico, Radiology Health Safety Officer

MARIA REYNA-XAVIER UNIVERSITY HOSPITAL

Sr. Ma. Celeste Rivas, SPC, Administrator
Dr. Raul Winston Andutan, Medical Director
Sr. Evelyn Aguilar, Health Care Waste Management Committee Head
Sr. Placida Anyayahan, Dietary and Linen Departments Head
Mr. Clemente Tahub, Biomedical Unit, Staff
Architect Gebe Dumaug

OUR LADY OF PEACE HOSPITAL

Sr. Marie Jeanette Grabato, SPC, Administrator
Dr. Roehl Salvador, Medical Director
Engr. Jed B. Baraquiel, Hospital Engineer

PERPETUAL SUCCOR HOSPITAL

Sr. Santanina Maria Bernaldez, SPC, Administrator
Dr. Pureza Onate, Medical Director
Sr. Myrna Borromeo, SPC, Head, Housekeeping Department
Mr. Jared Escarpe, In-charge of Biogas
Architect Ma. Celia Navarro, In-house architect
FROM THE BACKYARD TO THE FRONTLINE: Initiatives of Philippine Hospital Workers on Best Environmental Practices

PHILIPPINE HEART CENTER
Dr. Manuel T. Chua-Chiaco, Jr., Executive Director
Engr. Joe Barsaga, Chair, Health Care Waste Management Committee
Ester Borja, Immediate Past Chair, Health Care Waste Management Committee

SAN LAZARO HOSPITAL
Ms. Eleonorita Reyes, Chief Administrator
Dr. Winston Go, Medical Center Chief II & Chairperson, Health Care Waste Management Committee
Ms. Karen Arago, DMD, Co-chairperson, Health Care Waste Management

DENTISTRY DEPARTMENT TEAM
Dr. Ma. Teresa Angeles, Dr. Rosalina Cuenca, Dr. Bona Espartero,
Dr. Arlene Fabro, Dr. Manluiquez Lao, Dr. Jowin Tabuloc, and Dr. Gerald Luis Tuazon

ST. PAUL HOSPITAL-TUGUEGARAO CITY
Sr. Edith Christine Aguirre, SPC, Administrator
Dr. Rolando Mesde, Medical Director
Ms. Richael Batang, Supervisor, Housekeeping Department
Ms. Amira Camille Calata, RN, Infection Control Nurse
Ms. Heidi Peralta, Human Resource Coordinator
Mr. Rowel delos Santos, Operating Room Staff

AUTHOR
Yvette Severo Montecillo

HEALTH CARE WITHOUT HARM-ASIA
Merci V. Ferrer, Director
Faye V. Ferrer, Safer Chemicals Campaigner
Sonia G. Astudillo, Communications and Press Campaigner

CONSULTANTS
Jorge Emmanuel, Ph.D, Chief Technical Advisor
UNDP - Global Environmental Facility Project
Ruth Stringer
HCWH International Science and Policy Coordinator

Layout Artist: Mitzi Sabando

Cover Photo from http://galloping-textures.deviantart.com/
All photos by Yvette Severo Montecillo, unless otherwise specified.
INTRODUCTION ............................................................................................................................................. 1

REVENUES FROM THE PRACTICE OF ZERO WASTE .................................................................................. 3
Maria Reyna-Xavier University Hospital Waste Management Team
Finds Waste Minimization and Segregation to be a Good Business

A CULTURE OF SAFETY IN HEALTH CARE ........................................................................................ 9
General Santos Doctors Hospital’s Radiology Technology Team
Promotes Safe Practices to Prevent Radiation Exposure

SHIFTING AWAY FROM TRADITIONAL CHEMICALS ............................................................................. 17
St. Paul Hospital-Tuguegarao City Housekeepers
Find Safer Alternatives for Hospital Cleaning

ZERO-MERCURY PRACTICE IN HOSPITALS ......................................................................................... 23
San Lazaro Hospital Dentists
Initiate the Use of Mercury-Free Alternatives

BREAKING NEW GROUNDS IN SUSTAINABLE ENERGY PRODUCTION ........................................... 31
Perpetual Succor Hospital Biomedical Waste Man
Manages First Philippine Hospital Biodigester

FROM DOWNSTREAM TO MAINSTREAM ............................................................................................... 41
Philippine Heart Center and Our Lady of Peace Hospital Engineers
Discharge Cleaner Water
The modernization of Philippine hospitals in the 20th century brought a vast improvement in the country’s practice of health care. Today, with the Restructured Health Care Delivery System, primary services are provided at the local government level and are aimed at prevention and promotion of health. Secondary services are offered to patients requiring additional resources for treatment and are provided at the municipal to provincial hospital levels. Tertiary services are for patients needing highly technical and specialized skills which are found in medical centers, large hospitals, and national specialty hospitals. This system allows tertiary facilities to focus on complicated cases and provide their specialized services to a greater number of people needing those services.

The expansion of the health care system, however, has resulted in new concerns. Emerging problems such as the increase in biomedical waste meant a greater desire to resort back to traditional methods of treating waste, such as medical waste incineration, or to choose the newer so-called “waste-to-energy” technologies, both very expensive and with little or no attention given to pollution control. Incineration, although initially aimed at preventing transmission of infectious diseases from medical waste, is under greater worldwide scrutiny from scientific experts and the general public because of the hazardous pollutants generated by incineration including the highly toxic and environmental persistent by-product of burning: dioxins. Toxic at extremely low concentrations, dioxins are a family of compounds classified as Known Human Carcinogens by the International Agency for Research on Cancer, an agency of the World Health Organization.

On-going evidence-based inquiries have also unearthed a list of other concerns in health care, concerns that not only impact patients’ overall health, but also the health and safety of health care workers and communities. Health care facilities produce a significant amount of not only general waste, but toxic wastes such as mercury and several hazardous chemicals ranging from disinfectants to expired medications.

In the 21st century, the Philippine government started to address concerns regarding dioxin release and mercury exposure of patients in health care settings. In 2000, the Philippine Clean Air Act was passed, which bans any form of incineration, including the burning of medical waste. In 2008, an administrative order was passed which mandated the use of mercury-free devices in health facilities. These initiatives gained international attention, primarily because both laws were among the first to have been passed globally. To date, however, no local policy or law regulates the management of hospital chemicals.

Three Health Care Waste Assessment Reports were conducted by Health Care Without Harm-Asia on Philippine hospitals: St. Paul de Chartres Hospital in Tuguegarao, Cagayan Valley; Saint Paul Hospital Cavite in Dasmarinas, Cavite; and General Santos Doctors Hospital in General Santos City. The reports gave similar conclusions, namely, that infectious and hazardous hospitals wastes (e.g., pathological waste, sharps) comprise only about 15-20% of total hospital waste, while the rest is composed of recyclable, residual and compostable/ biodegradable waste (Health Care Without Harm, 2007). This is further supported by Tabish (2005) who states: “it is estimated
that about 85% of the waste generated is non-hazardous, about ten percent is infectious and 5% non-infectious but hazardous”.

Recognizing the need to address the issue, the United Nations Development Programme together with the Health Care Without Harm and the World Health Organization worked on a “Global Healthcare Waste Project” funded by the Global Environment Facility (GEF). The primary goal was to protect public health and the global environment from the impacts of dioxin and mercury releases.

The UNDP GEF project, which started in 2008, was implemented in seven counties (Argentina, India, Latvia, Lebanon, Senegal, Vietnam and Philippines) to develop, demonstrate, and sustain best health care waste management practices that are locally appropriate and globally replicable. In the Philippines, the project also demonstrated non-incineration technologies for the treatment of infectious waste. Below are the objectives for the project:

- Establish model facilities and programs, to exemplify best practices in health care waste management.
- Deploy and evaluate commercially available, non-incineration health care waste treatment technologies appropriate to the needs of the Philippines.
- Introduce the use of mercury-free devices in model facilities, evaluate their acceptability and efficacy, and develop and disseminate awareness-raising and educational materials related to mercury.
- Establish or enhance training programs to build capacity for the implementation of best practices and technologies both within and beyond the model facilities and programs.
- Review relevant national policies, seek agreement by relevant authorities on recommended updates or reformulations as needed, seek agreement on an implementation plan and, if appropriate, assist in holding a policy review conference for these purposes.
- Disseminate project results and materials to stakeholders and hold conferences or workshops to encourage replication.
- Make project results on demonstrated best techniques and practices available for dissemination and scaling-up regionally.

As part of its commitment to promote hospitals with best practices in environmental management and as a contribution to the UNDP GEF Project, Health Care Without Harm-Asia produced this documentation of hospitals with outstanding practices in health care waste and environmental management in the Philippines. Specific areas included in this documentation are:

- Clean Water Sustainability
- Greener Buildings
- Health Care Workers Safety: Radiation Exposure
- Renewable Energy
- Safer Chemicals
- Waste Minimization
- Zero Mercury
Revenues from the Practice of Zero Waste

Maria Reyna-Xavier University Hospital Waste Management Team Finds Waste Minimization and Segregation to be Good Business

Maria Reyna-Xavier University Hospital (MRXUH) is a hospital with a commendable practice in health care waste management. The practice of proper segregation, conscious adherence by all medical staff to safe infection control practices, strict monitoring of recyclable wastes, as well as an organized materials recovery operations system, and innovations aimed in minimizing waste volume are well-integrated into the hospital system, from leadership to the worker levels.

MRXUH in Cagayan de Oro City is located in Northern Mindanao, in the southern part of the Philippines. It is a private, 4th level tertiary, training-teaching facility with a 140-bed capacity. MRXUH provides specialization training and patient services in the departments of general medicine and surgery, paediatrics, and ENT (otorhinolaryngology- Ear Clinic and Surgery Center). The services of this facility primarily cater to ill clients with low socio-economic backgrounds in the region.
Upon entry to the hospital, visitors and clients are instantly made aware of the strict minimization practice of the hospital with the “styrofoam packaging not allowed” signage posted on the guard podium at the hospital entrance. Polystyrene foam, which is commonly called styrofoam, is used as a disposable take-out container for food and drinks and a very common item in Philippine fast food restaurants and canteens. The foam is made from polystyrene, a petroleum-based plastic. Its biggest threat to health is during its manufacturing. Polystyrene comes from a toxic liquid called styrene. At high concentrations to which many plastics manufacturing workers are exposed, styrene can affect the nervous system and cause tiredness, slowed reaction time, problems in concentration and balance, and changes to color vision (ATSDR, 2012). Styrene is also a possible human carcinogen. HCFC-22, a gas used in the manufacture of polystyrene foam, is a greenhouse gas and causes harm to the ozone layer. Benzene, a chemical component of polystyrene foam, is also a known carcinogen and enters the body through the skin and respiratory system (US CDC, 1994). The environmental impacts of polystyrene foam can be significant. Even in countries with good recycling programs such as the US, plastics account for 17% of all waste discarded in landfills with polystyrene comprising 1% of that figure (US EPA, 2011). However, because of the lightweight nature of polystyrene and foam, the volume it occupies in landfills is much greater. Polystyrene foam floats on water and small pieces look like food and have been ingested by fish, sea birds, and other marine animals. Studies have found that polystyrene foam represented 15% of the total volume of litter recovered from storm drains and 11% of coastal debris pieces (CIWMB, 2004).

Aside from the ban on styrofoam, the MRXUH Administrators are also taking steps to minimize use of single-use disposable plastics.

In the dietary department, current Dietary Department head Sr. Placida Anyayahan has replaced cling films or food wraps used to cover food trays with hard plastic baskets. Her department has also required hospital staff to bring their own spoons, forks, and water containers in order to eat in the hospital canteen.
FROM THE BACKYARD TO THE FRONTLINE: Initiatives of Philippine Hospital Workers on Best Environmental Practices

Mr. Clemente Tahub runs a well-organized and profitable operation from their Materials Recovery Facility (MRF). According to the Health Care Waste Management Committee Head for MRXUH, Sr. Evelyn Aguilar, their department earned enough revenues in 2011 such that they were able to use the excess MRF income for a hospital staff recreational trip. The hospital administration used part of the funds as a reward to recognize the staff’s role in the success of the waste management program. This positive reinforcement was an incentive for the staff to follow the hospital’s segregation requirements at the source (that is, in hospital wards and other areas). From July 2011 to May 2012, the income from the Materials Recovery Facility of MRXUH totalled Php201,526.05 (approx. US$4,798.23). Part of the income was also used for projects aimed at proper environmental practices and waste management.

Mr. Clemente Tahub, MRF unit biomedical maintenance man.

Sr. Anyayahan is also the administrator of the hospital’s linen department, which practices strict segregation of infectious and non-infectious linens for washing. She explains that since infectious linen are treated with bleach (sodium hypochlorite) and are usually washed longer than the non-infectious linen, this practice helps reduce chemical usage.

Another feature of the linen department is a linen repair area, where torn and damaged linens are mended so that they can be reused or altered to be used as wash rags or pillow cases.

Since the linen laundry area is situated in a separate building in the hospital premises, the available space is maximized by hanging the bed linens outside to dry in the sun. This practice has decreased the usage of the laundry dryer, which is only used on rainy days. This has actually saved the facility thousands of pesos per month in electricity and bleach purchase costs.

The MRF Unit is managed by Mr. Clemente “Enteng” Tahub. He has been working in the hospital since 1987 and was recently awarded for his 25 years of service. He initially worked as a gardener then as a biomedical maintenance man for the hospital’s MRF unit.
MRXUH’s Materials Recovery Facility Unit.
In order to facilitate the determination of recyclable/recoverable waste and their subsequent collection, Mr. Tahub systematically organized the MRF unit’s segregation process. Using precise documentation of all materials dropped-off in the unit, he is able to accurately track all potential income from the recyclables and estimate when he needs to start contacting partner materials purchasers. The MRF unit profits from the sales of such materials as metal cans, aluminium, metal tin roofs, heavy scrap metal, sturdy plastic containers (such as PET bottles), newspapers, cardboard boxes, glass dextrose bottles/collapsible plastic containers, and autoclave-treated needle-less (defanged) syringes.

During his designation in the area, Mr. Tahub constructed a three-chamber deep pit for placenta composting. From the delivery and operating rooms, placental waste is transported to the MRF unit for treatment in an autoclave and composting. The placenta stays in the pit for a period of 1-2 months to allow natural decomposition and aerobic digestion by bacteria in the soil, after which the compost is exposed under the sun until fully dried and then mixed with compost soil to be used as fertilizer for the garden.

The garden in the MRF unit yields local crops such as eggplant, onions, tomatoes, calamansi (calamandarin), malunggay (Moringaoleifera), okra (gumbo) and pechay (Pak choi or Bok choy). The local crops are then sent to the dietary department either to be sold in the canteen or cooked as part of the patients’ meals.
FINDING SOLUTIONS FOR WASTE PROBLEMS

The residual wastes from treated sharps had been an eyesore in the MRF unit for some time. With the recent flooding in the region due to heavy rains, MRXUH’s engineering department was hesitant to build pits for sharps, which could end up floating on the hospital premises during floods. This problem was solved by in-house Architect Gebe Dumaug, who came up with the idea of placing cement inside the filled-up sharps containers to weigh them down. Construction of the sharps pit in the MRF unit is currently underway, with the blocks used for the pit walls made from cemented sharps container. According to MRXUH, this project will reduce their residual waste, especially autoclave-treated sharps. Pouring cement inside of the sharps containers serves two purposes: it effectively encapsulates the sharps (needles) while forming rigid and non-floating blocks with the identical size and shape as the containers. The blocks, which are placed inside the sharps pit layer upon layer, cost about 50% less than regular cement blocks used for building such pits.

With a dedicated, resourceful, and creative team, MRXUH’s health care waste management program will continue to grow. As Sr. Aguilar explained: “We constantly search for ways to lessen our hospital’s waste. We will never be contented with our practice until we do achieve zero waste.”

REFERENCES


Health care facilities are a source of toxic and hazardous waste. When discharged improperly, these wastes impact not only the patients, but the general public and the environment as well.

One type of hazardous waste is radioactive waste from radionuclides, which are increasingly used by hospitals for diagnostics and therapeutic applications. Long-term, low-level radiation exposure has been linked to cancer and DNA changes (genetic and teratogenic/foetal mutations). Short-term, high-level exposures, however, can cause burns and radiation sickness. The symptoms of radiation sickness include nausea, weakness, hair loss, skin burns, or diminished organ function (US EPA, 2012).

In a study by Khan et al. (2010), the most commonly used isotopes in hospitals are technetium-99m (Tc-99m), iodine-131 (I-131), iodine-125 (I-125), iodine-123 (I-123), fluorine-18 (F-18), tritium (H-3) and carbon-14 (C-14) which may be
in liquid form, with lesser amounts as solids and minimal amounts as gas. These isotopes can contaminate syringes, needles, cotton swabs, vials, contaminated gloves and absorbent materials, as well as clothing and utensils which constitute the solid radioactive waste material from patients administered with high doses of radioisotopes like I-131.

Given the health risks associated with radiation exposure, hospital administrators and specifically those directly working in the radiological departments and in health care waste management are charged with upholding the primary objective of safe radiological waste disposal, which is to ensure that radiation exposure to the public, radiation workers and environment does not exceed the prescribed limits (ICRP Recommendations of the International Commission on Radiological Protection (2005) and Murthy BKS (2000)).

According to the Policies and Strategies for Radioactive Waste Management (2009) of the International Atomic Energy Society (to which the Philippines is a member country), it is “accepted that the person or organization that creates the waste is responsible for it and for its safe management.” It is therefore the responsibility of hospitals to ensure safe disposal of radioactive wastes. As of the date of this research, however, the author was unable to find current updates on the status of Philippine hospitals in the area of radioactive waste management.

General Santos Doctors Hospital (GSHD) is one hospital with noteworthy practices in radioactive waste management and disposal. With the initiative of GSHD’s radiology department team, proper management and disposal of radioactive waste are strictly implemented. In addition to the practices currently in place, innovations to improve safety in the area are also being carried out.

Marion Deo Sunico, 23, is GSHD’s Radiological Health Safety Officer. He and his team observe strict compliance to ensure the safety of their patients and workers by eliminating and reducing unnecessary exposures to radiation.
The following are safety procedures used in GSDH’s radiology services department:

1. Personal Protective Equipment (PPE) must be worn at all times for procedures as appropriate. PPE include lead apron, lead gloves.

2. Documentation of all procedures. Details in the table below.

3. Radiological level indicator card must be worn at all times.

4. Rostering/shift of radiology services team members to avoid overexposure.

5. Daily measurement of radiation levels with a radiation detection survey machine.

6. Proper preparation, storage and disposal in protective environments and containers.

7. Proper labelling of all radioactive waste containers: date, when expired, latest radiation reading result.

8. Only trained personnel are allowed to handle radioactive waste.
Protective chambers for the preparation of radioactive mixtures (dyes, injections for treatment, etc.)  Fume hood directs the gaseous radiation into a separate chamber, lead-lined cupboard and receptacles for direct disposal of radiation-contaminated waste, radiation mixture preparation chamber (technologists prepare the mixture with their lead-gloves clad hands inside this chamber).
The radiation services team follow strict protocols for delay-to-decay (or storage-for-decay) of their radioactive waste. Examples of specific policies and a survey form based on GSDH’s practices are shown below:

**Delay-to-Decay Protocol**

1. Short-lived radioactive material (physical half-life less than 65 days) may be disposed of after decay in storage (DIS). Keep material separated according to half-life.

2. Use separate containers for different types of waste (e.g., capped needles and syringes in one container, other injection paraphernalia such as swabs and gauze in another, and unused dosages in a third container. Because the waste must be surveyed with all shielding removed, the containers in which waste will be disposed must not provide any radiation shielding.

3. When the container is full, seal it with string or tape and attach an identification tag that includes the date that it was sealed, the longest-lived radioisotope in the container, and the initials of the person sealing the container. The container may then be transferred to the DIS area.

4. Decay the material for at least 10 half-lives of the longest-lived radioisotope in the container.

5. Before disposal as in-house waste, monitor each container as follows:
   - Check your radiation detection survey meter for proper operation.
   - Plan to monitor in a low level (less than 0.05 millirem per hour) area.
   - Remove any shielding from around the container.
   - Monitor all surfaces of each individual container.
   - Discard as in-house waste only those containers that cannot be distinguished from background. Record the date on which the container was sealed, the disposal date, and the type of material (e.g., paraphernalia, unused dosages). Check to be sure that no radiation labels are visible.
   - Containers that can be distinguished from background radiation levels must be returned to the storage area for further decay or transferred for burial.

6. If possible, Mo-99/Tc-99m generators should be held 60 days before being dismantled because of the occasional presence of a long-lived contaminant. When dismantling generators, keep a radiation detection survey meter (preferably with a speaker) at the work area. Dismantle the oldest generator first, then work forward chronologically. Hold each individual column in contact the radiation detection survey meter in a low-background (less than 0.05 millirem/hr) area. Record the generator date and disposal date for your waste disposal records. Remove or deface the radiation labels on the generator shield.

7. A storage area for radioactive waste is specially provided for at the 3rd floor of the hospital near the isolation room and is considered as an extension of the Nuclear Medicine Facility. Appropriate locks and signs are provided and only authorized personnel have access to this room.

### Department of Nuclear Medicine

**RADIOACTIVE WASTE DISPOSAL/STORAGE ACTIVITIES AND SURVEY FORM**

<table>
<thead>
<tr>
<th>Date (m/d/y)</th>
<th>Disposal</th>
<th>Storage</th>
<th>Type syringes/beads/vials/generator</th>
<th>Radionuclides and Procedure</th>
<th>Quantity (pcs, units, units, etc.)</th>
<th>Dose Rate at Surface (mrem/hr)</th>
<th>Technician</th>
<th>Reviewer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DISPOSAL:** This means that waste has decayed and will be disposed as ordinary waste.

**STORAGE:** This means that waste will be stored for decay purposes in the area designated by the Medical Isotopes Committee as storage area for radioactive wastes.
For the delay-to-decay or storage-for-decay process, a special storage area for the radioactive waste is used. Located in the 3rd floor of the hospital near the isolation room, the storage area is considered an extension of the Nuclear Medicine Facility. Appropriate locks and signs are provided and only authorized personnel have access to the room.

This development of safety practices, Sunico asserts, is a team effort. For the system to work, the workers must believe in the safety principles to ensure that no harm will come to hospital workers and the public. He further explains: “With the issue of radiation exposure, we cannot afford to be complacent. We continuously have to make sure our exposure will be minimal, so we try to develop our strategies in order to avoid unnecessary exposure.”

**EXCELLENT WORKER SAFETY PRACTICES**

Radiation safety is not the only example of best practices at GSDH in environmental management. The hospital is well-known for its commendable solid waste management practices. In previous years, GSDH was recognized by different institutions for its ecological consciousness and quality health care. The following are the awards given to the hospital since 2003:

- PHA Quality Medical Services Award (November 2005)
- Gawad Pangulo Kapaligiran Award (May 2005)
- DENR’s award for Active Support during the Environment Month (June 2005)
- Commendation from DOH Manila for an Active Solid Waste Management
- DOH Region XII “Most Healthy Hospital Award” (December 2003)

In September 2005, GSDH participated in the International Health Management Award in Kuala Lumpur, Malaysia by submitting an entry on Hospital Solid Waste Management. That same year in December, the hospital was invited by the World Health Organization to share its experience on Health Care Waste Management in relation to the National Environmental Health Action Plan.

GSDH also promotes good occupational health and safety practices to protect its employees. As of 2010, needlestick injuries have become a very rare occurrence in the hospital. This is partly due to the strict “no recapping” policy of the hospital. Sturdy, locally-made stainless steel needle cutters are available in the nurses’ stations to separate needles mechanically from the syringe without
manual handling, and to maximize the capacity in the puncture-proof sharps containers. When filled-up, the containers are brought to the sharps vault located at the MRF unit of the hospital.

Employees are also required to receive the hepatitis vaccine. In the case of a needlestick injury, a protocol to ensure worker safety is in place, including diagnostic procedures and post-exposure evaluation and follow-up.

Despite their previous accomplishments, GSDH management continues to find new practices to improve on with the help of their employees. This approach of continuous improvement arises from the leadership’s desire to nurture the potential in each of their employees. In the goal of ensuring health for all, decision-making does not always proceed in a descending manner but can also be participatory and guided by the experiences of the staff, thereby fostering excellence in the practices of the front-line personnel.

REFERENCES


Shifting Away from Traditional Chemicals

St. Paul Hospital- Tuguegarao City
Housekeepers Find Safer Alternatives for Hospital Cleaning

Traditional hospital practices in infection control can expose health care workers to chemicals that have adverse health effects. Toxic disinfectants like glutaraldehydes have been known to cause chronic occupational asthma, eye irritation, rhinitis, and dermatological conditions such as contact dermatitis and persistent hand eczema (US OSHA, 2006). This puts health care workers, who often come in contact with hospital disinfectants and chemicals, at risk for contracting health problems due to these exposures.

It’s another eight-hour shift in St. Paul Hospital in Tuguegarao City. For the housekeeping department, this means bringing out the main cleaning agents used for scrubbing: vinegar and baking soda. These are the same common ingredients used in Filipino homes for cooking or in dipping sauces. While most hospitals use commercial chemicals to clean areas in their hospitals, this private hospital in the northern region of the Philippine Cagayan Valley uses vinegar for cleaning rooms in the hospital that had been previously occupied by a patient. The housekeeping staff also prepares baking soda as polish for stainless steel found mostly in door panels and handles, among others, in the different hospital wards.
According to Richael Batang, head of the housekeeping department of this tertiary hospital, specific protocols employ dilute acetic acid (vinegar) as a surface cleaner in the terminal cleaning phase (after manual scrubbing with water and soap) of non-critical items in the following areas:

- Rooms and comfort rooms (toilets) including fixtures and furniture of discharged patients with non-infectious diseases
- Morgue area
- Public comfort rooms
- Ward comfort rooms

She further explains that during the terminal cleaning phase, the “application of the solution would start from the ceiling and go down to the whole floor area”.

Since 2008, SPH Tuguegarao’s housekeeping department have used diluted 4-7% acetic acid as part of their efforts to come up with a cleaning system that is cost-effective, efficient, and safer for the hospital staff as well as the environment. Instead of using products laden with chemicals such as sodium hypochlorite (bleach), formaldehyde, ethanol, glutaraldehyde and others, they make use of a mixture of vinegar and tap water with a concentrate: diluent ratio of 1.291 litres vinegar: 40 litres water.

This shift from chemical disinfectants to alternative natural substances for surface cleaning of non-critical items is part of an occupational safety precaution and environmental health consideration. According to the US Bureau of Labor Statistics “working with or being exposed to toxic chemicals is the single largest contributing risk factor associated with occupational illness and injury in health care”. To elaborate, many traditional cleaning products, floor strippers and disinfectants often contribute to poor indoor air quality and may contain chemicals that cause cancer, reproductive disorders, respiratory ailments (including occupational asthma), eye and skin irritation, central nervous system impairment and other human health effects (Best Environmental Practices in the Health Care Sector, 2010).

The benefits involving vinegar as a cleaning agent has not gone unnoticed over the years. An evidence review published by the National Collaborating Centre for Environmental Health in Vancouver Canada (http://
ncceh.ca/en/about_us), entitled Effectiveness of Alternative Antimicrobial Agents for Disinfection of Hard Surfaces, cites a similarity of results from studies by Yang et al. (2009) and Vijayakumar & Wolf-Hall (2002). These studies suggest that vinegar (acetic acid) exhibits the most antimicrobial efficacy, followed by lemon juice (citric acid) and baking soda (sodium bicarbonate). Organic acids such as acetic acid are hypothesized to cross the cell membrane of bacteria where the release of protons (H+) causes the cells to die (Bjornsdottiret al. 2006).

Specifically, the NCCEH reviewed evidence that gram-negative bacteria, such as Shigellasonnei, Salmonella spp., E. coli, P. aeruginosa, and Yersinia enterocolititia are more susceptible to organic acids (e.g., acetic acid, citric acid) than Gram-positive bacteria, such as S. aureus and L. monocytogenes. The highly cross-linked cell walls of Gram-positive bacteria are believed to impair the diffusion of the organic acids into the cell, preventing antimicrobial action (cited in: Yang et al. 2009; Bjornsdottiret al. 2006; McKee et al. 2005).

In comparison, reviewed literature suggests that although baking soda is generally ineffective against E. coli, P. aeruginosa, S. aureus, and Salmonella spp., it has notable virucidal activity against feline calicivirus (norovirus surrogate) (Malik & Goyal 2006, and Rutala et al. 2000).

Studies comparing acetic acid (AA), citric acid from lemon juice (CA) and baking soda (SB) give similar results in that the efficacy of AA, CA, and SB vary greatly (<1 log to >5 log reduction of test microbes; contact times ranging from 0.5 min to 15 min) depending on test organisms and test conditions. When used at higher temperatures, vinegar and lemon juice are observed to result in increased antimicrobial efficacy (Yang et al., 2009; Wu et al., 2000; Virto et al. 2005).

However, the difficulty in assessing antimicrobial efficacy plus the narrow antimicrobial spectrum of these alternative agents may limit their application as hard surface cleaners. Being aware of this, Ms. Batang and her housekeeping team have been careful to identify high-risk areas in the hospital, such as the infectious units or the patient isolation areas. For such areas, stronger hospital-grade disinfectants are used. The shift from toxic chemical cleaners to natural alternatives should be part of an infection control program that includes surveillance, monitoring, outbreak investigation, development of standard and transmission-based precautions, assessment of antibiotic
use, reporting, sterilization and disinfection procedures, and environmental cleaning that makes use of safer alternatives.

Although the use of strong disinfectants cannot be totally eliminated, minimizing their use in surface cleaning of non-critical items at SPH Tuguegarao Hospital has had economic advantages in addition to decreasing chemical exposures of hospital staff and patients. As of 2011, SPH Tuguegarao consumed a total of 198 gallons of acetic acid, amounting to Php6,500 to 7,000 (approx. US$160). This cost is less than half of the costs incurred if chemical disinfectants were used.

Some hospitals soak used needles and syringes in chemical disinfectants such as hypochlorite solution before disposal. Another environmentally-sustainable practice of this hospital is the use of a separate autoclave machine in the laboratory department for sterilizing used needles prior to being sent to a holding area for sharps waste. In the hospital, the puncture-resistant sharps containers directly go into the autoclave machine once filled up. This reduces chemical consumption and occupational exposures. The hospital has a strict no-recap policy in place.

INNOVATIONS IN THE WORKPLACE

SPH Tuguegarao has undergone a recent renovation, in which the structural design was modified to maximize natural lighting by placing larger glass windows in special areas such as theatre/operating room, recovery, delivery, and newborn unit rooms, and wards like the paediatric ward. In the theatre/operating rooms, “transparent walls” were installed instead of regular walls to separate rooms. This design allows the medical staff to “see into” the other room (drapes are placed around the operating table to protect patient’s privacy). This system helps the team in one room to immediately determine if their assistance is needed in the other room due to a challenging medical procedure. The design is also an energy-efficient innovation since lights and equipment not in use can be seen and turned off accordingly without having to go into the unoccupied room. In these areas, the light switches are labelled for easy control and to avoid wasting electricity.
In the pharmacy department, floor space was maximized by placing labelled sliding shelves holding medications. This gives the pharmacy a clutter-free look, an initiative by one of the sisters previously assigned in the hospital department, Sr. Placida Anyayahan.

Another innovation by this hospital was the installation of “breathable cupboards” which holds autoclaved sterile packs, sterile gowns, and sterile cloth used as sterile field surfaces for procedures (drapes). The breathable cupboards prevent condensation from the humidity inside the packs, a common occurrence in a tropical country like the Philippines, thereby inhibiting the growth of pathogens. In general, sterile packs must be handled using aseptic techniques and stored in a manner that keeps them dry; moisture from condensation brings with it microorganisms from the air and surfaces (Centers for Disease Control and Prevention, 2008). The reuse of autoclaveable materials also greatly reduces the waste generated by the hospital.

SPH Tuguegarao was awarded by the Department of Health-Center for Health and Development Region I (Cagayan Valley) for Hospital Good Practices on Health Care Waste Management in September 2008. In July 2009 they were given a Certificate of Recognition for Good Practices in Housekeeping and Health Care Waste Management. In June 2009, the Department of Environment and Natural Resources (DENR) awarded the facility a Certificate of Recognition for Implementing an Efficient Ecological Solid Waste Management Program.
REFERENCES


Zero-Mercury Practice

in Hospitals

San Lazaro Hospital Dentists Initiate the Use of Mercury-Free Alternatives

MERCURY IN EARLY CIVILIZATIONS

In ancient Greek, Roman, Chinese and Hindu civilizations, mercury was believed to possess magical life-prolonging, healing, and protective properties. Mercury was also associated with prosperity: in old Hindu culture, mercury was believed to be at the core of all metals, and the practice of alchemy was called “Rasasiddhi” which literally translates to “knowledge of mercury.” Similarly, in ancient European alchemy, it was generally believed that the correct combination of mercury and other substances would yield riches of gold (Sloane J, undated).

Despite mercury’s allure as a potential source of power, some ancient people also recognized the substance to be highly toxic. Sloane’s article, which documents the history of mercury use worldwide, traced mercury intoxication as having first appeared during its mining in Spain and Italy. Mercury was associated with neurovascular system-linked symptoms of initial tremors, which then progressed to severe mental damage. Interestingly, cinnabar—mercury’s only known ore — was found painted on prehistoric skulls at an ancient Mayan site in Peru dating back to 500 BC.
The Romans used mercury mining as part of their penal system for criminals, slaves and those deemed to deserve this type of punishment. The penal institutions’ wardens were aware that the prisoners would eventually die because of mercury intoxication, thereby saving them the effort of executing the prisoners. In Danbury, Connecticut the practice of applying mercury in the process of making felt hats caused mercury poisoning among workers, their families, and some customers. Consequently, the symptoms of nerve and brain damage produced by mercury intoxication were termed the “Danbury shakes.” The phrase “mad as a hatter” in Lewis Carroll’s Alice in Wonderland came from mental disorders that felt hat makers often exhibited due to chronic mercury exposure. In 1961, the US Public Health Service banned the use of mercury in the felt industry.

In the modern world, mercury is still widely utilized. The production and use of mercury-containing fluorescent bulbs and lamps for industry and homes is still in place. However, the chemically-safer and longer-lasting alternative light-emitting diode (LED) lighting is slowly replacing fluorescent lamps in industrial and domestic use. Although having a higher initial cost at the moment, LED lights can be a cost saving option in the long term due to their longer life compared to cheaper but short-lived fluorescent lamps.

**MERCUY IN THE PRACTICE OF MODERN HEALTH CARE**

Mercury is still used in the medical field as a vaccine preservative and an ingredient in over-the-counter medications, stimulant laxatives, topical antiseptics, ointments and creams, eye drops, and nasal sprays. Mercury is also used as a major component of dental amalgam for tooth filling.

In 2012, the US Food and Drug Administration (FDA, 2012) revised its regulation dealing with over-the-counter drugs containing certain active ingredients that the FDA felt had questionable safety and effectiveness. Among the ingredients of concern were mercury and mercury compounds used in: dandruff, seborrheic dermatitis and psoriasis drugs; skin bleaching products; topical antimicrobial medicines and antiseptic tinctures used for first aid; products for treating diaper rash; and some contraceptives. The FDA averred: “Based on evidence currently available, there are inadequate data to establish general recognition of the safety and effectiveness of these ingredients.”

Both the World Health Organization and United Nations Development Programme have acknowledged that concerns about mercury intoxication are valid, and both agencies are promoting the use of safe mercury-free alternatives. The WHO is collaborating with HCWH to phase out mercury in health care (www.mercuryfreehealthcare.org).

In the practice of alternative medicine, particularly traditional Chinese medicine, the reddish mercury-containing mineral cinnabar is contained in most of the preparations for application. In 2008, a safety review of such traditional Chinese medications found that cinnabar led to significant mercury intoxication when heated, consumed in large doses or if taken for a long period (Liu et al. 2008).

Owing to its property as an opaque liquid with a high density and linear thermal expansion coefficient, mercury was considered an ideal substance for barometers, diffusion pumps, coulometers and many other laboratory instruments (Ramanathan 2006). In health care, mercury has been used in devices to measure patient’s blood pressure (sphygmomanometers) and temperature (thermometers). In the Philippines, the phase-out of mercury-containing devices was met with initial resistance among health care workers. This was attributed to concerns regarding the accuracy of non-mercury containing medical devices. However, a published literature review in 2008 comparing the accuracy of mercury-free devices versus mercury-containing device in measuring human temperature concluded that spirit-filled and microprocessor (digital) mercury-free thermometers yielded
comparable results to the mercury-containing devices (The Office of Emergency Management and Occupational Health and Safety (EMOHS), 2008). A recent study, published in June 2012, concluded: “[N]o clinically significant differences were observed between the two types of sphygmomanometers” (Saxena Y et. al., 2012). The WHO’s guidelines on replacement of mercury thermometers and sphygmomanometers provide a more comprehensive assessment of accuracy (WHO, 2011).

MERCURY PHASE-OUT IN PHILIPPINE EDUCATION AND HEALTH CARE

In education, mercury is introduced to students in some schools in its elemental form as part of the Chemistry laboratory class. One such incident, which affected 213 students and faculty, occurred in 2006 in St. Andrew’s School in Paranaque City, Philippines. The case drew international attention through media and the internet and prompted concerns about mercury exposure of students in schools and eventually other areas as well. Of the exposed victims, 10 students were admitted to the Philippine General Hospital because of intoxication. To adequately remove mercury, the school was closed for a month while experts from the US EPA assisted in containing and managing the spill. Even so, the residual mercury could not be thoroughly removed (US EPA, 2008). As of 2013, one of the victims was still suffering from cerebral and neurovascular damage brought about by this exposure.

As awareness grew, the incident led to public and media pressure and eventual government scrutiny of the use of devices in health care, which when handled or disposed of improperly can cause debilitating and life-long damage. In 2008, the Philippine Department of Health’s Administrative Order 21 (AO 2008-21) took effect, regulating the Gradual Phase-Out of Mercury in Philippine Healthcare Facilities and Institutions. In support of this mandate, the Philippine Health Insurance Corporation (PhilHealth) included hospital compliance with this law as part of its accreditation requirement. Similarly, the Philippine Department of Interior and Local Government (DILG) released Memorandum Circular 2010-140 on Mercury Reduction Program for Healthcare Facilities, which is implemented by the local government units (LGUs). The country’s phase-out of mercury-containing devices has resulted in a significant number of hospitals replacing mercury-containing devices with safer alternatives (984 out of 1,851 hospitals) within the same year that the law took effect (as cited by Ferrer F, 2011: Philippine Hospital Association, 2009).
ZERO-MERCURY IN SAN LAZARO HOSPITAL

One of the hospitals well known for its compliance not only in the phase-out of mercury-containing devices but also in the management of spills and good practices in mercury storage is San Lazaro Hospital (SLH). Located in the heart of one of the heavily populated areas in Manila, this hospital is the only highly specialized institution that primarily caters to patients with infectious diseases ranging from the most common and treatable cases to the very rare and severely infectious illnesses. SLH is the sole referral hospital for infectious/communicable diseases and clinical care of HIV/AIDS, and is also the National Reference Laboratory for tests on HIV/AIDS and sexually-transmitted infections (Philippine Department of Health, 2010). As such, this hospital caters to a very large clientele with a rated capacity of 500 beds.

PACKAGING AND TEMPORARY STORAGE OF MERCURIAL DEVICES

**SPHYGMOMANOMETER**

<table>
<thead>
<tr>
<th>STEP 1</th>
<th>STEP 2</th>
<th>STEP 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut the rubber bulb and knot the tubings.</td>
<td>Seal with duct tape areas for possible leak.</td>
<td>Seal the sphygmomanometer with duct tape for possible leakage.</td>
</tr>
</tbody>
</table>

SLH’s containment and storage of mercurial devices.
(Source: San Lazaro Hospital Mercury Storage Presentation)
FROM THE BACKYARD TO THE FRONTLINE: Initiatives of Philippine Hospital Workers on Best Environmental Practices

From the Backyard to the Frontline: Initiatives of Philippine Hospital Workers on Best Environmental Practices

Zero-Mercury in the SLH Dentistry Department

For more than a decade, SLH’s dentistry department has shown exceptional initiative in the zero-mercury practice. Back in 1995, more than 13 years before the phase-out of mercury use in clinical devices in the country, clients of SLH were already enjoying mercury-free dental filling services as unknowing recipients of a service that would be considered good environmental practice many years later.

Thirteen years ago, SLH Dentistry Department’s Chief Dentist Dr. Rosalina Cuenca was asked for suggestions on how to upgrade her department’s services. At the time, SLH’s dentistry department mainly focused on tooth extraction and fluoride treatments. She requested the procurement of mercury-free dental fillings. The fillings are composed of glass ionomer cement and part of the tooth filling process involves light curing.

The end result of the filled-up tooth cavity highly resembles the actual tooth in its color and appearance,
Unlike dental amalgams which are colored silvery-black. This type of dental filling would usually cost between Php1,500-3000 (approx. US$30-70) per tooth in dental clinics. In SLH’s Dentistry Department however, the service is offered to clients at a minimal cost of Php150-300 (approx. US$3.50-7). The expense is subsidized by the government through the people’s taxes (also known as the “prepaid mechanism”). On average, SLH caters to 3,000-6,000 patients per year who avail of their dental filling services.

Although the reason for Dr. Cuenca’s choice was initially for aesthetic purposes, this decision proved to be very important many years afterwards when concerns about the safety of traditional mercury-based fillings sparked debates among health experts and the general public. Last June, a comparative health risk evaluation between mercury dental amalgam and resin-based alternatives published by HCWH in collaboration with Healthier Hospitals Initiative and University of Illinois at Chicago School of Public Health, further explained this issue: “[D]ue to well-documented toxicity and resulting health effects of certain forms of mercury and its compounds, potential association between exposure to mercury released from amalgam and disease formation in humans with amalgam fillings has been scientifically debated in academic and regulatory communities throughout the 20th century and now at the beginning of the 21st century.”

However, despite extensive review of existing literature of mercury-containing dental amalgams, both the US EPA (2004) and the European Commission’s Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR, 2008) agree on the insufficiency of evidence that links mercury-containing dental fillings and health problems of clients and health workers working with these substances. The data, however, do not totally rule out that mercury-containing dental amalgams may have an impact on public health.

In 2005, the United Nations Development Programme estimated that 362 tons of dental mercury are consumed worldwide. This claim is further strengthened by Erdal (2012) who reviewed studies conducted in Saudi Arabia (Shraim et al, 2011), Canada (Richardson, 2001 and Trip et al, 2004), US (EPA 2008, 2011), and Europe (EU European Environmental Bureau, 2007). These studies reached similar conclusions about the significant contribution of mercury from dental offices to the overall mercury contamination.
in wastewater (surface and groundwater), soil and the atmosphere. Although there may be insufficient data to link mercury-containing dental fillings and toxicity-related health problems of patients and health workers, it may be inferred that the larger public is exposed through improper wastewater discharges and air and soil pollution. All authors and agencies mentioned in the papers above call for either appropriate wastewater treatment prior to discharge, or replacement of mercury in dental clinics with safer alternatives.

According to Powers and Wataha (2008), the current criteria for selection of a material for dental filling is based on aesthetics, fluoride release, wear resistance, strength and ease of use. They further enumerated and evaluated the following commercially-available dental fillings used worldwide:

1. Composites which are aesthetically pleasing, strong, and wear-resistant but have low or no fluoride release;

2. Compomers which are less wear-resistant but have good aesthetic properties and release fluoride;

3. Resin-modified glass-ionomer cements which release more fluoride than compomers but are not as wear-resistant and are not used in posterior restorations;

4. Conventional glass ionomers which release the most fluoride and are best for patients with a high risk dental caries in low stress applications.

SLH has been using the conventional glass ionomers for their dental fillings since Dr. Cuenca’s procurement request was granted in 1995. This decision may have seemed an expensive one at that time but that purchase now seems to be worth its weight in gold. People serviced by SLH’s dentistry department have better-looking and healthier smiles, at a minimal cost to the environment.

As recognition for their endeavours in reducing the environmental imprint, SLH received the “First Do No Harm Award for Mercury-Free Health Care” from HCWH-Asia in 2011.

REFERENCES


Trip, L., Bender, T., Niemi, D. Assessing Canadian inventories to understand the environmental impacts of mercury releases to the Great Lakes region. Environmental Research. 95:266-271.


In Sustainable Energy Production

Perpetual Succor Hospital
Biomedical Waste Man Manages
First Philippine Hospital Biodigester

Perpetual Succor Hospital (PSH) is well-known for pioneering numerous medical procedures in the Visayas and Mindanao Regions. The hospital is recognized by national and local societies and organizations for a number of exceptional services to the community. Among the most remarkable of its accomplishments are the following: being the first hospital outside of Metro Manila to perform a kidney transplant (1986), to install state-of-the-art diagnostic and interventional facilities in non-invasive diagnostic procedures and invasive cardiac procedures (1994), and to perform open heart surgery (1994). The hospital is the first to perform coronary angiography (1995), to have a Cancer Institute providing a comprehensive cancer care program, the first in the Visayas and Mindanao to have a vertical laminar air-flow cabinet used in the safe preparation of chemotherapy drugs, and the first in Cebu to have a hospital-based Skin and Laser Surgicentre (2006). In addition to these medical advances, PSH is a multiple recipient of the “Cleanest Hospital in Cebu City” award (2002), the first hospital to receive the Hall of Fame award as the Cleanest Hospital in Cebu City (2006), and the recipient of the Philippine Hospital Association’s Patient Safety Award (2006).
In keeping with their commitment of service to their patients and the community, administrators of PSH had been considering ways to reduce their energy consumption and adopt renewable energy sources as they embarked on major projects to improve their hospital buildings. In 2012, their plans became a reality and the hospital started reaping the benefits of a more sustainable operation than in the previous years. As Sr. Myrna Borromeo shared, this is largely due to the dedicated and innovative Health Care Waste Management Team in their facility.

For Jared Escarpe, 23, a golden opportunity came when he proposed a plan that had been in his mind since he started work at PSH in 2010. Escarpe began as a staff member in the housekeeping department and then was assigned the following year as biomedical waste personnel. He had grown up in a barangay (small community) in Sitio Tac-an, Barangay Budla-an in Cebu City, where the major source of income was from agriculture. In his community, biological wastes such as crop leavings and poultry waste would go into the community’s biodigester to generate methane gas for cooking purposes. This practice so fascinated young Escarpe that when he initially started working with PSH, a hospital well-known for its state-of-the-art facilities as well as its ecologically-sustainable operation, he hoped that he would be able to impart what he knew about biodigester work.

Having the hospital administrators agree to his plan, however, was another story. Escarpe was a young, newly-hired employee who did not possess an engineering degree nor had he received any formal technical training to operate a full-scale biodigester. Biodigesters are relatively rare in the country and having a hospital operate one within its premises was unheard of. If his plan was approved, it would be the Philippines’ first biodigester intended for biomedical wastes and one of the first in the world. To the credit of the administration, they did not consider his lack of formal education and training as a barrier to implementing the plan. He had seen how biodigesters worked for more than half of his lifetime and had much experience and informal training on it. What he did not know, he made up by conducting his own research on existing materials on biodigesters.
1. Manure, urine, wastewater, leftover feeds are deposited in the inlet tank and mixed thoroughly into slurry consistency.

2. The slurry is released into the biogas reactor thru the inlet pipe. When the required retention time of 20-35 days is attained, methane gas is generated and deposited at the upper dome gas storage. Gas is produced in oxygen-free or no air environment inside the fermentation chamber, giving an odourless reaction of all the waste inside.

3. When the gas control valve is closed, enough pressure is generated inside the upper dome storage and will displace the fermented/digested sludge towards the outlet tank by natural hydraulic pressure. Gas pushes the liquid out into the settling and filter tank and finally overflows into the effluent liquid storage, which can be recycled/reused as excellent organic, natural fertilizers with biological pesticidal character.
When the gas control valve is opened for use of the methane gas, the liquid at the outlet tank will in turn push the gas out into the gas pipeline and finally conveyed to the stove/burners or engine as fuel.

A stirring mechanism is built inside the digester in order to break the formation of scum at the liquid surface which prevents gas to pass through the gas pipeline especially if the manure comes from large ruminants like cows, carabaos feed with forages. The regular stirring of the liquid inside enhances the fermentation and digestion because the microorganisms at all levels are achieved.

OVERVIEW OF BIOGAS DIGESTER
Tandem Model

Biodigester Plan and Diagrams for PSH.
(Source: Jared Escarpe, Perpetual Succor Hospital)
BIOGAS DIGESTER DIAGRAM
Fixed Dome Household Model Biogas Digester
Knowing he needed proof to convince the hospital administrators, he built a mini-digester, one that would actually produce methane. After five days, it was ready. Placing biodegradable waste such as garden waste and some vegetable food waste, he then met with the hospital administrators and the Health Care Waste Management Committee. During the meeting, he demonstrated how the mini-digester generated methane by producing flame from the gas.

A few months after that demonstration, the biomedical waste construction was under way in PSH. In less than a year (2011), the digester was ready for operation and started to receive biodegradable wastes such as garden waste (as a source of carbon and to reduce the odor of the waste breakdown products), and food waste (as a source of nitrogen necessary for the bio digestion process) from the dietary department. An additional component of the digestible waste would be from placenta, which used to be a problem for the hospital. The project cost the hospital Php250,000 (approximately US$5,950) for two biodigester reservoirs. The biodigester layout was designed by Engineer Bobby Bahinting, while Escarpe himself designed the inlet for the drainage to the reservoirs. The previous practice was to have the placenta waste picked up by the city sanitation department, a potentially unsafe practice. Since the hospital lacked the space to allot to placenta composting, they had no other options at the time. With biodigestion, however, they can treat the placenta via autoclaving and then transport it safely to the biodigester system for shredding. The remains would then be drained into the digester reservoir (the process is outlined in the previous page).

Currently, the biomedical waste digester is on its pilot implementation phase. As mentioned, the biodigester is fed specific types of biodegradable wastes such as garden waste (dry leaves and cropped plants), food waste, and placenta. Data such as sludge and reservoir temperature, pH, gas composition, measurement of input (waste type and weight per type per day), and gas output will be documented under technical supervision to ensure accuracy and continuity of methane gas production. Two months after the digester started receiving the first batch of digestible waste, the quantity of methane was insufficient for kitchen and laundry use, as expected. The maximum yield of methane is expected within six months from operation (June or July 2013).
Biodigester Construction. (Source: Jared Escarpe, Perpertual Succor Hospital)

Consultation on proper biodigester flow and management with the HCWH team.
SUSTAINABLE ENERGY: SOLAR POWER

In 2012, PSH pioneered the use of renewable energy among hospitals in the country. With an increased bed capacity from 240 to 320 beds resulting from the hospital renovation, PSH administrators decided to install solar panels in the roof deck area of the hospital with the objective of supplying electricity for water heating purposes to cater to 120-200 rooms.

GREEN BUILDING: GREEN WALLS

PSH is located in the center of Cebu City and most of the hospital’s land area is occupied by buildings. As a result, some wards inside the hospital become quite warm especially in summer while air-conditioning costs have skyrocketed.

A problem related to the air-conditioning was the venting of hot air from the air-conditioner’s cooling system to some parts of the hospital, in particular, the hospital chapel. Some nuns and patients’ relatives noticed the problem. The solution came in the form of “green walls” on the empty walls outside the chapel near the windows. The “green wall”, so aptly named, was built by planting climbing plants along the external building walls until they eventually covered the wall area. The result was fresher and much cooler air. The hospital administration liked the idea so much that they decided to plant an indoor/walkway garden just.
outside the ward windows. The benefits of the garden were impressive: over a month after the construction of the walkway garden, the electricity bill was greatly reduced. This was presumably because of the decreased use of the air-conditioning and bedside fans due to the cooler air inside the hospital.

A vegetable garden was also planted on the empty roofdeck of one hospital building. Organically grown crops like sweet potatoes, onions, tomatoes, calamansi (calamandarin), malunggay (Moringa oleifera), okra (gumbo) and pechay (Pak choi or Bok choy) are now thriving in modified tin boxes, with soil from the compost pits. When the vegetables are ready, they are harvested and then sent to the dietary department for patients’ consumption. Sr. Borromeo imposes a strict no-insecticide policy thereby reducing the exposure of the patients and staff to toxic chemicals.

The soil on which the plants grow are taken from the compost area in the hospital’s backyard where most kitchen waste is vermicomposted by African night crawlers, a breed of earthworms specifically used for their ability to recycle most biodigestible waste into a very nutrient-rich soil (Misra RV and Roy RN, 2003).
Other proposals to make the hospital more ecologically sustainable have been approved by the hospital board. Architect Ma. Celia Navarro, PSH in-house architect, has drafted ecologically-sound plans which include the following proposed improvements:

- **Green Replacement**: placing plants on the concrete surface of the parking space of the hospital.
- **Natural Windows**: provision of large window openings to maximize natural lighting and reduce the need for artificial lighting.
- **Rain Harvesting**: rainwater collection for plant irrigation and toilet flushing
- **Efficient Lighting**: use of CFLs (compact fluorescent lights) and LED (light emitting diode) bulbs to reduce energy consumption by 30%.
- **PV Solar Power**: for artificial lighting
- **Passive Cooling**: provision of cross ventilation (windows are opened along the corridors to allow movement of air inside the building and to allow fresh air to enter and hot air to escape outside).

PSH has made the goal of reducing their environmental impact a part of their normal hospital operations. Being a major medical center in a thriving metropolitan area in the country has not been an impediment for the administrators of this institution in promoting an ecologically cyclical, healing operation, one that not only functions to bring back health throughout a patient’s stay, but also tries to enhance the well-being of the community and the environment.
From Downstream to Mainstream

Worldwide, concerns surrounding the future availability of clean water are becoming more apparent. Industrialization and urbanization, often seen as a sign of a nation’s progress, along with population growth inevitably lead to an increase in water demand. When the supply of fresh water cannot keep up with the demand, a water crisis ensues often accompanied by grave environmental consequences. It is estimated that freshwater demand for industrial use will increase from 30 Billion Cubic Meters (BCM) to 120 BCM by the year 2025 (Babu, 2008). This dire estimation makes the need for proper wastewater treatment of high water volume discharge facilities all the more necessary.

The Philippines is an archipelago composed of 7,107 islands with a total land area 300,000 km2. Topographically, the Philippines is broken up by the sea, giving it one of the longest coastlines in the world. Moreover, bodies of water are intertwined throughout the land area all over the country. Bays, fountains, lakes, rivers, seas, straits, and waterfalls are located near communities and are often used for drinking, preparing and washing food, and recreation. Without a
safe source, despite its accessibility, this would make the population susceptible to contamination and toxicity in the water.

The Philippine Clean Water Act (2004) requires that any facility discharging wastewater into Philippine waters and land must procure a wastewater discharge permit from the Regional Office of the Environmental Management Bureau. Those covered by this law who may need to secure a wastewater discharge permit are industrial companies or agricultural operations located near bodies of water and who discharge a large volume of water into these.

In the 3rd Edition Philippine Healthcare Waste Management Manual (2012), it is recommended that “all health care facilities have their own Wastewater Treatment Plan”. Among the first hospitals which have treated their wastewater, and have successfully sustained the practice, two hospitals have been documented. Both are located in the National Capital Region: 1) Philippine Heart Center, and 2) Our Lady of Peace Hospital.

The Philippine Heart Center (PHC) is the premier cardiac hospital in the country. It features a quality, clientele-focused service based on numerous research projects, evidence-based care, and continuous education. For 2011, the hospital admitted about 14,484 patients, performed over 34,800 non-invasive cardiac diagnostics (in and out-patients), and performed invasive cardiac catheterization on over 4,700 patients.

With the volume of patients coming in and staying in the hospital, the water consumption showed a dramatic increase over the years 2005-2009. This increase in water consumption resulted in a significant expense to cover the water bills.

Engineer Joe Barsaga (Engineer IV-Mechanical Department) is the person in charge of PHC’s Sewage Treatment Plan (STP). He proposed the construction of this treatment plan about 2 years ago. Today, the STP has its own maintenance staff that monitors and ensures the smooth flow of the wastewater treatment process around the clock and all days of the week. A specific set of tasks is assigned to every person in each of the eight-hour shifts.
Babu (2008) outlined the major steps in wastewater treatment as listed below. Each step can be accomplished using one or more treatment processes or types of equipment.

1. **Preliminary treatment** - to remove materials that could damage or clog plant equipment or occupy treatment capacity without being treated. In some designs, preliminary treatment or pre-treatment is considered part of primary treatment.

2. **Primary treatment** - to remove settleable and floatable solids.

3. **Secondary treatment** - to reduce biochemical oxygen demand (BOD) and remove dissolved and colloidal suspended organic matter by biological action. Organics are converted to stable solids, carbon dioxide, and more organisms.

4. **Disinfection** - to remove microorganisms and eliminate or reduce the possibility of disease transmission when the flow is discharged.

The PHC’s STP process flow is outlined as follows:

**FROM THE SEWERAGE SYSTEM, WASTEWATER FLOWS INTO THE FOLLOWING:**

1. **Primary treatment section:** raw influent which may contain materials such as sand, broken glass or sticks passes through a pre-treatment area containing coarse screens to separate the wastewater. The purpose of preliminary treatment is to protect plant equipment by removing large materials which may cause clogs, jams or excessive wear.

   After these materials are removed, the main process of primary treatment entails the settling or sedimentation of other solids as raw sludge.

   - Grit is heavier than inorganic solids and includes sand, gravel, clay, egg shells, coffee grounds, metal filings, seeds, and other similar materials. The coarse screens remove the grit while keeping other solids in suspension. Once separated, the grit goes to proper disposal.

   - The screened water enters the equalization tanks, where solids suspended in the water are allowed to settle to the bottom to form raw sludge while fats, grease and oil float to the top. This is the main area for primary treatment. PHC uses gravity (settling) to separate the suspended solids from the liquid.

2. **Secondary treatment section:** after primary treatment (primary settling), the wastewater goes through a biological process to degrade organic material.
The PHC STP process uses two sequencing batch reactors (SBRs) in which air is bubbled through one tank in order to stimulate the growth of aerobic bacteria which are needed to degrade the organic matter. Unlike the raw sludge from the equalization tanks, the sludge from the SBR is activated (rich in microorganisms needed to break down organic waste) because of aeration. SBRs generally function sequentially such that one tank operates in the aerating and filling mode while the other allows the activated sludge to settle to the bottom where bacteria continue to multiply until all dissolved oxygen is used up. The tanks can switch functions depending on the stage of treatment.

From the SBR used for settling the activated sludge, some of the sludge (now called the waste activated sludge or WAS) goes to an aerobic sludge digester for further treatment. After some time, some of the activated sludge in the aerobic digester is returned to the aeration tank to “seed” the next batch with good bacteria to feed on the next batch of organic waste. The remaining sludge from the digester can be treated further by digestion, composting, and drying after which it is reused as fertilizer.

The clear water from the top of the SBR where sludge has settled is pumped through pipes. Some of the water goes to the disinfection stage while another portion is recycled to maintain the hospital garden’s landscape.

DISINFECTION: treated sewage from the SBR is treated with sodium hypochlorite, followed by filtration before being discharged into the city’s sewer system.
The STP maintenance crew are trained to test the water pH levels every day. This is to ensure that during the secondary treatment process, the ideal alkalinity in the water environment is maintained for denitrification. The optimum pH range for denitrification is between 6.5 and 8.0 (US EPA, 1993).

The PHC STP also undergoes a monthly water examination of the water and wastewater conducted by an independent water analysis laboratory (CRL Corporation, a DENR and DOH accredited laboratory) to ensure that water quality standards are met.

Engr. Barsaga has a lot of passion and commitment to his work. He states: “For a proper wastewater treatment facility to work properly, adequate manpower plus an experienced, knowledgeable and passionate team should be working on this facility full time.”

His work with PHC’s STP has been noted by the Department of Health. In the 3rd Edition Philippine Healthcare Waste Management Manual, he authored the health care wastewater management chapter.

Now in its 36th year, PHC continues to do its part to protect the environment. It recently received the Gold Award from Accreditation Canada International, and was accredited as an International Training Center by the AHA Life Support.
Our Lady of Peace Hospital (OLPH) is owned by the Foundation of Our Lady of Peace Mission Inc. and is administered by the Sisters of Saint Paul de Chartres. The hospital was built to provide affordable quality health care services to all, especially indigent patients who are given free medical consultation services and ward accommodation. The hospital has a 100-bed capacity, and offers specialized services like craniofacial care (repair and care for patients with cleft lip, cleft palate and craniofacial defects), eye care, physical therapy and rehabilitation (for neurological, musculoskeletal and pediatric rehabilitation). The hospital also offers standard medical services like emergency room, out-patient and in-patient treatment, and operating room, laboratory and radiological services.

OLPH’s aim is to pursue “a better quality of life for the present and future generations, protect the environment, and help the government in implementing the Philippine Environmental Laws such as Environmental Impact Statement System (P.D. 1586) and the Pollution Control Law (P.D. 984 and ADO 25).” In addition, as health care professionals, they consider it their responsibility to “protect and promote people’s right to health.” Their goals and responsibilities are the basis for their decision to construct a Sewage Treatment Plant.

Below is the outline of OLPH’s STP process
(OLPH STP Process Protocol, 2012):

1. PRIMARY TREATMENT: The wastewater is conveyed to the Bar Screen for the removal of large solids before going into the sump pit.

   - Wastewater is then pumped into the Equalization Tank (EQT) where homogenization takes place through the air mixing process from the blower.

   - With the water level controller in the EQT, the wastewater is automatically pumped to the Aerobic Biological Clarifier (ABC).
SECONDARY TREATMENT: The homogenized wastewater undergoes biological treatment in the ABC where the BOD (Biochemical Oxygen Demand) and TSS (Total Suspended Solids) are reduced. There is a continuous sludge return in the ABC and excess sludge flows by gravity to the Activated Sludge Digester (ASD) when the valve is opened manually. The floating sludge can be manually scraped and put into a bucket for drying prior to disposal as domestic solid waste. The excess sludge from the ASD is discharged periodically to the Filter Press System where more liquid is removed prior to disposal as domestic solid waste.

DISINFECTION: The clear supernatant liquid in the ABC flows through a wire canal by gravity to the Chlorine Contact Chamber (CCC) and is injected with chlorine to disinfect it before disposal. Disposal is by gravity flow to the creek.

The plant is operated and maintained by the Maintenance Department of the hospital. Under the supervision of Engineer Jed Baraquiel, the Hospital Engineer and the Pollution Control Officer, the STP staff makes certain that the effluent discharged by the plant is within the parameters required by the Department of Environment and Natural Resources (DENR). A discharge permit is obtained from the DENR yearly. Engr. Baraquiel also submits a quarterly Self-Monitoring Report on the operation and laboratory analytical test results of the effluent of the STP as part of the requirements of the DENR. Water testing and analysis is conducted by Mach Union Laboratory, a testing facility accredited by the DENR and the DOH.
Engr. Baraquiel has been monitoring some components of the STP that need upgrading, specifically the filter press system, motorized mechanical bar screen and the chemical mixer. Nevertheless, results of the laboratory analysis of the effluent remain within the prescribed parameters.

The hospital is working on the re-use of the effluent or STP discharge for flushing common toilets in the ground floor of the hospital. This project could save the hospital as much as 90 cubic meters of water per month or the equivalent of Php7,000 (approx. US$170). The hospital also plans to re-use the effluent for watering the plants around the hospital.

A study and observations are being conducted on the possible use of excess sludge from the STP as soil additive and fertilizer for the garden. The hospital hopes to accomplish all of the above-mentioned plans by the end of 2012.

REFERENCES


