GLOBAL GREEN and HEALTHY HOSPITALS

Health Care Without Harm

SUSTAINABILITY IN ACTION

Best Practices from Global Green and Healthy Hospitals Asia Members and other Countries

Photo by Yuriy Klochan/123rf

A collection of concise, inspiring and featured applications of the Ten Sustainability Goals by Global Green and Healthy Hospitals Asia Members and other Countries

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SUSTAINABILITY IN ACTION

Best Practices from Global Green and Healthy Hospitals Asia Members and other Countries

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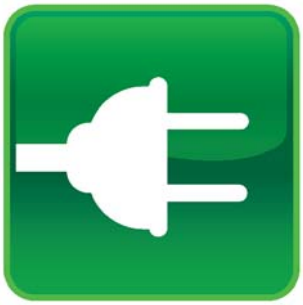


ENERGY: Implement energy efficiency and clean, renewable energy generation

WATER: Reduce hospital water consumption and supply potable water

Global Green and Healthy Hospitals has its foundation in a comprehensive framework of 10 interconnected goals for the health sector to address and promote greater sustainability and environmental health.

TRANSPORTATION: Improve transportation strategies for patients and staff

FOOD: Purchase and serve sustainably grown, healthy food

PHARMACEUTICALS: Safely manage and dispose of pharmaceuticals

BUILDINGS: Support green and healthy hospital design and construction

PURCHASING: Buy safer and more sustainable products and materials

Photo by amenic181

The Global Green and Healthy Hospitals Network aims to contribute significantly in putting the health care sector back in the center of healing.

ABOUT THIS COMPENDIUM

Since the Global Green and Healthy Hospitals inception in Asia, its members have been encouraged to record, track and monitor their journeys toward sustainability and to ultimately develop a compilation of best practices where other hospitals and health facilities and systems can also learn from. A venue to share their concerns, difficulties, successes and continually create ripples of inspiration. An inspiration that can encourage other members of the health care sector to take part in and uphold responsibility towards our planet and our people.

We have made this publication possible for healthcare stakeholders to be able to obtain inspiration from the good practices of Global Green and Healthy Hospital members from the Asia region.

This online publication is going to be updated regularly in order to give way for more case studies that will be gathered after this initial publication.

THE 10 GGHH SUSTAINABILITY GOALS

It compiles all the case studies implemented and documented by GGHH member hospitals in Asia. You will find topics here which focus on the 10 Global Green and Healthy Hospital Agenda Goals. Which are Leadership, Waste, Water, Energy, Chemicals, Food, Building, Transportation, Pharmaceutical, and Purchasing. All the activities and policies related to the mentioned Agenda Goals directly and indirectly contributes to Climate Change due to the greenhouse gas emissions that take place in all systems of health care.

THE IMPORTANCE OF THIS COMPENDIUM

Through this document, the leadership of the health care sector is given the focus and recognition in order to usher in a broader and more strengthened collaboration towards greener health care and a healthier environment; and by showcasing their best systems and applications, every innovator from the sector are given the proper acknowledgement. More importantly, to have an accessible guideline and concrete examples for others to learn from and accommodate.

LEADERSHIP

Prioritize Environmental Health as a Strategic Imperative

Photo by Alexey Poprotsky/123rf

CHINA NATIONAL HEALTH DEVELOPMENT RESEARCH CENTER

Strategic Research on Developing Green Health and Care System in China

GGHH AGENDA GOAL

Leadership

RESEARCH GOAL

Through summing up and analyzing domestic and international advanced concepts and practical experiences, this research project aims to generalize and summarize appropriate development models for China's Green Health and Care System, as well as to facilitate the formulation of Construction and Development Strategy of China's Green Health and Care System.

PROGRESS ACHIEVED

1. Completed a theoretical framework of Green Health and Care System;
2. Involved key elements of Green Health and Care System in relevant national standards and planning, such as The 13th Five-year Healthcare Construction Plan, the General Hospital Construction Standards and the Evaluation Standard for Green Hospital Building (GB/T51153-2015);
3. Raised recognitions of the importance of Green Health and Care System among national and provincial policy makers;
4. Participated in knowledge exchanges and attracts the attention of international communities.

BACKGROUND

First of all, external factors have driven the proposal of Green Health and Care System. Green development of the healthcare sector is in line with China's needs in political, social and economic, scientific and technological, resource, as well as development in other spheres. What's more, problems within the current systems have pushed the formulation of Green Health and Care System. High non-medical costs, inefficient healthcare, lacking conservation awareness, scattered care delivery, increased tension between physicians and patients and other issues not only have hindered the development of China's healthcare system, but have posed global challenges. These internal forces are therefore also driving structural changes.

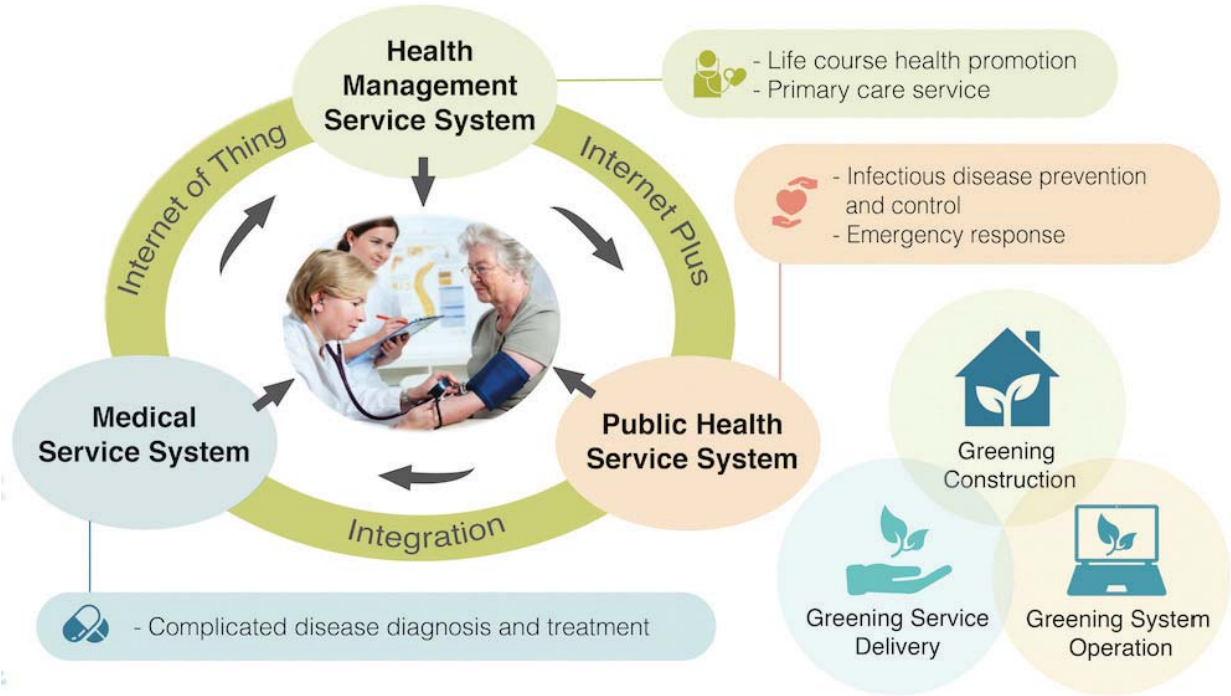
As more attention has been paid to "green" by the public, and as health care service has been moving away from a linear and biomedical model of thinking towards to a more biological model, "green" - as the base color of development - is not just a notion of economic development, but will also become a source of impetus to brand-new development models. Upholding the concept of green development in healthcare sector and building a Green Health and Care System will surely become a key component in the construction of Healthy China, and have already become a new trend in leading global health development.

GREEN HEALTH AND CARE SYSTEM (GHCS)

Green Health and Care System (GHCS) is a new model of delivery health care service. GHCS is people-centered and health-centered, takes safety, high efficient, low consumption, intelligent, innovative, sustainable, and resilient as main characteristics. GHCS provides life-cycle service management and whole process manage of disease. GHCS's purpose is to establish a new health service model that promotes "Less Sickness and No Sickness" for the population. GHCS's ultimate goal is to let everyone enjoy green, and let everyone possess health.

- **FRAMEWORK FOR GREEN HEALTH AND CARE SYSTEM**

The Green Health and Care System is composed of three sub-systems, including health management service system, medical service system and public health service system (as shown in the picture).



Health management service system aims to enhance and maintain life-cycle health for urban and rural population, including life course health promotion and primary care services. It consists of two components: public health management and health self-management, in which governments, society and individuals will altogether involve. Medical service system focuses more on complicated diseases diagnosis and treatment.

The public health service system pays more attention to population-based risk management service that has externality, including infectious disease prevention and control, as well as emergency response.

- **CONTENTS OF GREEN HEALTH AND CARE SYSTEM**

Greenization for each of the three sub-systems within the Green Health and Care System can be reflected in greening construction, greening operation of the system, and greening service delivery.

- Greening construction provides the infrastructure basis to establish healing environment.
- Greening operation of health care system is embodied indifferent levels of GHCS. At macro level, it is embodied in the highly efficient integration among the three sub-systems. At the meso level, green operation is reflected in the integration among different types and levels health institutions in each sub-system. At the micro level, it is demonstrated in the greening operation within each single health institution.
- Greening service delivery means the health and care service provided by Green Health and Care System is affordable and valuable.

NEXT STEPS

The framework of Green Health and Care System is quite comprehensive, the research team will further analyze and utilize advanced experiences from other countries and other industries, develop roadmaps to guide green practices, promote policy transformation, conduct pilot projects, and involve all sectors of society to participate in the development of Green Health and Care System.

DEMOGRAPHIC INFORMATION

China National Health Development Research Center (NHDRC) is a national research institution, established in 1991 under the leadership of National Health and Family Planning Commission of China (NHFPC). It works as a national think-tank providing technical consultancy to health policy-makers. The major responsibilities include conducting research on national health reform and development strategy, national health related public health policy, to provide consultancy and advice for the policy makers, health management and practice, health policy and technology assessment, basic theory and methodology of health economics and health administration, and participating in related practical works.

LINK:

China Health Development Forum— Construction and Development Strategy of Green Health and Care System

http://www.nhei.cn/nhei_en/center_en/web/content.jsp?news_id=4028e4814ddc3f400153c1a75c9d00da&f_page=news&

DATE SUBMITTED: June 2016

DALIN TZU CHI HOSPITAL TZU CHI MEDICAL FOUNDATION (TAIWAN)

Active Transportation: Step Right Up!

GGHH AGENDA GOAL

Leadership

HOSPITAL GOAL

- To ban public smoking areas within hospital vicinity
- To save electricity by encouraging the usage of staircase through creation of a supportive environment
- To promote good health among employees and patients through exercise

PROGRESS ACHIEVED

- Increase in human health benefit. Banned public smoking area in compliance with Taiwan National Policy banning smoking in all indoor public areas ratified January 11, 2009.
- Closed selected elevators at night time to minimize usage. At night, only 10 out of 23 elevators are operational

THE ISSUE

A staff physical examination was done in the year 2006. Based on the results, the hospital had seen the urgency to improve the cardiorespiratory endurance of the employees. The result of the test showed that 67% of the employees' fitness level is below average.

The hospital deemed that through promotion of aerobic exercises and other physical activities the health of their employees will be improved. The table below shows the results of the Cardiorespiratory Endurance Fitness Test Result.

Table 1.0 Cardiorespiratory Endurance Fitness Test Result in 2006

Employees	Excellent	Good	Average	Bad	Very bad	Total
Admin Staff	7	16	88	152	34	297
Technicians	12	26	90	133	35	296
Doctors	2	20	38	69	13	142
Nurses	8	26	175	354	122	685
Total	29	89	401	729	212	1420

SUSTAINABILITY STRATEGY IMPLEMENTED

To promote and support this behavior, current spaces such as staff dormitory and staircases were transformed and decorated to encourage physical activities. Moreover, physical activities will be incorporated in to their work-time to engage employees' participation.

Posters displaying messages on benefits of walking may be seen around the hospital. It was indicated in the posters that using the stairs is an excellent way to cope with job-related stresses and incorporate physical activity into a sedentary work life

To monitor and further enhance the program, Dalin Tzu Chi Medical Hospital established a Staff Health Promotion Committee which consists of members from different departments. The members of this committee comes from the Departments of Community Health, Human Resource, General Affairs and the Superintendent's Office

IMPLEMENTATION PROCESS

1. Environment Analysis

Identify priority areas by calculating cigarette butts among the staircase. This activity was conducted to promote utilization of stair cases. During the implementation of smoking bans in all public indoor areas, smokers found staircases as inconspicuous area for smoking. Table below presents the number of cigarette butts found in different areas for a period of twenty days monitoring.

Hospital encourages visitors to take the stairs (Up 5 floors and down 4 floors).

Table 2.0 Number of Cigarette Butts Found in Identified Areas

Identified Areas	5F	6F	7F	8F	9F	10F	11F	13F	Total
Area A (Patient's Ward)	124	16	37	801	1097	840	1147	14	4076
Area B (Patient's Ward)	17	39	890	754	1006	929	969		4604
Central	29	34	27	44	34	35	36	26	265
Garden	1611	1484							3095
Total	1781	1573	954	1599	2137	1804	2152	40	12040
Average/ Day	89	79	48	80	107	86	108	2	602

2. Redecorate Rarely Used Stairs

To create a supportive environment, posters and murals were placed in strategic locations within the stair areas. Stair doors from Basement to 3rd Floor were kept open, furnished and decorated. These activities were done to encourage patients to immediately decide to take the stairs because of the benefits presented and pleasantness of the environment portrayed in the murals.

Healthy stairs decorated with natural sceneries and health information.

"Finishing 260 staircases steps is not a dream!"

"100th step, way to go!"

"150th step, keep it up!"

"Almost there, keep going! Congratulations! You did it."

Motivational signs on stairs

3. Stairs Challenges were Introduced:

Stairs logs were tracked by scanning personal ID card and participation will receive recognition and tokens. Winners will also be appointed as ambassador to promote this healthy initiative.

4. Media:

Posters, news covers, newsletters and hospital computers' desktop wall-papers all show information about the program.

TRACKING PROGRESS

1. For the first 2 years, a stairs logs tracking system was used to increase participation and instill culture of using the stairs.
2. Direct Observation:
3. Significantly reduced number of smokers seen at staircase

CHALLENGES AND LESSONS LEARNED

Strategies should go beyond education or communication to achieve significant behavioral changes among target population. We believed that environment modifications may present opportunities which are free and readily available.

NEXT STEPS

Implement Intelligent Building Energy Management System (iBEMS) for better energy monitoring in elevator usage.

DEMOGRAPHIC INFORMATION

The first Tzu Chi General Hospital was inaugurated on August 17, 1986 The Hospital practices the respect for life and patient – oriented medical care principles in Eastern Taiwan.

On the other hand, Dalin Tzu Chi General Hospital, a hospital established in a land with an area of 137,800sqm, was inaugurated on August 13, 2000. The hospital is serving the people in the area of Yunlin and Chia-yi, a place with disproportionate medical resources.

Hospital provides consultative service, in-patient palliative care unit (acute hospital) and hospice home care service. The hospital has 957 beds, 20 operating rooms and 1756 employees. With the present facilities and manpower the hospital is able to serve an average of 78,742 outpatients per month (944,904 annually) with an estimated 17,578 days of stay per month.

LINKS

http://dalin.tzuchi.com.tw

QUOTES:

"I have a busy schedule as a surgeon. But taking the stairs helps me exercise more and conserve time as it is much faster to use the stairs than wait for an elevator."
- Cardiologist, Dr. Lin

KEYWORDS / TOPICS:

Active transportation, stairs, worksite health promotion

DATE SUBMITTED: August 2015

TAOYUAN CHANG GUNG MEMORIAL HOSPITAL

Green and Healthy Hospital Environment Achievable with Leadership

GGHH AGENDA GOAL

- Leadership

HOSPITAL GOAL

- To reduce carbon dioxide emission
- To reduce energy consumption

PROGRESS ACHIEVED

- In pursuit of complying with the decrees and policies on environmental protection. Taoyuan Chang Gung Memorial Hospital launched Energy Management Promotional Team in 2006, led by Vice Superintendent Cheng – Ta Yang. The hospital is committed to uphold fundamental environmental principles such as energy saving and waste minimization.
- The quarterly conference is held for proactive review and promotion of measures for energy saving and waste minimization
- The Taoyuan Chang Gung Memorial Hospital team has been totally committed to energy saving and carbon dioxide emissions reduction. All employable means were implemented to reduce energy consumption while enforcing waste minimization strategies as an allied activity. Waste minimization activities included recycling. The results of the Hospital's initiative have been impressive which earned them recognition from renowned authorities. These are Environmental Protection Administration, EY, Bureau of Energy and MOEA in Taiwan. The Hospital has received awards for energy saving, waste minimization and green procurement in 2009, 2010 and 2013.
- The Hospital received ISO 20001 in 2014.

Receiving the EPA Outstanding Award in Promotion of Waste

Receiving the EPA Outstanding Award in Energy Saving and Emission Reduction Action

Receiving the ISO 50001:2011 energy management systems in 2014

THE ISSUE

- Foreign caregivers hired to take care of patients who do not know Chinese characters fail to categorize waste properly
- The habit of workers not removing unnecessary water from waste adds to the volume of generated waste
- The energy saving effectiveness of air conditioners is affected by climate
- The individual behaviors of employees, patients, visitors and family members affect the effectiveness of energy saving and recycling activities
- The growing global demand for energy confines the possibility and range for a drop in energy prices.

SUSTAINABILITY STRATEGY IMPLEMENTED

The commitment of the high-level administrators of the Hospital to the GGHH has led the plan to be wholeheartedly well-implemented by all possible means. Vice Superintendent Cheng-Ta, Yang as the core leader, in collaboration with the members from respective departments, sponsors the quarterly conferences on a regular basis. The sustainability strategies implemented in recent years include the following.

- Ban on non-green (not eco-friendly) items: Patients and employees are encouraged to use washable tableware.
- The e-sheets operating system minimizes paper consumed.
- Digital imaging uses a PACS system
- The maintenance and repair of equipment are emphasized, with regular maintenance and repairing of equipment taking place
- The department with the highest rating in waste categorization and overall neatness receives a reward each month.
- The multilingual waste disposal and recycling poster is posted on the walls near the soiled linens room.
- The innovative improvement project for energy saving and waste minimization is rewarded.
- Electronic devices with energy label are bought.
- Applying to and installation of LED lamps and infrared sensors.
- Sponsored training sessions for energy saving and waste minimization allow all employees to be familiar with the measures being promoted.

IMPLEMENTATION PROCESS

- A quarterly conference sponsored on a regular basis aims at provision of medical services by energy-saving and global green means in order to manage a healthy workplace and maintain the sustainability of the earth.
- The institutions and departments are required to set energy saving and waste minimization index in advance each year. Those who fail to achieve such index are requested to investigate the cause through an analysis and submit PDCA report.

TRACKING PROGRESS

- The departments receive a monthly inspection by the 5S and Safety Inspectors Team led by the supervisors for assessing and rating how well waste recycling and energy saving measures are performed, with the outcomes announced each month in order to enhance ambient neatness and autonomous safety and health management. The departments with good ratings receive a prize of NT$ 2,000, and the departments with low ratings (i.e. abnormal state), recorded with pictures, receive orders for improvement and their improvement is subsequently tracked by the Administration.
- ISO 50001-2011 energy management systems along with Plan, Do, Check, Action
- (PDCA) apply to procedural improvement for betterment and understanding of energy consumption in order to set proper energy management goals and to constantly improve energy consumption efficiency.

CHALLENGES AND LESSON LEARNED

Taoyuan Chang Gung Memorial Hospital as a regional hospital has a thriving quantitative growth of medical services and outpatients over the past few years, but an increase in medical operational affairs leads to a rise in energy consumed and waste produced. This is why we need adequate comparative benchmarks to detect and regulate the rise in energy consumed and waste produced brought by the thriving quantitative growth of medical services provided (patients, employees and medical operations).

NEXT STEPS

Taoyuan Chang Gung Memorial Hospital launching ISO 50001 - 2011 energy management systems, being awarded by the Bureau of Energy, MOEA and the Environmental Protection Administration, EY, is continuously committed to the enactment of global green ideas in medical practices in response to global eco initiatives through ongoing improvement, constant advancement, enhanced internal training and global green ideas promoted for patients and employees to exercise at home.

DEMOGRAPHIC INFORMATION

Taoyuan Chang Gung Memorial Hospital , founded in Dec. 2003, is committed to the enhancement of domestic medical care of chronic diseases, the integrity of traditional Chinese and western medicine, and the establishment of a system of preventive medicine and holistic medical treatment for acute and chronic diseases. The Hospital on the hill of Guishan District, Taoyuan City, Taiwan Province, secluded among green hills, is one of the top 3 magnificent architectural works in Taiwan. The structure has an innovative, elegant windmill shape connected by a paired-line cross, making blue sky and green land visible at each corner of the Hospital, i.e. it is indeed a Garden Hospital.

LINKS

http://www.cgmh.org.tw

QUOTES:

Energy saving and emissions reduction achieved by me, In pursuit of the best through self-examination

Ongoing improvement with unceasing commitment

KEYWORDS / TOPICS:

Leadership, waste minimization, Energy Saving, CGMH

DATE SUBMITTED: June 2015

CHEMICALS

Substitute Harmful Chemicals with Safer Alternatives

Photo by Yuriy Klochan/123rf

TAIPEI MEDICAL UNIVERSITY HOSPITAL

Chemicals Reduction and Management

GGHH AGENDA GOAL

Replace toxic chemical substances with safer alternatives.

HOSPITAL GOALS

- Reduce the chemicals used.
- Use the comprehensive management way to non-replaceable chemicals.

PROGRESS ACHIEVED

- Replaced the mercury sphygmomanometers to electronic ones to lower the risk of mercury leakage.
- Only under the following circumstances are mercury sphygmomanometer used: in cases where it is difficult to use the electronic version to read the blood pressure; negative-pressure ward inpatient.
- No mercury spills have occurred in the past three years.

THE ISSUE

Mercury is a persistent bio-accumulative metallic substance, which highly threatens environment and human health. Acute mercury poisoning can cause severe pulmonary edema, which then leads to respiratory failure and death. Long- term exposure to mercury will cause chronic poisoning, leading to problems with the gastrointestinal, kidney and nervous systems. In our hospital, the source of mercury is mainly in the mercury sphygmomanometer. Broken mercury sphygmomanometers may occur in ward areas and expose the registered nurses, patients and cleaners exposed to vapor mercury.

SUSTAINABILITY STRATEGY

Implemented Under the sustainable goals to avoid using mercury, first build the consensus with the clinical staff. Checking the user habits and make sure only short-term training is needed to maintain the measurement accuracy in making the change from mercury to electronic sphygmomanometer. Secondly, check to make sure which situations require the use of mercury sphygmomanometer.

IMPLEMENTATION PROCESS

Setting the mercury sphygmomanometer management policies and develop the standard operation procedure in decontamination and waste handling. Provide necessary training for staff in the clinical and Biomedical Division who may need to handle accidental mercury leakage.

1. Extremely limited use of the mercury sphygmomanometer: only for special patients such as the one whose blood pressure cannot be read by electronic meters, or those in the negative-pressure ward inpatient departments.
2. Standards: Biomedical Division is trained to use the mercury sphygmomanometer in hospital and conducts regular maintenance annually. Users have to use the mercury sphygmomanometer under the standard procedures.

3. Exercise on emergency response: when mercury leak occurs, turn off the air conditioning immediately and then notify the officers in charge (notify Labor Safety Department during day times and Duty Head Nurse during night times and holidays). Evacuate people to a comparatively safe area. Put on the activated carbon mask and use empty needle to draw the visible mercury, and then seal it in the plastic bottle. Train handlers to use mercury leak handling kits to deal with invisible mercury to neutralize its toxicity and avoid volatilization into the air to harm humans.

Fully use the electronic sphygmomanometer

Mercury leak handling kit

Mercury leak cleaning process

TRACKING PROGRESS

According to the hospital's incident reporting systems in recent years, no mercury spill was reported, and no mercury leak handling kit was used.

CHALLENGES AND LESSONS LEARNED

There are still few patients who are not suitable to use the electronic sphygmomanometer.

NEXT STEPS

The Biomedical Division will centrally manage the mercury sphygmomanometer to avoid unnecessary usage.

DEMOGRAPHIC INFORMATION

- The name of the institution: Taipei Medical University Hospital
- Its network: The first Affiliated Hospital in Taipei Medical University Healthcare System
- Address: 252, WuXing St., XinYi Dist., Taipei City 11031, Taiwan.
- Building scale: 3 medical building in total.
- Number of beds: more than 800 beds.
- Number of employee: more than 2000 staffs

KEYWORDS / TOPICS:

Mercury, Sphygmomanometer

WESTERN HEALTH, MELBOURNE, AUSTRALIA

Anaesthetic Gases- Greenhouse Gas Reductions

GGHH AGENDA GOAL

WASTE- Carbon Emissions and Financial Cost Chemicals

HOSPITAL GOALS

To reduce hospital greenhouse gas emissions by changing the type of anaesthetic gases used.

PROGRESS ACHIEVED

- Financial benefits- approximately USD $22,500 per year
- Environmental benefit- 140 tonnes of CO2e emissions per year. (equivalent to 36 return long haul flights from Melbourne, Australia to London, UK).
- Human health benefit- Workplace safety studies have shown that waste anesthetic gases can be harmful to staff if not properly exhausted

THE ISSUE

Western Health has approximately 700 beds and is situated in Melbourne, Australia. Like most hospitals in Australia, a variety of different general anaesthetic gases are used, but primarily sevoflurane, desflurane with some nitrous oxide (N2O). Propofol is an intravenous anaesthetic agent that can be substituted for the prior general anaesthetic gases. The Anaesthetic Department had become aware in May 2012 through publications by Dr. Sulbaek Anderson and Dr. Jodi Sherman in Anesthesia and Analgesia that desflurane and N2O had large global warming potentials (much greater than sevoflurane or propofol).

Desflurane and N2O have high global warming potentials compared with sevoflurane (or propofol). Through a change away from desflurane and N2O an individual anesthesiologist can considerably reduce their environmental footprint.

All general anaesthetic gases have similar clinical effects and there are no large benefits in using one agent appropriately instead of another in most situations.

Undoubtedly, for an individual anesthesiologist, the greatest contribution one could make to lessening their effects upon climate change would be to replace all use of desflurane and N2O with sevoflurane and propofol. For example, complete transfer from the use of desflurane to sevoflurane as one's standard, general anaesthetic gas would be the equivalent of no longer flying return economy Melbourne, Australia to London, UK fortnightly!

SUSTAINABILITY STRATEGY IMPLEMENTED

As a result of several presentations on this topic in 2012 the majority of the Anaesthetic Department voluntarily reduced their desflurane and nitrous oxide use and attempted to use lower flows of gases in general. There was very little appetite within the Anaesthetic Department for mandatory cessation of the use of all desflurane and N2O.

IMPLEMENTATION PROCESS

No staff training was required apart from the initial presentations. Implementation was straightforward and achieved by anesthesiologists simply changing their practice to avoid desflurane and nitrous oxide. Note though that junior registrar (resident) doctors from other hospitals on rotation through Western Health were educated by senior anesthesiologists about avoiding the use of desflurane and nitrous oxide where possible.

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TRACKING PROGRESS

Outcomes were obtained through audits of the usage of the different gases comparing 2011 and 2015. Desflurane use more than halved from 198 bottles in 2011 down to 82. Sevoflurane use remained relatively unchanged at 1,584 bottles in 2011 to 1,522 bottles in 2015. N2O use declined by just under 15% over the 4 years. As can be seen, desflurane use was but 12% of sevoflurane use in 2011 (and 5% in 2015).

Interestingly the use of propofol (an intravenous general anaesthetic agent) did not change more than 5% from 2011 to 2015. The number of operations per annum also did not markedly change from 2011 to 2015. These data suggest that anesthesiologists were using all gases at lower flows (i.e. becoming more economical/efficient) in 2015 vs. 2011 although this cannot be corroborated.

CHALLENGES AND LESSONS LEARNED

Since we were already a healthcare system that used limited amounts of desflurane compared with sevoflurane the opportunities to reduce such usage were evidently lessened. If we had been a high user of desflurane much more significant financial and environmental improvements could have been made. It is currently impossible at our hospitals to quantify the proportion of nitrous oxide used for laboring mothers in the Birthing Suite vs. that used for general anaesthesia.

NEXT STEPS

1. It has been considered by some members of the Anaesthetic Department to mandate the removal of desflurane and nitrous oxide although this appears unlikely.
2. Removal of desflurane canisters from the anaesthetic machines for use only upon sustained request has also now occurred.
3. Ongoing education of new anaesthetic doctors and nurses to avoid the use of desflurane and nitrous oxide continues.

DEMOGRAPHIC INFORMATION

Western Health, Melbourne, Australia. Approximately 700 beds total, 18 operating rooms. General hospital (no cardiac surgery, minimal neurosurgery) with a large maternity section.

DATE SUBMITTED: June 2016

WASTE

Reduce, Treat and Safely Dispose of Healthcare Waste

Photo by cylonphoto/123rf

NATIONAL KIDNEY CENTER

Pioneer in Safe HealthCare Waste Management in Nepal

GGHH AGENDA GOAL

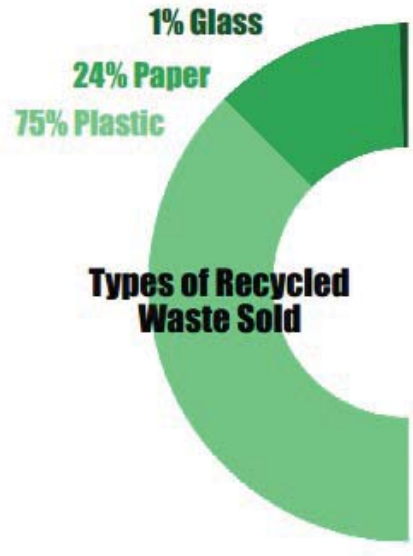
- Leadership
- Energy
- Waste
- Chemicals

HOSPITAL GOALS

- Provide affordable, sustainable, international standard dialysis and kidney disease treatment throughout Nepal
- Improve the health status of Nepalese by organizing awareness programs for kidney disease prevention
- Develop human resources for kidney care and treatment.

PROGRESS ACHIEVED

Safe health care waste management implemented in all the units—with a governance structure and system in place for safe waste segregation, transportation, treatment using autoclave technology, and recycling.



THE ISSUE

Hemodialysis generates a lot of risk waste.

SUSTAINABILITY STRATEGY

The implementation of the safe health care waste management system would not have been possible without the leadership and support from Dr. Rishi Kumar Kafle, Founder, President, and Executive Director of NKC.

The buy-in and cooperation from all hospital staff was also important. The provision of training for all hospital staff, and their participation in the planning process contributed to their buy-in and cooperation in implementing the health care waste management system. All new staff members are oriented and trained to implement the health care waste management system.

IMPLEMENTATION PROCESS

1. Diagnostic Assessment Initially, the waste management system at NKC was established in an ad hoc manner, but after its implementation, we realized that a diagnostic assessment should be conducted as a first step. The diagnostic assessment process helps to gain an understanding of:
   - The volume and type of waste at the health facility
   - Existing waste management practices
   - Opportunities and barriers in implementation of new system
   - A re-assessment was conducted at the NKC.

A re-assessment was conducted at the NKC in September 2013.

One of the findings from the re-assessment showed that NKC had a needle destroyer, but it was used at the Waste Treatment and Storage Center, after collecting the syringes from the units. This puts the waste handlers at risk to needle stick injuries.

In response, the system was modified in which needle cutters were provided to each unit, and staff members were trained to cut the needle immediately after use at source. This new practice enhanced the safety of the waste handlers and other staff members.

Refresher training for NKC staff

2. Design and Construction of the Waste Treatment and Storage Center

On February 10, 2014, the waste treatment center was updated and modernized, including a new autoclave thanks to the collaboration of HCWH and funding from WHO and the Gates Foundation.

There are separate areas or rooms for:

- Storage of infectious waste
- New vacuum autoclave
- Storage of general and recyclable wastes
- Storage of consumables
- Staff washroom

The layout was designed so that infectious and non-infectious wastes are kept separate at all times; they are never in the same room, and enter and leave the center by different doors. Waste from the risk trolleys is brought to its own area in order to undergo treatment using non-burn technology i.e., autoclave.

After disinfection, the recyclables are stored and sold to a local scrap dealer. Data on the waste generated is recorded at different stages—when it is collected, autoclaved and sold.

Inauguration of the Waste Treatment and Storage Center by Secretary of Health

3. Waste Segregation at Source

The re-assessment found that staff members were segregating waste, but not systematically and consistently, and this was partly because there were different segregation systems in the different units, with different types of bins and labeling. Following standardization of all the bins and labeling, and training for all staff, waste was properly segregated.

4. Waste Collection and Transportation

Based on the results from the re-assessment, changes were made to waste collection and transportation. A schedule and route was designed together with hospital staff to ensure safe transportation of waste. The waste for all units is now being transported to the Waste Treatment and Storage Center at a fixed schedule rather than at haphazard times. The waste is being transported by waste management staff rather than by the nurses or other hospital staff. All waste handlers wear personal protective equipment, including appropriate mask, glove and protective clothing, and use forceps when handling.

Needle cutting and waste segregation at unit

Safe handling of waste

LESSONS LEARNED

A systematic and comprehensive diagnostic assessment of the health care waste management system of the health care facility must be conducted as a first step. Adopt a participatory approach. All staff members should be involved in the design and planning of the health care waste management system to ensure buy in and ownership of the system. The location and labeling of the waste bins are critical success factors for waste segregation at a health care facility.

NEXT STEPS

Four satellite dialysis centers have been established in different parts of Nepal, with plans to establish more throughout the country so that patients do not have to travel to the capital for dialysis services. In all the satellite dialysis centers, health care waste management will be considered and integrated in the running of the centers.

QUOTES

"We are a health care center and we are working tirelessly to improve people's health. Therefore, it is critical that the disposal of our waste do not harm the same people that we treat", Dr. Rishi Kumar Kafle, Founder President and Executive Director of National Kidney Center

"When the NKC was established in 1997, the medical waste generated after dialysis was one of the main issues for us. How can we dispose the huge amount of waste safely without harming the staff that works here, the patients, the community, and the environment?

There was no one working on this issue in Nepal at that time, so in 1999, I studied the World Health Organization Handbook on Safe Health Care Waste Management, which was just published, and I started implementing the suggested system at the NKC.

I designed and supervised the construction of the Waste Treatment and Storage Center where infectious waste is autoclaved and recyclables stored. I managed to get a faulty autoclave that was donated to Mission Hospital, and repaired it with the help of biomedical technicians of NKC. I then worked with the NKC staff to plan and implement the waste management system throughout the center.

From the experience and lessons learned here, I led the establishment of a model health care waste management system at Bir Hospital in 2010—one of the oldest hospitals in Nepal.
Today, I am proud that we have established model systems that other hospitals can adopt."
Mr. Mahesh Nakarmi, Founder Member and Executive Director of Health Care Waste Management Program of Health Care Foundation Nepal

DEMOGRAPHIC INFORMATION

The National Kidney Center was established by Health Care Foundation Nepal (HECAF) in 1997. The NKC is an ISO9001:2008 certified dialysis center. NKC has been a member of the Global Green and Healthy Hospitals Network since 2013.

Health Care Foundation Nepal, established in 1994, is a national non-governmental and not-for-profit organization with a mandate to work in three core areas: (1) health care, (2) environmental health and (3) emergency health.

http://www.nationalkidneycenternepal.org
http://www.hecaf.org
https://www.facebook.com/medicalwastenepal/

PAROPAKAR MATERNITY AND WOMEN'S HOSPITAL

Waste Management

GGHH AGENDA GOAL

- Leadership
- Energy
- Waste

HOSPITAL WASTE GOALS

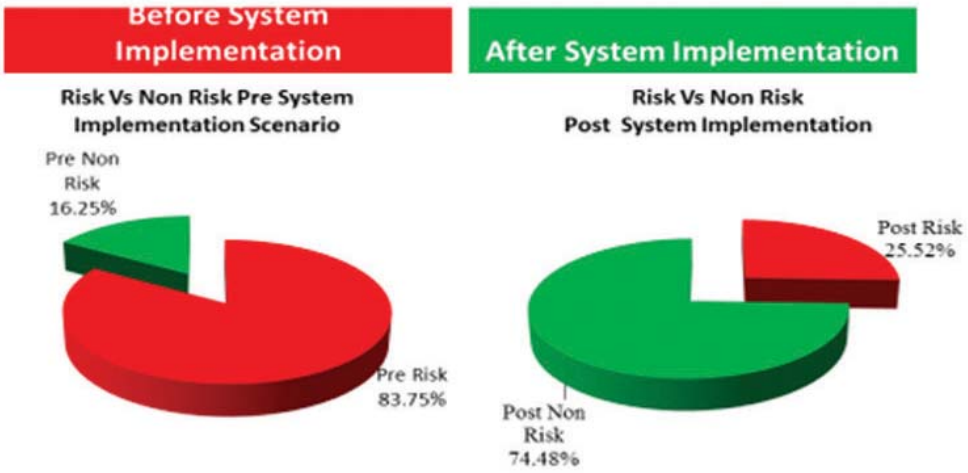
- A leader in managing waste safely and sustainably using non-burn technology
- A leader in generating energy from organic & pathological and food waste

> ***"Now we are giving utmost priority to the safety of the patients. We segregate the waste into hazardous and non-hazardous categories, and sterilize the hazardous waste."***
>
> ***~ Dr. Jageshwor Gautam***
> ***Director, Paropakar Maternity and Women's Hospital***
>
> Source: http://admin.myrepublica.com/feature-article/story/36154/maternity-hospital-making-money-from-hazardous-waste.html

PROGRESS ACHIEVED

- Certified as a member of the Global Green Healthy Hospitals Network in 2015.
- Implementation of safe health care waste management system completed in all the wards—with a governance structure and system in place for safe waste segregation, transportation, treatment and recycling.
- Fully functional Waste Treatment and Storage Center established with a validated pre-vacuum autoclave in place—a recommended non-burn technology for treating infectious waste.
- Practices safe injection and safe handling of sharps with the use of needle destroyers and needle cutters in all the wards.

RISK VS NON RISK



- Risk waste has been reduced from 84% to 25%
- Currently, 79% of its waste is recycled, generating about NPR 19,000 (USD 178) per month. (Types of waste recycled: Paper - 59%, Plastic - 34%, Glass - 4%, Rubber - 3%)
- Pioneering two-stage biodigestion plant to dispose of placenta (pathological waste), and food leftovers (organic waste), and also generate methane as a renewable fuel.
- Research in vermicomposting of sanitary pads.

THE ISSUE

- Communities living near the hospitals complained about the burning of medical waste, exposing them to toxic pollutants such as dioxins and furans that have adverse impacts on their health and the environment.
- Disposal of hazardous medical waste through the municipal system without disinfecting it was a threat to the waste handlers and municipal staff.
- With 16,000 babies born a year at the hospital, disposal of placenta was a major issue. The hospital disposed the placenta in an open pit, which puts people and the environment at risk.
- There was no system for waste management. Nurses and other hospital staff were responsible for disposing waste, which was done in a haphazard manner, exposing them to risks of infection and injury.

> ***"I volunteered to be a waste coordinator in this ward because I think it is important for the hospital. I have been working here seven years and I am very impressed with how the health care waste management system has transformed the hospital. It is much cleaner and safer now."***
>
> ***~ Shrijana Bhattarai***
> ***Ward Waste Coordinator***

SUSTAINABILITY STRATEGY

- Behavioral and attitude change is the most critical for ensuring sustainability of the health care waste management system.
- To bring about this change, all the hospital staff members received orientation and training, and they were involved in each and every step of the system implementation process.
- The system was designed and developed based on a diagnostic assessment conducted at the very beginning, and on feedback from staff.
- As recommended by WHO, a hospital waste coordinator has been appointed and a waste management committee has been established, chaired by the director of the hospital, to oversee the health care waste management system at the hospital.
- The committee deals with all the issues and decisions related to waste management, and ensures that all new staff receive training on the waste management system, on segregating waste at source, and on injection safety and safe handling of sharps.

IMPLEMENTATION PROCESS

Following a diagnostic assessment, a safe and sustainable health care waste management system was designed and implemented for the Paropakar Maternity and Women's Hospital (PMWH).

Technical assistance was provided by Health Care Foundation Nepal (HECAF), including orientation, training and advisory support.

The design and implementation process was coordinated by the PMWH waste coordinator and waste management committee. It involved all PMWH staff to ensure ownership of the waste management system.

PMWH focused in particular on behavioral changes in segregation practices, waste transportation, waste treatment and waste storage.

SEGREGATION PRACTICE

Previously, only 5% of the waste bins were labeled, and they were not standardized.

Two new features have been introduced in each ward:

1. A general waste collection area for PMWH staff and visitors with standardized, color-coded and clearly labeled bins for different sorts of waste—biodegradable, paper, plastic, and bottles and cans.
2. A tailored medication trolley designed for segregation of waste at source, which include separate bins for infectious waste and a needle cutter.

WATER TRANSPORTATION

Dedicated waste handlers at the PMWH have been appointed, trained, vaccinated and given personal protective equipment. Daily, they transport waste from the hospital buildings to the Waste Treatment and Storage Center on a fixed route and at a fixed time.

WASTE COLLECTION CENTER

Infectious waste and sharps are treated in the autoclave, and non-risk waste stored for recycling.

PMWH disposes on average 900 syringes per day. Previously these syringes were burned in the open, releasing toxic pollutants. Now the disinfected syringes are recycled and generate income for PMWH.

As this is a maternity and women's hospital, special attention is given to the disposal of placenta and sanitary pads, which are generated in large volumes on a daily basis.

Working together with HECAF, Health Care Without Harm and a biodigester design expert, PMWH is installing a pioneering biodigester to treat placenta/pathological waste and food/organic waste. As a bonus, the digester generates methane, which can be used as a renewable fuel.

The biodigester has two chambers to ensure that the placenta has as long as possible to break down. Treated waste overflows into the sewer with no extra handling and no power needed.

Biodigestion Plant for Placenta and Food Waste

Biodigestion Plant for Placenta and Food Waste Technical Details

Volume Size of First Stage Digester: 15 m3
Feeding Material: Placenta only (Pathological Waste)
Maximum Input: 65kg of placenta per day (currently, PMWH disposes 40kg of placenta per day)

Volume Size of Second Stage Digestor: 20 m3
Feeding Material: Food leftover only (Organic Waste)
Maximum Input: 80kg of food waste per day

Estimation of total gas output: 12 m3 per day
Usage: The biogas generated will be used in the hospital kitchen

Vermicomposting of Sanitary Pads

The earthworms convert some of the autoclaved sanitary pads into compost that is used for non-food gardening in the hospital grounds.

LESSONS LEARNED

- Design the health care waste management system based on a diagnostic assessment that should be conducted at the start. The diagnostic assessment: (1) Measures the amount and composition of waste generated to determine the specifications and cost of the waste management facility and equipment; (2) Observes the existing waste management practices; and (3) Recommends a feasible waste management system for the hospital that is safe and environmentally sound.
- Begin implementation of the health care waste management system in one ward first. This becomes the model ward that is replicated hospital-wide. This has proven to be an effective implementation strategy.
- Involve all staff in designing and implementing the waste management system to ensure its success, ownership and sustainability. This includes the involvement of not only nurses, doctors and housekeeping staff, but also administration and finance, and security.

NEXT STEPS

Reports on the design and operation of the biodigestion plant will be published.

ABOUT PMWH AND HECAF

The hospital located in Thapathali, Kathmandu provides services in the areas of obstetrics, gynecology and neo-natal care to about 125,000 women and children annually. The hospital has 415 beds and over 16,000 babies are born at the hospital each year.

At the request of PMWH, Health Care Foundation Nepal (HECAF) started implementing a health care waste management system at PMWH in July 2012.

HECAF, established in 1994, is a national non-governmental and not-for-profit organization with a mandate to work in three core areas: (1) health care, (2) environmental health and (3) emergency health. HECAF established the National Kidney Center in 1997, offers technical support in developing a safe and sustainable health care waste management system, and provides capacity development and training in emergency management and disaster risk reduction.

info@hecaf.org
http://www.hecaf.org
https://www.facebook.com/medicalwastenepal/

NORVIC INTERNATIONAL HOSPITAL KATHMANDU, NEPAL

Leader Among Private Hospitals in Nepal in Safe, Sustainable and Environmentally-Friendly Practices

GGHH AGENDA GOAL

- Leadership
- Waste
- Chemicals

HOSPITAL WASTE GOALS

- Be a leader among the private hospitals in the promotion of safe, sustainable and environmentally-friendly practices.
- Implement safe and sustainable health care waste management.
- Substitute mercury-based equipment with safer alternatives.

PROGRESS ACHIEVED

A proper and safe health care waste management system was implemented in 2012 with technical support from Health Care Foundation Nepal (HECAF) and Health Care Without Harm (HCWH)

- Norvic International Hospital is the first private hospital in Nepal to become a member of the Global Green and Healthy Hospitals (GGHH) Network in 2013.
- A safe health care waste management system is now implemented throughout the hospital, and managed by the hospital's waste management committee.
- A fully functional waste treatment and storage center has been constructed, with a validated steam-based autoclave installed.
- Safe injection and safe handling of sharps are practiced in the hospital, with needle destroyers and cutters in all hospital wards.

Figure 1: Four-bucket system for waste segregation in each ward at Norvic International Hospital

- All members of the hospital staff have received training on safe health care waste management.
- The hospital is a mercury free health care facility.
- Risk waste has been reduced from 69% to 29% of total waste after the implementation of the safe health care waste management system.
- On average, the hospital recycles 15 tons of waste per year generating a revenue of about NPR 252,000 (USD 2,500) annually, which contributes to the maintenance and operation of the waste management system. 7 tons of food waste is generated by the hospital annually, which becomes part of the municipal waste stream.

THE ISSUES

Like many hospitals in Nepal, Norvic International Hospital used to burn its syringe waste in a small chambered incinerator or just out in the open. The burning area was located just below the building with VIP and deluxe wards, affecting the health of hospital staff, patients and visitors.

Moreover, the hospital did not disinfect its waste before disposal, affecting the municipal staff, waste scavengers and people residing near the landfill sites.

"We are proud to be the first private hospital in Nepal to initiate safe health care waste management and phase out mercury-based equipment. Through various eco-friendly practices, we are committed to protecting the health of our environment. When the environment is healthy, we are healthy."

~Basanta Chaudhary
Chairman, Norvic International Hospital

SUSTAINABILITY STRATEGY

At Norvic International Hospital, the strategies used to sustain the health care waste management system include the adoption of a participatory approach to system design and implementation, capacity building for all hospital staff, a good governance structure, and the promotion of positive behavior change.

Behavioral and attitude change is the most critical for ensuring sustainability of the health care waste management system. To bring about this change, all the hospital staff members received orientation and training on health care waste management, and they were involved in each and every step of the system implementation process.

Figure 2: Discussion on the bucket placement in the trolley (a participatory approach)

The system was designed and developed based on a diagnostic assessment conducted at the very beginning, and on regular feedback from staff throughout the implementation process.

To oversee the health care waste management system at the hospital, a hospital waste coordinator was appointed, and a waste management committee established, as recommended by the World Health Organization (WHO).

The committee, chaired by the director of the hospital, deals with all the issues and decisions related to waste management, and ensures that all new staff members receive training on the waste management system, on segregating waste at source, and on injection safety and safe handling of sharps.

In each ward, a ward waste coordinator is appointed to ensure that waste is properly segregated and managed at the ward level. The ward waste coordinators report to the hospital waste coordinator.

IMPLEMENTATION PROCESS

All the staff members of the hospital, including nurses, doctors, support staff and administrative staff were involved in the design, planning and implementation of the waste management system at the hospital.

As described briefly above, the first steps involved a diagnostic assessment conducted by a team from HECAF. This was followed by a series of orientation and training on waste management for all hospital staff—including both medical and support staff.

Various meetings were conducted with staff members from different wards to increase staff participation. Suggestions on the location of bins for waste segregation in the wards (see Figure 1), the design of medication trolleys (see Figure 2), and the type of needle destroyers required were discussed and taken into account.

Before implementing the system throughout the entire hospital, a model ward was selected and the system was implemented there. Only after the waste management system was successfully implemented in the model ward, was it replicated to other wards and units in different phases. It took one year to implement the system in all wards and units of the hospital.

A waste treatment and storage center was developed inside the hospital premises, and an autoclave (Figure 3) was procured to treat its infectious waste, and the hospital no longer has to burn its waste.

Figure 3. Autoclave used for treatment of infectious waste

On average, the hospital treats 31 kg of infectious waste and 3 kg of syringes waste daily.
To ensure that the autoclave is functioning effectively, the integrator and biological indicator or spores test is conducted weekly.

General waste like paper, plastic, glass and disinfected waste is sold to local scrap dealers to generate some income.

TRACKING PROGRESS

The hospital tracks progress through:

- Records of the amount of infectious waste autoclaved;
- Results of the regular efficacy testing of the autoclave;
- Records of maintenance of the autoclave; and
- Records of waste sold for recycling, and income from the sale (after transportation costs are deducted).

These record sheets for data collection were developed with support from HCWH.

CHALLENGES AND LESSONS LEARNED

Behavior change is the primary factor that determines the sustainability of the established health care waste management system. The hospital has found that the success of the system depends heavily upon staff behavior and their attitude towards the system.

Figure 4. Waste transportation trolley

NEXT STEPS

The hospital is planning to install a biodigestion plant for the management of biodegradable and pathological waste.

ABOUT NORVIC INTERNATIONAL HOSPITAL AND HECAF

Norvic International Hospital was established in 1994 by Chaudhary Group, one of the most prominent corporations in Nepal. Norvic International Hospital is the first private hospital that obtained an ISO certification 9001-2008, and is renowned for its critical and cardiac care facilities. It is a 137-bed hospital and is in the process of adding 163 more beds, to total to a 300-bed multi-specialist general hospital. For more information see http://www.norvichospital.com/.

At the request of the hospital, HECAF started implementing a health care waste management system at the hospital in 2012.

HECAF, established in 1994, is a national non-governmental and not-for-profit organization with a mandate to work in three core areas: (1) health care, (2) environmental health and (3) emergency health. HECAF established the National Kidney Center in 1997, offers technical support in developing a safe and sustainable health care waste management system, and provides capacity development and training in emergency management and disaster risk reduction. For more information see http://www.hecaf.org.

ANNEX: OLD VS NEW WASTE MANAGEMENT SYSTEM

Old Waste Management System	New Waste Management System
1. SEGREGATION SYSTEM FOR GENERAL PUBLIC	
	
2. SEGREGATION AT SOURCE (MEDICATION TROLLEY)	
	
3. SEGREGATION PRACTICE IN WARDS	
 	 

Old Waste Management System	New Waste Management System
4. ONSITE WASTE TRANSPORTATION SYSTEM	
	
5. WASTE TREATMENT SYSTEM	
	
6. WASTE STORAGE	
	

KATHMANDU MODEL HOSPITAL

Safe and Sustainable Health Care Waste Management

GGHH AGENDA GOAL

- Leadership
- Waste

PROGRESS ACHIEVED

LEADERSHIP

- Kathmandu Model Hospital, established and managed by PHECT, a non-governmental organization, has a fully operational health care waste management system since December 2014. This safe and sustainable system was designed and implemented with technical support from Health Care Foundation Nepal (HECAF) over a two-year period (2012-2014).
- The need for a safe and sustainable health care waste management system was recognized by Dr. Bharat Pradhan, Executive Director of PHECT-Nepal. He saw how the system worked when he was employed at Bir Hospital, also a member of the Global Green and Healthy Hospitals (GGHH) Network (see case study at http://bit.ly/2cWblOZ).
- Dr. Pradhan's leadership was critical to the successful roll out of the health care waste management system at the hospital, and he chaired the newly established Waste Management Committee. PHECT also manages another hospital—Kirtipur Hospital, which is currently establishing its health care waste management system with support from HECAF.
- Dr. Pradhan is leading the Association of Non-Governmental Hospital of Nepal, a network of seven hospitals in Nepal. Under Dr. Pradhan's guidance, a workshop on safe and sustainable health care waste management was held in 2015 to raise awareness on the importance of this issue among the seven hospitals.

WASTE

- Currently, the percentage of risk waste generated is about 15%, which is within the range expected by the World Health Organization (WHO) if there is proper segregation of waste. Prior to the implementation of the waste management system, the percentage of risk waste was 76%.
- Previously, the waste generated were either sent to landfill or burned. Now infectious waste is treated using steam-based autoclave technology that has been validated by experts.
- 28% of total waste is recycled and 28% of total waste is food waste that is composted. This means a total of 57% of waste diverted from landfill.
- On average, the monthly revenue generated from the selling of recyclables is around NPR 20,000 (USD 190).
- 7% of the total waste includes sharp glass, sharp metal and leftover liquid such as water into water bottle and saline bottle.

- Proper segregation of waste in wards has resulted in less chances of epidemic. Waste transportation and handling is carried out according to WHO guidelines, reducing the risk of exposure to infectious waste.
- Waste is segregated at source with improved sharps management, reducing needle-stick and sharps injuries at the hospital.
- At Kathmandu Model Hospital, waste segregation is everyone's responsibility. With the four-bucket system in each ward (Figure 2), and the medication trolleys custom-designed to promote waste segregation at source (Figure 3), waste is segregated by the hospital staff or visitor who generates the waste.
- The new waste management system has not only benefited the staff of the hospital but also the community living in the vicinity of the hospital, as the hospital waste is no longer burned or disposed of haphazardly on the streets.
- This waste management system is robust enough that the hospital was able to continue treating its waste through the devastating 2015 Gorkha Earthquake.

Figure 1. Nurse demonstrates the cutting of syringes with needle cutter

Figure 2. Four-bucket system in the wards for waste segregation at source

Figure 3. Waste handler at the hospital with personal protective equipment collects waste from the ward

Figure 4. Risk waste being transported to the waste treatment and storage center using elevator dedicated to the transportation of waste

THE ISSUES

The management of health care waste was a major challenge for Kathmandu Model Hospital. The hospital did not have a system to segregate waste, risk waste was mixed with non-risk waste, and risk waste was not treated. Waste handlers at the hospital were not provided with proper personal protective equipment. This exposed hospital staff, municipal waste handlers and the community to risk of disease transmission, injury, chemical exposure and other health-related concerns.

Figure 5. Collecting recyclables from the dumped waste prior to the implementation of the safe health care waste management system

Figure 6. Improper handling of waste

Figure 7. Waste storage area prior to the implementation of the safe health care waste management system

Figure 8. The same area (in figure 7) has been transformed into a waste treatment and storage center, with separate bags for different types of recycled waste, and a steam-based autoclave for the treatment of risk waste

SUSTAINABILITY STRATEGY

Since the enactment of Nepal's 2011 Solid Waste Management Act that provides the legal basis and regulation for health care waste management, and a strict notice has been published for all hospitals to manage their waste within the hospital periphery, hospitals are paying more attention to the safe management of health care waste.

The main objectives of the Solid Waste Management Act are to:

- Make arrangement for the systematic and effective management of solid waste by minimizing the solid waste at source, re-using, processing or disposing of the solid waste; and
- Maintain the clean and healthy environment by minimizing the adverse effects of solid waste on public health and the environment.

At Kathmandu Model Hospital, its strategy to sustain the health care waste management system is through continuous training of staff, including orientation on the health care waste management system for new staff, and refresher training for existing staff. The revenue generated from recycling could contribute to the cost of these trainings, as well as to the organization of awareness raising events on the 3R (reuse, reduce, recycle) approach that involves all staff members.

IMPLEMENTATION PROCESS

The hospital team, with technical support from HECAF, rolled out the safe health care waste management system through a step-by-step process.

Firstly, a waste coordinator to lead the implementation of the safe health care waste management system at the hospital was assigned.

Secondly, a waste management committee was established to make decisions on waste management issues at the hospital.

Thirdly, a model ward was chosen to implement the safe health care waste management system. A waste coordinator for the model ward was assigned to coordinate, monitor and report on the waste management activities at the ward.

At this model ward, waste segregation at source was introduced. The segregated waste was then transported to the waste treatment and storage center where risk waste was treated using steam-based autoclave, and recyclable products stored.

After a month of implementation at the model ward, a review was held to assess the waste management system, and improvements were made accordingly.

At the same time, HECAF provided training on safe health care waste management to both medical and support staff at the hospital.

The space within Kathmandu Model Hospital was limited, and finding a suitable area for the establishment of a waste treatment and storage center was a big challenge. At first, during the implementation of the system in two wards, a passage in the mortuary area was selected for the waste treatment and storage center, but this space was insufficient once the system was replicated to additional wards. An alternative larger space was needed for the system to function.

By chance, the HECAF team encountered a space where scraps were piled up all over the area. The hospital management cleared out the whole space and reconstructed the area for waste treatment and storage.

The construction of the waste treatment and storage center and the roll out of the safe health care waste management system hospital wide in all the wards took almost two years to complete. From time to time, the waste management committee meets to discuss any problems, areas of improvement and issues of sustainability.

Figure 9. Demonstration of the safe health care waste management system at the model ward

Figure 10. Training session to sensitize doctors

TRACKING PROGRESS

- A recording tool collects data on daily waste generation. The record gives a clear indication of the amount of waste produced by each ward, and what happens to the waste—including the amount of waste that goes to the landfill and the amount that is recycled.
- A monitoring record sheet logs the status of waste management.
- A waste sale record sheet keeps details of the amount of recyclables sold.
- An autoclave log sheet records the autoclave parameters each time that it is used.
- These record sheets for data collection were developed with support from Health Care Without Harm (HCWH)

CHALLENGES AND LESSONS LEARNED

After developing the waste management system in the hospital, the main challenge was to change the behavior of the people that visited the hospital, whether it was the patient or the patient's visitor. When the waste segregation was first introduced, patients and visitors were unwilling to segregate waste and complained about it. But with regular orientation for the patients and visitors, waste segregation has now become a part of regular practice in the wards and throughout the hospital.

As mentioned previously, a key issue that the hospital faced was the lack of space. As the hospital is located at the city centre, it is difficult to expand. It was a challenge finding adequate space for establishing the waste treatment and storage center. In the end, a solution was found, and a key takeaway from this experience is the importance of flexibility in the design of the safe health care waste management system that is based on context and resources available, and the participation of staff members to come up with solutions.

"Through the process of establishing a safe health care waste management system at Kathmandu Model Hospital, employees have been empowered to solve issues together, as a team. The key to successful health care waste management is the bringing together of team work, supportive management and relevant technical guidance. This combination is not easy to accomplish, but it is possible and we are evidence of it."
~ Ms. Radhika Ghimire, Nursing Supervisor and Waste Coordinator, Kathmandu Model Hospital

"The main problem was not the space, but the proper management of space. If managed properly, any reliable space can be utilized."
~ Ms. Urukshya Dongol, Program Coordinator, Health Care Waste Management Program, Health Care Foundation Nepal

NEXT STEPS

The health care waste management system is now fully operational hospital wide. HECAF has handed over the system to the hospital to manage, but continues to monitor the system together with the waste management committee of the hospital.

Next steps include:

- Reform of the waste management committee.
- Provision of refresher training to the staff of the hospital.
- Use of the GGHH Hippocrates Data Center to measure actions toward reducing the hospital's environmental footprint.

ABOUT KATHMANDU MODEL HOSPITAL AND HECAF

Kathmandu Model Hospital, located in Pradarshani Marg, Kathmandu, is a tertiary-level hospital with 135 beds, established and managed by a non-governmental organization—PHECT-Nepal. It provides patients with both diagnostic and curative services, including 24-hours emergency care, laboratory testing, pharmacy service, radiology and ambulance service. Kathmandu Model Hospital became a member of the GGHH Network in 2013. For more information see http://web.phectnepal.org/kathmandu-model-hospital/.

At the request of the hospital, HECAF started implementing a health care waste management system at the hospital in 2014.

HECAF, established in 1994, is a national non-governmental and not-for-profit organization with a mandate to work in three core areas: (1) health care, (2) environmental health and (3) emergency health. HECAF established the National Kidney Center in 1997, offers technical support in developing a safe and sustainable health care waste management system, and provides capacity development and training in emergency management and disaster risk reduction. For more information see http://www.hecaf.org.

BUDDHIST TZU-CHI DIALYSIS CENTRE

Waste: Reduce, Re-use, and Recycle For Our Future Generations

GGHH AGENDA GOAL

- Leadership
- Waste

HOSPITAL GOAL

- Reduce volume of waste generated through education, recycling and conscientious utilization of resources
- Effectively lessen carbon dioxide emission by significantly lowering amount of waste produce
- Motivate employees and patients to participate in waste reduction programs and activities to safe guard Mother Earth

PROGRESS ACHIEVED

Since the Buddhist Tzu Chi Dialysis Center was founded, we have been practicing the use of reusable food containers and implementing recycling programs. Among the generated wastes being recycled are papers, aluminum foils, plastics and packaging used in the clinical areas.

The employees and volunteers abide by the center's policy. The cooperation of both employees and volunteers had reduced generation and increased diversion of wastes through recycling. From recycling, the total amount of funds is given back to Tzu Chi Dialysis Center Funding. The activity implemented by the Buddhist Tzu Chi Dialysis Center has been awarded 2016 Penang Environmental Sustainability Award.

Recycle & Reuse: Using of recycable items for teaching purposes

The wastes that are not sold are fully utilized and reused for teaching purposes or are repurposed for other usage such as shoe racks, files keepers or containers. These activities not only divert waste but indirectly involves volunteers and patients in recycling and reuse programs. Over-all these activities reduces pollution and safe guard our Mother Earth. The table below shows the annual revenue and volume from selling recyclables.

Table 1.0 Annual Volume of Recyclables Collected and Volunteers Participated

Month	Volume of Recyclables (Kg)		Total Active Volunteers	
	2015	2016	2015	2016
January	576103	622244	2143	3237
February	10511905	1088206	2785	1825
March	2294669	1640515	1972	3085
April	2628893	1979058	2099	2934
May	3032259	2319390	2571	2763
June	3390848	2703048	2681	2868
July	3782858	3092711	2727	2938
August	4184222	3503757	2794	2921
September	4598337	3891550	2961	3049
October	4958337		2994	
November	4957138		3016	
December	5447195		3141	

THE ISSUE

Solid Waste reduction and management plays a significant role in the ability of nature to sustain life within its capacity. However, it is one of the major environmental problems experienced in Malaysia. Currently over 23,000 tons of wastes are produced each day in the country. It continues to increase with the growing population and development while only 5% of the generated waste is recycled. This phenomenon leads to environmental pollution due to excessive waste production.

SUSTAINABILITY STRATEGY IMPLEMENTED

Buddhist Tzu Chi Dialysis Centre practices frugality and sustainability with modern and high technologies in equipment and facilities. It ensure all employees and volunteers are aware of their frugality and waste reduction campaign to continuously protect the environment. They have conducted campaigns through orientation and placing posters to educate patients and employees. The activities constantly remind everyone to save the environment.

The dialysis center has upgraded their documentation and recording of dialysis treatment by using Therapy Data Management System (TDMS). It is an effective data management system for their growing number of patients and the rising requirements for documentation of patients. The utilization of the Therapy Data Management System officially started on 17th of February, 2016. Manual management of these data is not ideal as it involves a great deal of administrative work and uses up valuable resources particularly paper and time. This also ensures patients' safety with protection of environment. The table presents the saving the dialysis center are able to acquire through the Therapy Data Management System:

Table 2.0 Savings Acquired from Using the Therapy Data Management System

Paper	Time	Pen	Other Benefits
used/month/patient: 7 pcs (both side printed) 130 patients=910 pcs pcs/month Per Year 10,920pcs If fully utilized the maximum capacity of 240 patients **Total Paper Saved: 20,160pcs** It takes about 1 tree (11 meters tall) to make about 58 Kg of paper - 1pc of A4 paper = 7 gm* 20,160 pieces = 141,120gm (141kg) * 2 mature trees saved *It takes up to 20-40 years for a tree to mature	• 1 flow sheet estimated 2 min, • 2min x 40320 pages/ 60min = 1344 hours / year A Staff works 7 hours/ day Average staffing / day : 12 Amount of times we can save per person : 16 days **Total Time Saved: 1344 hours**	Total staff : 34 Each pen cost: RM 0.70 Average usage: 1 pen / month / staff **Total pens saved: 408 pens** **RM 285.60 (USD 64.29)**	**Space saving:** Few cabinets used which allows more storage capacity for other usage **Data Analysis:** Faster, better and more accurate results which allows faster decision **Better Document tracing:** Easier and faster for document retrieve and making Doctor's round smoother and more efficient

** Total number of patients as of 31st Oct – 130 individuals*

IMPLEMENTATION PROCESS

It has been Buddhist Tzu Chi Dialysis Center policy to practice vegetarianism and use of reusable food container, recycling papers, aluminum foil and plastic at the clinical area. They have regular activities and education program implemented by the volunteers to pass the knowledge on recycling and the importance of environment protection to nurses and patients. They are not only doing recycling at the centers but encouraged them (nurses and patients) to practice it at home and their community. They also have a "recycling" day every month where their patients, volunteers and employees participate in the nearby community to segregate waste.

Recyclable items are sent to Tzu Chi Recycling stations to be sold. Proceeds of the sold recyclables are then used by the Center to fund its dialysis treatments. The fund not only used for the three dialysis

centers but also to subsidized about 200 patients who are doing dialysis treatment at the other hospital or other dialysis centers. As for the TDMS implementation, the center ensures proper professional training for the appointees of the company. All of the nurses have to go through the fundamental training and have their competency evaluated. There were also specially trained nurses who are the termed “Super Users”. They will provide support and continuous training to all nurses.

TRACKING PROGRESS

The Buddhist Tzu Chi Dialysis Center do not have any specific tracking system but we continuously encourage and educate all staff, volunteers and patients regarding the waste reduction and the effect of carbon emission. The only data that the center has are the number of volunteer and amount of waste sold at recycling centers. Awareness campaign and support from the management helps in sustaining and maintaining of this project.

CHALLENGES AND LESSONS LEARNED

The center needs to identify better and more efficient strategy to reduce generated waste. We need to provide more education and activities to all patients, employees and volunteers. These activities will further create awareness and instill green habits to all and ensure sustainability.

Reducing waste and frugality practices requires behavioral change but personal habits are proven difficult to change. The waste reduction plan may only be implemented through cooperation from different stakeholder. In order to address this concern, continuous communication, education and training will be given to develop good habits.

Recycling at Community

NEXT STEPS

It is always challenging to do things which the majority is not doing or introducing new rules and regulations. More so, it is difficult to turn them into something that is workable or feasible. There are always people who will disagree or oppose the newly implemented policies and practices.

However, with hard work and perseverance that the dialysis gained through experiences on how to smartly use the data to communicate and to encourage change will surely assist in the implementation. Although tools or modern technology can be very helpful, we human still are the backbone of energy solution and driver for change and betterment of the society. It is with this rationale that the dialysis center will continue its effort in advocating and encouraging nurses, employees and patients, If possible, further enhance their waste management program.

Other means of monitoring will also be employed to better evaluate the program implementation.

DEMOGRAPHIC INFORMATION

Buddhist Tzu Chi Dialysis Center was the first dialysis center to provide free hemodialysis treatment, EPO injection, Blood tests and regular specialist checkup for all patients irrespective of race, religion or creed. Presently we have 3 Tzu-Chi Dialysis centers in Malaysia, Penang (PGDC), and Butterworth (BWDC) and in Alor Star (KDC).

As at 31st of October 2016,

- PGDC has 36 Hemodialysis machines, a total of 130 patients and 34 nursing staff
- BWDC has 36 Hemodialysis machines, a total of 97 patients and 21 nursing staff
- KDC has 22 Hemodialysis machines, a total 73 patients and 21 nursing staff

Buddhist Tzu Chi Dialysis Centre also provides free basic screening under the CKD awareness and prevention program

LINKS

http://tzuchi.org.my

QUOTES:

Do not let the environment influence our mind. We need to improve the environment with diligence and perseverance. We have to be mindful of each footstep we take is the beginning of our commitment to cherish our planet. (Jing Si Aphorism by Master Cheng Yen)

KEYWORDS / TOPICS:

Waste reduction/ energy consumption and reduction/ carbon emission.

DATE SUBMITTED: November 2016

DALIN TZU CHI HOSPITAL, TZU CHI MEDICAL FOUNDATION (TAIWAN)

Environmental Stewardship: Hospital Waste Reduction

GGHH AGENDA GOAL

- Leadership
- Waste

HOSPITAL GOAL

- To reduce amount of generated waste through recycling and conscientious utilization of resources
- To motivate employees to participate implemented programs on waste reduction

PROGRESS ACHIEVED

- Over the past ten years, the general waste has decreased from 2.92kg to 2.63 kg per bed daily
- The hospital is able to save NT$ 21.5 million per year through utilizing the e – administration and health care administration system
- The volume of recycled wastes was increased by 163,477 kg from 2005 – 2014.
- In the past fifteen (15) years, the hospital was able to decrease volume of produced waste through using reusable utensils. The hospital has promoted and mandated their employees and patients to use reusable utensils whenever possible. During this time, six million pairs of chopsticks were prevented from reaching the waste stream. The hospital has abided by the government policy of taking back unconsumed medicines. Since September 2010 we have collected 3,501.12 Kg, an average of 49.21 Kg monthly

Recycling is practiced in each nursing station. There are 9 categories recycling bins: metal, paper, plastic, soft bag, biomedical waste, glass, aluminum, PET bottle and garbage.

Reusable utensils only in the hospital.

THE ISSUE

In Taiwan, hospitals produce around 90,000 tons of waste and 23,561 tons of biomedical and healthcare waste every year. Processing these generated volumes of waste implies high costs. If the hospitals can work on reducing waste produced, cost of processing them such as treatment will not only be decreased but this will also mitigate the level of pollution released to the environment.

SUSTAINABILITY STRATEGY IMPLEMENTED

In health care facilities, the management of medical waste is one of the most important tasks. As part of the sustainability strategy of Dalin Tzu Chi Hospital, green policies were adapted in conjunction with modern technologies, efficient facility and equipment.

One of the improvements Dalin Tzu Chi Hospital is working on is development of an electronic health care information system. This innovation will aid the hospital in becoming paper and film free. The hospital also provides sufficient resources to their employees such as provision of reusable utensils, education and knowledge through training and practical exposure to recycling work.

Simultaneous with all these activities, the hospital develops policies which ensures and links patient safety with protection of environment. Moreover, timely and periodic orientations and forums are conducted. Employees and patients are invited to participate to be further educated about environmental concerns and the initiatives of the hospital.

IMPLEMENTATION PROCESS

The recycling work is also the important strategy in the hospital. In each nursing station, nine (9) bins are situated for each recycling category. Hospital volunteers, employees and their families share their time with Dalin Tzu Chi Hospital. They gather at the recycling station within the hospital and sort wastes from the hospital and nearby local communities regularly.

Table 1.0: Waste per Hospital Bed per Day 2005-2014

Table 1.1: The Weight of Recycled Materials 2005-2014

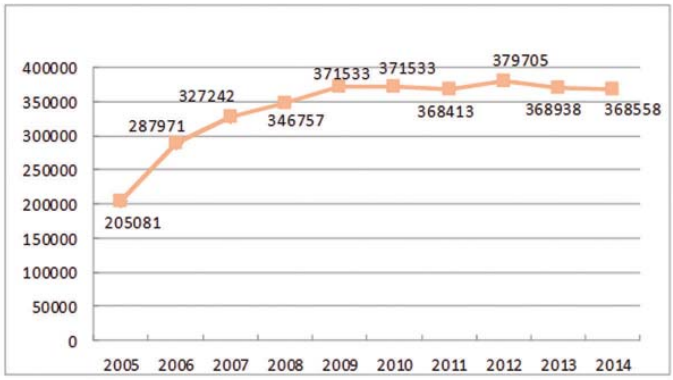


Table 1.2: Bio Medical Waste 2012-2014

	2012	2013	2014
Total biomedical waste	**17502 kg/month**	**17668 kg/month**	17767 kg/month
Visitors (person/month)	**19968**	**20162**	20658
Waste/bed	**0.87kg**	**0.87kg**	0.86kg
In-patient (ward and hemodialysis)	**9838 kg/month**	**9699 kg/month**	9703 kg/month

Quality Control Circle (QCC) was established. The group is composed of varied stakeholders who become members of different teams. The members of QCC discuss possible solutions to address concerns of the hospital. Through the implemented activities of the QCC program, the amount of generated wastes was effectively reduced from 2.92kg/bed to 2.63kg/bed per day. In the hemodialysis room, the equipment is designed to successfully decrease the artificial kidney fluid from 0.9 kg to 0.8 kg per bed.

TRACKING PROGRESS

The Department of General Affairs monitors the weight of wastes. The tables below show the results of monitoring conducted by the Department of General Affairs.

CHALLENGES AND LESSONS LEARNED

There is an immense opportunity for the hospital to identify safer and better efficient strategy to reduce generated wastes. The hospital's goal to lessen the volume of wastes produced is potentially achievable. However, this will require systematic and careful transition strategies such as educating employees to institute sustainable changes in habits and form green social norms within the hospital.

NEXT STEPS

The hospital develops policies which encourage incorporation of environmental protection in various processes implemented in the hospital it is seen by Dalin Tzu Chi Hospital as a way of also taking care of the safety of each patient and employee.

Dalin Tzu Chi Hospital aims to continue providing this service to all its patients and employee. It is in our vision to continue seeking innovation to manage and reduce hospital waste. Furthermore, the hospital will continue to strictly monitor daily hospital activities where wastes are generated.

The team has worked to refine the regulations on medical waste management and the lobbying focus on ban on incineration to burn municipal, bio-medical, and hazardous waste. At the moment the hospital is filing their fifth appeal to the Ministry of Environmental Protection. Dalin Tzu Chi Hospital is hoping to get approval for non-incinerating a portion (approximately 10%) of their medical waste. The medical waste may be recycled after high-temperature sterilization. They can be reconstituted into plastic products for industrial uses such as vehicle's lamp holder, socket, pedals and fan blades among others.

DEMOGRAPHIC INFORMATION

The first Tzu Chi General Hospital was inaugurated on August 17, 1986 The Hospital practices the respect for life and patient – oriented medical care principles in Eastern Taiwan. Dalin Tzu Chi General Hospital, a hospital established in a land with an area of 137,800 sq. m, was inaugurated on August 13, 2000. The hospital is serving the people in the area of Yunlin and Chiayi County, a place with disproportionate medical resources. Hospital provides consultative service, in-patient care unit (acute hospital) and hospice home care service. The hospital has 957 beds, 20 operating rooms and 1756 employees. With the present facilities and manpower the hospital is able to serve an average of 78,742 outpatients per month (944,904 annually) with an estimated 17,578 days of stay per month.

LINKS

http://dalin.tzuchi.com.tw/

QUOTES:

"If we live a simple lifestyle and reduce our carbon footprint while constantly cherishing the earth, we shall slow down the global warming crisis."

KEYWORDS / TOPICS:

Waste

DATE SUBMITTED:

31st August 2015

TILGANGA INSTITUTE OF OPHTHALMOLOGY KATHMANDU, NEPAL

Realizing our Vision for Sustainable Development in Nepal through Safe Health Care Waste Management and Solar Power Generation

GGHH AGENDA GOAL

- Waste
- Energy

PROGRESS ACHIEVED

WASTE

- Institutionalization of a safe health care waste management system and establishment of a waste management unit to manage hospital waste.
- Implementation of a safe health care waste management system in half of the units at the hospital.
- Fully functional waste treatment and storage center with a validated autoclave.
- Introduction of safe injection practice in the hospital using needle destroyers and cutters.
- Only 34% of the total waste is sent to landfill.
- Risk waste has been reduced from 47% to 25%.
- 63% of the total waste is recyclable and is sold to scrap dealers, generating a revenue of NPR 4,000 (USD 40) per month on average.
- As this is a specialist hospital, its waste stream is unlike regular hospitals, with an exceptionally high percentage of recyclable waste and very little food waste. 2% of the total waste is food waste, and 3% of the total waste includes sharp glasses, sharp metals and leftover liquids in water bottles and saline bottles.

ENERGY

- The hospital installed 156 solar panels from Sunpower Inc., USA. Each panel is 245 Wp.
- The total capacity of the installed solar panels is 38.22 kWp.
- The hospital also installed six X-TH 8000 solar inverters from Studer Innotec, Switzerland.
- The solar power is used to generate electricity for the operation theater and the outpatient department.
- With the installation of the solar panels, diesel consumption has been reduced by about 432 liters per week. There has also been a 7.5% to 10% reduction in electricity consumption.

Figure 1. Two-bucket sytem for general waste collection

Figure 2. Health care waste treatment and storage center

Figure 3. Non-risk waste transportation trolley

Figure 4. Solar panels at the roof top of the hospital

THE ISSUES

Tilganga Institution of Ophthalmology (TIO) is located on Bagmati Bridge, near the Bagmati River. Hindus and Buddhists consider it a holy river, and a number of Hindu temples are located on its banks. The river, however, is polluted and choked with untreated waste. A June 24, 2016 article on Kathmandu Post stated that the river is 10% water and 90% sewage. Previously, TIO contributed to polluting the river and dumped its waste in the municipal waste container near the river.

But TIO was eager to change its waste management practice and approached Health Care Foundation Nepal (HECAF) to design and develop a safe and environmentally-friendly health care waste management system for them in 2013.

TIO was also keen to use clean renewable energy sources to address the problem of frequent power cuts and protect public health. Previously, electricity power cuts and shortage of petroleum affected the regular operation of the hospital, and TIO had to use generators that run on diesel to fulfill energy demands. Subsequently, a decision was made by hospital management to use clean renewable energy sources by installing solar panels to support its critical facilities, like the operation theaters.
Sustainability Strategy

TIO's sustainability strategy for waste management includes:

- Establishing a waste management unit to handle issues and decisions related to waste management at TIO.
- Adopting a participatory approach to system design and implementation, and ensuring that staff members' comments and feedback are taken into consideration. This promotes staff ownership of the system.
- Training for all staff members on the safe management of waste, including segregating waste at source, injection safety and safe handling of sharps.
- Generating revenue from the recycling of waste.

Figure 5. Meeting with hospital staff to discuss the placement of waste buckets and waste segregation stands in the hospital units (participatory approach

TIO's sustainability strategy for energy management includes:

- Engaging with renowned companies to set up the system for solar power generation at TIO.
- Ensuring that the agreement with the companies does not just include installation and set up, but also regular monitoring and update, and training for staff members on maintaining the solar panels and battery bank.
- Undertaking regular monitoring of the solar panels and battery bank.
- Providing evidence to hospital management that the cost of diesel for the generator, and the cost of electricity and petroleum have been reduced, with the use of solar power.

Figure 6. Battery bank for solar energy

IMPLEMENTATION PROCESS

The implementation process for safe health care waste management started with an assessment of the waste situation at TIO. This diagnostic assessment was conducted by HECAF to understand the amount and type of waste generated at the hospital, as well as observe and document TIO's existing waste management practices.

This was followed by a series of trainings and meetings with medical and support staff of TIO to raise awareness, build capacity on waste management issues, and design a safe health care waste management system for TIO in a participatory

Figure 7. Waste segregation stand used in the operation theater

manner, which takes the comments and feedback from all staff members into consideration.

To ensure waste segregation at source, it was collectively decided that each unit at TIO will have a two-bucket system to segregate general waste, and there will also be a waste segregation stand in the required units, like in the operation theater.

A waste treatment and storage center was established inside the hospital premise. All the waste generated by the hospital (both general waste and risk waste) is transported to the waste treatment and storage center by a designated staff member that has been trained to handle the waste safely.

An autoclave was procured to disinfect risk waste in an environmentally-friendly way. To ensure that the autoclave is functioning effectively, the integrator and biological indicator or spores test is conducted on a regular basis.

Figure 8. Autoclave used for treatment of infectious waste

General waste like paper, plastic, glass and disinfected waste is sold to the local scrap dealers to generate some income to help cover the system maintenance costs.

TRACKING PROGRESS

For waste management, the hospital tracks progress through:

- Records of the amount total waste (risk and non-risk waste);
- Results of the regular efficacy testing of the autoclave;
- Records of maintenance of the autoclave; and
- Records of waste sold for recycling, and income from the sale (after transportation costs are deducted).

These record sheets for data collection were developed with support from Health Care Without Harm. TIO also tracks energy consumption by fuel type – electricity, petroleum and diesel, since the installation of the solar panels.

Figure 9. Waste transportation trolley

CHALLENGES AND LESSONS LEARNED

During implementation, TIO faced some difficulties in procuring the required equipment, as well as some technical issues in operating the equipment, causing considerable delays in establishing the health care waste management system.

Regular meetings to update staff members on progress was important to sustain their interest and commitment to the new system.

NEXT STEPS

Currently, not all units in TIO have adopted the safe health care waste management system. One of the next steps is to expand this system throughout the hospital to all units, including training for staff in all units on health care waste management.

TIO plans to install additional solar panels to increase its capacity. TIO also plans to address the other goals of the Global Green and Healthy Hospitals (GGHH) network.

"We faced some challenges implementing the waste management system. Changing the attitude and behavior of staff members was the most challenging, but the most important. We also had some problems with getting the autoclave to work. But things are working smoothly now and we are planning to replicate the health care waste management system in our 18 community screening centers."
~ Hari Vinwar, Assistant Manager of Maintenance, Tilganga Institute of Ophthalmology

ABOUT TILGANGA INSTITUTE OF OPHTHALMOLOGY AND HECAF

TIO is the implementing body of the Nepal Eye Program, a non-profit, community-based, non-governmental organization. TIO was established in 1994. Previously, it had about 1,200 patients and performed about 75 operations per week. But when the institute expanded in April 2009, its services also expanded from an outpatient eye care facility to a full American-standard eye hospital serving 1,500 patients per day, with more expertise and greater research capabilities. For more information see http://www.tilganga.org.

With the expansion of the institute, more waste is generated, and the institute faced many difficulties in its management of the health care waste. At the request of the hospital, HECAF started implementing a health care waste management system at the hospital in 2013.

HECAF, established in 1994, is a national non-governmental and not-for-profit organization with a mandate to work in three core areas: (1) health care, (2) environmental health and (3) emergency health. HECAF established the National Kidney Center in 1997, offers technical support in developing a safe and sustainable health care waste management system, and provides capacity development and training in emergency management and disaster risk reduction. For more information see http://www.hecaf.org.

WESTERN REGIONAL HOSPITAL (WRH) POKHARA, NEPAL

Implementation of Safe Health Care Waste Management System

GGHH AGENDA GOAL

- To establish safe and sustainable health care waste management system in the hospital and become a role model in western region of Nepal
- To reduce toxic chemicals in the hospital through mercury elimination

HOSPITAL GOALS

- To reduce POPs generated from burning of health care waste
- To reduce the risk generated from untreated health care waste to the health care workers, cleaning staff, patients, visitors, waste pickers, municipal staff and other community.

PROGRESS ACHIEVED

- Autoclave-based waste management system installed and operating
- Reduction in dioxins and other POPs created as waste burning is eliminated
- Fewer needle stick injuries reported by cleaning staff
- Clean-up of hospital grounds
- Phase-out of mercury thermometers and blood pressure meters
- Waste segregation at source and improved sharps management
- Sale of recyclable wastes to subsidise waste management system
- Composting of food waste

Before and after implementation of safe health care waste management system in WRH

Open waste burning: before safe health care waste management system implementation

Safe collection of risk waste: The same view after safe health care waste management system implementation

Open waste burning: before safe health care waste management system implementation Safe collection of risk waste: The same view after safe health care waste management system implementation

THE ISSUE

Pokhara is an important tourist city situated in the western part of Nepal. New hospitals are mushrooming day by day but concern on managing medical waste was secondary.

Five years ago, the Western Regional hospital (WRH), the largest government hospital in Pokhara, was either burning its health care waste of disposing it in the municipal stream.

Continuous burning of medical waste in the backyard of the hospital was considered a huge public health and environmental problem by the hospital management. There was a long strike by the locals demanding to stop dumping health care waste generated form the hospitals.

In this context, WRH requested HECAF for technical assistance to establish a safe health care waste management similar to the system based on non-burn technology pioneered in the National Kidney Center by HECAF.

IMPLEMENTATION PROCESS

Phase I (2008)

- Sensitization for hospital management and stakeholders
- Training of the nursing and housekeeping staff of hospital
- Model ward selection and implementation of segregation system in consultation with staff
- Replacement of mercury thermometers and blood pressure meters
- Regular monitoring of model ward in first three month of implementation
- Replication in three more wards with the help of previously trained staff and staff of model ward

Work to establish safe health care waste management system was started from the year 2008. Mr. Mahesh Nakarmi and Ms. Saraswoti Thakuri from HECAF visited the city waste disposal system, hospitals and landfill site and conducted a sensitization seminar all stakeholders related with health care waste management.

During the first phase of work, in 2008, HECAF implemented a model waste segregation and handling system in the surgical ward of the hospital. Once this was established, a similar system was replicated to other three wards by the trained staff of the hospital.

The system was developed in consultation with staff. Therefore program was very well received by the staff of the hospital. Local participation is one of the main strengths of the program.

However, due to lack of budget WRH was unable to purchase the autoclave for waste treatment.

Phase II (2011)

- Replication of waste management systems in remaining five wards
- Construction of waste collection center
- Purchase of autoclave for waste treatment
- Establishment waste treatment and storage center

To alleviate the financial problems, HECAF and HCWH then introduced the hospital to the UNDP Public Private Partnership (PPP) program. This program provided the financial support to the hospital to implement phase II activities from 2011 onwards. A waste collection area and a treatment center were established, and the system was replicated to other remaining five wards in the second phase of activities.

Cleaners of the hospital have reported fewer needle stick injuries after the establishment of this new waste management system. The program has been very popular with the nurses, cleaners, doctors and management of the hospital. This has been developed as a model in western region and other people from various private and government hospital also visits this hospital to look for its waste management system.

In 2013, the infectious waste was being autoclaved and recyclable waste was sent for recycling through a private vendor. Biodegradable waste generated from the hospital is being composted on the back yard of the hospital.

Implementation of this environmental friendly safe health care waste management system has stopped the waste burning, which has reduced 2989 micrograms International- Toxic Equivalent per year (I-TEQ/year) dioxin release to the environment. The UNDP/GEF guideline was used to calculate the dioxin level (see links for more info).

The Hospital management was convinced of the importance of having a safe health care waste management system. They have a plan to allocate yearly budget for waste management. Furthermore, the funds collected from the sale of recyclable waste have been useful for minor maintenance and replacement of the equipment.

The autoclave used for waste treatment is simple and easy to operate. Any literate person can use machine after short training. Locally available repair and maintenance service and simple technology are important factors that make this a sustainable waste treatment option.

The hospital is also moving towards mercury free health care. All the mercury containing thermometer and blood pressure equipment had been replaced in the hospital with digital one.

Autoclaving the waste

Hands on training session

Dr Buddhi Thapa, observing the training and discussing with the staff

TRACKING PROCESS (2011 TO TILL NOW)

- Generation of health care waste is tracked by weighing collected waste at treatment and recycling center.
- Regular staff meetings are conducted to collect feedback for improvement.
- Monthly reports are prepared and submitted to the management including all financial details and waste generation.

CHALLENGES AND LESSON LEARNED

- Budget from the government for the autoclave did not arrive, which made it impossible to accomplish the project in Phase I as originally planned.
- Involvement of different stakeholders was essential to complete the process but did result in significant delays. The public private partnership (PPP) concept involved different stakeholders such as private companies and hospital management. Liaising and reaching consensus between these partners delayed the process.
- Municipal staff are not aware about the autoclaving system of the hospital and its importance to kill germs of waste. Therefore, nearby community including landfill staff oppose the dumping of autoclaved waste at the landfill.

NEXT STEPS

- Establish regular training program on health care waste management
- Allocate regular yearly budget for health care waste management
- Improve monitoring of autoclave operation and maintenance
- Disseminate the information and lesson learned to the general public
- Liaise with the municipal landfill staff for disposal of autoclaved non-recyclable waste.

DEMOGRAPHIC INFORMATION

Western Regional Hospital (WRH) is government regional hospital with 350 beds, situated in the western part of Nepal. Average bed occupancy of the hospital is 70%.

LINKS

- United Nation Development Program (UNDP): Global health care waste project. Medical waste incinerator report. http://gefmedwaste.org/article.php?list=type&type=33
- Guidance on Estimating Baseline Dioxin Releases by UN/GEF Global Healthcare Waste Project July 31st, 2009 http://gefmedwaste.org/downloads/Dioxin%20Baseline%20Guidance%20July%202009%20UNDP%20GEF%20Project.pdf

QUOTES:

Dr. Buddhi Bahadur Thapa, Medical Supertendent, WRH

"Health care waste management was felt very necessary part of hospital management so we conducted series of meeting with the ministry, municipality and other donor organization for establishment of health care waste management system. It was very difficult in the beginning but now it has become easy and well received by the staff. This is very important and all health care facilities should establish heath care waste management system to make their own staff, patients, visitors and public free from risk associated with health care waste."

GUNJAMAN SINGH HOSPITAL
PITHUWA VILLAGE, CHITWAN DISTRICT, NEPAL

GGHH AGENDA GOAL

- Safe and sustainable waste management

HOSPITAL GOALS

1. Safe and sustainable hospital waste management

PROGRESS ACHIEVED

Proper hospital waste management was implemented in 2011.

- Training was done by the team of Mahesh Nakarmi from Healthcare Foundation Nepal (HECAF) in Kathmandu.
- Infectious waste is treated by autoclave (see photo on the right)
- The Center hasneedle and syringe destroyers to prevent reuse of syringes and prevent injuries during disposal.
- We have a new constructed compost bins for biodegradable waste
- The center is mercury free so there is no mercury waste
- Pharmaceutical stocks are monitored and the ones with the closest expiry dates are used first. This saves money and prevents generation of pharmaceutical waste
- As much waste as possible is recycled

We have also one person responsible for waste management: M. Surej.

Cost of equipment, trainings, transport and living costs around USD 500 plus staff time and travel and allowances for HECAF to do the training.

After implementing the waste management program and cleaning properly our hospital and surroundings we have achieved a good standard of hygiene from which our staff and patients are benefitting and learning.

THE ISSUE

Chitwan is a rural district in the eastern lowlands (Terai) of Nepal. There is little municipal waste management and no healthcare waste management. Most healthcare facilities burn waste in pits or badly made incinerators. Medical waste dumping is also common.

SUSTAINABILITY STRATEGY IMPLEMENTED

The Center is funded by Swiss NGO "Shanti Med Nepal" and private sponsorship. Environmental health and sustainability is an important factor in decisions in the development in the hospital. So far, the Center has become mercury free, implemented safe healthcare waste management, installed solar electricity

backup and solar water disinfection. Dr Gonseth, the Swiss dermatologist who founded Shanti Med Nepal and spends part of the year at the Center, is committed to sharing her environmental expertise with others wherever possible.

IMPLEMENTATION PROCESS

In such a small facility, the decision making and implementation process is comparatively simple. Dr Gonseth was responsible for selecting the projects to be undertaken, any necessary fundraising, identifying collaboration partners and directing implementation for all elements within GSH.

The project to implement medical waste management in other similar projects is led by HECAF. All participating parties (HECAF, GSH and HCWH) worked together on the plans, which are supported by a small grant. GSH will host a demonstration site which will be important in training of staff from other facilities. HECAF are responsible for the implementation of the project and HCWH are providing technical support as requested.

The day care centre's waste is disinfected in a 40-litre autoclave. Most of the electricity comes from solar power system (see separate case study)

TRACKING PROGRESS

Healthcare waste management: success is measured by the ability to treat and recycle as much as possible of the waste produced by the facility. Parameters recorded include the amount of infectious waste autoclaved; results of the regular efficacy testing of the autoclave; records of maintenance of the autoclave; amounts of waste sold for recycling; income from the sale of recycling and any profit remaining after transportation costs are deducted.

CHALLENGES AND LESSONS LEARNED

The original hospital manager was against the project and tried to disrupt it. He refused to issue staff with PPE and tore down posters about the project. He was eventually replaced and the project has been more successful since.

NEXT STEPS

- HECAF is leading a project with GSH and HCWH to implement safe waste management in small facilities in Chitwan District. There is a wide interest in installing the proper waste management and there is the support of the District Public Health Office and the national Ministry of Health and Population. GSH will both serve as a demonstration site and source of expertise during the project.
- It is planned to expand from the current daycare center to a small hospital being built nearby. In the first phase, it will have twenty-five beds, expanding eventually to fifty beds. Sustainable healthcare waste management will be implemented at the hospital.

DEMOGRAPHIC INFORMATION

Gunjaman Singh Hospital, Pithuwa-3, Chitwan, Nepal, is an independent non-profit day care centre, funded by NGOs and private donation. Gunjaman Singh Hospital has 50 – 70 patients daily and has10 staff members (including two Nepali doctors). Mostly of the time there is also a volunteer doctor or another specialised person from Switzerland there to give trainings to the staff.

Ruth Stringer: "It is really impressive to see that the whole centre, including the x-ray machine, and the waste autoclave, can be run on a single array of solar panels. The leadership provided by Dr Gonseth will have an impact far beyond Gunjaman Singh Hospital, as the partnership with HECAF shows."

ENERGY

Implement Energy Efficiency & Clean, Renewable Energy Generation

Photo by Temistocle Lucarelli/123rf

TAOYUAN CHANG GUNG MEMORIAL HOSPITAL TAIWAN

Advocating Energy Saving and Emission Reduction through Efficient Energy Utilization

GGHH AGENDA GOAL

- Energy

HOSPITAL GOAL

- A total of 1,171 sets of lights were altered. Instead of having two 28W light tubes, they were replaced with just one 28W light tube. The change allowed the hospital to save 287,222 KWH/ year of electricity and reduce carbon emissions by 149.9 tons/year in B3 – B5 parking lots
- Bollard lamps in situated in outdoor trails in South and North part of the hospital were replaced. Bollard lamps using 26W of electricity were changed to LED light which utilizes just 8W. Annually, due to changing bollard lights the hospital was able to bring down electricity consumption to 6,070 KWH and their carbon footprint by 3.2 tons
- In public areas (entrance lobby, cashier, and dispensation waiting areas), installed 2 26W recessed lamps were replaced with one 12W LED lights. This has allowed the hospital to decrease electric consumption by 710,377 KWh per annum and reduce emission 370.8 tons/yr
- Guide lamps located in the driveway of B1 – B5 and F1 such as the HPS, halogen and metal halide lamps were change to LED lights. In B1 – B5 single 70W HPS lamps and 35W halogen lights were replaced with single 10W LED lights. In F1, single 250W metal halides were changed with single 100W LED lights. This action enabled the hospital to only utilize 206,736 KWH/ annum of electricity and cut back their carbon emission to 107.9 tons/year
- Installed 14W T5 fluorescent lamps in 160 wards with individual switches for independent control saves as much as 16,352 KWh/ year and decrease emissions by 8.5 tons/yr
- Installation of new control circuit reduced the number of lights that are left turned on by half. The new control circuits manages light in 28 elevator lobbies which has twenty – four (24) 28W fluorescent lamps and twelve 12W down lamps. Due to the installation of the new control circuit, the hospital was able to save 100,074 KWH/year of electricity and decrease emission by 52.2 tons/ annum
- The energy-saving measure implemented in water, electricity and oil consumed led to a decrease of 26.9 KLOE (-0.39%) and carbon emission by 701 tons in contrast to figures acquired in year 2010
- In 2011-2013 the following achievements were observed 3.23% waste reduction, 41% of water reused, NT$98.189598 million saved in green procurement and 622,580 kg wastes were recycled

*All 26W*2 PL recessed lamps altered to 12W*1 LED ones*

*All 35W*1 driveway halogen lamps altered to 10W*1 LED ones*

*All 70W*1 driveway guide HPS lamps in B1-5 and F1 altered to 10W*1 LED ones*

THE ISSUES

- Energy prices increases continually
- High cost of energy-saving equipment
- The climate has a strong effect on the energy-saving effectiveness of air conditioners
- Energy consumption affects individuals

SUSTAINABILITY STRATEGY IMPLEMENTED

- Energy saving and emissions reduction employed a sound organizational structure employing a top – down management approach. Departments from the hospital including the nursing department, pharmacy, clinical laboratory and administration have set of responsibilities to carry out the program. Efficient and highly skilled Task Force was place in charge to guide the implementation of the project
- A separate Task Force was also created to promote and orient the hospital community of the program. Although departments have autonomy in managing the program within their jurisdiction, a common goal was set. Identifying a common goal assist in achieving benchmarks in air condition, illumination, electricity management and other pursuant to existing medical requirements
- A project for energy-saving and emissions reduction improvement is submitted on a yearly basis, progress is traced on a monthly basis, and implementation status is reported on a yearly basis
- The operational administration covers and improves total quantity control, unit cost control, controllable cost control, irregularity improvement analysis, operational performance assessment. They are also facilitating discard and replacement of energy-consuming equipment, time interval and automated control
- The energy-saving measures developed by engineering department include energy-saving design in the planning phase of buildings and electromechanical systems. Moreover, they also take charge of the introduction of new energy-saving equipment, adoption of devices and materials with high efficiency, opting of accurate engineering, introduction of automated facilities and simplified manual operation
- The promotional campaigns for energy saving include hospital-wide lecture E – learning, webpage promotion, and posters.
- An autonomous energy-saving audit during off-work time is documented
- A regularly-sponsored energy – saving and waste minimization meeting reviews the measures and executive status of improvements.

IMPLEMENTATION PROCESS

In the initial phase of hospital construction, the blueprint included green concepts. These concepts provided framework for instituting energy saving ideas and mechanism such as:

- central monitoring system
- ice storage air conditioning system
- off-peak electricity
- large illumination windows using micro-mirror glass
- inverter air conditioning system
- joint washing by tunnel washer
- T5 LED lamps

In spite of the efficient and environmentally friendly mechanisms installed, Taoyuan Chang Gung Memorial Hospital still maintains a comfortable and patient – centered hospital environment.

TRACKING PROGRESS

A central monitoring system controls energy management of water, electricity, air conditioning and steaming systems which reduces energy wasted. An air conditioning mainframe equipped with a certain capacity presets for workloads, automatically increases or decreases actual loads. This system prevents overconsumption and reduces electricity expenditures. In addition, a schedule control program manipulating air conditioning chambers, ventilators and exhausters through temporal requirements further reduces electricity consumed.

As for water control, the water reservoirs managed through peak/off-peak level controls (during holidays water and electricity is not controlled for water source safety) makes more room available for water supply quantity during off-peak hours. A holistic management mechanism consisting of operation management, total amount control and cost control were employed.

Training and auditing for energy saving, regular energy-saving and waste minimization meetings which monitors the effects and results of the strategies carried out are conducted.Challenges and Lessons Learned

- The biggest challenge in energy saving is to change users' habits. To address this concern, a compulsory participation of employees in an online learning to develop energy saving habit was mandated; implemented by audit institution
- In addition to proactive promotion for energy saving at the supply end, the Hospital identifies the user end as its most significant concern. It is difficult to know exactly how the user end consumes energy, preventing a sound analysis and assessment for improvement. Given that ISO 50001:2011 (Energy Management System) was used as guide because of the benchmarks it has set. Energy Saving Systems are applied in each department encouraging employees to act on energy saving and emission reduction program.

NEXT STEPS

- The waste minimization project is promoted constantly with the objective of energy saving by 0.1% per annum in 2012-2016 based on the 2011 baseline. The hospital is also aiming to maintain energy consumption by 2017-2020
- Besides the respective energy-saving programs that have been initiated, the enactment and promotion of ISO 50001:2011 (Energy Management System) further shows the Hospital's commitment. The Hospitals aim to maintain and enhance its Eco – Friendliness and fulfill its corporate social responsibility through influencing employees to save energy and reduce emissions.

DEMOGRAPHIC INFORMATION

Taoyuan Chang Gung Memorial Hospital, founded in Dec. 2003, is committed to the enhancement of domestic medical care of chronic diseases, the integration of traditional Chinese and Western medicine. The hospital also aspires for the establishment of a system of preventive medicine and holistic medical treatment for acute and chronic diseases.

The Hospital is situated on the hill of Guishan District, Taoyuan City, Taiwan Province, secluded among green hills, is one of the top three (3) magnificent architectural works in Taiwan. The structure has an innovative, elegant windmill shape connected by a paired-line cross, making blue sky and green land visible at each corner of the Hospital, making it indeed a Garden Hospital.

LINKS

https://www.cgmh.org.tw/

QUOTES:

Energy saving and emissions reduction achieved by me
In pursuit of the best through self-examination
Ongoing improvement with unceasing commitment

KEYWORDS / TOPICS:

Central monitoring , ISO 50001 , CGMH

DATE SUBMITTED: June 2015

EDA HOSPITAL

Increasing Energy Effectiveness by Management Methods in Taiwan Regional Hospital

GGHH AGENDA GOAL

- Energy

HOSPITAL GOAL

- Reduce energy costs
- Reduce carbon dioxide emissions

PROGRESS ACHIEVED

Hospitals are responsible for providing round-the-clock and uninterrupted service to ensure safety and maintain quality health care for the patients they are servicing. Despite the increase in volume of patients being cared for and number of equipment and facilities in the hospital from 2011 -2013; there was no substantial increase in the energy use intensity (EUI) recorded. EDA hospital has successfully maintained energy consumption at 175 kW/m2. The promising outcome gained may be attributed to timely equipment maintenance and utilization of energy conserving devices. The table below presents EDA Hospital's EUI annually from 2010 – 2013.

Table 1.0 E – DA Hospital Annual Energy Use Intensity from 2010 to 2013

Year	2010	2011	2012	2013
Area (m2)	169,813.53	169,813.53	169,813.53	169,813.53
Power (kWh)	27,461,000	28,082,916	29,050,200	29,401,968
EUI (kW/m2)	161.71	165.4	171.1	173.14

THE ISSUE

E- Da Hospital aims to promote healthcare in natural environment, bringing together the concept of healthcare and environmental friendliness. The hospital is looking at achieving this aim by establishing a first class international medical center in a preserved natural, healthy, and comfortable environment.

Moreover, the population of in – patient and out – patient and out – patient has been servicing has been continually increasing. It is the priority of E-Da Hospital to continue bringing quality services while keeping the hospital's EUI low through efficient usage of energy resources.

SUSTAINABILITY STRATEGY IMPLEMENTED

In addition to the environmental-friendly architectural design and the choice of energy-conserving equipment, E-Da Hospital has sustained efforts to maximize energy efficiency and minimize carbon emissions in recent years. For instance, the Occupational Safety and Health Office proposed the strategy of five R's: Replace, Reuse, Reduce, Recycle, and Resource management to further improve environmental friendliness of the hospital.

Moreover, different strategies have been implemented, including close monitoring of power, water, and diesel consumption. Quantity of produced waste and volume of diverted waste through recycling were also recorded. Special efforts to digitalized medical records, administration documents and integrate laboratory checklists into the information system were conducted. This has resulted to reduced paper and manpower utilized.

IMPLEMENTATION PROCESS

Replace

1. Illumination system

In compliance with the power conservation policy of the hospital, high energy efficiency lighting devices were used to replace currently installed lights. Newly installed lights provided suitable illumination intensities and reduced both energy used and carbon emission (Table 2.0).

Table 2.0 Strategies Implemented to Improve Illumination System and Energy Reduction Outcome

Improvement Strategy	Specific Activities	Outcome
Improvement of lighting condition over the passages in wards	Replacement of 408 projection lamps (50W) with 136 pot lights (23W) and removal of lampshades from 204 pot lights.	Reduction of power consumption by 17.272kW per hour with improved illumination.
Progressive replacement of incandescent lamps with light-emitting diode (LED) devices (Figure 1.0)	Totally 2,783 incandescent lamps in the hospital have been replaced with LED lamps since 2012.	Curtailing of daily power consumption from 1,756.22 kWh to 778.58 kWh, equivalent to a total reduction of 276,932.16 kWh and 148.44 tons of carbon dioxide emissions per year.

Figure 1.0 Replacing Incandescent Lamps with Light – Emitting Diode (LED) Devices

2. Power system

(a) Power Source for Boilers:

Natural gas was used instead of diesel. Diesel consumption is reduced by 143,231.34 liters while carbon dioxide emissions were decreased by 304 tons, annually

(b) Heat Pump System:

Gas, diesel, and electricity-generated hot water were replaced by the heat pump system Integration of the hot water to water heat pump and into the air-conditioning system reduces CO2 emissions by 360 tons/ year (Figure 2.0).

Figure 2.0 Hot Water Produced from Heat Pump System

3. Water system

Water saving restrictors were installed in tap water sources such as faucets and showers This has heightened water usage efficiency (Table 3.0 and Figure 3.0)

Table 3.0 Comparison of Water Consumption Before and After Installation of Water –Saving Restrictor

Item (number)	Rate of water flow (L/min)		Amount of water saved (L/min) (percentage)
	Before	After	
Automatic infrared sensor tap (n = 622)	6.9	2.4	4.5 (65.2%)
Manual tap (n = 359)	9.0	3.4	5.6 (65.2%)
Shower head (n = 510)	9.2	5.6	3.6 (39.1%)

Figure 3.0 Installation of Water – saving Restrictors on the Taps and Showers of the Hospital

TRACKING PROGRESS

There are a number of departments in EDA Hospital which work together to implement the program. This committee is headed by the Superintendent in collaboration with Administration Center, Nursing Department and other units. This committee is also in – charge of monitoring and evaluating implementation outcomes and impacts

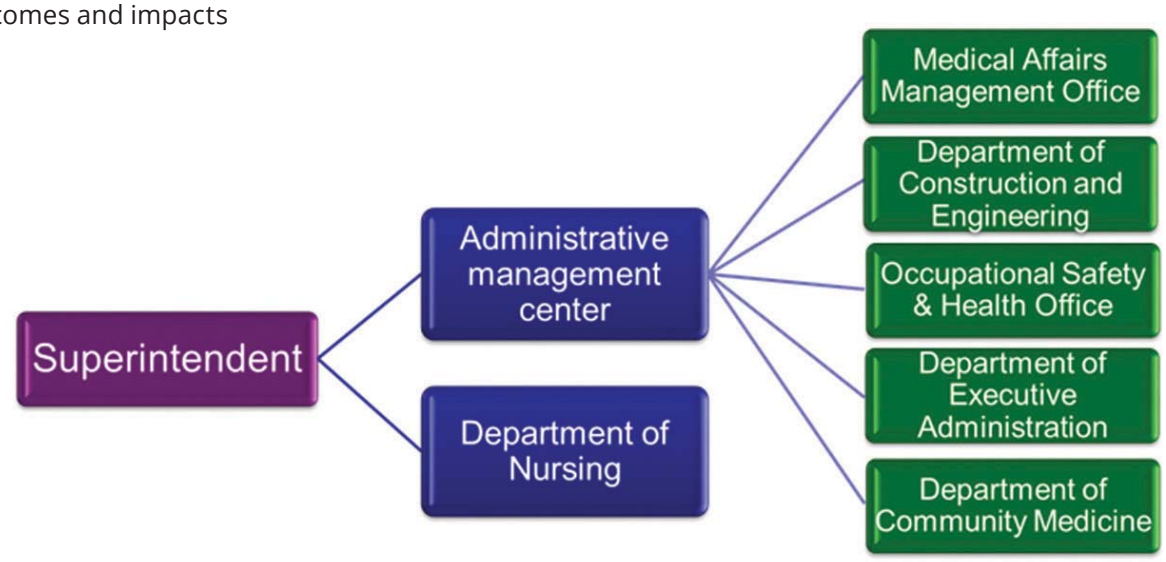


Figure 4.0 The Administrative Framework of Environment and Resource Management at E-Da Hospital

DEMOGRAPHIC INFORMATION

Since its foundation in 2004, E-Da Hospital has always been adhering to the vision of " to be a world-class medical center internationally". Its elite teams in various medical centers have been serving patients with professional medical knowledge, techniques, a patient-centered diagnosis and treatment mode. E-DA Hospital has received the Joint Commission International (JCI) Accreditation in 2008, 2011, and 2014.

The total number of employees are 2761 people, including physicians, nurses, technicians. The numbers of beds in E-Da Hospital are 1251 beds. We specialize in Total Hip Replacement & Total Knee Replacement, Brachial Plexus Injury Treatment, Laparoscopic Bariatric Surgery, HyperhidrosisTreatment, Gamma Knife Radiosurgery, Prostate Laser Surgery, Polysomnography and Cardiac Catheterization Examination with intervention.

E-Da Hospital features a 24-hour Trauma & Emergency Center, 29 operating rooms and 6 types of intensive care units including MICU, NSICU, CVSICU, GSICU, PICU and PSICU. We are equipped with state-of-the-art equipment including PET/CT, Gamma Knife, CT, MRI and RapidArc and provide patients with high quality medical services.

E-Da Hospital is located in Yan-Chao district over the northern part of Kaohsiung City. Based on the concept of health care reinforcement and environmental friendliness, the hospital was built with the aim of providing an excellent healing environment for our patients at a first-class international medical center in a well-preserved natural, healthy, and comfortable hospital environment.

Accordingly, in compliance with the government policy on energy efficiency and environmental protection, the hospital not only has incorporated the concept of environmental preservation into architectural designs,

but it has also promoted greenery for environmental improvement, adopted energy-saving illumination designs, used toilet & shower utilities with proven water efficiency, established a central monitoring system for overseeing air-conditioning & other power use inside the hospital, digitalized documents to reduce paper use as well as set an energy efficiency goal with "energy use intensity" (EUI) which is an assessment of energy use per unit area in a building in order to be an environmental-friendly medical institute that can provide safe and high-quality patient care.

LINKS

With the continuous collaborative effort of all devoted personnel of E-Da Hospital, the institute was given a number of awards (Figure 5.0) in recognition of its contributions to enhancing energy efficiency and reducing carbon emissions after its establishment in 2004:

1. First prize in "Waste Recycling and Reduction" by the Environmental Protection Administration, Executive Yuan, Taiwan, R.O.C. in 2006
2. First prize in "Outstanding Energy Conservation" by the Bureau of Energy, Ministry of Economic Affairs, R.O.C. in 2007
3. First prize in water conservation by the Bureau of Energy, Ministry of Economic Affairs, R.O.C. in 2007
4. (4) Bronze medal of Symbol of National Quality (SNQ) in hospital information management for the submitted project "Sentry of Disaster Prevention: Central Control Management System" given by the Institute for Biotechnology and Medicine Industry in 2012
5. "Award of Outstanding Energy Conservation" by the Bureau of Energy, Ministry of Economic Affairs, R.O.C. in 2013
6. First prize of "Environment Friendly Health Care Facility" by the Ministry of Internal Affairs in two successive years of 2013 and 2014
7. Participation in the project of "Saving the Earth through Reduction of Carbon Emissions: Role of Health Care Institutes" organized by the Health Promotion Administration, Ministry of Health and Welfare, R.O.C. in 2013, emphasizing on establishment of solid plans on water, power, oil, and waste reduction and recycling.
8. Award of "Outstanding Public Architecture" by the Kaohsiung City Government in 2014
9. Award of "Environment Friendly Health Care Architecture" in 2014 by the Kaohsiung City Government
10. Silver medal for successful creation of a tobacco-free environment by the Global Network for Tobacco Free Health Care Services in 2014

Figure 5.0 Awards Received by E-Da Hospital in Acknowledgement of Its Contributions to Environmental Protection

KEYWORDS / TOPICS:

Energy Conservation, Contracted Demand, Power Factor, Time Rate

DATE SUBMITTED: May 2015

SHANGHAI CHEST HOSPITAL

Renovation of Boiler Flue Gas Heat Recovery and Solar Hot Water System

GGHH AGENDA GOAL

- Energy

HOSPITAL GOAL

- Build a boiler flue gas heat recovery system and solar hot water system, to heat water with the waste heat of flue gas and solar energy.
- Reduce energy consumption and improve energy efficiency.

PROGRESS ACHIEVED

- Boiler flue gas heat recovery system achieved energy savings of 6.1%-7.3% and the efficiency of boiler was enhanced greatly.
- With the use of solar hot water system, the total replacement rate of fuel heating has reached 31.67%. Annual energy saving is about 50 tce, and the decrease rate of heating resource cost (energy-saving rate) is 30.44%. The energy saving effect is significant.

THE ISSUE

The hot water supply system of the hospital's second ward building has four storage heat exchangers, two of them are for the 13th-15th high floors and the others for lower floors. Cold water is supplied from the roof water tank, and the vapor is supplied centrally through the boiler room where there is one Shuangliang steam boiler (rated capacity is 6-tons/hour), and two Cochran "Wee Chieftain" six type quick-install steam boilers (rated capacity is 4.5-tons/hour). They were all fuel-fired boilers before retrofitting to be fuel gas boilers. From the purchase of diesel fuel to the vapor into the heat exchangers, the estimated energy utilization ratio and the heating cost were 13.44%-22.25% and 0.2403-0.2675 yuan/MJ ($.034 - $.037 USD/MJ) respectively.

SUSTAINABILITY STRATEGY IMPLEMENTED

In order to reduce energy consumption and cost, and to improve energy efficiency, the hospital implemented the following two projects:

- **Boiler flue gas heat recovery system**

The system directs the boiler flue gas into a waste heat recovery device. Water in the exchangers is heated by absorbing the sensible heat in the exhaust gas, achieving the objective of making use of waste heat.

- **Solar hot water system**

A new solar heat collector was added on the roof of the second ward building. By increasing the temperature of water supplied into the heat exchange room in the basement, the heating demand was decreased, thus achieving energy savings.

IMPLEMENTATION PROCESS

- **Boiler flue gas heat recovery system**

The hospital installed an air lock valve and a branch pipe in the main gas flue pipe of the three boilers. Then a superconducting heat exchange device was installed behind the branch pipe (configure according to 10.5t boiler). The equipment was on the roof beside the boiler room. The recycled waste heat was used to circularly heat water in the nearby 6-ton heat insulating water tank. Under normal operating conditions of the boilers, the water temperature can be raised to 60-65^0. Then the water is sent into the original plate heat exchanger on the roof of outpatient building, by the water pump, to supply the building's hot water system.

- **Solar hot water system**

Picture 1: The boiler room after transformation

Picture 2: The boiler gas flue pipe

The solar hot water system is composed of a heat collector, hot water tank and circulating pump, as well as a measurement and control system. The collector has 142 1.8m×1.5m heat collection units. The volume of the hot water tank is 24 m3. There are two hot water circulating pumps, one for normal use and the other as standby.

Temperature measurement and electronic control valves are set on the inlet end of the hot water tank (they automatically control the inflow according to the water level), and temperature measurement and flow measurement devices are installed on the outlet.

Temperature sensors are placed inside the hot water tank and heat collector respectively. The system is heating water with the collected solar energy through solar collectors. The control mode of the system is that based on the temperature sensors, when the water temperature of the heat collectors is 5^0 higher than that in the hot water storage tank, the hot water circulating pump automatically opens and then puts the water with lower temperature, in the hot water storage tank, into the heat collectors for heating, then the water of higher temperature in the collectors is sent into the storage tank for reserve.

TRACKING PROGRESS

- **Boiler flue gas heat recovery system**

The superconducting heat exchanger fully absorbs the sensible heat in the exhaust gas and heats the water in the exchanger. The temperature of the discharged exhaust gas falls by 110^0 from 200^0 to 90^0, which contributes to 6.7%-7.3% energy conservation, and saving 1392908×6.1%=84967m3 fuel gas every year, saving 339,018 RMB (about $48,000 USD). The expected service life of the system is 10 years, so the static income is about 3.4 million RMB (about $490,000 USD). The benefits are even more significant when the expected rise of gas prices are taken into account.

Picture 3: solar collectors on the roof

- **Solar hot water system**

After put into use, the total replacement rate of fuel heating reached 31.67%. In terms of energy savings, the heating resource cost of central hot water system fell from 0.041533 kgce/MJ to 0.028889 kgce/MJ, saving about 50 tce each year, and the decreased rate of heating cost (energy-saving rate) was 30.44%. The annual energy conservation economic effect was about 311,000 RMB (about $45,000 USD). The energy savings are significant.

CHALLENGES AND LESSONS LEARNED

Hospitals, as a special type of public building, have characteristics of complex functional layout and active crowds, lots of large-scale equipment, complex energy systems, year-round operation, a higher overall energy consumption than the general public buildings and have great potential for energy savings. Therefore, it is of great significance to strengthen the hospital energy management, improve the hospital energy efficiency and build energy-saving hospitals.

Both the renovation project of boiler flue gas heat recovery system and solar hot water system were implemented by means of contract energy management with the third-party energy service companies, which provide a very reasonable and effective way to promote hospital energy conservation management.

DEMOGRAPHIC INFORMATION

Shanghai Chest Hospital was built in 1957, which is the earliest 3-A-Class hospital specialized on the diagnosis and treatment of heart, lung, esophagus, trachea and mediastinal diseases, integrating medical treatment, teaching and research in China. The hospital is located in Xuhui District, Shanghai, covering an area of 26,000 m2, admits more than 300,000 emergency patients, outpatients and inpatients from the whole country each year.

This case study was submitted by China Building Technique Group Co., Ltd. The original paper has been published in "Series of Green Retrofitting Solutions for Existing Buildings—Green Retrofitting for Existing Hospital Buildings Case Studies".

BEIJING SHIJINGSHAN DISTRICT WULITUO HOSPITAL

Renovation of Coal-Fired Boiler in Geriatric Ward in North Xin'an District

GGHH AGENDA GOAL

- Energy

HOSPITAL GOAL

- Replace the original coal-fired boilers with electric boilers, and run it with 8h off-peak electricity at night.
- Alleviate the tension of heat source in Beijing, save energy and reduce consumption.

PROGRESS ACHIEVED

- The project improved the heating efficiency and degree of automation, while also significantly reducing energy consumption.
- The electric boiler achieved zero pollution, no noise, and reduced the hospital's CO2, SO2, and nitrogen oxide emission.

THE ISSUE

Wulituo Hospital is located in Beijing Shijingshan District. Before the renovation, the hospital was heated with a non-press boiler. Though the heating pipe network facilities were completed, the boiler heating system was running in a low heating temperature and low efficiency, it also caused serious pollution. In addition, heating shortage has already appeared. The problem of heating source needs to be solved urgently.

SUSTAINABILITY STRATEGY IMPLEMENTED

According to the current municipal heating mode and the policy of low off-peak power price, the hospital selected two solid heat storage electric boilers to supply heat from different heat sources. The electric boilers store heat while heating at night, and then use the stored heat to supply heat during the daytime. Furthermore, the solid heat storage electric boilers come with a hot air-water heat exchanger, and the hot water produced can directly go into the heating pipe network.

Selection of main equipment:
Drawing on the calculation method of the whole day cooling capacity of Ice Storage Systems, the hourly temperature on the day when daily mean temperature is the lowest among typical years was adopted as a basis for heat load calculations, resulting in the total heating load 246KW. Two 350KW electric boilers were selected. The electric boilers supply and store heat during 11pm-7am, and the heat for 7am-11pm is provided by the heat storage tanks.

According to the heat supply and demand balance table 1, the night 8hr heat storage of the boilers is enough to afford the 16hr of heat consumption during the day without the need to start the boilers for supplemental heat. Therefore, according to the heating principle of sub-time heating with different heat sources and the 246KW heating load, the project's "coal to electricity" heating station influenced the use of two 350KW atmospheric resistance electric water boilers (including heat supply and storage mode). Specific parameters are as shown in the table 2.

Table 1. The balance of heat supply and demand

Thermal requirement per unit		**60 W/m²**	**Building área**	**4100 m²**	**Total capacity of boiler**		**0.7MW**
period	**The hourly coefficient**	**The hourly load per unit W/m²**	**Daily maximum heat consumption MWh**	**The night 8h heat consumption MWh**	**Daytime 16h heat consumption MWh**	**The night 8h heat storage capacity MWh**	**The remaining heat MWh**
0	0.96	57.62	0.24	0.24		0.46	
1	0.97	58.33	0.24	0.24		0.46	
2	0.98	58.90	0.24	0.24		0.46	
3	0.99	59.38	0.24	0.24		0.46	
4	1.00	59.72	0.24	0.24		0.46	
5	1.00	59.95	0.25	0.25		0.45	
6	1.00	60.02	0.25	0.25		0.45	
7	0.99	59.68	0.24		0.24		
8	0.97	58.26	0.24		0.24		
9	0.93	55.96	0.23		0.23		
10	0.89	53.12	0.22		0.22		
11	0.84	50.10	0.21		0.21		
12	0.79	47.33	0.19		0.19		
13	0.75	45.13	0.19		0.19		
14	0.73	43.84	0.18		0.18		
15	0.72	43.44	0.18		0.18		
16	0.73	43.64	0.18		0.18		
17	0.74	44.11	0.18		0.18		
18	0.74	44.55	0.18		0.18		
19	0.75	44.79	0.18		0.18		
20	0.74	44.62	0.18		0.18		
21	0.74	44.35	0.18		0.18		
22	0.74	44.25	0.18		0.18		
23	0.74	44.69	0.18	0.18		0.52	
			5.03	1.88	3.15	3.72	0.57

Table 2 Specifications of the main equipment

number	Equipment name	Specifications and parameters	Amount	Remarks
1	The atmospheric resistance electric water boilers	Heating load is 350kW, supply and return water temperature is 95/70^{0}C	2	
2	The atmospheric resistance heat storage tanks	V=55m3m^{3}the temperature in the tank is 95^{0}C	2	
3	The plate heat exchanger	exchanging heat quantity is 210.6kW, area is 15m^2	2	
4	First side hot water pump	33t/h, 11m, 5.5kW, 1450rpm	3	Two in used, one for backup
5	Secondary side hot water pump	13t/h, 20m, 2.2kW, 1450rpm	3	Two in use, one for backup
6	Softened water treatment device	handling capacity 1.5t/h	1	
7	Softened water supply pump for outer net	0.15t/h, 20m, 0.55KW, 1450rpm	2	One in use, one for backup
8	The straight dirty remover	66t/h, 100W/220V	1	
9	The straight dirty remover	26t/h, 100W/220V	1	

Operation mode of heat-supply system:

As mentioned above, sub-time heating with different heat sources, from 11pm to 7am next day, a total of 8hr heating by boilers using non-peak electricity, minimizes the energy input costs. At the same time, the electric heat storage boiler operates to supply a partial load directly and store the heat required during daytime. From 7am to 11pm, a total of 16hr of heating is provided with heat stored during the night before. The electric heating boiler room also works as a backup heat source and the standby ratio is 100%.

The heating pipe network uses the underground direct burial mode, which has advantages of small occupied road section, good waterproof and short construction period. The current heat network of hospital is a dendritic pipe network system, which is running in a good condition. Thus keeping the current outer net unchanged, the heat source side of the heating network is connected to the current outer net.

Automatic control system:

The structure of the control system is the man-machine interface -PLC- converter - instrument mode. The basic principle is that with the change of the heat users' temperature and the return water pressure, it can automatically control the valve opening, circulating pump and water supply pump speed so as to achieve constant temperature and pressure, as well as the interlocking protection for the system simultaneously. The heating operation units have the initiative to regulate the heating system about the flow and temperature of water supply network to meet the heating needs of users and ensure a certain economic value.

Water supply scheme of the heating system:

The water source for the heating station is tap water from Tegang Property Company. According to the system's requirement on water quality, automatic water softener is used. A softened water supply pump provides constant pressure for the boiler and hot water system, and make-up water.

TRACKING PROGRESS

In the design, construction and operation of the project, the hospital has adopted more mature and reliable energy-saving measures, and selected conservation-oriented systems and products, thus met the State, and Beijing's laws and regulations on energy conservation and environmental protection as well as enhanced users' comfort.

Electric boiler technology has been very mature and has high thermal efficiency and automation; when using the off-peak electricity, the users can also reduce cost. So the social benefits of electric boilers can be seen obviously from technology, market, economy and so on.

In terms of environmental benefits, electric boiler is relatively cleaner, and has no pollution, no noise that can protect the environment and benefit the public. Also, it can reduce the hospital's CO_2, SO_2 and NO_X emission.

CHALLENGES AND LESSONS LEARNED

In recent years, because of the high emissions of SO_2 and other acid gases emission from coal fired boiler, Chinese government has intensified efforts to shut down the coal fired boilers. Oil-fired boilers have also been limited. Though the use of natural gas is vigorously promoted and supported, the development of gas-fired boilers is also constrained because of the tight supply and a rising trend of future price. While, the use of electric boilers can effectively reduce pollution and can be an important way to solve smog in Beijing. For the power grid enterprises, it can improve the utilization rate of off-peak electricity at night and effectively reduce the peak-valley differences of grid load.

For power generation enterprises, it can improve the utilization efficiency of the power generation equipment, increase the power generation amount, and reduce the power generation cost. For customers, it doesn't increase the heating costs. Therefore, for the comprehensive consideration of environmental protection, energy-saving, emission reduction, and full use of clean energy, electric boiler is the must choice in future development.

DEMOGRAPHIC INFORMATION

Shijingshan District Wulituo Hospital was built in 1976, and combined with the mental health care institute in Shijingshan District in 1996. It is responsible for health care, outpatient, hospital treatment and rehabilitation of the whole region's mental health communities. As the community health service center in Wulituo, it also undertakes the six-in-one functions of community health service (prevention, health care, health education, family planning, rehabilitation and medical treatment).

This case study was submitted by China Building Technique Group Co., Ltd. The original paper has been published in "Series of Green Retrofitting Solutions for Existing Buildings—Green Retrofitting for Existing Hospital Buildings Case Studies".

KAOHSIUNG MUNICIPAL SIAOGANG HOSPITAL (KMSH)

Creating a Green Environment Initiative

GGHH AGENDA GOAL

- Energy
- Water

HOSPITAL GOAL

- To maintain consumption of energy and water consumption, despite the growth in patient number

PROGRESS ACHIEVED

- Kaohsiung Municipal Siaogang Hospital (KMSH) has continually improved hospital structure and equipment. Annual expansion and facility refurbishment were conducted. Corresponding with these developments, electricity and air conditioning temperature are closely monitored and energy efficient devices were installed. Daily electricity expense drops from NT$ 30,209 to 29,625 during 2011-2013. Annual electricity and gas saving is 2,000,000NTD, saving 45% of total expenditure
- Old hospital apparatus were replaced using 37% of the hospital's annual budget to purchase more efficient and green equipment
- Installed solar panels were used to preheat water, saving 40 KWh/day electricity
- A decreased in annual carbon production of 297,437 kg has been attained after using green tableware and self - prepared meal box
- In 2011-2013, water consumption remains constant despite the growth in patient number. Compared to consumed water from 2009 – 2010 (11,026,646 cu.m), despite increase in number of patients, water utilized in 2011 – 2013 (125,412 cu.m) has decreased.

THE ISSUE

1. Energy and Water Resource:

Increasing number of patients and personnel, purchases of equipment and structural expansion have resulted to elevated pharmaceutical supplies, drugs, energy and water consumption. Consequently, the amount of generated wastes have also grown.

2. Tableware:

In 2008, we have seen the need to cultivate the habit of using green tableware among staff. We encouraged practicing energy conservation concept in daily life while communicating with our partner communities.

SUSTAINABILITY STRATEGY IMPLEMENTED

KMSH's approach to medical services, teaching and research is based on the principle of "CARE" which means Cooperation, Accountability, Reverence and Effectiveness. We collaborate with communities to improve health awareness, to provide holistic care service, clinical teaching and medical technology research.

In addition, we acknowledge that coordination with the community is a vital strategy to become a hospital providing thee best quality holistic care while incorporating environmental conservation and occupational safety principles.

The hospital has employed several measures to ensure environmental protection while maintaining superb delivery of quality services. Among them are development of safe working atmosphere by harmoniously co-existing with the natural environment, provision of safety equipment and a team managing efforts implemented.

IMPLEMENTATION PROCESS

1. Energy

Index	Strategy
Natural Gas	Replaced gas boilers with tubular boiler set and heat pump which can reduce gas and energy usage.
Indoor Carbon Dioxide	Installation of total heat Exchange detector on air - conditioners. Labor Safety Section monitors concentrations of carbon dioxide every six months.
Electricity	1. Energy – saving mechanisms were installed in electricity system, lighting system, boiler and air – conditioners 2. Purchase of modern and energy efficient elevators. 3. Advocating carbon foot print reduction and saving energy to staff, patients and their family through (state method, ex. Leaflets, talks etc. 4. Labels were displayed in conspicuous áreas to notify and remind tbe public of lighting control schedule
Water	1. Mounting water – control equipments and water – saving devices in public toilets and bathrooms in ward section

2. Food

Index	Strategy
Amount of environmental-friendly tableware utilized	Trying to make staff get into the habit of using green tableware.
The amount of carbon reduction using environmental-friendly tableware	Increasing the usage of different green tableware and decreasing supply of disposable tablewares
Bring the concept of energy saving and carbon reduction to communities' lifestyle	Bring the concept of energy saving and carbon reduction to communities and practicing the concept in daily life.

In addition to these activities, we have set aside a budget for Social Responsibility and Organizational Commitment of the Hospital for the next three years. This particular budget may be used to publish researches to enhance, and stabilize delivery of quality medical services.

TRACKING PROGRESS

KMSH established a team called Energy Saving Committee whose primary task is to identify activities, measures and equipment which promotes energy utilization reduction and comfortable environment. It is also their role to continuously update and develop hospital's system to increase energy efficiency and reduce utilization.

CHALLENGES AND LESSONS LEARNED

Increasing number of patients resulted to heightened demand for equipment, hospital space, manpower, medicine and energy consumption. As expected, volume waste produced has also increased. In response to the situation, our superintendent Dr. Wen – Jeng Wu and Executive Administrator Mr. Wei – Chou Chang organized an Energy Saving Committee to promote energy efficiency projects, train staff of different departments and monitor results of launched projects. It is our vision to become a low – carbon hospital with the assistance of our partners – staff and the whole hospital community.

NEXT STEPS

- Promote Recycling to Neighbor Communities:

We will set - up Automatic Recycle Machine (ARM) which enables automatically compresses waste to reduce its volume, significantly. The equipment makes recycling more efficient and may be more readily administered. We are the first hospital in Taiwan who will install ARM and provide a convenient and innovative way of recycling.

- Utilization of Renewable Energy Sources – Installation of Solar Panel in Large Quantities:

Kaohsiung have an abundant supply of solar energy, therefore we will install solar panels to generate non-pollutive and low carbon footprint energy source

- We are aiming for KMSH to become the first hospital to receive the certificate of "Benefit Corporation" in Taiwan.

Environment protection is a responsibility of all global citizens. We expect to create a green environment initiative with the whole KMSH community.

DEMOGRAPHIC INFORMATION

In 1998, Kaohsiung Medical University signed an agreement with the Kaohsiung City Government with a 10 - year operation right (1st phase) of the Siaogang Hospital. Kaohsiung City is a well – known industrial city. KMSH is located in the area surrounded by three major industrial zones in southern Kaohsiung. It is the home of many industrial factories including some large-scaled highly pollutive ones. The annual energy consumption and carbon dioxide emission of this area is top-ranked in Taiwan.

KMSH has 34,711 square meters floor area, 19 clinical branches, 953 employees, 492 beds including 334 general beds and 158 special hospital beds. There were another 40 beds for psychiatric day care. The hospital provided 24-hour emergency care and excellent medical service for the patients in accordance with our vision of "quality, efficiency, concern, and innovation".

QUOTES:

Creating a green environment initiative with KMSH

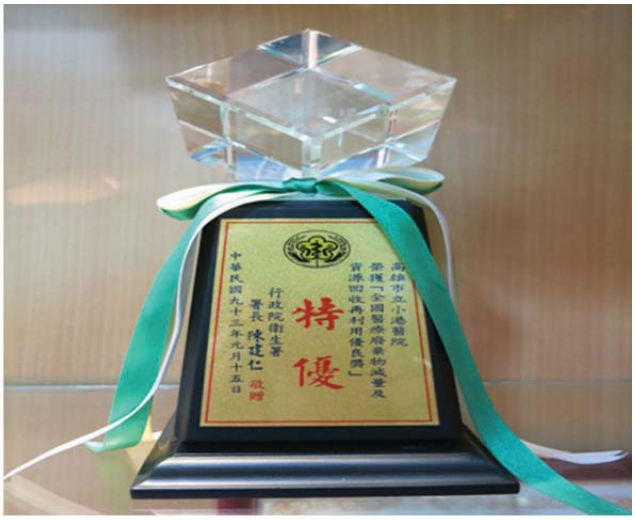
KEYWORDS / TOPICS:

Green environment ,KMSH, Carbon reduction, Social Responsibility and Organizational Commitment of Hospital, ARM, solar panels, Benefit Corporation

DATE SUBMITTED: May 2015

Kaohsiung Municipal Siaogang Hospital (KMSH)

GMISS- Global Medical Instruments Support and Service Program



We were awarded for excellent quality of Indoor air by Environmental Protection Bureau Kaohsiung City Government Department of Health awarded the “National Medical waste reduction and resource recycling superior Award“

BEIJING HUILONGGUAN HOSPITAL

The Integrated Management of Energy Conservation

GGHH AGENDA GOAL

- Energy
- Water

HOSPITAL GOALS

- Reduce energy consumption and develop green and healthy hospital
- Establish the hospital to be energy-saving model of public institutes

PROGRESS ACHIEVED

- The hospital was awarded Beijing Outstanding Water-Saving Institute and Outstanding Energy Saving Institute of Changping District. The hospital still meets their energy-saving and consumption-reduction targets.even though the space for medical use and the need for healthcare staffs is continuously increasing,
- Output energy consumption in 2014 decreased by 25%, and dropped by 34.78% in the 3 years from 2012 to 2014. The total energy consumption in 2014 increased by -13.84%.
- The energy consumption of per building area in 2014 was 0.051 ton/m2, reduced by 13.56%.
- A number of energy conservation projects were completed and achieved good effect of energy saving.

THE ISSUE

Beijing Huilongguan Hospital pays great attention to energy and resource conservation. It scaled up efforts at several aspects during China's 12th Five-year Plan period, including energy-saving planning and management, energy-saving technology renovation, developing demonstration projects, using energy-saving products, conducting energy-saving advocacy and education.

The hospital became one of the first Capital Volunteer Cleaner Production Auditing institutes in 2012. The energy auditing of the hospital has been successfully completed in 2013. In 2014, HuiLongGuan Hospital joined the Global Green Healthy Hospitals (GGHH) as the first large psychiatric medical institute in the nation that joining in the network. In 2015, the hospital is developing to be an Energy-saving Model for Public Institutes.

SUSTAINABILITY STRATEGY IMPLEMENTED

1. Optimizing the management system, keeping the work of energy conservation in good order.
2. Conducting publicity and training, enhancing hospital leaders and staffs' awareness of energy conservation.
3. Highlighting energy saving technologies, promoting economic performance steadily.

IMPLEMENT PROCESS

Detailed implementation program:

1. Optimizing the management system, keeping the work of energy conservation in good order.

1.1 Setting feasible goals

The hospital developed plan for energy conservation and building green and healthy hospital based on practical situation, set energy saving goal for each year and decomposed the tasks.

1.2 Strengthening the instrument responsibilities

An energy-saving leading group was organized and adjusted according to needs. The group was led by a major hospital leader and department leaders took charge of specific work in different area.

1.3 Completing rules and regulations

The hospital has established a supervision system for energy saving measures, such as arranging specific staff to conduct statistical analysis of energy consumption and publicize the data regularly, and applying rewards or penalties according to the assessment of energy consumption. According to the performance assessment, departments which took more than 1% of the hospital's total energy consumption, such as the boiler room, the dining hall and the electrician room, were required to set energy-saving goals and specify the responsibilities.

2. Conducting publicity and training, enhancing hospital leaders and staffs' awareness of energy conservation.

2.1 Using modern media publicity, such as pictures, advertising lights, banners, TV and so on.

2.2 Carrying out environmental protection programs

During the national propaganda month and propaganda week on energy saving, major leaders of the hospital personally led the environment protection activities, promoting green activities, such as reducing the use of elevators. Green transportation has become the common view of the hospital staff.

2.3 Incorporating the environmental publicity into work

Proposals for saving food, intolerance of waste and civilized dining were posted in dining hall. Water saving signs were pasted on the walls next to water consuming points. In addition, different environmental tips were provided to the staffs, including setting a proper air conditioning temperature, triggering automatic shutdown when no one using computers for more than half an hour and turning off lights for empty rooms.

3. Highlighting energy saving technologies, promoting economic performance steadily.

3.1 Replacing lights with energy-saving lights.

3.2 Using ground-source heat pump system (GSHPS).

This initiative not only saves electricity, but also improves efficiency of heating and cooling system, which benefits more than 800 patients and staffs in the building.

3.3 Reforming tap water pipeline network to avoid water leaking.

After the reform, daily water consumption was reduced by 20%, which decreased from 1,100 tons to 880 tons per day.

3.4 Replacing old transformers and building new distribution room. The new type transformers can reduce no-load loss by about 10% and reduce load loss by 22%.

3.5 Reconstructing boilers from coal-burning to gas-burning for pollution reduction.

Four boilers have been replaced by two 8-ton gas boilers and two 4-ton gas boilers. The measure reduces 4,700 tons demand for coal each year.

3.6 Other measures to conserve resource

Four old elevators with high cost and low efficiency engines in Building 2 and Building 3 were replaced with high efficiency ones.

Some old split-type air conditionings were replaced.

Shuttle bus routes were refined.

In addition, the hospital improved the hospital's landscaping. The green gardens provides better environment for patients and staffs, and in the meanwhile indirectly reduce the hospital's energy consumption by reducing heat-island effect and the usage of air conditionings.

TRACKING PROGRESS

Table 1. Total Energy Consumption reduction of 2012-2014

Items	2012	2013	2014	The rate of energy consumption increase in 2014 (%)	The rate of output energy consumption decrease in 2014 (%)	The rate of output energy consumption decrease for the three years (%)
Total industrial output value						
(10,000 RMB)	40,548.6	44,549.3	51,035	--	--	--
Total energy consumption(TCE)	2,777.75	2,681.92	2,310.66	-13.84	--	--
Output Energy consumption						
(TCE/10,000RMB)	0.069	0.06	0.045	--	25.00	34.78

Table 2. Reduction of energy consumption of per building area in 2010-2014

Items	2010	2011	2012	2013	2014
Total energy consumption(TCE)	2,962.64	2,881.34	2,777.75	2,681.92	2,310.66
Building area (m2)	45,656	45,656	45,656	45,656	45,656
Energy consumption of per building area (TCE/ m2)	0.065	0.063	0.061	0.059	0.051
The rate of energy consumption reduction of per building area (%)	3.08	3.08	3.08	3.28	13.56
(TCE/10,000RMB)	0.069	0.06	0.045		

Table 3 Parts of the energy conservation projects

Projects	Estimated annual energy saving		Amount of annually saved expenditure (10,000 RMB)
	Physical quantity/year	tce/year	
Reconstructing boilers from coal-burning to gas-burning	4,700 tons of coal	2240	2.86
Replacing old lights	70,000 kwh	86.03	5.60
Reforming tap water pipeline network	53,426 tons of water	--	30.83
Using ground-source heat pump system (GSHPS)	29,700 kwh	36.5	2.67
Reforming electric water heater	55,000 kwh	67.60	3.50
Replacing old split-type air conditionings	320,000 kwh	393.38	22.40
Replacing old transformers	16,800 kwh	20.65	1.18
Refining shuttle bus routes	12 tons of gasoline	20.74	9.30
Total	--	--	78.34

DEMOGRAPHIC INFORMATION

Beijing Huilongguan Hospital is a Third-level First-class (high) psychiatric hospital, affiliated to Beijing Municipal Health Bureau. The hospital covers 147,543 square meters in total. It has about 46,000m2 of floor space, and bed capacity of 1,369, with staff over 1,200. The utilization of beds of Huilongguan Hospital is about 108%. It is currently a leading psychiatric hospital in clinical care, medical teaching and research in China.

MACKAY MEMORIAL HOSPITAL

Love as a Starting Point, Journey Towards a Green Hospital

GGHH AGENDA GOAL

- Energy
- Water
- Waste

HOSPITAL GOALS

- Reduce energy costs by 5% in three year in Taipei branch
- Achieve a 1% water consumption saving in Tamshui branch
- Gain 1% electric energy saving at Tamshui branch in 2015
- Reduce Medical waste at 3% per year in Taipei and Tamsui branch

PROGRESS ACHIEVED

- Energy consumption decreased by 4.36% in Taipei
- Used wáter is decreased by 24,202 cu.m with utilization rate reductionof 4.82%
- Due to advanced waste processing techniques and the MMH's programs to
- encourage recycling, the 2013 waste diversion rate has increased by more than 17.47%.

THE ISSUE

The Energy Usage Intensity(EUI) in MacKay Memorial Hospitalis higher than Taiwan's national utilization average(241~169Kwh/(m2.yr). We hope to set a benchmark in Taiwan by decreasing our own EUI.

SUSTAINABILITY STRATEGY IMPLEMENTED

The strategies implemented are presented below:

- To announce the importance of Green policy to hospital employees and patients
- To practice self-management of resources within each department
- To evaluate the efficiency and eliminate high energy consuming equipment
- To reuse and recycle resources
- To set annual target and evaluate the achievement rate
- To participate in external accreditation to improve the energy saving ability

IMPLEMENTATION PROCESS

To reduce carbon emissions generated, heighten energy savings and reduction, the 5S principle. The hospital also deems that incentivization is of great importance and benefitting the institution. Due to this, we added an "R" to the 5R being implemented which include "Replace, Reduce, Recycle, Reuse, Application of Green Resource and Employees Rewards.

Employees are also encouraged to submit energy saving and reducing ideas. The employees who had suggested appealing and plausible ideas and invention may be rewarded up to 60% of the income (saving resulted from the implementation of the idea/ invention).

TRACKING PROGRESS

Mackay Memorial Hospital is ISO50001 accredited. In accordance to ISO50001 Energy Management Team is mandated to develop and update internal audit plans annually. Members of the Audit Chamber evaluate the Energy Management Team once a year to assess efficiency of their energy reduction activities.

In order to ensure full implementation of ISO50001, Mackay Memorial Hospital contracts an external third party auditor to supplement any internal evaluation it conducts.

CHALLENGES AND LESSONS LEARNED

Mackay Memorial Hospital was built more than 135 years ago. We recognize that our facilities are timeworn which affects effective and efficient energy utilization. However, we are committed to innovate our system towards an energy efficient operation through purchasing new equipments and implementation of green policies.

To carry out Green policy, each department in the hospital has to provide allocation for the management responsibility, to implement energy management program, and to fulfill energy management requests. They are also expected to reasonably utilize resources and to purchase low energy consumption products.

Furthermore, they are mandated to set up "Energy Management Committee" in order to implement and achieve goals specified under "Energy Saving and Carbon Reduction" objectives of Mackay Memorial Hospital

Invention for reduce medical waste

NEXT STEPS

1. To apply for and secure ISO50001 accreditation for Taitung Branch by 2016.
2. To develop a "Green Procurement Policy Manual" where guidelines for purchasing energy – efficient products and equipments will be specified.
3. To replace all old equipments with new energy – efficient apparatus.
4. To reduce dependence and demand for paper, there is a plan to establish a Medical Mobile Networks
5. To use new fiber materials for easy cleaning
6. To purchase local product
7. To improve medical wastes segregation to increase volume of wastes recycled and reused.

DEMOGRAPHIC INFORMATION

Name of Hospital	Number of Employees (As of December 2013)	Number of Beds (As of January 2014)
MacKay Memorial Hospital Taipei Branch	Physicians: 556 Nurses: 1,379 Medical Personnel: 868 Administrators: 480 Total: 3,283	1,120
MacKay Memorial Hospital Tamsui Branch	Physicians: 266 Nurses: 1,074 Medical Personnel: 517 Administrators: 254 Total: 2,111	1,095
MacKay Memorial Hospital Taitung Branch	Physicians: 66 Nurses: 551 Medical Personnel: 166 Administrators: 137 Total: 920	492
MacKay Memorial Hospital Hsinchu Branch	Physicians: 140 Nurses: 563 Medical Personnel: 371 Administrators: 217 Total: 1,291	579

LINKS

http://www.mmh.org.tw/

QUOTES:

Love as a Starting Point, Journey towards a Green Hospital

KEYWORDS / TOPICS:

ISO50001, energy management, CSR

TAIPEI MEDICAL UNIVERSITY HOSPITAL (TMUH)

Carbon Reduction and Energy Management

GGHH AGENDA GOAL

- Saving Energy

HOSPITAL GOALS

- Reduce more than 8 million dollars in annual energy costs.
- Reduce 500 tCO2e carbon emissions per year.

PROGRESS ACHIEVED

1. During 2009-2012 three years period, including rainwater storage facilities total reduction of carbon emission is 1500 tCO2e.
2. Comparing the relationship between total amount of outpatient (including emergency cases) and inpatient services and energy expenditure between 2009 and 2012, the growth rate of services was 42% but the energy expenditure was only 24%.
3. Taipei Medical University Hospital (TMUH) upholds caring the earth concept, executes “Green Procurement Strategies” through purchase green energy index, low pollution, recycling and saving resource, and use products to meet the green environment goals. TMUH has won various honors reward such as “Green Procurement Benchmarking enterprise” for five consecutive years, “Taiwan green brand” for four consecutive years in first place in medical service, Energy Saving Business Awards and as benchmark hospitals in Green Friendly environment.
4. Set the electronic platform to reduce the paper consumption and manpower Saved more than 30 million NTD annually.

THE ISSUE

1. Follow by the hospital vision in green environment policy, setting the short to long term plan in reducing carbon emissions.
2. Set out the budget and then to implement the project by specialized department.
3. Setup the environmental management plan to regularly review the daily work process, improve the environment and check all facilities and equipment, which include air, water, energy, all kind of waste, and recycling activities. To fulfill the social responsibilities and achieve sustainable development.

SUSTAINABILITY STRATEGY IMPLEMENTED

Set up the energy conservation and environmental management specialized to the internal and external ISO 14001 environmental auditing regularly, including air, water, energy, all kind of wastes and recycling. To fulfill the social responsibilities and achieve sustainable development; planning the short-term, medium-term and long-term environmental protection projects and track the target achievements every six months. The strategy was effective in reducing pollution and saving the energy. In order to become one of Taiwan Green Enterprise, TMUH input countless manpower and resources to improve environmental quality, promote reduction of energy and wastes, taking responsibility to protect the Earth.

IMPLEMENTATION PROCESS

1. Establish systematic management structure: used the systematic manner to improve energy efficiency and reduce energy consumption to reach the continuous improvement goal. TMUH has the energy management team to integrated whole hospital's carbon reduction plan, implementation, execution, monitoring and reporting. Superintendent is the team head and other members including General Affairs Department Director, members in Maintenance Division and in Construction Division. The team has to track and monitor the saving implementation result.
2. In order to fully implement the energy management and change the management behavior, we hold internal training and encourage all employees to participate. The Construction Division members act as the specialist to manager the hospital's carbon reduction plan, implementation, execution, monitoring and reporting.
3. Benchmark the method in energy-saving to get the best plan in carbon reduction. Act early to control the energy efficiency by complying with greenhouse gas regulation to reach the best energy usage
4. Air conditioning is the largest energy consumption. TMUH modifies the equipment to frequency converters and conducted years of central monitoring. Small fans switch are used to control temperature settings that can reduce energy consumption.
5. Central air condition condensers are cleaned with open water jet machine to clean them.
6. Diesel fuel for boiler was change to liquid natural gas.
7. High-efficiency lighting (LED and T5)
8. Introducing digital imaging systems: replace the tradition image system which causes films consumption and flushing solution pollution problem.
9. Set up the multi-channel message delivery platform to reduce printing paper: online Human Resources' system, electronic official document system and knowledge management system. These systems can streamline internal processes and enhance the operational efficiency, and can reduce more than 400,000 sheets of paper annually, equivalent to building 1.5 Daan Forest Parks.

TRACKING PROGRESS

Include the energy-saving plans into the hospital's annual development plan. The energy management team executed the plan, monitor the indicators and hold regular meetings to track the effectiveness of energy saving and carbon reduction.

CHALLENGES AND LESSONS LEARNED

Energy saving plan must rely on cross-sector cooperation and executed by responsible division. In the initial year of implementation, TMUH only set up the annual development plan and faces restriction during execution. After observing benchmark institutions and review the literature, the hospital developed 3-5 years long-term projects. After obtaining consensus by the board, the energy saving plan was incorporated into sustainable management than enhance the energy conservation efficiency.

NEXT STEPS

Energy saving plan with conservation toward "high efficiency", "high-value", "low emission" and "low reliance on" energy consumption and supply system. We will create win-win situations in energy, environmental and economic.

DEMOGRAPHIC INFORMATION

The name of the institution: Taipei Medical University Hospital
Its network: The first Affiliated Hospital in Taipei Medical University Healthcare System
Address: 252, WuXing St., XinYi Dist., Taipei City 11031, Taiwan.
Building scale: 3 medical building in total
Number of beds: more than 800 beds.
Number of employee: more than 2000 staffs

QUOTES

"Green Environmental Hospital" is the Taipei Medical University Hospital Sustainability goal. Create a patient-centered service platform to wholeheartedly dedicate the comprehensive care form body to soul.

KEYWORDS / TOPICS:

Carbon emissions

WATER

Reduce Hospital Water Consumption & Supply Potable Water

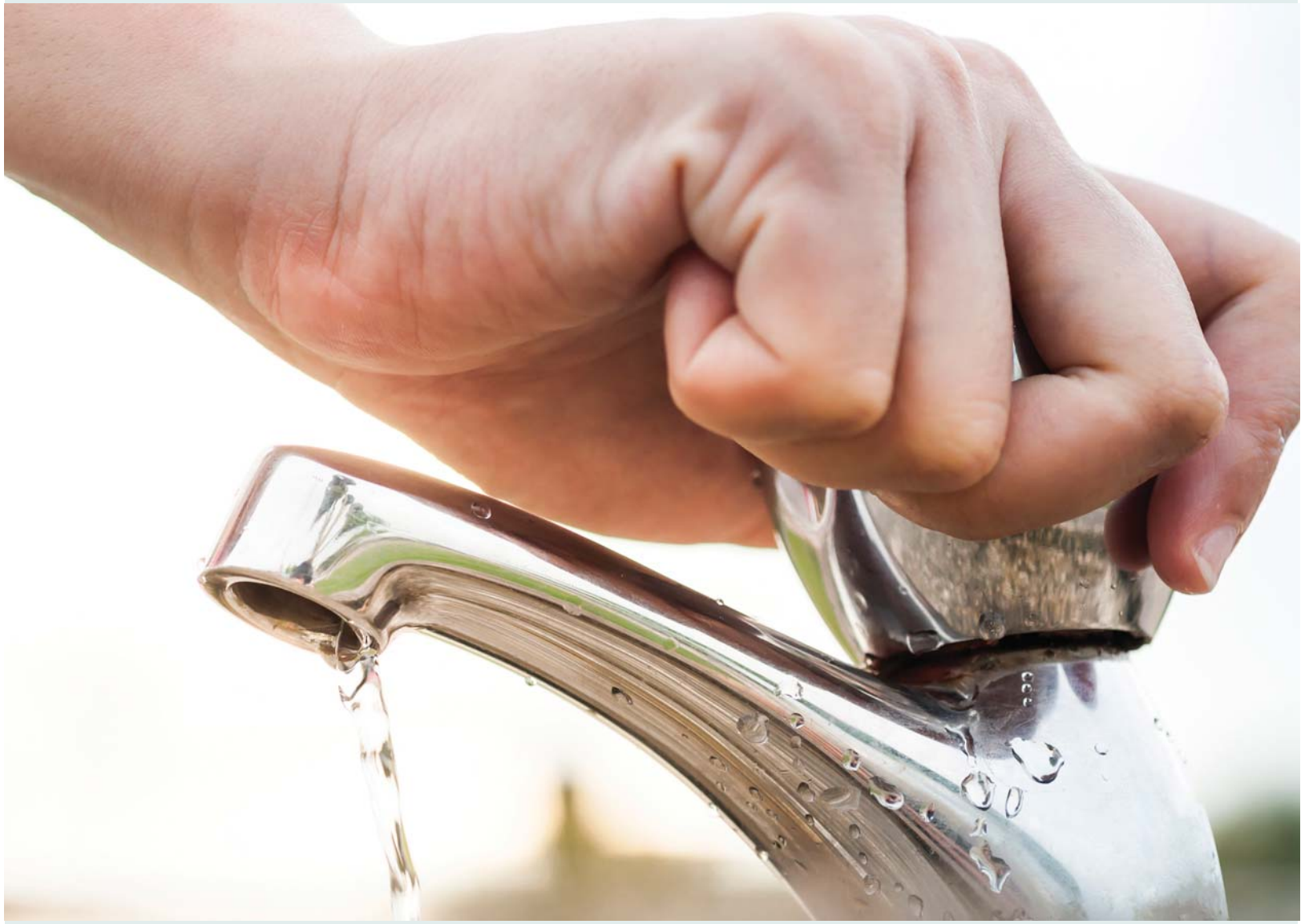


Photo by Tanawat Pontchour/123rf

BUDDHIST TZU-CHI DIALYSIS CENTRE (PENANG BRANCH)

Water – A Precious Commodity: Conserving and Reducing Water Consumption Using Recycled Reject Water Processed from Water Treatment System

GGHH AGENDA GOAL

- Water

ORGANIZATION GOAL

- To reduce the volume of utilized water through limiting water consumption and wastage
- To fully utilize the recycled reject water from the water treatment system for non-critical water use such as toilet flushing, watering plants and cleaning the premises
- To create a tranquil and calming atmosphere at the lobby from the soothing water flow sound made by the "water curtain" which utilizes recycled reject water

PROGRESS ACHIEVED

Penang Buddhist Dialysis Center moved to a new building on 14 January, 2015. After transferring, a more advanced and improved water treatment system was used in processing the water for hemodialysis treatment

With this water treatment system we are able to:

1. Re-use the reject water or recycle the reject water after passing through the Reverse Osmosis (RO) membrane without compromising the water quality in terms of chemical composition, bacteria and endotoxin count. The mentioned indicators comply with ISO 13959, standard requirement for processing hemodialysis water
2. The installed water treatment system has energy saving features which uses inverter control. This technology only produces dialysis water based on demand through the RO pump.
3. Collect and store the "dump water" (final reject water) from the water treatment system for toilet flushing, cleaning of the building premises, watering the plants and the "water curtain". In addition to the Water Treatment System which allows us to utilize reject water, we are also implementing controls to reduce water consumption.

   These controls are as follows:

- Volume Controlled Faucets:
- typical taps discharge 15 to 18 liters per minute compared with low-flow and aerating models which
- Taps with an aerator or flow restrictor may reduce flow to less than one third of the standard taps.

4. Dual Flush Toilets

- an old-style single flush toilet can use up to 12 liters of water in one flush, whereas more water efficient dual flush toilets average less than four liters

By using the controlled flow tap and dual flush toilets, on average of each visit to the washroom enable us to save 9.9 L of water. With the total occupant of 100 people and on average of 5 visits per person to the washroom, we are able to save 4,950 L of water per day, which is equivalent to Ringgit Malaysia (RM)2.87 ($.68 USD) /day (RM 0.58 - per 1000L). This enable us to save as much as RM 1033.20 ($247 USD)/year.

In hemodialysis, on every treatment, each patient uses up 150 Liter of RO (Reverse Osmosis) water which mean raw water consumption is 300 liters based on 50% recovery from the conventional RO system (Advance water treatment system which we are using uses much less raw water); which means each patient would require only 200 liter of raw water per treatment. By reusing the reject water from the water treatment system we reduce water consumption and tremendously reduce the cost and water wastage. With the current 120 patients, we will be able to save 12,000L = RM69.60 ($16.63 USD) and with average of 12 treatments for each patient per month, we save RM 835.20 ($200 USD).

Water Treatment System for Hemodialysis

The table below presents savings on water consumption and expenditures. The computation is based on constants such as average time for washing hands (10 seconds), tap flow (2.5 L per wash for typical tap flow and 0.6 L per wash for controlled tap flow), volume of water for flushing (12 L for single flush and 4L for dual flush system) and volume of recycled water through the water recycling system.

Table 1.0 Comparison of Water Consumption and Expenditure Base on Water Control System Installed

Water Taps and Toilet Flush

Water Control System	Average Daily Usage	Total Water Usage	Water Saved	Total Water Saved (for 100 persons)	RM Saved Daily
Standard Tap (15 L/Min)	5 times (10 secs) /person /day	12.5 L	9.5L	950 L	0.551 ($0.13)
Controlled Flow Tap (4L/Min)		3.0 L			
Single Flush System (12L/ Flush)	5 times /person /day	60 L	40L	4000 L	2.32 ($0.55)
Dual Flush System (4L/ Min)		20 L			

Reverse Osmosis Water Treatment System

Water Control System	Average Daily Usage	Total Water Usage for 120 patients	Water Waste (as reject water)	Total Water Saved (per 100 patient for one treatment)	RM Saved
Previous Water Treatment System	36000	18000	18000	the calculation is based on dialysis treatment of 4 hours-each patient using 120 L of RO water per treatment	
New RO Water Treatment System	24000	18000	8000	10000L from raw water and 8000 L from the reject water are fully recycled. A total of 18000	10.44 ($ 2.49)

THE ISSUE

Malaysians' water consumption per person is over 200 L per day which contributes great impact on the environment. Much more can be done in environment protection by saving and reducing water wastage.

SUSTAINABILITY STRATEGY IMPLEMENTED

The water treatment system enables the reuse of reject water and improves the recovery of the water 90% (conventional water treatment systems recover only 40 – 60%). With this specially designed system, we are able to fully reuse the reject water for flushing the toilets, cleaning the building premises and watering the plants allowing us to conserve water

Malaysia is blessed to have plenty of rain water but we need to be more conscientious in using water as environment conservation is one of Tzu Chi's missions. We have also placed posters or messages for staff/ volunteers to conserve water.

Watering of plants using the reuse reject water

IMPLEMENTATION PROCESS

The old water treatment system had the reject water being discarded. This was replaced by a new one, the Reverse Osmosis (RO) Water Treatment System. The new water treatment system is able to reduce consumption and wastage of water.

Water Treatment is mandatory for hemodialysis treatment and RO water is very critical in hemodialysis treatment. Hemodialysis cannot be carried out without RO water, making it an imperative for the Dialysis Center to install the equipment.

TRACKING PROGRESS

Assuring the high quality of purified water (permeate), it is regularly tested as part of quality assurance and to note possible actions for improvement. The recommendations are based on the Association for the Advancement of Medical Instrumentation Standards (AAMI Standards) and adhere to the guidelines by the Ministry of Health (Malaysia)

CHALLENGES AND LESSONS LEARNED

Many people are still unaware of the substantial water consumption for hemodialysis treatment and amount of water being "wasted" as the reject water are being discarded from the water treatment system. Employees and volunteers learned about the reuse of reject water. Awareness on substantial water consumption enabled them appreciate the resources.

NEXT STEPS

We are looking forward to ensuring that the water consumption at the center are limited and conscientiously used; optimizing reuse of processed water while maintaining its high quality. We will continue to monitor and abide to the required guidelines.

We also plan to check with the technical staff on how we can monitor the water consumption at different areas e.g. clinical for hemodialysis treatment, general area like the hall and the office premises.

DEMOGRAPHIC INFORMATION

Buddhist Tzu Chi Dialysis Center was the first dialysis centre to provide free dialysis treatment, EPO injection, Blood tests and regular specialist checkup for all patients irrespective of race, religion or creed. Presently we have 3 Tzu-Chi Dialysis centres in Malaysia, Penang (PGDC), Butterworth (BWDC) and in Alor Star (KDC).

As at 15th of August 2016,

- PGDC has 36 Hemodialysis machines, a total of 126 patients and 32 nursing staff
- BWDC has 33 Hemodialysis machines, a total of 94 patients and 21 nursing staff
- KDC has 22 Hemodialysis machines, a total 69 patients and 21 nursing staff

Buddhist Tzu Chi Dialysis Centre also provides free basic screening under the CKD awareness and prevention program

LINKS

http://tzuchi.org.my

QUOTES:

Water is a precious commodity and every drop counts - Teoh Bee Ling

KEYWORDS / TOPICS:

Reuse of Reject Water from water treatment system/Water-the precious commodity

DATE SUBMITTED: September 2016

DALIN TZU CHI HOSPITAL, TZU CHI MEDICAL FOUNDATION (TAIWAN)

Every Drop Counts: Greywater Procurement and Distribution System

GGHH AGENDA GOAL

- Water

ORGANIZATION GOAL

- Reduce the amount of water consumed by the hospital for their various activities and needs
- Recycle used fresh water to be used for non – critical water need of the hospital.

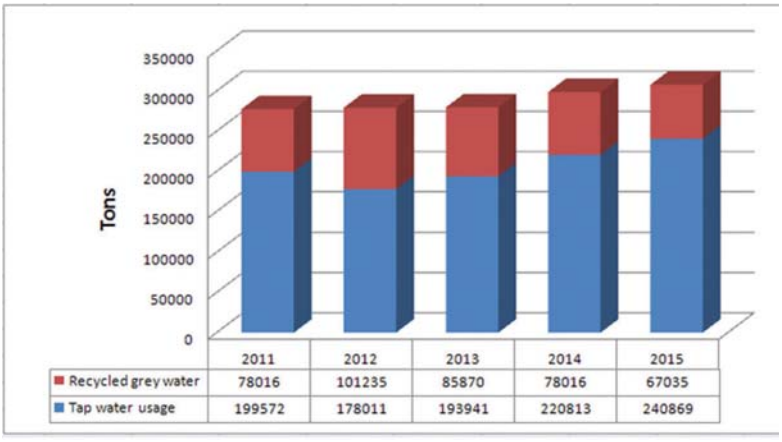
PROGRESS ACHIEVED

Presently, the hospital is outsourcing treatment of approximately 371,304 tons of used water annually. Used water is obtained both from tap water and recycled water sources. Out of this processed used water, the hospital is able to purchase and utilize an average of 82,369 tons of recycled water. In year 2014 and 2015 the hospital acquired 78,016 and 67,035 tons of water respectively, from their partner Water Recycling Facility. The hospital only obtains the volume of recycle water that they need preventing wastage of recycled water.

The water treatment costs NT 3.9 – 4.5/ton. The volume of recycled water required by the hospital is purchased by the hospital at NT 2-3/ton. This enables them to save NTD127,682 (USD26,275) in a year if recycled water is used instead of freshwater which is procured at NT 12-13/ton. It is a NT 4.5 – 5.5/ton saving. Moreover, utilization of freshwater from tap water sources is reduced because recycled water is used instead.

Monthly, around 6,864 tons recycled grey water is used in watering plants and toilet flushing. Recycled water is being used in 631 toilets, including 168 toilets in dormitory areas. The table below presents the amount of fresh water and recycled water used annually.

Table 1.0 Tapwater and Recycled Water Utilized Annually by Dalin Tzu Chi Hospital



Total water cost saved 2011-2014 = USD 105,59

Greywater Circulation System

Implementation	After Intervention
Grey water used as toilet flushing	1. Annual average recycled grey water used by the hospital is 82,369 tons 2. Electricity used in usage and circulation of greywater is 39KWH/ton 3. Saved electricity is 4415KWH/year
Waste Water Blower: The Waste Water Blower is being controlled automatically. They are opened alternately for 16 hours. Intelligent Building Energy Management System (IBEMS) is used to monitor and control these processes according to the needs of the hospital. IBEMS is a system which controls optimal energy consumption through smart analysis, implement initiatives and intelligent controls. The system also monitors the consumption which aids the hospital to build baseline energy consumption data.	Blower 27.36KW * 2 sets, both operates 16 hours per day and total saved 80227KWH electricity yearly

THE ISSUE

More can be done in environmental protection by hospitals just from saving electricity, which is greatly beneficial in reducing carbon dioxide emissions and costs. Hospital initiative may greatly contribute in environmental protection. Hospitals are resource intensive in terms of water and electricity consumed. Although Taiwan is an island surrounded by sea, it is ranked 18th in countries with water shortage issues. According to the data from the Water Resources Agency, Ministry of Economic Affair, toilet water usage is the highest among hotels, hospitals and department stores.

Permeable pavement to reserve water

Currently, water consumption in hospitals is 742 liters per person per day. Adopting water-saving equipment in bathrooms and cooling tower will reduce utilization to 459 liters per day. Moreover, saving on electricity will aid immensely on reducing carbon dioxide emission and acquired costs.

Grey water reclamation used for plants watering.

SUSTAINABILITY STRATEGY IMPLEMENTED

Water permeable bricks use to allow water to penetrate the ground and revitalized water reserve. Specially designed plumbing systems are installed to circulate and distribute recycled water and conserve water, a precious natural resource.

People in Taiwan have grown more ecologically conscious after suffering several severe droughts and other natural disasters. We seem to be more conscientious in using water. This practice is also closely tied with the mission of Tzu Chi Foundation. To strengthen the program, we have formed an environmental protection committee to appeal and promote to the public water conservation habits.

IMPLEMENTATION PROCESS

The hospital quantifies electricity and water consumption regularly. It is through this monitoring method that we are able to initiate and adopt efficient ways to conserve them. Initially, we installed water saving devices such as electronic sensor water taps and dual flush toilets. Later on, the water pressures were reduced. We have also adjusted the volume of flow on each tap to reduce consumption. Collection of greywater, sending out for treatment and purchased of needed recycled water for toilets and non-critical hospital water need is also applied.

To ensure and monitor these activities, Dalin Tzu Chi Hospital formed an Environmental Management Committee chaired by the superintendent. All the information is cascaded to employees of Dalin Tzu Chi Hospital through visual material (eg. Posters), trainings and orientations. The hospital management acknowledges that through these activities every employee of Dalin Tzu Chi Hospital has developed green habits to protect the environment.

EDUCATION SIGNS IN TOILETS FOR USER:

Toilet cubicle has informative signs in them. In the sign the following text may be read:

"Is the water looking slightly yellowish?
It is normal, because we are using recycled water.
Please gently lift the flush for us to save water together."

TRACKING PROGRESS

The hospital monitors purchased recycled water's quality through its smell and color. They also asks the partner Water Recycling Facility to submit water sampling results conducted by an eligible water quality auditor or testing firm. The indicators monitored are temperature, pH, chemical oxygen demand (COD), biological oxygen demand (BOD), suspended solids (SS) and coliform level. The Department of General Affairs also monitors the water consumption of the hospital.

CHALLENGES AND LESSONS LEARNED

The lack of water quality standards of grey water have led to limited use in daily life. Employees learned about green initiatives during the orientation or on-job training programs. In implementing the programs and activities we often ensure that there is a consensus among the management, department and employees. More importantly we see to it that awareness is created in everyone within the hospital. It is very fortunate that we did not encounter much difficulty.

NEXT STEPS

Looking forward, we plan to maintain the current water consumption of the hospital in spite of the increasing number of patients being served. Under safety regulation, grey water quality will be monitored daily and tested twice every year by a certified company. We will continue to abide by the set policy and standard.

In addition, we will remain adamant in increasing volume of grey water recycled and exploring further use of recycled grey water. It is our vision to provide nearby communities with water and adapt a higher energy efficiency waste water treatment process and facility.

DEMOGRAPHIC INFORMATION

The first Tzu Chi General Hospital was inaugurated on August 17, 1986 The Hospital practices the respect for life and patient – oriented medical care principles in Eastern Taiwan.

Dalin Tzu Chi General Hospital, a hospital established in a land with an area of 137,800 sq. m, was inaugurated on August 13, 2000. The hospital is serving the people in the area of Yunlin and Chiayi County, a place with disproportionate medical resources. Hospital provides consultative service, in-patient care unit (acute hospital) and hospice home care service. The hospital has 957 beds, 20 operating rooms and 1756 employees. With the present facilities and manpower the hospital is able to serve an average of 78,742 outpatients per month (944,904 annually) with an estimated 17,578 days of stay per month.

LINKS

http://dalin.tzuchi.com.tw

QUOTES:

"Water is a resource that has no substitute. It is a necessity to place great deal of attention to water conservation and put them to practice despite the increasing need and demand for water."

-Vice Superintendent of Dalin Tzu Chi Hospital, Dr. Ming-Nan Lin.

KEYWORDS / TOPICS

grey water, permeable bricks,

DATE SUBMITTED: August 2015

YONSEI UNIVERSITY HEALTH SYSTEM (YUHS)

Water Management and Recycling System

GGHH AGENDA GOAL

- Water

ORGANIZATION GOAL

- Encourage and Facilitate Water Conservation
- Significantly Reduce Hospital's Water Consumption

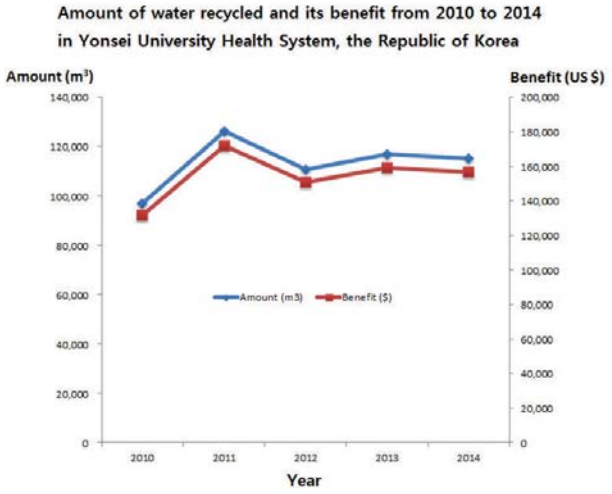
PROGRESS ACHIEVED

- Environmental Benefit: An automatic control system daily measures the volume of water recycled at exactly the same time. The system measured that on the average the hospital recycles at least 316m3 per day. Yearly, the hospital is able to save 115,405 m3 of water which is used for toilet flushing and other water needs.
- Financial benefits: Approximately $160,000 per year saved during the last five years comparing it to projected cost since the establishment of the program and hospital

THE ISSUE

Around year 2000, concerns about global water crisis and awareness of the need of water-saving were growing in the Republic of Korea. The increased awareness also affected management strategies in the special context of hospital environment.

During the construction of the new hospital in YUHS, there was an agreement that water for flushing toilet and watering garden was costly- and water-consuming, and the need of water recycling system came to the fore.



It was then decided to install a water recycling system which costs approximately KRW 695,000,000. The water recycling system is an intermittent type. This means the amount of recycled water depends on the domestic sewage and underground water.

SUSTAINABILITY STRATEGY IMPLEMENTED

Green Severance Task Force

- The Task Force is composed of heads and/or deputy heads in charge of purchasing, facility, building, customer management, and the Institute of Environmental Research.
- All members are responsible for reporting their activities, developing strategies for greening healthcare, and sharing the information with faculty in their departments.
- To boost bottom-up process, Green Severance Task Force held an idea contest and all faculty members were encouraged to make any suggestions regarding greening healthcare.

Water saving promotion as part of "Green Severance 10" activities

- The slogan of "Green Severance 10" imbues all staff and faculty with social and environmental responsibility.
- Details of the activities are posted on message boards in hospital.

IMPLEMENTATION PROCESS

The new hospital's construction planning started in 1994. Passing through 10-year designing and about 5-year construction period, the new hospital was completed with 1,004 beds in 2005. The implementation of water recycling system was part of the new hospital's construction plan because the system needed special piping from the beginning of construction. In response to increased awareness of water-saving and its benefit, the CEO and the office of planning decided to implement the system in the new hospital.

In particular, Kim, Do Hyun (Environment Section Chief, Office of Facilities Maintenance) and Shin, Young Kug (Manager, Office of Facilities Maintenance) facilitated the program.

Control Center and Mimetic Diagram

The recycled water is stored at Heavy Water Pit and then is supplied to hospital's toilet by Heavy Water Pipe. The use of recycled water is for patient and consulting rooms.

In addition to the installation of recycling system to conserve water employees are oriented. Korean Environmental Industry and Technology Institute (KEITI), a quasi – governmental organization affiliated with the Ministry of Environment provides orientation on wastewater disposal. These orientations are conducted through E-discussions.

TRACKING PROGRESS

The control center for water management is located at the first basement level in the new hospital, monitoring the amount and pH of water. The amount of water recycled is measured on a daily basis, and the Facility team reports the current status of water recycling at the Green Severance Task Force meeting.

CHALLENGES AND LESSONS LEARNED

Yonsei University Health System is not only concerned on the cost reduction outcome of installing the Water Recycling System. Moreover, the hospital values the significant contribution of water recycling in preventing water pollution and saving water resource. However, Yonsei University experienced concerns in implementing this program.

Although water recycling is always beneficial and profitable for hospital and environment water quality has become an issue. Thus, YUHS applied its own water quality standards which are stricter than those of corresponding Act (Promotion of and Support for Water Reuse Act). Also, water quality is measured by the Institute of Environmental Research in YUHS twice a year. They measure the pH level, residual chlorine, chromatility, and turbidity. Activated carbon used in filtration is replaced three times a year. In addition, preventive maintenance and cleaning of the inner Heavy Water Pit are conducted.

NEXT STEPS

Yonsei University Health System Aims to strengthen Water Quality Management through the following activities:

1. Replacement of heavy water filters quarterly and strengthening water management through water analysis such as pH, BOD, COD.
2. Optimal the mounting cost of drugs on an input - output reduction and efficiency gains through Jar-test * jar-test : is the test to measure the most optimum drug content to be add in the heavy water production processes.
3. Once or twice a year of the heavy water pit inside cleaning will be carried out, including sediment removal.
4. Periodically check the toilet water quality
5. Analysis of heavy water production and groundwater inflow periodically
6. Case Study on the heavy water related literature and activation will be carried out.
7. Groundwater will be used to complement recycled water
8. Utilization of recycled water for as cooling water, car wash and fire control.
9. Maximize the capacity of the system which is at 900m3. Currently, the hospital recycles 160m3 of water.

DEMOGRAPHIC INFORMATION

Yonsei University Health System is led by its CEO and President, who also serves as the Vice-President for Health Sciences of Yonsei University. He oversees 2 graduate schools (Public Health and Nursing), 3 colleges (Medicine, Dentistry, Nursing) and 5 hospitals (Severance Hospital, Gangnam Severance Hospital, Yongin Severance Hospital, Severance Mental Health Hospital, and the Dental Hospital).

There are approximately 7,000 employees throughout the Health System, which include some 2,000 physicians and 5,000 support personnel. In addition, a total of 24,000 students have graduated from the colleges and graduate schools. The hospitals have around 3,700 beds and see around 3 million outpatients and 1 million in-patients annually. The total lot size is 95,000 Pyung (77 acres) with a building size of 18,000 Pyung (59,508m^2=640,538ft), and a total floor area of 140,000 Pyung (462,840m^2=4.98 million ft^2).

KEYWORDS / TOPICS:

Water conservation, Water Recycling, Yonsei University Health System

CAPITAL MEDICAL UNIVERSITY
BEIJING DITAN HOSPITAL

Recycle of Soft Water Discharged from Dialysis Room

GGHH AGENDA GOAL

- Water

ORGANIZATION GOAL

- Recycle and reuse the soft water discharged from dialysis room.
- Save water and at the same time reduce the cost of the boilers.

PROGRESS ACHIEVED

- On Monday, Wednesday and Friday, the hospital saves 10.5 tons water per day, on Tuesday and Thursday, the hospital saves 5.25 tons water per day. The amount of water saved per week is 42 tons and 2,184 tons per year.
- The hospital's effective reuse of the soft water has avoided waste, and at the same time reduced the cost of the boilers.

THE ISSUE

The Dialysis room of Beijing Ditan Hospital covers an area of 472.06m2 with 18 beds. Its maximum amount of treated patients in a month is 490, and by average 450 per month. Large quantity of reverse osmosis water is needed when conducting dialysis. The water is produced by the water treatment system of the dialysis room. The reverse osmosis water obtained through the treatment is about 25-30% of the original raw water, and the other 70-75% soft water was normally discharged into sewer.

Dialysis room working hours		
Date	Working hours	Number of patients
Monday	All day	28
Tuesday	Half day	14
Wednesday	All day	28
Thursday	Half day	14
Friday	All day	28
Saturday	Off	0
Sunday	Off	0
Weekly total		112
Monthly total		448

Table 1. Dialysis room working hours and number of patients

Picture 1. Water treatment system

On average, there are 15 dialysis treatments per day, and the maximum amount in one day is 28. The dialysis room is open all day on Monday, Wednesday and Friday, half day on Tuesday and Thursday, and closed on Saturday and Sunday.

The consumption rate of purified water in dialysis is about 0.5L/minute and one dialysis operation lasts for 4 hours, so one operation uses about 120L purified water in total. For the all-day working day which has 28 patients, the total purified water consumed is about 3,360L (3.36 tons). For the half-day working day, the number is 1,680L (1.68 tons). The purified water used for dialysis is about 25%-30% of the raw water, so the total amount of water treated is 6.72-13.44 tons, and the amount of discharged soft water is about 5-10 tons. To avoid wasting water, the hospital leaders required to look for ways to recycle and reuse the soft water.


地坛医院透析室排出水化验结果

经我公司专业水化验员对透析室排出水进行化验，得出水硬度为：0.01mmol/L，氯离子为：34mg/L，PH 值为：7 。根据工业锅炉水质标准（GB1576-2001 工业锅炉水质），化验结果符合蒸汽锅炉用水。在锅炉使用过程中，注意监测锅水碱度。

北京奥林联诚能源设备有限公司

2012 年 3 月 14 日

Picture 2: Result of the water test

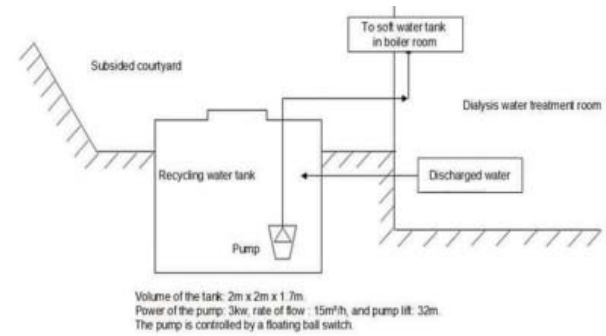


Figure 1 Diagrammatic drawing of the retrofitting plan

SUSTAINABILITY STRATEGY IMPLEMENTED

IMPLEMENTATION PROCESS

After discussion and examination, the hospital made the preliminary decision to use the discharged water from the dialysis room's water treatment system to the boilers, but the discharged water need to be able to meet the standards of boiler water, so water sample was collected and sent to Beijing Aolinliancheng Energy Equipment Co. Ltd. for testing. The result showed that the soft water met the industrial boiler water standard (GB 1576-2001, testing result: hardness: 0.01mmol/L, chloridion: 34mg/L, PH value: 7).

Picture 3. Soft water transfers to the water tank in boiler room

A 2m x 2m x 1.7mrecycling water tank was installed outside of the dialysis room's water treatment plant, in a subsided courtyard on the north of outpatient building. In the water tank, a diving pump was installed. The pump pumped the recycled water to the boiler room's soft water tank which was 3.8m x 2.8m x 1.6m. The pump's power is 3kw, rate of flow is 15m³/h, and pump lift is 32m. The pump is controlled by a floating ball switch.

TRACKING PROGRESS

There are four 8-tons team boilers in the hospital's boiler room. Two of them in use and the other two for backup. The boilers provide the entire hospital's heating and hot water. The heating season of the hospital is from Oct. 15 to the next year's Apr. 15. Water consumption of the boilers is 30 tons/day and the amount of crude salt used for water demineralization is 100kg. In non-heating seasons, the boilers consume 8 tons/day water for hot water and the crude salt used for water treatment is 26kg. The price of crude salt is 0.65 Yuan/kg (0.1 USD). The expense for treating 1 ton water is the sum of 1 ton raw water's price and 3.3kg crude salt's cost, which is:5.8+2.15=7.95 Yuan ($1.28 USD).

Picture 4: Recycling water tank

The water recycling system was put into use on August 13, 2012. The monitoring data showed that the pump started for 5-6 times on Monday, Wednesday and Friday, and each time lasted for 7 minutes. According to the pump's rate of flow, the pump delivers 1.75m³(1.75 tons) water each time and 10.5m³(10.5 tons) each day when the dialysis room is in all-day operation, which provides enough water for the boilers in non-heating seasons, but additional soft water is needed on Tuesday, Thursday, Saturday and Sunday.

According to the above description and analysis, it is concluded that on Monday, Wednesday and Friday, the hospital saves 10.5 tons water per day. On Tuesday and Thursday, the hospital saves 5.25 tons water per day. The amount of water saved per week is 42 tons and 2,184 tons per year.

It is indicated from the above mentioned data that the project has a tangible result. The hospital's effective reuse of the soft water has avoided waste, and at the same time reduced the cost of the boilers.

CHALLENGES AND LESSONS LEARNED

Ditan hospital has ever planned to reuse the discharged soft water for irrigation or fire-fighting. However, the fire-fighting water tank is far away from the dialysis room, which makes it difficult to construct the project. Since the soft water lacks of mineral matters and trace elements, it is not suitable for irrigation neither. Finally, the hospital decided to use the soft water for boilers, which not only save water but also reduce the cost of softening water for the boilers. In addition, the soft water tank of the boilers is close to the dialysis room, which made it convenient for the construction work.

DEMOGRAPHIC INFORMATION

Capital Medical University Beijing Ditan Hospital is a class 3A hospital (high) under Beijing Health Bureau. It covers an area of 75000 m2, with 600 beds. There are 955 staffs in the hospital. Beijing Ditan Hospital specializes in the treatment of infectious disease. It is superior in hepatopathy treatment, infectious disease treatment, intensive care and combination of Chinese traditional and western treatment. The hospital also makes its remarkable progress in scientific research.

PHILIPPINE HEART CENTER

Hospital Engineers Discharge Cleaner Water

GGHH AGENDA GOAL

- Water
- Waste

HOSPITAL GOAL

- Water recycling
- Wastewater treatment for safe discharge

PROGRESS ACHIEVED

- All wastewater produced by the hospital is treated, disinfected, and tested to be safe before discharge into the city sewer system
- Treated wastewater is recycled and used to irrigate hospital grounds.

THE ISSUE

The Philippine Heart Center is the premier cardiac facility in the Philippines. Since 2005 the number of annual patients at the hospital has grown dramatically to close to 15,000 in 2011. Along with the increase in patients has come an increase in water consumption and wastewater production at the facility. The Philippine Heart Center has an average discharge of 540 cubic meters of wastewater per day.

The implementation of the Philippine Clean Water Act of 2004 required large-scale facilities such as the Philippine Heart Center to implement wastewater treatment plans and apply for wastewater discharge permits. The country's Department of Health, then in the process of drafting and deliberating the 2011 revision of its Health Care Waste Management Manual, also began to highlight the importance of health care waste facilities managing their own wastewater.

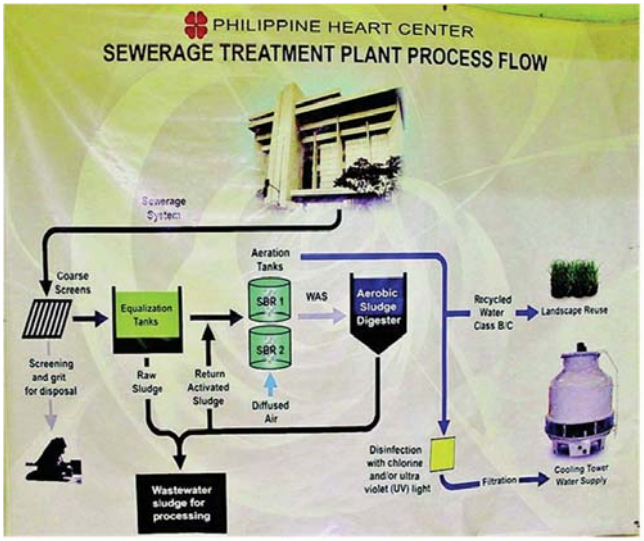
The Philippine Heart Center was appointed as a member of the technical working group tasked with the revision of the health care waste manual of the DOH. As a member of that working group, the Philippine Heart Center saw the importance of minimizing its own impact on the water supply and updating its own facilities to support the hospital's mission of environmental stewardship and responsibility.

SUSTAINABILITY STRATEGY IMPLEMENTED

The Philippine Heart Center, in order to meet regulations and better manage its wastewater, decided to build its own on-site wastewater treatment plant. The water effluent generated by the hospital is now treated prior to discharge to the city sewer system. Treated wastewater is also utilized to irrigate the hospital ground. The hospital is also planning to further utilize treated wastewater for its urinals and toilets.

IMPLEMENTATION PROCESS

The sewage treatment plant (sequencing batch reactor technology) was a project conceptualized and proposed by the hospitals' Engineering and Maintenance Division headed by Engineer Joe Barsaga and was funded by the Philippine Heart Center for PHP10 million (US$205,000) in 2009.



From project conceptualization to actual operation of the sewage treatment plant, it took the hospital two years to implement the project.

Much of time during pre-construction was dedicated to researching the appropriate plant design for the needs and size of the facility, as well as the capability to ensure a safe discharge. A series of best practices for proper treatment throughout all phases of the process was agreed upon: preliminary treatment, primary treatment, secondary treatment, and disinfection.

- **Preliminary treatment:** 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.
- **Primary treatment:** the main process of primary treatment entails the settling or sedimentation of other solids as raw sludge.
- **Secondary treatment section:** the wastewater goes through a biological process in sequential batch reactors (SBRs). Air is pumped through the wastewater, stimulating aerobic bacteria and other microorganisms. These digest organic materials in the wastewater. After sufficient reaction time has elapsed, the microorganisms are allowed so settle out as sludge and are combined with the raw sludge from the primary treatment stage and disposed of.
- **Disinfection:** treated sewage from the SBRs is treated with sodium hypochlorite, followed by filtration before being discharged into the city's sewer system.

The hospital hired four additional staff members to monitor and ensure the smooth flow of the wastewater treatment around the clock. The hospital is spending around PHP 90,000.00 (USD 2,000) quarterly in electricity for the operation of the sewage treatment plant.

TRACKING PROGRESS

The wastewater treatment plant maintenance crew is trained to test the water's alkalinity every day. This is to ensure that during the secondary treatment process, the alkalinity of the water environment is maintained between 6.5 and 8.0, which is suitable for denitrification.

The sewage treatment plant also undergoes a monthly water examination conducted by an independent water analysis laboratory accredited both by the Department of Health (DOH) and the Department of Environment and Natural Resources (DENR) to ensure that water quality standards are met. The hospital's wastewater discharge is tested monthly by an independent laboratory accredited by the DENR for biological oxygen demand, chemical oxygen demand, total suspended solids, settleable solids, oil and grease, surfactants, pH, and total coliforms.

DEMOGRAPHIC INFORMATION

The Philippine Heart Center is a 354-bed tertiary care center. There are twenty-one nursing units, including 53 Intensive Care Unit (ICU) beds, 24 suites, 56 private rooms, a presidential suite, 74 semi-private rooms, 3 adult service wards, and a pediatric service ward.

QUOTES:

"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."

- Engineer Joe Barsaga, Head, Engineering and Maintenance Division, Philippine Heart Center.

TRANSPORTATION

Improve Transportation Strategies for Patients and Staff

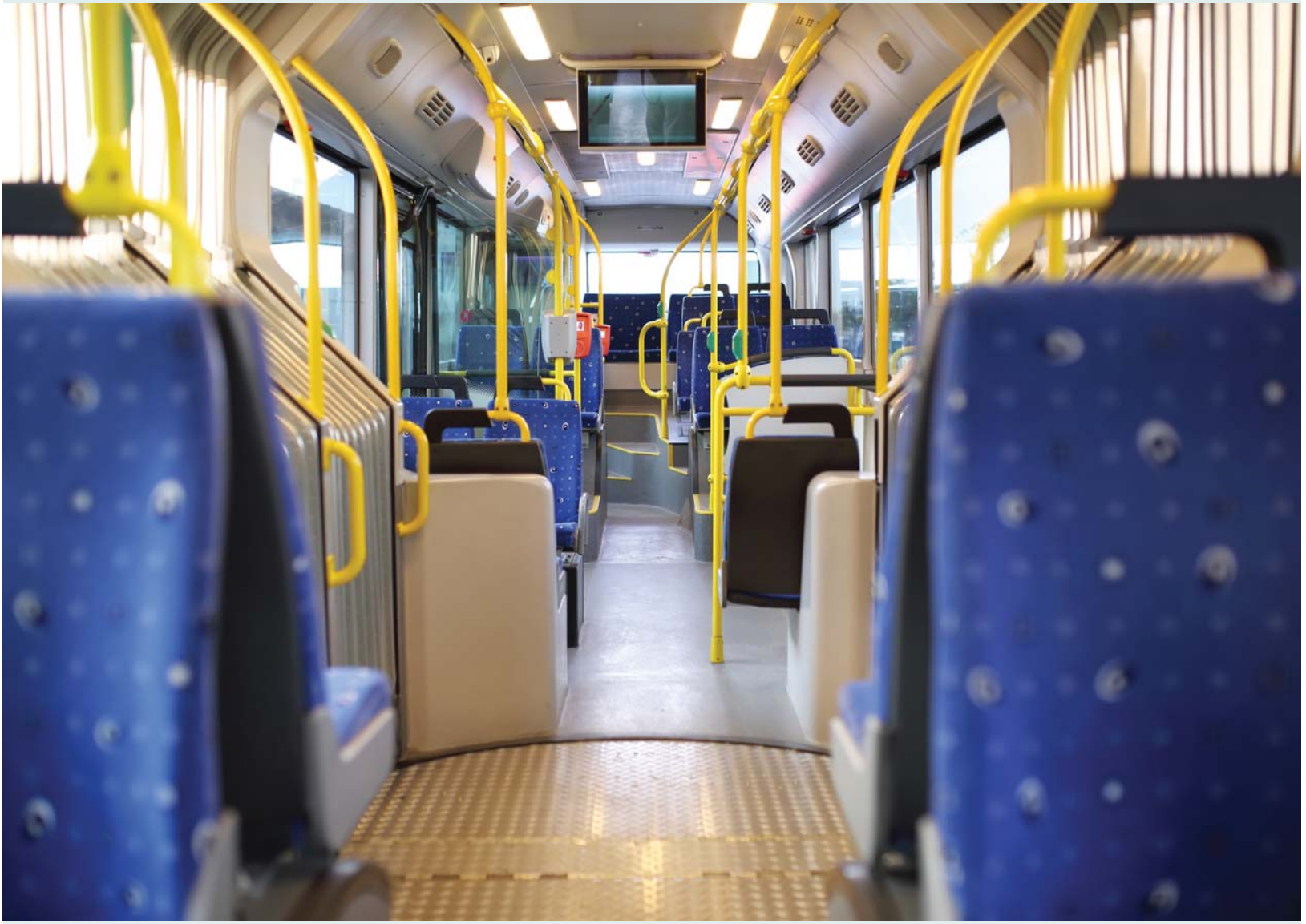


Photo by Rawpixel

TAICHUNG TZU CHI HOSPITAL
TZU CHI MEDICAL FOUNDATION

Hospital Carpooling App: Give a Ride to Improve Sustainable Mobility

GGHH AGENDA GOAL

- Leadership
- Transportation

HOSPITAL GOAL

- Reduce carbon dioxide emission 3 tons per year through integration of sustainable transport system.
- Encourage participation of employees and patients through heightened number of carpooling by 6500 users in 2016

PROGRESS ACHIEVED

The development of a Carpooling Services mobile app truly entails the initial cost. By implementing this strategy, the hospital invested approximately NTD 100,000 (USD 3,200). However, the benefits reaped from the established system offsets the costs. Since 2011, accumulated total savings of 1,688,412 liters for the 95 unleaded gasoline vehicles is NT$26,405,656 (US$ 833,512). The transport system has serviced 277,534 passengers. Together, this system had successfully offset 3,732 tons of carbon dioxide.

THE ISSUE

The World Health Organization recommends reducing greenhouse gas emission to promote populations' health. According to statistics from the U.S. Environmental Protection Agency, 13% of greenhouse gas emission comes from vehicle exhaustion. Hospital carpooling services can support sustainable transport, optimizing the occupancy rate of vehicles and increasing accessibility of rural populations to medical care. Carpooling passengers will help reduce high greenhouse gas emission by cars through reduced vehicle use, hence leading to less air pollution.
Sustainability Strategy Implemented

The hospital carpooling buses are to serve the community who would be travelling more than 20 kilometers (km) away from the hospital. Buses are linked with a customized mobile application (Patent no. M46339). The application provides real-time information about the departure and arrival time of the buses in every stop. Passengers can conveniently wait at the out-patient area once they arrive at the hospital.

In order to encourage more hospital visitors to use the service, the hospital developed brochures which are strategically placed within the hospital premises. To maintain and enhance the quality of transportation services the hospital need to spend around NTD 1,400,000 (US$ 44,191). These measures enable Taichung Tzu Chi Hospital to keep their transportation services quality maintained.

IMPLEMENTATION PROCESS

The hospital established a team which consists of staff from Medical Affairs Department and General Affairs Department. They also involve the hospital carpooling volunteers who are trained and are tasked to plan and adjust routes of the Carpooling service. They are required to monitor the number of passengers from each and every stop. The collected data are used for tracking the service, analyzing the current system and identifying possible improvements for future.

TRACKING PROGRESS

The carpooling services had been able to reduce the volume of fuel utilized to transport individuals and patients from the hospital to other strategic locations near their homes. The table provided below shows the volume of fuel conserved and the cost saved annually since its implementation.

Table 1.0 Conserved Fuel from the Transportation System

Year	Volume of Fuel in Liters for 95 unleaded gasoline buses	Cost Savings in New Taiwan Dollar (NTD)
2011	45,825	714,622
2012	133,412	2,087,262
2013	234,070	3,658,018
2014	465,437	7,280,660
2015	529,364	8,278,302
2016 (Jan-Jul)	280,304	4,386,792
Total saving:	**1,688,412**	**NT$26,405,656 (US$ 838,700)**

Table 2.0 Carbon Emission Reduction from the Transportation System

Year	Distance Travelled (in Km)	Total Distance Travelled(km)	Number of passenger	Carbon Dioxide Emission Reduction (tons)
2011	27	458,255	16,844	101
2012	35	1,334,124	37,573	295
2013	36	2,340,705	65,027	517
2014	74	4,654,378	62,897	1029
2015	88	5,293,640	60,155	1170
2016 Jan-Jul	80	2,803,040	35,038	620
Total	**340**	**16,884,142**	**277,534**	**3732**

The service provided by the hospital to their patients enables them to sustainably transport 250 persons per day to meet their medical needs. The Bus Transit System particularly services the patients and individuals living 20Km or farther from the hospital.

Since December 2010 to July 2016 the hospital carpooling service provided 277,534 person-times. Ninety percent of the passengers were between ages 40-65 years old, 36% had Oriental Medicine appointments, 22% had Neurology appointments, and 16% had Gastroenterology appointments. The number of carpooling routes increased from 9 to 12 in year 2013 with about 120 bus stops. The number of person-year served increased by 1.7 fold in year 2012. From year 2011 to 2015 CO_2 emission equivalent to 3,112 metric tons was conserved (4,893,082 Kilowatt-Hour).

CHALLENGES AND LESSONS LEARNED

We collaborated with community health center, through their routine health talks and workshops; we try to promote the benefits of Bus Transit System. During off-peak hours, when fewer passengers are taking the rides, the frequency of the pick-ups is adjusted.

The local government has learned of the need for public transportation to the hospital in certain areas, they therefore had to reorient the service route in order to avoid overlapping of their own resources with that of what Tzu Chi is already doing. One certain bus – Bus #123's route was integrated with that of the service areas of Tzu Chi and therefore has avoided unnecessary trips and excess in resources.

NEXT STEPS

In the future, the plan is to develop routes according to the feedbacks collected from passengers and volunteers. The service expansions will be planned geographically (distance of every 10kms from hospital). We wish to increase the engagement of the local community leaders, volunteers other stakeholders in developing the Bus Transit System. They will join the hospital in identifying the stops and ways to further improve the service. With the use smart integrating system, the most energy-efficient and carbon – emission saving way of transporting hospital visitors will be calculated and developed.

DEMOGRAPHIC INFORMATION

Taichung Tzu Chi Hospital is located in Tanzi District of Taichung City (Central part of Taiwan), spanning over 184,921 square-meters and holds a 1081 beds capacity, with a staff member of more than 1,500. We provide holistic health care and preventive medicine services through community, home visits and health counseling. We opted for local construction materials to protect the ecosystem and to prevent land erosion.

LINKS

http://taichung.tzuchi.com.tw/w/?id=1581

Transport Access Guide Case study

GGHH AGENDA GOAL

- Transportation

MATER GOAL

Transport has been a major theme of the Sustainability at Mater program. There is a need to:

- free up car parking for patients at the Mater South Brisbane campus
- support Sustainability at Mater
- encourage staff to benefit from greater participation in active transport
- reduce scope 3 emissions (staff travel to/from work).

PROGRESS ACHIEVED

Release of a Transport Access Guide (TAG) to encourage use of active transport by staff (the main users of onsite car parking)

Promotion of the TAG via emails, online stories, presentations, digital screens in several staff cafés, Ride2Work Day www.ride2work.com.au visits by staff to the Mater intranet page launch event and hundreds of

- positive response from staff and interest in modifying the TAG for outpatient/visitor use
- planned inclusion of TAG in a smart phone app for new staff
- generation of interest in other initiatives including the car-pooling database, Bicycle User Group (BUG), and way finding
- support from feedback of 2000+ staff who pledged to reduce their number of car trips on Mater's Environmental Sustainability Pledge

THE ISSUE

Staff dependence on campus car parking is high, with cars contributing to:

- lack of parking for patients and visitors
- missed physical activity opportunities
- local air pollution and scope 3 greenhouse gas emissions.

There is a compelling rationale for promoting active transport. Benefits are diverse including improved health and wellbeing, environmental benefits, and in some cases, cost savings.

BACKGROUND RESEARCH/SCOPING

A review of Mater's transport infrastructure, existing

Above: sample digital screens in several staff café transport information sources, and published literature was undertaken. It was found that there are strong opportunities for staff to participate in active travel at Mater.

The published literature suggests that a well-planned TAG can provide a useful tool for promoting alternatives to single-occupant private vehicle use: public transport, walking, cycling and car-pooling. Web research uncovered samples of TAGs produced by other trip generators, including healthcare organisations in NSW, where TAGs were first promoted via workshops offered by the NSW Roads and Traffic Authority.

Internal consultation identified potential stakeholders could include:

- marketing and communications staff, intranet managers and graphic designers
- Mater Bicycle User Group
- human resources management staff (e.g. for orientation of new staff)
- way-finding committee
- staff who committed to less car use when they completed 'the Pledge'
- all managers who induct and/or support staff.

Following consultation, it was decided not to attempt a full Active Travel Plan at this time, due to various resourcing and policy limitations. No full evaluation is planned due to the complexity of travel choices and methodology challenges. For example, external factors and personal factors impact on individual travel patterns.

IMPLEMENTATION

Sustainability staff collaborated with marketing and communications staff about the scope of the initiative. A graphic designer was then commissioned to draft the TAG, with reference to the existing corporate look and feel of Sustainability at Mater, and in line with budget limitations.

A launch event coincided with Ride2Work Day —riders were provided with a copy of the TAG and encouraged to help spread the word about the TAG (in their roles as internal advocates).

Presentations by the sustainability team incorporated information about the TAG's features, evidence-base and availability. Presentations also highlighted the value of the content including URL links to the smart phone app by public transport provider (Translink), the Mater car-pooling database, and Mater Bicycle User Group.

Human Resources personnel are working towards including the TAG in corporate orientation and a smart phone app/online portal.

CHALLENGES, LESSONS LEARNED AND POTENTIAL FUTURE COMPLEMENTARY STRATEGIES

Transport is a contentious issue at the site as staff highly value the low cost parking provided to them (particularly given the hospital's proximity to the city). So messaging included the notion that they need not give up driving every day, rather to consider changing their travel patterns on some days. This also links in with the previous pledge behaviour to reduce car trips.

There was some concern that the TAG may have sent the wrong message to Mater's many staff shift-workers, given there may be issues regarding personal safety for some staff who travel after hours. This however is addressed through multiple 'face to face' presentations about the Sustainability at Mater program. Anecdotal evidence suggests this has been a low cost, simple and successful initiative to assist with the promotion of the Sustainability at Mater program within its current resources.

CONTEXTUAL INFORMATION ABOUT MATER

Mater Health Services comprises several hospitals, health centres, a world-class medical research institute and pathology and pharmacy businesses, all with one aim—to provide exceptional care. Ourconcerted pursuit of innovation — to discover, improve, adopt and adapt— differentiates Mater as a leader in the areas of health, education and research. By integrating these fields into the delivery of exceptional healthcare services, Mater is committed to the development and maintenance of healthy communities.

Mater is dedicated to providing healthcare services through a sincere commitment to our core Values of Mercy, Dignity, Care, Commitment and Quality. A Catholic not-for-profit ministry, we are committed to a holistic approach to healthcare in response to ever changing community needs. We continually strive to improve how we deliver patient care, keep our knowledge and skills relevant, advance our understanding of illness and health and manage resources effectively.

KEYWORDS

Transport, active transport, staff travel, transport access guide

HEALTHY FOOD

Purchase & Serve Sustainably Grown, Healthy Food

Photo by dolgachov

BUDDHIST TZU-CHI DIALYSIS CENTRE (PENANG BRANCH)

Vegetarianism and Utilization of Reusable Food Containers Reduces Carbon Emissions

GGHH AGENDA GOAL

- Food
- Waste

ORGANIZATION GOAL

- Reduction of carbon footprint through the promotion of vegetarianism, and utilization of reusable food containers.

PROGRESS ACHIEVED

- "ONLY VEGETARIAN" food policy was implemented since the opening of the center on 3rd August 1997.
- The use of reusable food containers and tumblers for food and drinks in Tzu Chi Dialysis Center were also initiated on the same date.
- Both policies were implemented and was accepted by all employees and patients in due respect to Master Cheng Yen, Founder of Tzu Chi Foundation who encourages them to respect and cherish other living creatures. Patients are only served with bread and beverages during dialysis treatment, and are encouraged to have their meals at home.
- Patients who observe vegetarianism show significant better control of phosphate compare to before conversion to vegetarian diet. To promote vegetarianism, all employees have free vegetarian lunches packed in reusable lunchboxes every Tuesday, Wednesday and Thursday since the day the dialysis center opened.
- The Buddhist Tzu Chi Dialysis Center institutionalized a policy requiring the employees to bring only vegetarian food in reusable containers to work in days where free vegetarian lunches are not served. Since the implementation of the policy the compliance of the employees is at 100%.
- The number of plastic wastes in the hospital was prevented due to employing policy on utilization of reusable lunchboxes since the dialysis center.
- The number of individual employees who decided to become vegetarian has increased from 28 to 51 employees in just a span of a year from January 2015 to September 2016
-

The reduction in carbon emission computation through vegetarianism and utilization of reusable containers and utensils are shown in the tables below:

REUSABLE CONTAINERS AND UTENSILS

On average, food packaging for meals prepared or brought by employees, patients and volunteers is at least 200 plastic bags a day. This is the amount of plastic we save a day because food packaging used here are reusable containers.

The carbon emission of plastic is about 6 kg CO2 per Kg of plastic. A normal plastic bag used for food packaging is about 5 g - 20 g depending on size and thickness. For the computation we used 10g being the average of 5g and 20g.
References: Environmental Working Group, US 2011

Table 1.0 Carbon Emission Reduction through Reduction of Plastic Bags

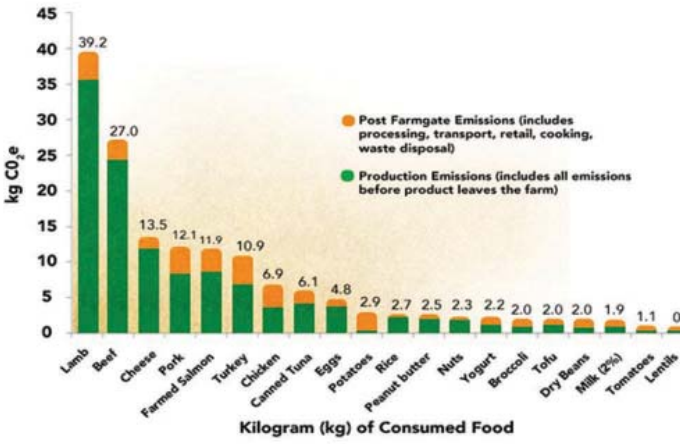
Duration	**Plastic bags saved**	**Average plastic weight (10 g)**	**Reduction of Carbon dioxide emission (1Kg of plastic : 6 Kg of CO2)**
Computation Process	**(days * average plastic container consumption)**	**(average number of plastic containers / Average plastic weight)**	**(total plastic weight * CO2 Emission of Plastics)**
1 Day	200 bags	2 Kg	12 Kg CO2
25 Days	5,000 bags	50 Kg	300Kg CO2
290 Days	58,000 bags	580 Kg	3,480 Kg CO2


Food packed in reusable food containers for the patients and employees

VEGETARIANISM PRACTICED

On the average a Malaysian adult chicken meat consumption is 40.85kg per year. Each day a person consumes 0.112kg of chicken which is about 0.037kg every meal (Chicken is chosen due to cultural acceptance by all races and religions in Malaysia).

Every 100 gram of chicken is equal to18.4 g of protein. On the other hand, 100 gram of tofu is equivalent to 10.9 g of protein. The body requires a serving of protein each day which is around 7g.



Environmental Working Group, US (2011)

To meet the minimum protein requirement of 7g, an individual should take in 37g of chicken or 64 g of tofu. The table below shows the carbon emission generated for every 1kg production of chicken and tofu.

References: Nutrient Composition of Malaysian Foods 1997; Malaysian Food Composition Tables

Table 2.0 Generated Kg of CO2 for every serving of 7g of protein

	Kg of CO2 generated per Kg	Kg of CO2 generated as per 7g protein
Chicken	6.9	0.255
Tofu	2.0	0.128

SAMPLE COMPUTATION:

Givens:

1. Conversion Equivalent of per Kg of CO2 for every per Kg of Meat.

Adult Malaysian Average Chicken Consumption	
Adult Taiwanese Average Meat Consumption	**Kg of CO2 Generated per Kg of Chicken**
40.85 Kg yearly	281.865 Kg CO2
0.112 Kg per day	0.7728 Kg CO2
0.037 Kg per meal	0.2553 Kg CO2

2. Equivalent Kg of tofu for every Kg of Meat per serving of protein (7g).

- Ratio of soybean to chicken in terms of protein content

Variable Computed	Grams of Tofu needed to acquire 7g of Protein	Applied Mathematical Operation (Division)	Grams of Chicken needed to acquire 7g of Protein	Tofu – Meat Ratio
Ratio of Soybean to Meat	64	÷	37	= 1.7297

- Kg equivalent of tofu per Kg of meat

Variable Computed	Kg of Meat	Applied Mathematical Operation (Multiplication)	Tofu – Meat Ratio	Kg equivalent of Tofu to 1 Kg of Chicken
Kg equivalent of Soybean for every 1Kg of Meat to have same amount of protein	1	*	1.7297	= 1.7297

3. Generated Kg of CO2 for every serving of tofu based on 7g of protein

Variable Computed	Kg of CO2 produced per 1Kg of Tofu	Applied Mathematical Operation (Multiplication)	Kg equivalent of Tofu to 1 Kg of Chicken	Generated Kg CO2 of Tofu to have same amount of protein as with 1Kg of Chicken
Generated Kg CO2 of soybean to have same amount of protein as with 1 Kg of Meat	2	*	1.7297	= 3.4594

4. Carbon Emission Impact of 1 Kg of chicken in contrast to equivalent Kg of tofu

Type of Meat	CO2 generated per 1Kg of Chicken	Applied Mathematical Operation (Subtraction)	Generated KgCO2 of Soybean equivalent to 1 Kg of Chicken	Carbon Emission Impact
Chicken	6.9	-	3.4594	= 3.4406

5. Carbon Emission Reduction of Tofu Substitute for 200 persons per year.

Adult Taiwanese Average Meat Consumption	Applied Mathematical Operation (Multiplication)	Carbon Emission Reduction from Tofu as Substitute	Net Carbon Emission Reduction per person	Carbon Emission Impact
40.85 Kg yearly	*	3.4406	140.5485	28,1097
0.112 Kg per day	*	3.4406	0.3853	77.06
0.037 Kg per meal	*	3.4406	0.1272	25.44

THE ISSUE

- The Buddhist Tzu Chi Dialysis Center continues to grow and develop. At present, we have a total of 126 Hemodialysis patients, 32 Nursing staff, 55 Administration and supporting staff, and 5 Volunteers in this building.
- Environmental scientists have warned on the long-term effects of synthetic chemicals used in food packaging could be damaging our health. In a paper published by the Journal of Epidemiology and Community Health, the authors said small amounts of chemicals used in these materials can diffuse into food, and this can be accelerated by increased temperatures, the type of material used and the length of time foods were stored.
- Vegetarianism not only indirectly reduces carbon dioxide emission but also have the benefits of
    - Lower body weight
    - Better cholesterol levels
    - Live longer
    - Lower risk of developing cancer
    - Reduces Risk of Cardiovascular Disease

Nutrition counseling for patient by a Dietitian

SUSTAINABILITY STRATEGY IMPLEMENTED

Buddhist Tzu-Chi Dialysis Center not only provides holistic and humanistic approach to patient care, by encouraging vegetarian diet we are also protecting the environment , reduce water pollution and deforestation and also reduce animal cruelty, suffering and deaths of countless animals.

In carrying out this endeavor, we work closely with our stakeholders, our patients and employees. Initially, applicants are informed of the policies during the interview. Once hired, at their first day of work, an orientation is again conducted. Patients on the other hand are informed of the policies; they are explained on the rationale behind the policies. Annually, on family day and renewal of agreement in conducting dialysis they are once again reminded of these policies.

New patients are briefed on the vegetarian food policy

All new patients and volunteers are informed and advised regarding the vegetarian food policy, and the use of reusable food containers. They are also encouraged to do recycling not only due to environmental reasons but also to raise funds for dialysis treatment (a portion of charity fund in aid of the dialysis treatment comes from recycling products).

Volunteers conduct talks and activities to promote environmental protection and vegetarian food demonstration regularly at the center.

As supplement to the dissemination of information, lunch for patients and employees are provided on specific days of the week. These lunches are vegetarian and packed in reusable containers. They are also given new sets of food container, water bottle and chopsticks when hired or admitted to the dialysis center.

IMPLEMENTATION PROCESS

For Tzu Chi as an organization, vegetarianism comes naturally and a policy we follow. Tzu Chi Master, Cheng Yen, encourages her followers to respect and cherish fellow living creatures, no matter the size or the species. This also means to abstain from harming other creatures and indulging in meat products.

Guests also have to abide by the Vegetarian policy and the use of food container and utensils.

Through this effort, we are not only able to conserve all forms of life; we are also able to contribute to reducing pollution and improving our individual health by eating responsibly and ethically. We do not face any issues of rejection or anyone against this policy, as we all respect and understand its implementation.

TRACKING PROGRESS

In Tzu Chi Dialysis Center, we all encourage the usage of reusable food container and would inform whoever that do not do so and it has become our culture and practice.

We do not track or force but rather educate and it has been part of our culture and practice). We do not monitor individuals who embraced vegetarianism as we believe it has to come from the heart and willingly.

However, we do have more employees becoming Tzu Chi Commissioners who are required to be vegetarians.

In terms of the utilization of the reusable utensils, it is observed that patients and employees are compliant. In instances where the policy is not observed, both are immediately counseled.

CHALLENGES AND LESSONS LEARNED

Through perseverance, continuous education and support, we managed to reduce the usage of food packaging by using the reusable food container. Most employees are still not fully observing vegetarianism and we continue to encourage them to carry on eating vegetarian meals even at home. At least five to six meals a week, vegetarian meals are served to them enabling them to take vegetarian meal while at work.

NEXT STEPS

There are still rooms for improvement and the hospital is making efforts to encourage more employees and patients to observe vegetarianism. Moreover, provide a more stringent campaign of utilizing reusable containers and recycling to safeguard the Mother Earth. The adamant monitoring of indicators such as compliance with the policies will also be observed.

DEMOGRAPHIC INFORMATION

Buddhist Tzu Chi Dialysis Center was the first dialysis center to provide free dialysis treatment, EPO injection, Blood tests and regular specialist checkup for all patients irrespective of race, religion or creed.

Presently we have 3 Tzu-Chi Dialysis centers in Malaysia, Penang (PGDC), Butterworth (BWDC) and in Alor Star (KDC).

As on 15th of August 2016,

- PGDC has 36 Hemodialysis machines, a total of 126 patients and 32 nursing staff
- BWDC has 33 Hemodialysis machines, a total of 94 patients and 21 nursing staff
- KDC has 22 Hemodialysis machines, a total 69 patients and 21 nursing staff

Buddhist Tzu Chi Dialysis Centre also provides free basic screening under the CKD awareness and prevention program.

LINKS

http://tzuchi.org.my

QUOTES:

Saving Lives, Safeguarding Health and Upholding the Spirit of Love and Comprehensive Patient Care with Professionalism and Humanitarianism. -Ms. Teoh Bee Ling

DATE SUBMITTED: September 2016

TAICHUNG TZU CHI HOSPITAL
BUDDHIST TZU CHI MEDICAL FOUNDATION

Promoting Vegetarian Lifestyles with the Usage of Recyclable Dinnerware to Lessen Negative Impacts on the Environment

GGHH AGENDA GOAL

- Food

HOSPITAL GOAL

- Reduce carbon dioxide emissions

PROGRESS ACHIEVED

- Since the opening of vegetarian food court in 2010, there were eight different restaurants provide varied cuisine styles to the public. The restaurant received "Food Safety" recognition in 2014 and is periodically screened through ISO-22000/HACCP. Moreover, Local Health Department has awarded "Certificate of Self-disciplined Good Hygienic Practice (GHP)"
- In the past five years, from 2010 – 2014, by serving vegetarian food selection for 1,943,000 person – times (cafeteria monthly income divided by 50 NT (Food Court Employee) and 70 NT (Cafeteria Employee) we were able to reduce our carbon dioxide emission by 1,516 metric tons through decline in consumption. An additional reduction of 271 metric tons of CO2 is acquired by none utilization of disposal chopstick which are incinerated after disposal. Please see Table 1.0 to see data for computing person time and carbon emission reduction. The sample computation follows the table below.

Table 1.0 Carbon Emission Reduction

	Cafeteria Employee	Cafeteria Employee	Food Court Employee	Food Court Employee	Total
Year	Person	Carbon Emission Reduction (tons)	Person	Carbon Emission Reduction (tons)	Carbon Emission Reduction (tons)
2010	359699	281			281
2011	368945	288	7865	6	294
2012	424414	331	176036	137	468
2013	355635	277	267770	209	486
2014	434530	339	316918	247	586
Total	1943223	1516	768588	599	2115

Sample Computation:

Givens:

1. Conversion Equivalent of per Kg of CO2 for every per Kg of Meat

Adult Taiwanese Average Meat Consumption			
	Red Meat	Poultry	Seafood
Kg of CO2 Generated per Kg of Meat Product	19.7 Kg CO2	4.3 Kg CO2	8.5 Kg CO2
Adult Taiwanese Average Meat Consumption per Meal	58%	18%	24%

2. An adult Taiwanese daily meat consumption is 0.153kg/day; each meal is at 0.051kg/day (0.153kg divided by 3)

3. In terms of protein content every Kg of meat is equal to 0.57 Kg of soy

4. Protein Content per serving of meat and soybean
   - 1 serving of protein is 7g
   - 7g of protein = 35g of meat
   - 7g of protein = 20g of soybean

5. Generated Kg CO2 of soy bean production is equal to 0.92 Kg CO2/ 1Kg of product (Oversea by boat)

**References:* *Carlsson – Kanyame and Gonzalez, Am J Clin Nutr (2009)*
Taiwan's National Nutrition Survey (2005 – 2009)

Sample Computation:

1. Generated Kg of CO2 for every Kg of Meat

Type of Meat	**Generated Kg of CO2 per Kg of Meat**	**Applied Mathematical Operation (Multiplication)**	**Average Meat Consumption Percentage of Adult Taiwanese per Meal**	**Generated Kg of CO2 based on Percentage of Meat Consumption**
Red Meat	19. 7	*	0.58	= 11.426
Poultry	4.3	*	0.18	= 0.774
Seafood	8.5	*	0.24	= 2.040
Total				= 14.240

2. Equivalent Kg of soy bean for every Kg of Meat per serving of protein (7g)

- Ratio of soybean to meat in terms of protein content

Variable Computed	**Grams of Soybean needed to acquire 7g of Protein**	**Applied Mathematical Operation (Division)**	**Grams of Meat needed to acquire 7g of Protein**	**Soybean – Meat Ratio**
Ratio of Soybean to Meat	20	÷	35	= 0.5714285

3. Generated Kg of CO2 for every serving of soy bean based on 7g of protein

Variable Computed	Kg of CO2 produced per 1Kg of Soybean	Applied Mathematical Operation (Multiplication)	Kg equivalent of Soybean to 1 Kg of Meat	Generated Kg CO2 of soybean to have same amount of protein as with 1Kg of Meat
Generated Kg CO2 of soybean to have same amount of protein as with 1 Kg of Meat	0.92	*	0.57	= 0.52

4. Ratio of Generated KgCO2 of Soy bean for every Kg of Meat (Red Meat, Poultry, Seafood)

Type of Meat	Generated KgCO2 of Soybean equivalent to 1 Kg of Meat	Applied Mathematical Operation (Multiplication)	Ratio of Type of Meat for every 1Kg of Meat based on Adult Taiwanese Consumption per meal	Generated KgCO2 based from Meat Type per 1 Kg of Meat Ratio
Red Meat	0.52	*	0.58	0.3016
Poultry	0.52	*	0.18	0.0936
Seafood	0.52	*	0.24	0.1248

5. Carbon Emission Impact of 1 Kg of meat (Red Meat, Poultry and Seafood) in contrast to equivalent Kg of soybean

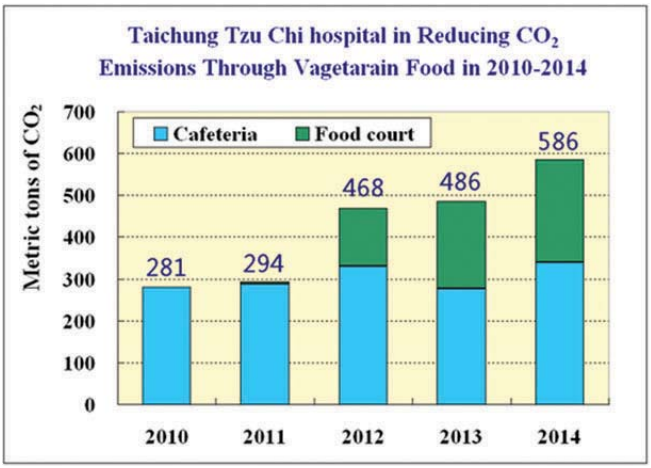
Type of Meat	CO2 generated per 1Kg of Meat	Applied Mathematical Operation (Subtraction)	Generated KgCO2 of Soybean equivalent to 1 Kg of Meat	Carbon Emission Impact
Red Meat	11.426	-	0.3016	= 11.1244
Poultry	0.774	-	0.0936	= 0.6804
Seafood	2.040	-	0.1248	= 1.9152
Net Carbon Emission Impact	= 13.72			

6. Generated Kg CO2 per meal based Net Carbon Emission Impact of 1 Kg of Meat

Net Carbon Emission Impact	Applied Mathematical Operation (Multiplication)	Average Taiwanese Adult Meat Consumption	Kg CO2 /meal/ day	Soybean – Meat Ratio
13.7	*	0.051	0.6987 KgCO2/ meal/ day	= 0.5714285

- It has been estimated that employees have increased orders for vegetarian meals by 22.8%. In 2013 only 355,653 vegetarian meals were served. However, it has rose to 434,530 vegetarian meals in 2014. Only 67% of the in-patient orders vegetarian meals in 2013 but figures have increased to 81% in 2014 (percentages presented is based on a four - years average).

- In Taichung Tzu Chi Hospital employee's satisfactions increased by 12% from 2014-2015. In 2014, satisfaction rate is at 76% but has increased to 88% in 2015 after the hospital's kitchen served vegetarian meals instead of having it catered.



Superintendent Dr. Sou-Hsin Chien and doctors working at the hospital are cooking vegetarian meals to serve the volunteers and show appreciation for their work.

THE ISSUE

- Greenpeace International's report indicated that 1 kg of meat indirectly produces 13 kg of carbon dioxide emission.
- Taiwan's dining out population uses around 10 million disposable chopsticks yearly. Disposable chopsticks are not only toxic when chemicals are ingested; they are also a huge burden for our environment after being incinerated.

SUSTAINABILITY STRATEGY IMPLEMENTED

Taichung Tzu Chi Hospital values holistic approach when it comes to patient care and environment. In promoting vegetarian lifestyles and usage of recyclable dinnerware to lessen negative impacts on environment the following strategies were undertaken:

- Information, Education and Communication Campaigns (IEC)
  - Nutritionist from the Hospital organizes monthly health talks at the hospital lobby and local communities to promote vegetarianism. Participants are being educated on healthy diet and benefits of being vegetarians.
  - Employees of the hospital are encouraged to participate in harvesting vegetables and crops from the hospital's farm. In turn they are taught how to prepare vegetarian delicacies and were given references for the recipes.
- Upholding the core principle of vegetarianism which is "safety and health", healthy low fat diets meals are planned and made with locally sourced produce
- The hospital has a farm where organic vegetables and crops were planted. Fertilizers used to enhance growth and nutrients of the crops come from fermented herbs which are also organic.

IMPLEMENTATION PROCESS

1. Taichung Tzu Chi hospital collaborated with restaurants to set up different vegetarian booths in the food court. Reusable dinnerware was cleaned with an 80 degree Celsius disinfecting process.
2. Through hospital's announcement employees were encouraged to bring their own dinnerware. Leftovers were also collected for composting.
3. The food court service received SGS (Societe Generale de Surveillance) and HACCP (Hazard Analysis and Critical Control Point System) certification. The accreditation is being managed by hospital's Catering Safety and Hygiene Management. Vegetarian nutrition classes were provided monthly to employees to promote healthy lifestyles.

TRACKING PROGRESS

Taichung Tzu Chi Hospital values the satisfaction of patients and employees. Often, the basis of their satisfaction in terms hospital meals is determined through the quality of service. This is gauged and observed through a survey conducted using a questionnaire which 85% - 90% of the employees responds to. The questionnaire includes criteria for menu design, quality and variety of meal.

CHALLENGES AND LESSONS LEARNED

In the past, hospital outsourced their meal services to local businesses. However, to increase revenue, businesses often sacrifice meal quality to cut down cost. Over the years, customer's satisfaction and number of meal orders have decreased. Subsequently, customers started ordering meat-containing meals from nearby businesses. This situation has led to difficulty in cutting down CO2 emission. To satisfy diverse tastes and medical needs of customers as well as elevating the quality of vegetarian meals, we ceased outsourcing soon after the contract expired and began operating the restaurant on our own through the Diet and Nutrition Department.

NEXT STEPS

Taichung Tzu Chi Hospital acknoledges that there is still room for improvement. We may still further enhance meal quality and variety. In terms of structure service área may be expanded.

We also hope to continually reduce the amount of CO2 production from animal consumption by replacing traditional meals with vegetarian meals.

DEMOGRAPHIC INFORMATION

Taichung Tzu Chi Hospital is located in Tanzi District of Taichung city, spanning over 184,921 square-meters and holds a 1081 beds capacity, with a staff number of more than 1,500. We provide holistic care and preventive medicine through community medicine, home visits and health counseling. Since the beginning, we opted for local construction materials to protect the ecosystem and prevent land erosion.

LINKS

http://taichung.tzuchi.com.tw/w/?id=1581

QUOTES:

"Adequate nutrition is a basic need. Adequate nutrition access is a basic human right. In Taichung Tzu Chi Hospital, we hope to serve nutritious and delicious vegetarian meals / plant-based diet for our patients and staff. Since 2014, catering services were outsourced to different restaurants providing variety food options and they were all well-received. We believe a guided vegetarian diet will give good nutrition to stay healthy and to promote environmental health." - Mr Chung-Wei Yang, Chief of Nutrition Service Department"

KEYWORDS / TOPICS:

Food Safety, vegetarian meals, recyclable dinnerware, carbon dioxide emissions

DATE SUBMITTED: May 2015

PHARMACEUTICALS

Prescribe Appropriately, Safely Manage, and Properly Dispose of Pharmaceuticals

Photo by Tyler Olson/123rf

HEALTH DEPARTMENT XÀTIVA – ONTINYENT (SPAIN)

Measures to Reduce Production of Hazardous Health Care Waste

GGHH AGENDA GOAL

- Leadership
- Chemicals
- Waste
- Pharmaceuticals
-

HOSPITAL GOAL

- Reduce, treat and dispose of the waste generated in healthcare centres, especially hazardous waste, with safety.
- Replace harmful chemicals with safer alternatives.
- Reduce the carbon footprint of the hospital.

THE ISSUE

Over the last two years, we at DSXO have committed to promoting the GGHH Network, the objectives of the GGHH Agenda and environmentally responsible practices in its healthcare centres. We also maintain a strong commitment to training members of the healthcare system on environmentally responsible and sustainable practices, and advocate for policies and practices that improve environmental health. This also involves the reduction in volume of waste, especially hazardous waste (one of our prime objectives), and the reducing social, environmental and economic costs of waste management.

SUSTAINABILITY STRATEGY IMPLEMENTED

To meet our objectives, we have placed much focus on training our staff and awareness building. Staff training sessions have been a key tool in improving environmental health. Having started one year ago, this training is complimented by a programme of suggestions with selected actions that are implemented and the results of which are collected. In addition to this, random daily inspections are carried out by the Department of Preventive Medicine to evaluate the improvement of waste management.

We have also strengthened internal and external communication to raise awareness at an institutional and community level.

Other actions have included the implementation of electronic medical record system, a reduction in onsite consultations at the hospital (with improved telehealth between primary health care centres and hospitals), and the introduction of a „Guide to Good Use of Paper and Printers“ (which has lead to the reduction of the number of printers in our facilities).

In terms of pharmaceuticals, we have established a “Program for the Optimized Use of Antibiotics in Hospitals”, to optimize antibiotic prescriptions and educe the generation of pharmaceutical waste. We have also enhanced peritoneal dialysis at the hospital and made the switch to the exclusive use of iron oxide in sentinel node marking surgery for breast cancer.

IMPLEMENTATION PROCESS

In 2014, we established a ‘Plan of Action and Awareness for Environmental Improvement Action’, to reduce waste production and consumption of natural resources, assessing compliance and international recommendations, with particular reference to the Global Green and Healthy Hospitals Agenda. Environmental actions promoted by:

External Communication: The development and dissemination of policy and of a good environmental practices manual for citizens and health professionals. Press releases were sent to newspapers, radio and TV and we also published information and news on our institutional websites (http://xativaontinyent.san.gva.es/, www.san.gva.es and www.gva.es) and social networks (@gva_dsxo and Facebook). We also attended the „Health Council“ quarterly meetings to promote citizen participation through associations of users, patients, consumers and municipalities.

Internal Communication: Internal communication was mainly carried out by e-mail and intranet. We also created a program of training sessions conducted by the Department of Preventive Medicine, covering: 1. Knowledge of and compliance with environmental regulations. 2. Minimization and segregation of waste production, and 3. Knowledge of negative environmental impacts of health activities. Improvement actions are collected through a program of suggestions. The annual cost of a nurse attending a training program is €25,000 for both hospitals.

TRACKING PROGRESS

Two nurses and a preventive medicine physician conduct daily inspections of waste management in hospital service units, especially in key areas such as emergency, ICU and operating rooms. From these inspections, they have compiled a report containing actions for improvement, aimed at informing future training sessions.

Participants on the training sessions are evaluated and in the first half of 2015, we conducted 17 training sessions with 255 participants.

We also record the volume of hazardous waste produced as classified by regional legislation. To date, production of Type III waste has amounted to 50,343kg in 2012, 50,382kg in 2013 and 46,064kg in 2014. For type IV waste, the figures are: 5,556kg in 2012, 4,780kg in 2013, and 3,070kg in 2014 for a 44% reduction in type IV waste over 2 overs.

CHALLENGES AND LESSONS LEARNED

1. Definitive action from the management team for environmental improvement, based on the service of preventive medicine, developing a strong professional awareness by improving environmental health from the health activity.
2. We now have clear, strong environmental objectives.
3. A program of continuing education is vital, with a constructive and transparent debate, as well as feedback through a program of suggestions.
4. The public support for environmental improvement is essential.
5. Support of health professionals most involved in the activities and in environmental improvement, such as nursing, is necessary, if you want to act and improve.

NEXT STEPS

Until 2017:

1. Improve training in environmental management: 1 weekly session for 20 people, with program suggestions.
2. Create an Environmental Health Unit.
3. Influence the preventive maintenance of facilities and equipment, avoiding failures.
4. Develop improved "single-use classified material", choosing suppliers that complying with legislation.
5. Implementation of an inter-centre management of plastic containers for hazardous waste.
6. Reducing the use of formaldehyde, especially in pathology service.

DEMOGRAPHIC INFORMATION

The Department of Health Xativa-Ontinyent provides a public assistance network for 210,000 people in Valencia, Spain, with two hospitals and primary care:

- Luis H. Alcanyís Xativa (university hospital): 240 beds, 8 operating rooms, 1 TAC, 1 NMR (hospital)
- H. General of Ontinyent: 45 beds, 3 operating rooms, 1TAC (hospital)
- 19 health centres and 51 smaller municipal clinics (primary care)

LINKS (ACCESSED: 24 AUGUST 2015).

1. European List of Waste: http://ec.europa.eu/environment/waste/framework/list.htm
2. Local law GVA 240/1994 (in Spanish): http://goo.gl/yveES7
3. SIGRE: www.sigre.es/en/what-is-sigre/
4. PROA: Rodríguez-Baño J et al. Programas de optimización de uso de antimicrobianos (PROA) en hospitales españoles: documento de consenso GEIH-SEIMC, SEFH y SEMPSPH / Programs for optimizing the use of antibiotics (PROA) in Spanish hospitals: GEIH-SEIMC, SEFH and SEMPSPH consensus document. Enfermedades Infecciosas y Microbiología Clínica. 30(1): 22.e1-22.e23. Enero 2012. Doi: 10.1016/j.eimc.2011.09.018 Available in: http://goo.gl/pU7Q8H

5. Roig Bataller A. et al. Ganglio centinela con óxido de hierro. cómo lo hacemos. In: 30 Congreso Nacional de Cirugía. November 2014. Available in: http://goo.gl/wtqprs - (document in pdf) http://goo.gl/jDqROo
6. INNOVALL – Clúster Nacional de Innovación y Sostenibilidad: www.innovallcluster.com/en-us/Home/Section/lineas-trabajo-1

QUOTES:

CONCEPCIÓN OLIVER:
“It is better to reflect and think, before using and discarding“ (“Más vale reflexionar y pensar, antes que utilizar y desechar”).
“If we reduce waste, especially hazardous waste, we will improve the environment and to do this, we need to communicate, to make people aware“ (“Si reducimos desechos, residuos, sobre todo peligrosos, mejoramos el medio ambiente y tenemos que comunicarlo, para que la gente se conciencie”).

SERGIO GARCÍA:
“For every sanitary action, both collective and individual, we must consider its implementation with environmental improvement. We talk about clinical, social, and economic improvement, but rarely about environmental improvement.“ (“Para cada acción sanitaria, individual y colectiva, tenemos que pensar en implementar la mejora ambiental. Hablamos de la mejora clínica, social, económica… pero casi nunca de la mejora ambiental…”).

KEYWORDS / TOPICS:

Hazardous waste, waste management, environmental management, hospital, training.

BUILDINGS

Support Green & Healthy Hospital Design & Construction

Photo by Tyler Olson/123rf

YANZHOU PEOPLE'S HOSPITAL (SHANDONG PROVINCE)

Green Hospital Design

GGHH AGENDA GOAL

- Building

HOSPITAL GOAL

- Create a patient-centered hospital, which is humanized, digitized, energy-efficient and environment friendly.
- Divide the function districts rationally for different medical functions.

Fig1 The Yanzhou People's Hospital

THE ISSUE

The project of the Yanzhou People's Hospital is located in Xicheng District, Yanzhou City, Shandong Province. The area for the new hospital is rectangular in shape, 600 meters from north to south and 300 meters from east to west. It is mostly flat with convenient transportation.

The Hospital Architecture System Research Branch of Chinese Hospital Association (CHA) and the "Green Hospitals" leading group have established a five-year plan to promote green hospital development.
As a member of the association, Yanzhou People's Hospital has actively participated in green hospital development.

The design of Yanzhou People's Hospital was jointly completed by Shandong Architecture Design Institute, Taiwan Xuchangji Architectural Office and Beijing Shengdi International Architecture & Engineering CO. LTD. This is the biggest project in Shandong Province to use Ground-Source heat pump technology. It is also the first Third-level First-class hospital (high) in Shandong Province that adopts constant temperature and humidity technology in large-sized comprehensive ward buildings.

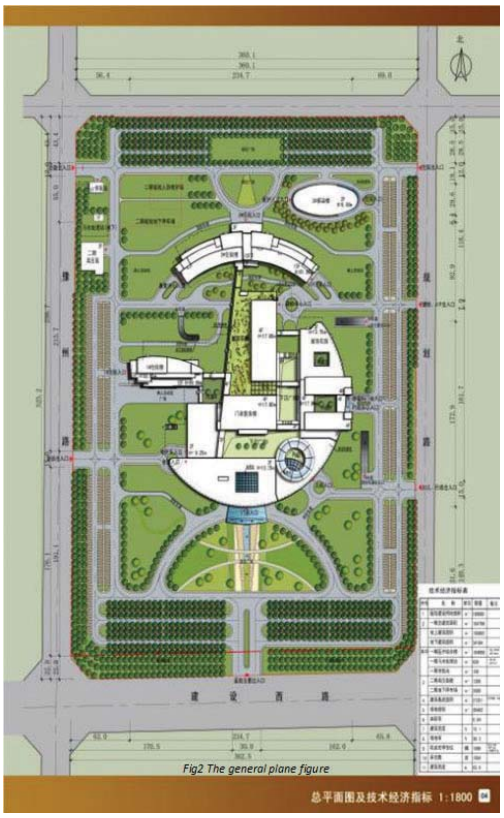


Fig2 The general plane figure

SUSTAINABILITY STRATEGY IMPLEMENTED

1. Highlight Ground-Source heat pump technology and constant temperature and humidity technology.
2. Embodied design philosophy includes harmonization and humanization, garden and zoology, information intellectualizing, energy-conservation and environment friendship and sustainability.
3. According to the surrounding environment, determine the position of the hospital's main entrances, and entrances of wards and emergency room, locate infectious diseases ward at the downwind of the hospital with separate entrance.
4. Based on flow lines, divide the hospital into three medical functional districts: outpatient clinic, medico-technical department and wards. Medico-technical department positions between the other two functional districts convenient for sharing medical resources.
5. Using arc shape in the design instead of the traditional rigid hospital style.
6. Centralized layout spares space for more green space creating a better healing environment. Internal courtyards are designed for better natural lighting and ventilation.
7. Entrances to different functional districts connect with different roads reducing hospital cross-infection among the districts.
8. The hospital has a total construction area of 184,000 square meters. It is composed of several medical function districts. Considering the position of different medical function districts, the design meets the requirements of them and allows medical processes are implemented smoothly, which creates a comfortable medical environment for both patients and doctors.

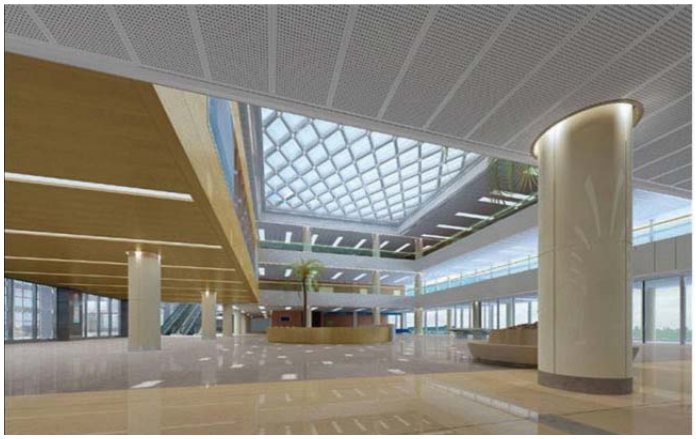


Fig3 Effect sketch of outpatient hall

Fig4 Effect sketch of hospital greening

IMPLEMENT PROCESS

1. Using energy-saving design and adopting energy-saving materials in building envelope, including roof, wall, doors and windows.
2. The overall green hospital design
   - 2.1 The hospital green area.
   - 2.2 Design of roof garden.
   - 2.3 Permeable pavement.
   - 2.4 Using spray cooling system to improve outdoor thermal environment.
   - 2.5 Using water cooling technology, taking advantages of water, such as rivers, waterscape and fountains, to reduce heat-island intensity and improve outdoor environmental comfort.

2.6 Natural ventilation, based on local climate characteristics and the overall hospital design, improving wind environment through rational layout of buildings, water bodies and green area, for the purpose of reducing heat-island intensity by natural wind in summer.

3. Ground-source heat pump, by testing the soil's thermal properties, it was concluded that ground-source heat pump applies to the project.
4. Independent temperature and humidity control air conditioning system.

Fig5 Ground-source heat pump system-1

Fig6 Ground-source heat pump system-2

PROGRESS ACHIEVED

1. **Ground-source heat pump**

The hospital project's cold load in summer is up to 11,818kw and thermal load in winter is 6,894 kW. There are three ground-source heat pumps in the refrigerating station to afford all thermal load in winter and part of cold load in summer. The rest part of cold load in summer will be afforded by two centrifugal chillers. The design of GSHP buried pipes is based on the thermal load to meet the requirements of heating in winter. In summer, GSHPs together with the centrifugal chillers can meet the needs of cooling. Centrifugal chillers will dissipate heat through a cooling tower. Inlet and outlet water temperatures of GSHPs will be 30/35^{0}C in summer and 10/5^{0}C in winter.

Fig7 Independent temperature and humidity control air conditioning system

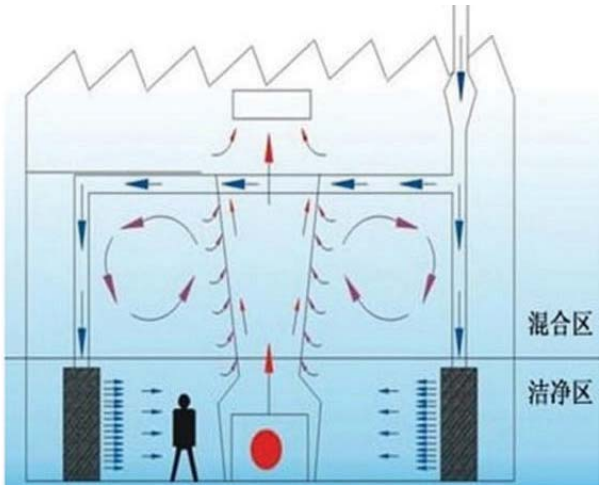


Fig8 Schematic diagram of independent temperature and humidity control air conditioning system-1

2. **Independent temperature and humidity control air conditioning system**

Independent temperature and humidity control air conditioning system has advantages of low-energy consumption, constant temperature and humidity, without cross-infection, blowing sensation, noisy or odors, and the indoor air parameters is less volatile and the concentration of PM2.5 is less than 10 μg/m3. Compared to traditional air conditioning system, independent temperature and humidity control air conditioning system costs 20% more on initial construction costs but only 70% of the operation costs. Payback period of the added cost is about 5 years. In addition, the system is lifelong maintenance-free.

(Submitted by the Hospital Architecture System Research Branch of Chinese Hospital Association)

TAICHUNG TZU CHI HOSPITAL BUDDHIST TZU CHI MEDICAL FOUNDATION

The Implementation of Building and Energy Management System in Optimizing Energy-saving Practices

GGHH AGENDA GOALS

- Buildings
- Energy
- Water

HOSPITAL GOAL

- Innovation in building design, system and equipment to reduce energy (electricity and oil) consumption by 1% yearly
- Reduce carbon dioxide emissions and quantify hospital's carbon footprint

PROGRESS ACHIEVED

- Building Materials were locally sourced. Roofs are tilted for rain catchment and easy installation of solar panels. Used brick are permeable to allow absorption of ground water
- Increase in electricity consumption was only 3% despite the 7% growth in medical services provided from 2013 – 2014
- The installation of solar power generation equipment in 2007 creates over 1,245,000 kWh of electricity. Generated electricity reduces hospital's CO2 emission by 128 metric tons and facilitates electricity savings of NT 3,487,000 dollars
- The installation of Building Energy Management System helped reduce operating time of Air Handing Units by 42%. Consequently, decrease in electricity usage and CO2 emission was recorded. Around 5,847,300 kWh and 3,134 metric tons of CO2 emissions were saved yearly compared to previous consumption
- The Heat Pump System effectively heats water from 26 to 58 Celsius. Using the Heat Pump System reduces the CO2 emissions by 42 metric tons and allows the hospital to save approximately NT 950,000 dollars annually. Before utilization of the Traditional Boiler incurs expenditure amounting to NT 1,300,000 for its operation using natural gas while generating 112.8 tons of CO2 emission. However, with the use of Heat Pumps, electricity consumed is around 131,000 kWh which is approximately NT 350,000
- Our solar panel installation and green building design received much recognition from various awarding institution. Some of these awards are "Jingyi" award in 2008 and "Green Building Certification (Silver)" from the Construction and Planning Agency of the Ministry of the Interior 2013
- From January 2012 to December 2014, 172,227 m3 of recycled water was collected from rainwater catchment and water recycling facility. The collected water replaced usage of tap water for irrigating gardens and cleaning public toilets which reduced hospital's CO2 emissions by 33 metric tons

Green label building

Building Energy Management System

Reclaimed water system

Rainwater system

THE ISSUE

In 2011, Taichung Tzu Chi Hospital has started to expand by increasing hospital beds from 381 to 1081. The expansion subsequently increased our energy needs which heightened our electricity consumption. The consumed electricity accounts for most of our energy expenditure (86.4%). Due to this, we faced significant challenges in managing and balancing energy consumption and expenditure with energy conservation.

- Taiwan ranked 18th in the list of countries experiencing water scarcity. On average, Taichung Tzu Chi Hospital consumes 742 liters per capita daily. This is relatively higher compared to other commercial sectors. However, installation of water – saving technologies and equipment reduced water usage by at least 38%

SUSTAINABILITY STRATEGY IMPLEMENTED

Installation of Building Structures and System:

- Our centralized monitoring system uses Building Energy Monitoring System (BEMS) that collects usage data of illumination, air-conditioning, medical gas, water, diesel expenditure and conditions of electrical circuits
- Using hospital's built-in Wastewater Reclaimed Systems, non-hazardous waste water from daily activities is filtered. Water is cleaned through sand filters, by addition of disinfectants and is then deposited in 6 storage tanks with a combined volume of 290 metric tons
- The rainwater harvesting system could store up to 276 metric tons of rainwater Public restrooms were equipped with water-saving toilets

IMPLEMENTATION PROCESS

1. Green Building Design :

- Since the beginning, we opted for local construction materials to protect the ecosystem and prevent land erosion. Therefore, we used water permeable bricks around the hospital and tilted roof. This action provided easy collection of rain water and setting up of solar panels to collect and generate electricity

2. Digitalized Monitoring System:

- We used BEMS collects usage data and compares with historical data of air-conditioning, illumination and water. If the system detects any abnormality in terms of the set trends, an alarm will be triggered and initialize usage reduction measure, if needed.
- Analysis of data collected from BEMS is made in conjunction with observed weather conditions, level of hospital activities and operated medical equipment in order to employ the best operating energy model

3. The 3R's (Replace, Re-use, Recycle)

- Helical recessed lamp is gradually replaced by LED lighting
- The boiler is being operated using natural gas and not with diesel as energy source
- Air Handling Unit schedule uses 42% less time compared to regular system to cool down
- Rainwater was collected to irrigate gardens and recycled water was used in public toilets in the hospital.
- Water-saving devices in public facilities were installed including sensor faucets, tap aerators, low-flush toilets and two-stage flushing devices
- Speed of water flow is adjusted in dormitories from 19.2L/min to 10L/min

4. Implementation of environmental conscious activities and obligatory classes that provide staff members with continual educational credits:

- Regular seminars and orientations are conducted to educate employees on energy-saving ideas and its incorporation to daily routines
- Every 22nd of April (World Earth Day) a seminar is arranged to communicate with the employees the importance of saving energy. During this particular seminar, saving energy is highlighted because of summer season. This season incurs highest electricity consumption among others
- Several policies and reminders have been communicated employees and patients such as, switching off electric appliances that are not in use, taking stairs instead of elevators (for 2-3 levels), setting air conditioners' temperature not exceeding 26 degrees Celsius, switching off lights at lunch breaks and shutting down personal computers after work

TRACKING PROGRESS

- Automatic Surveillance Systems monitors daily energy utilization from which energy expenditure may be collected. Acquiring this data facilitates setting energy expenditure limit for specific hospital location or department
- Green policies ensure that yearly goals are created to set limits for energy expenditure. The Maintenance Department reports actual amount of energy expenditures at monthly meetings held
- Cost for energy expenditure stays under 7% of hospitals net income. Yearly electricity consumption should be less than 2.80% (annual electricity utility cost divided by total kWh/year)

CHALLENGES AND LESSONS LEARNED

Energy demand in each departments of hospital is not the same. When we started to extend new building, we lack management indicators model to evaluate energy efficiency of different departments. Utilizing BEMS, collection and data analysis pertaining to energy expenditure was made more effective and efficient. This paved way in standardizing energy expenditure for different hospital location and departments. Moreover, departments who made significant reduction in terms of energy use and cost serve as benchmark for other hospital members.

Reducing Greenhouse Gas emissions requires behavioral change but personal habits were proven difficult to change. The energy conservation plan may only be implemented through cooperation from different stakeholder. In order to address this concern, continuous communication, education and training was given to develop good habits.

NEXT STEPS

Optimization of BEMS in response to changing climate is essential in helping hospitals to collect data on energy expenditure. This data could help hospitals determine the right decisions in updating their power-feeding system. In addition, computerized monitoring and routine maintenance are key elements to successfully prevent over-usage. Finally, public education is the most important factor in helping hospitals to reduce energy usage; therefore, protecting our natural resource.

DEMOGRAPHIC INFORMATION

Taichung Tzu Chi Hospital is located in Tanzi District of Taichung City, spanning over 184,921 square-meters and holds a 1081 beds capacity, with a staff number of more than 1,500. We provide holistic care and preventive medicine through community medicine, home visits and health counseling. Since the beginning, we opted for local construction materials to protect the ecosystem and prevent land erosion.

LINKS

http://taichung.tzuchi.com.tw/

QUOTES:

It is always challenging to turn a very difficult situation into something easy. More so, it is difficult to turn them into something that is workable or feasible. At the beginning of the implementation, we received opposition from hospital staff and visitors. By utilizing modern technology, we gained experiences on how to smartly use the data to communicate and to provoke change. Although tools can be very helpful, we human still are the backbone of energy solution. – Mr. Xu-Fu Yu, Taichung Tzu Chi Hospital

KEYWORDS / TOPICS:

Energy efficacy, Green Building, carbon dioxide emissions, Building Energy Management Systems, BEMS

Submission date: 2015/7/16

CHINA MEDICAL UNIVERSITY

Establish Environment Friendly Green Hospital in Multiple Aspects

GGHH AGENDA GOAL

- Building

HOSPITAL GOAL

- Execute and demonstrate sustainable operation through complete management policy to build low-carbon medical system, connecting to low-carbon society, promoting smart green public works.
- Achieve continuous improvement of energy performances, energy efficacy, and scientific energy audit through systemic management programs.

PROGRESS ACHIEVED

1. In 2013, we achieved 10 % reduction of water, natural gas, diesel duel, electricity, and waste, comparing with the previous year.
2. We introduced green building regulations to the latest hospital construction for site choices, designs, plans, and daily operation, and were rewarded by the Ministry of the Interior as Gold class green building for lowering environmental hazards in 2013.

THE ISSUE

- How to reduce energy usage under the special circumstances of medical services?
- Is it possible to effectively achieve energy conservation and carbon reduction of green hospital management through the low carbon consumption equipment of the new construction?

SUSTAINABILITY STRATEGY

Social responsibility is the key to sustainable organization development. Under the ground of Green Health Hospital Declaration signed by our superintendent, we have launched comprehensive energy conservation management in medical services, the community, and the staffs' life. To execute environment-friendly promotion with robust strategies, we build up low-carbon medical system and community with smart green public construction promotion as well as intensifying education and communication on energy conservation.

To build a green medical system with "high efficacy, high value, low carbon, low reliance" and formulation of energy conservation management strategies, our principles are energy stewardship, economic prosperity, and social responsibility, converting limited sources to efficient usage, developing clean energy, and continuing with sustainable energy.

IMPLEMENTATION PROCESS

1. Build up an professional energy management team:
   With the support of the board and the superintendent, we construct an energy management team, commencing with environment-friendly system, management, and education. Leading in International Green Building Evaluation, Leadership in Energy and Environmental Design (LEED), and ISO 50001 energy management system, we have ameliorated energy performance and continue to pursuit energy efficiency. We outsource to professional certification institution for commissioning energy management internal audit training guidance, and to understand and control energy efficacy and management.

2. Construct energy management policy: We develop energy management policies with reference to the most widely used international energy management system standards and green building assessment criteria, combined with existing state laws related to domestic hospitals in Taiwan.

   Establishing the operation and management processes, setting the operating standard manual, and offering a daily checklist for inspection and monitoring that makes up the basis of future improvements. With a comprehensive policy, procedures, standard operating manual with checklists for hospital energy management quality manual, we can continuously improve the quality of our energy management.

3. All for one: With educational training programs, advocacy activities, standardization of operating procedures, incentives, and inspection work, the better and correct energy use habits will be gradually rooted in energy management staff, patients and the public.

Green Health Hospital Declaration signed by our superintendent

4. Construction of green environment: In order to stabilize sustainable environmental development towards the goals of "ecology, energy saving, waste reduction, healthy", we intended to make 10 major energy-saving improvements, to build smart and modern green hospital.

The latest established hospital district begin with the main concepts of constructionof a green environment, from choosing the base of the building site, designing a sustainable low-power operation facility with water conservation and waste reduction self-management, pollution prevention and control during construction, to selecting building materials for green equipment maintenance and repair, without sacrificing indoor environmental quality and comfort. By brainstorming and innovation, we achieve to meet the green building sustainable design.

Toward Greatest Goals

Energy Performance

TRACKING PROGRESS

To scientifically prove the energy flow and usage structure, we have energy audit by basic data integration and analysis, to have a breakthrough ground for systemic management model. After the plans of adjustment and correction were carried out, we have follow up commissioning to meet up with our goal.

CHALLENGES AND LESSONS LEARNED

The efforts for the promotion of energy management is 80% on establishing management systems and 20% in technology aspects, thus strengthening the management staff to form correct habits is one of the difficulties, including promoting educational training programs for internal energy management, public awareness of the proper use of energy, and working together with the community to construct a green social environment.

NEXT STEPS

Our current improvement goals include stabilization of energy supply, elevation of energy efficiency, carbon reduction, and the development of alternative energy and sustainable development of the hospital environment. Through quality control practices, continuous review and improvement of existing internal energy management policies and audit system, we will implement project reviews of energy performance and indicators, in order to achieve the ultimate goal of energy saving and carbon reduction.

For the impact of the internal implementation and external difficulties we faced, the hospital will review and develop improvement projects, such as taking into consideration the perspective of day length and sunshine to build new renewable energy projects with solar power generation; upgrading the software to improve energy and resource efficient management through sophisticated management hardware facilities; establishing smart building and green modern health care system, to implement energy saving and carbon reduction with corporate social responsibility.

DEMOGRAPHIC INFORMATION

The bed capacity of China medical university hospital system is 3431, with a staff number of more than 5000. We constitute the system with the mission of improving human basic health rights, and always hold the service philosophy of “patient-centered, staff-valued, quality first, innovation and excellence, social contribution”.

PURCHASING

Buy Safer & More Sustainable Products & Materials

Photo by Rawpixel

PHILIPPINE HEART CENTER

Initiative on Green Procurement

GGHH AGENDA GOAL

- Purchasing

HOSPITAL GOAL

- The hospital aspires to promote the culture of making environmentally sound decisions in government, especially in the purchase and use of different products in every department of the hospital.
- The hospital intends to include environmental criteria in public tenders whenever possible and practicable
- The hospital aims to establish the specifications and requirements for products and services to be considered environmentally advantageous through its content, packaging, method of production and delivery
- As a Hospital promoting patient's well-being, environmental conservation and protection, green procurement aims to sustain and encourage participation on the carried out advocacy

PROGRESS ACHIEVED

The Philippine Heart Center has defined Green Procurement as "the act of procuring products and services where environmental considerations are incorporated as a basis of decision. This is in addition to the conventional judgment used such as price and quality. It is also procuring less of a particular service and product. The Green Procurement Team particularly upholds Environmentally Preferable Purchasing where products are generally (1) less toxic; (2) minimally polluting; (3) energy efficient; (4) safer and healthier for patients, workers and the environment; (5) higher recyclability and recycled content; and (6) with less packaging.

Green Procurement Team was created sometime April 2012 under the supervision of Eco-Friendly Committee Waste Management Component. The Green Procurement Team is composed of the representatives from different departments such as Engineering Department, Housekeeping Department, Infection Control Unit, Emergency Response Unit, Pulmonary Unit (Medical Department), Central Supply (Nursing Department) and Human Resources Department.

The Green Procurement Team led the institutionalization of Green Procurement Standard by incorporating them in the Philippine Heart Center Policy Manual also in 2012. The policy highlights three important components in procurement of products and services. These are product –, process – and manufacturer – specific attributes. Please see the table below for the characteristics of the identified attributes under each component.

Table 1.0 Green Procurement Component and Attribute

Component	Attribute
Product – Specific	Recycled content, reusable, biodegradable, energy and water efficient, Bio-based, organic and natural, non-hazardous material, free of noise pollution, low toxicity, durability, low VOC, renewable resources, packaging, upgradeable, resource conservation, preferably locally available, preferably with eco-label and eco-approval, solar powered preferred
Process – Specific	Transportation (eco-friendly delivery of goods), use of renewable energy during production, absence on greenhouse gas emission, closed – loop manufacturing
Manufacturer – Specific	No – environmental violations, credible environmental management system, corporate social responsibility, mechanism for engaging stakeholder, absence of ongoing protests, end-of-life agreement program, replacement agreement for manufacturer defect, waste agreement

The institutionalization of policy gave way to actual purchasing and utilization of patient –, employee – and environment – friendly equipment and devices. Among the products procured after the implementation of the policy are non-mercurial thermometers, sphygmomanometers and lithium batteries, elimination of usage of incinerators, usage of 134a refrigerants instead of the traditional ozone depleting substances, T5 CFLs and LED lights, water – less urinals, water – saving toilet features (ex. Dual – flush system), recyclable food packaging, use of eco-wood and fiber cements in construction, PPR and PPE pipes instead of PVC, low VOC, antibacterial and depolluting paints.

The ratification of the Green Procurement Policy has also allowed construction and installation of a Sewage Treatment Plant, Solar Panels, botanical gardens and vertical gardens, procurement of heat pumps and Air Conditioning Units. Adjacent policies and practices also rose from the Green Procurement Standard implementation. A few of them are inter-office usage of recycled paper, recycling of linens and paperless medical tracking through Med – Trak system.

The transition with the employees, manufacturer and service provider went smoothly. It was ensured that employees were informed of the changes through the quarterly orientations. On the other hand, manufacturers and service providers were brought in to the system by first ensuring that they are ISO certified. ISO certified companies adapt eco-friendly technology and procedures. Also, submitting clear specification for service bidders and manufacturers helps in of procurement.

THE ISSUE

The Philippine Heart Center is foremost committed to providing our patients with quality care and service while protecting the environment and advocate for health justice. Adamantly deciding to choose practices and actions that are environment and patient –friendly helps us uphold this commitment.

The enactment of Executive Order 30 (Establishing a Green Procurement Program For All Departments, Bureaus, Offices and Agencies of the Executive Branch of the Government) and collaboration with Local Government Authorities such as the Department of Environment and Department of Health also mandates the Philippine Heart Center to employ environment and health sustainable measures, policies and activities.

Being a semi-government hospital, procured product and services of the hospital undergoes bidding. Often, the most cost – efficient providers gains the required product and services. To secure that the most appropriate product or services is acquired, specification is adequately defined. In the end, the Bids and Awards Committee (BAC) are still obliged to comply with the Terms of Reference. The contract will still be awarded to the most competitive and responsive provider in terms of the stipulations in the terms of reference.

Initial installation and / or procurement cost are generally high. However, given a period of time, return of investment (ROI) is acquired and savings are made. Generally, the Philippine Heart Center aims to regain the investment in one to two years. The table below presents quantified ROIs and saving which shows that projected outcomes were achieved.

Equipment	Installation Cost in Php	Operation Cost in Php (Previous Equipment)	Operation Cost in Php (Present Equipment)	**Saving in Php (Monthly)	***Return of Investment in Php (ROI)
Boiler Heat Pumps		(total operation cost) 419,960 ≈ $9,160 (diesel) 338,000 ≈ $7,347 (water) 30,000 ≈ $652.17) (electricity) 48,960 ≈ $1,064			20 months
	5,653,200 ≈ $122,896		(electricity) 137,000 ≈ $ 2,978	282,960 ≈ $6,151.30	
Solar Panels	(total cost) 1,348,932 ≈ $29,325 (panels) 141,723 ≈ $3,081 (inverter) 607, 200 ≈ $13,200 (labor) 600,000 ≈ $ 13,305			70,000 ≈ $1,522	20 months

*$1=Php 46.00
**Saving = Previous Operation Cost – Present Operation Cost
***ROI = Installation Cost / Saving

SUSTAINABILITY STRATEGY IMPLEMENTED

The support of the Management led by the Hospital Director and the collaboration of employees are greatly important and needed to sustain the entire project initiated by the Eco – Friendly Committee. The collaboration of both the Management and employees are significant to the success of the advocated endeavors of the committee.

To inspire the management's support, the whole Eco – Friendly Committee particularly the Green Procurement Team ensures that initiated programs are practical and workable. This means that the presented programs and activities are properly researched, with cost – benefit analysis projections, return of investments and detailed specification. Upfront, the initial investment may be considered substantial. However, with the cost analysis projection it is often shown that the return of investment is just within 1 to 2 years. Moreover, the longevity of products, warranties and end of life disposal process are offered.

Education, Information and Communication were given to employees through quarterly orientation and public service reminders in strategic areas of the hospital.

Solar Panels and Heat Pumps

IMPLEMENTATION PROCESS

During the establishment of the Eco – Friendly Committee, Green Procurement Team was also formed. After the formation of the committee, a simple audit of existing policies, equipment and services were conducted. Comparison of product features and services given by suppliers are reviewed to find better substitutes for equipment and other materials.

The results of the audits which was conducted for a year served as baseline for development of new policies and product specifications. They were made to aid in the procurement process. Projects were also identified to further assist the hospital in upholding its commitment to transform their own healthcare system. To name a few, these projects are installation of solar panels and heat pumps.

Equipment and service providers were better selected through the list of specification the Green Procurement Team have developed.

Management and employees were routinely informed of the changes and developments of the programs and activities. Management is briefed on the program or activity cost-benefit projection while the employees are oriented on the safety benefits of the new equipment.

Simple monitoring logs are also prepared by the team to monitor their old and new equipment purchases. Every department has a record which contains the property endorsed to them as end user. Centralized record is kept by the Property and Supply Division. Innovation and development of materials are headed by individuals depending on their expertise or discipline. For example, mechanical and motor specification are drafted by mechanical engineers while electrical needs by electrical engineers. This also allows them to see which services or equipment purchases may be further improved or developed.

TRACKING PROGRESS

Philippine Heart Center measures its progress on Green Procurement Program through the following indexes:

Policies: Policies are constantly reviewed, developed, adapted and implemented every 2-3 years in time for the hospital's accreditation

Supply: The Philippine Heart Center continuously evaluates needed supply, equipment and services to identify better alternatives which are environment, patient and economically friendly.

Saving: Monetary savings from innovations made such as transition from boilers to heat pumps are monitored.

CHALLENGES AND LESSONS LEARNED

Innovation and development entails cost. At times these investments may seem large if the benefits (eg. monetary, environment, patient and employees (social)) are not taken into consideration.

Initially, meriting approval for the proposed programs and projects were difficult because of the start – up cost and other consideration.

However, with the adequately researched information and properly formulated justification of the programs and projects the difficulty is easily managed.

NEXT STEPS

The Philippine Heart Center is considering to transform the policies adopted into a Green Procurement Manual. The hospital is also adamant to acquire knowledge on carbon emission accounting to better gauge the impacts of their current operation and implemented programs and activities.

In terms of installation of new structures, the PHC is aiming to construct an energy efficient building (for parking) and their own autoclaving unit. The parking area will be solar powered. Auto claving unit situated within the hospital premises will reduc ne carbon emission acquired from transportation of properly segregated wastes for treatment and disposal.

DEMOGRAPHIC INFORMATION

The Philippine Heart Center, a semi-government hospital is a 382 – bed tertiary care center. There are 21 nursing units. This includes 53 Intensive Care Unit (ICU) beds, 3 hybrid operating rooms, 24 suites, 56 private rooms, 74 semi – private rooms, 3 adult service wards, a presidential suites, pediatric service ward and an auditorium. They also provide MRI, CT- Scan and Physical Rehabilitation Services.

LINKS

www.phc.gov.ph

HOSPITAL ISRAELITA ALBERT EINSTEIN
SÃO PAUL, BRASIL

Recycling Sterile Surgical Material Wrappers

GGHH AGENDA GOAL

- Waste
- Purchasing

HOSPITAL GOAL

- Ensure environmentally correct disposal of blue wraps by using reverse logistics
- Increase materials recycling

PROGRESS ACHIEVED

- Environmental Benefits: 40 tons of materials recycled in the first year of the project.
- Other qualitative results:
  - New sustainability initiatives in the or triggered by increased involvement and interest of the staff in this project.
  - Creation of a Green Team that meets monthly to discuss topics related to environment and sustainability.

THE ISSUE

The amount and variety of disposable materials used in patient care is continually increasing. More and more single use devices take up space on shelves rather than going in for reprocessing. From the perspective of patient safety, the benefits are incontrovertible, but there is a great concern regarding the environmental impact of the amount of waste produced by the hospital.

SUSTAINABILITY STRATEGY IMPLEMENTED

Figure 1: Material separated for recycling

Reverse Logistics, established by the new Brazilian Solid Waste Policy Law, requires the participation and responsibility of the manufacturers or suppliers to support and manage their products throughout their life cycle, even after use. Thus, in 2012, Albert Einstein Hospital started a pioneering partnership with Kimberly-Clark, provider of SMS blue wraps that are used to pack surgical boxes. These materials, which the hospital previously discarded as infectious waste, are now going in for recycling through the take-back system. The blue wraps or SMS (acronym for the 3 layers materials: Spunbond-Meltblown-Spunbond), are made of polypropylene, a kind of plastic resin that can be recycled.

IMPLEMENTATION PROCESS

The initiative started with a project called "Solid waste management in the operating room". Hospital staff characterized all waste generated in surgical procedures. This analysis demonstrated that the blue wraps, used to pack boxes of surgical sterile instruments, amount to 19% of the waste generated in operating rooms. As this blue wrap has no contact with biological materials, it is classified as non-hazardous waste. With this information in hand hospital staff contacted Kimberly-Clark to begin discussions on options for recycling and environmentally friendly disposal.

After a thorough search with Kimberly-Clark, the team identified a recycling company to receive and process the used blue wraps. Internally, the hospital trained a multidisciplinary group to sort and dispose of the materials properly. For every surgery, the same nursing professional that removes the blue wrap is responsible for proper disposal. The warps are separated and placed into a specific bag, to avoid to be mixed with contaminated wastes.

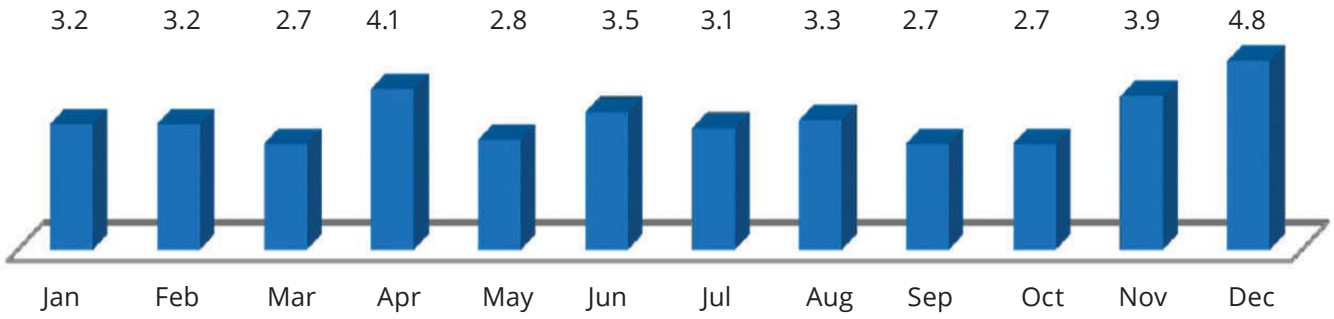
The wraps are collected every two weeks by the Kimberly-Clark´s partner, and sent for recycling. All the SMS collected are processed into pellets of polypropylene, which can be used for making new products.

Figure 2: Examples of blue wrap uses, packets being unwrapped and discard still in the operating room

TRACKING PROGRESS

The hospital implemented the project in early 2012 and after the first year, 40 tons of materials were sent for recycling. The results are presented monthly to staff involved with the project, to update them, congratulate them, and motivate them to continue their efforts.

Evolution of recycling blue wrap (t) - 2012



CHALLENGES AND LESSONS LEARNED

SMS is a polymer with high potential for recycling. Since this waste is generated in the operating room, it was difficult to find a partner who had the environmental permit and interest in recycling the material. A critical issue for the success of the project was to define the process flow, making possible the collection of the SMS before the start of the surgical procedures, in order to avoid contamination of the material. In this case, the training and involvement of the staff was essential.

NEXT STEPS

Currently the hospital is expanding the project to other operating rooms in external units. The hospital is also exploring bringing this recycling program to other departments, where it would be feasible to recycle products made of SMS, such as sheets, ground covers, etc.

DEMOGRAPHIC INFORMATION

The Sociedade Beneficente Israelita Brasileira Hospital Albert Einstein (SBIBAE) is reference in Brazil for physicians and patients, providing a complete healthcare services chain, from promotion, prevention and diagnosis to treatment and rehabilitation. The healthcare activities are carried out by several units, including the hospital, Diagnostic and Preventive Medicine, the Institute of Education and Research, the Institute of Management and Consultancy, and the Institute for Social Responsibility.

The Albert Einstein Hospital, is the largest of the ten institutions that composes the SBIBAE, located in the municipality of São Paulo, Brazil. It has 647 beds and 34 operating rooms.

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KEY WORDS

Recycling; Waste in Operation Room; Reverse Logistics; Blue Wrap; Polypropylene.

MATER HEALTH SERVICES, AUSTRALIA

Paper Reduction

GGHH AGENDA GOAL

- Purchasing

INSTITUTION'S GOALS

Procurement is a major theme of the Sustainability at Mater program and is vital to both gaining support and raising awareness of environmental sustainability (ES) initiatives within the organization. Changes such as reducing paper use through duplex printing, along with changing to recycled paper and then later carbon neutral paper were both cost effective and cost saving opportunities that also engaged staff to an ES initiative .

PROGRESS ACHIEVED

Achievements as at end of June 2015:

- Completed IT project (commenced April 2010) to change all multi-function devices (approx. 450) in non-clinical areas to default to duplex printing.
- Saved 7,538,531 pages through duplex printing.
- Reduced A4 paper purchases by 32 per cent since 2010/2011.
- Changed A4 paper to recycled paper in September 2010.
- Changed A4 recycled paper to A4 Carbon neutral paper in December 2011.
- Saved $60 000 through procurement decreases.

THE ISSUE

The Procurement and IT Sustainability Subcommittee identified a number of areas for investigation. Among the results, duplex printing was seen as a relatively easy initiative to address. Changes could be led by the IT department through configuration of all multi- function devices on the Mater network.

SUSTAINABILITY STRATEGY

Duplex printing was one of the first initiatives identified from the Procurement and IT Sustainability Subcommittee and was able reduce paper use through an IT change of practice. The second step involved changing the A4 virgin paper supply to recycled paper from September 2010. Initially the change did incur a cost increase per box/ream of paper however lower consumption offset the price increase for a cost neutral investment. Changing to carbon neutral paper in December 2011 also incurred a cost increase however the Director of Supply Services (member of the sustainability committee) was able to negotiate a price parity that allowed this product to be continued.

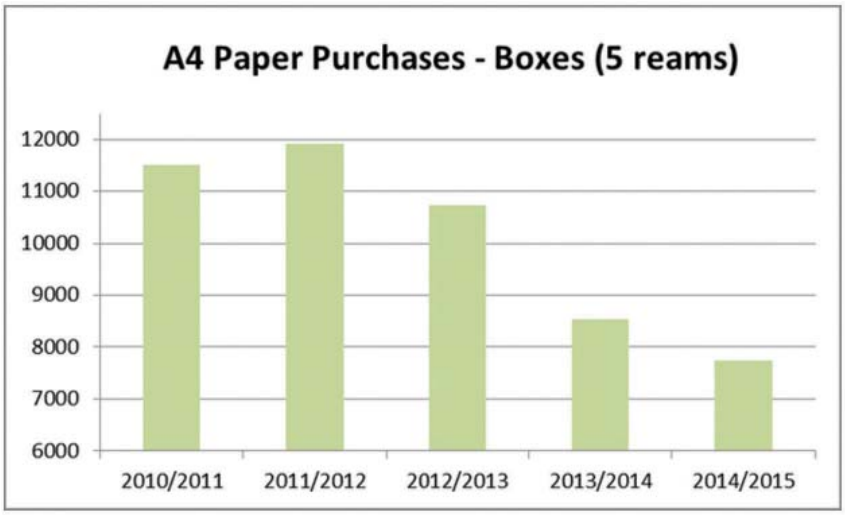
TRACKING PROGRESS

Mater has collected data on A4 paper purchases as per the graph since 2010/2011 and aside from a slight increase in the 2011/2012 period the quantity has reduced each year.

The increase in 2011/2012 data can be explained by improvements to our measurement capability.

Other factors contributing to the reduction of paper consumption include changes to business practices and health service delivery.

Mater has measured the carbon output for A4 paper use as part of scope 3 emissions and has reduced to zero emissions from a 2010/2011 position of 84.9 tonnes of CO_2 equivalent.



CHALLENGES AND LESSONS LEARNED

Throughout this process the subcommittee identified some departments that were unable to utilize Duplex printing for a number of reasons. If a solution could not be found, the multi-function devices were hard coded back to single side printing. Additionally, there are still a number of stand-alone, non-networked printers throughout Mater and many of these are unable to be changed to the duplex printing function.

Some clinical areas that produce printed patient reports were excluded from the mandated approach due to patient confidentially reasons. However it should be highlighted that a number of clinical areas have taken on the duplex printing initiative with no confidentiality issues identified.

NEXT STEPS

Duplex printing has been operational at Mater for a number of years and the change has been accepted by staff and is now a “business as usual” practice. The project has proved a useful change in business practice example to promote the benefits of ES initiatives and how they can be implemented for no cost and minimal impact to business.

In a separate but related initiative, the Director of Information Management will lead a large project to implement an enterprise/ corporate document management system. The project will initially focus on health record document management and over time will further reduce paper consumption on site.

Two other initiatives, secure print and pin activation through individual printing codes, were identified to assist with paper reduction. While these have been investigated, the current IT platform required to run the applications across the network does not support the software required to implement secure print as a standard feature and the initiative is “on hold” at present.

DEMOGRAPHIC INFORMATION

Mater Health Services comprises several hospitals, health centres, a world-class medical research institute and pathology and pharmacy businesses—all with one aim—to provide
Exceptional Care.

Our concerted pursuit of innovation—to discover, improve, adopt and adapt— differentiates Mater as a leader in the areas of health, education and research.

By integrating these fields into the delivery of exceptional healthcare services, Mater is committed to the development and maintenance of healthy communities.

Mater is dedicated to providing healthcare services through a sincere commitment to our core values of Mercy, Dignity, Care, Commitment and Quality.

A Catholic not-for-profit ministry, we are committed to an holistic approach to healthcare in response to ever-changing community needs. We continually strive to improve how we deliver patient care, keep our knowledge and skills relevant, advance our understanding of illness and health and manage resources effectively.

KEYWORDS / TOPICS:

procurement, paper, waste, duplex printing

Photo by Rawpixel

How to submit case studies

We encourage GGHH members to submit one or more case studies highlighting their work related to a GGHH Goal. If you are a a GGHH member and would like to submit a case study, please complete the case study template and send it to info@no-harm.org

Once received, submissions will be reviewed and considered for publication on greenhospitals.net.

If you are not a member of the GGHH but have information or a case study you would like to share, we invite you to consider joining this worldwide initiative that brings together hospitals, health systems, health, professional and/or academic organizations to reduce their environmental footprint and promote public environmental health.

Join Global Green and Healthy Hospitals

GGHH is an international network of hospitals, health care facilities, health systems, and health organizations dedicated to reducing their environmental footprint and promoting public and environmental health.

The Network has more than 997 members in 51 countries on 6 continents who represent the interests of over 32,300 hospitals and health centers. Our members are using innovation, ingenuity, and investment to transform the health sector and foster a healthy, sustainable future.

Send an email to greenhospitalsasia@no-harm.org to learn how to join.

SUSTAINABILITY IN ACTION

Best Practices from Global Green and Healthy Hospitals Asia Members and other Countries

To learn more about GGHH and the Asia network, visit our website **noharm-asia.org** or **greenhospitals.net**

Follow us in social media for regular campaign updates:

- HCWHAsia
- NoHarmAsia
- hcwhasia
- noharm-asia.org

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