

IDENTIFYING GREEN LOGISTICS BEST PRACTICES: A CASE STUDY OF THAILAND'S PUBLIC HOSPITALS

Thianthip Bandoophanit, Liz Breen and Kevin Barber

Khon Kaen Business School, University of Bradford School of Pharmacy and Medical Sciences and University of Bradford School of Management

Email: thiaba@kku.ac.th, L.Breen@bradford.ac.uk, kevindownsbarber@hotmail.com

Abstract

Purpose

Previous research (Bandoophanit et al, 2017) has shown that pharmaceuticals are a key input into effective healthcare operations but other equally important inputs are medical supplies, food, utilities, equipment and linen. As stated by the Twelfth National Economic and Social Development Plan (2017-2021) of Thailand, to attempt to deliver national Sustainable Development Goals (SDGs) organisations should preserve resources and minimize waste-generation in all aspects. The principal aim of this research project was to identify green practices and develop a model which supported and promoted healthcare efficiencies.

Research Approach

This was a mixed methods multi-site study using both qualitative and quantitative data collection and analysis methods. Six public hospitals were selected as case organizations, covering different types/sizes, locations, and environmental performance expertise. The data collection methods included interviews, documentation reviews and in situ observations. Respondents' selection was purposive and a bespoke form of content analysis was used for the data review before further cross-case analysis, resulting in the identification of best practices using key indicators.

Findings and Originality

In spite of facing financial crisis, by reviewing key logistical processes and lifecycle, the overuse of healthcare resources and the poor management of waste, were clearly identified within in this study. This had a negative effect on personnel and patient hygiene. The result of identifying effective GL practices were reported as: (i) promoting the usage of multiple-use medical devices that can minimize inputs, waste, and cost, and (ii) producing/selecting organic food materials and fruits and reusing these waste byproducts to create secondary products e.g. fertilizer, biogas and electricity and cleaning/sterilizing liquid. The results also indicated that there was a drive from leaders to introduce green and efficient systems to improve staff personnel awareness and engagement in this area. The output of this study presents a model for GL implementation guidance, grounded in Thailand's Sufficiency Economy Philosophy (SEP) concept.

Research Impacts

Currently, healthcare green logistics has received limited attention in developing nations and this study contributes to the reduction of these gaps. The SEP concept promotes sustainable health standards and underpins the focus and the originality/impact of this study.

Practical Impacts

This study recommends that staff in Thai hospitals focus on effective resource and waste management to contribute to sustainable sufficiency. This allows Thailand to offer an effective healthcare service to its patients. The study presents guidance and support to do this.

Keywords: Green Logistics Practices, Practice Identification, Thailand's Public Hospitals, Sufficiency Economy Philosophy (SEP)

Introduction

According to the Global Green and Healthy Hospital Agenda: *"Hospitals generate significant environmental health impacts both upstream and downstream from service delivery, through the natural resources and products they consume, as well as through the waste they generate."* (Healthcare without Harm, 2011). The health sector's global climate footprint is very substantial. The National Health Service (NHS) in England emits 25% of CO₂ each year of total public sector emissions (WHO and HCWH 2009: 5). Interestingly, logistics activities produces more than half of total emissions, particularly procurement (61%) and travel (13%) (NHS 2013). Therefore, to promote greater sustainability and environmental health by considering a close-loop supply chain – green logistics (GL) should be the responsibility of all hospital functions/departments. But how this is actually achieved operationally is unknown at present.

In Thailand, improving hospital operations (both logistics and environment) is often hindered by these factors especially the government systems/policies, insufficient support, financial crises, as well as poor behavior (PCD 2010; Singkarin 2012; PCD 2013; Rattanaumpawan 2015). Poor behavior in this study refers to two key issues; one is the overuse of resources while another is the mismanagement of waste (e.g. mixing, leakage and poor burning system). Preliminary studies in related areas have also revealed that 'GREEN and CLEAN', the key environmental policy that supports resources and waste control for Thailand's public hospitals, limits sustainable development. Such barriers as mentioned above need to be addressed and overcome. This requires a need for restructure the approach to and execution of resources and waste management at both national and hospital levels to meet this national agenda (focusing on both human and physical elements that impact directly on this). This study investigated the movement and lifecycle of resources and waste within Thai hospital sites and identified the GL practices that effectively control/minimize the use of hospital inputs.

Healthcare Resource and Waste Management

Hospitals use a wide range of resources including items such as linen, energy, food and cleaning products in addition to complex medical equipment and medicines. Various studies have identified significant wastes in the deployment of all these resources (e.g. HCWH 2011; Lapsuwansakul and Kunkum 2012). In general, the amount of resources that hospitals consume is driven by the number of inpatients and outpatients, equipment used, facility size, number and types of service, facility age and maintenance requirements (ESC 2003: 12). The avoidance of overusing resources by minimizing materials entering the hospital rather than focusing on waste control has been highly recommended (HCWH and WHO 2011). Therefore, the total environmental impacts can be minimized when integrating green into all units in the supply chain – called Green Supply Chain Management (GSCM) (Chin et al. 2015). It starts from the decision of selecting green materials (green procurement) for the production, to establish environmentally-friendly production and distribution of products, through to minimization of consumption and waste disposal (Ninlawan et al. 2010). Hospital waste was defined by the WHO (2011) as a byproduct of healthcare that includes sharps, non-sharps, blood, body parts, chemicals, pharmaceuticals, medical devices and radioactive materials. 80% of hospital waste is general waste (GW), while the remaining 20% is considered hazardous material that may be infectious, toxic or radioactive. Careful waste segregation and separate collection can reduce the waste volume that requires specialized treatment (WHO 2011). In doing so it also reflects upon management culture, policy and regulation and stakeholder influence on this supply chain.

Thailand's Healthcare Resource and Waste Management

This section firstly provides the overview of (i) how do hospitals manage their resources, from purchase planning through to waste disposal?, followed by (ii) the national agenda and policy to successfully manage hospital resources and waste. Investigating the operations and streams of healthcare resources and waste within Thai hospital sites was conducted by Bandoophanit et al. (2014a) and can be summarised as follows:

Apart from patient, resources and waste are another key flows moving inside hospitals. The inventory flow involves purchase planning, submitting requisitions, Director's approval, placing purchase orders (PO), receiving purchased inventories, storing, distributing, and discarding waste. Different categories of resources are controlled by the particular department/office. After resources are used, they become various types of waste including general waste (GW), infectious waste (IW), hazardous waste (HW), recyclable waste (RW), and wastewater. Each waste has own specific management methods.

Moving to national level, in the ethos of pursuing and embedding Sustainability the Thai government advocate compliance with the country's Sufficiency Economy Philosophy (SEP).

"At the heart of Sufficiency Economy Philosophy (SEP) is the idea of acting with knowledge and with virtue. This means not being wasteful or consuming too extravagantly, and planning ahead for future risks and shocks. This type of prudent, moderate resource management and forward thinking can help Thailand across the board – on the individual level, among private sector actors and in terms of national policy – when it comes to climate action." (2016: 40):

The SEP concept has been principally applied across Thailand since 1997 (NESDB 2017). The Ministry of Public Health (MOPH) introduced a key environmental policy for all healthcare settings, 'GREEN and CLEAN' later in 2011 (DOH 2012). It is grounded by elements especially the SEP concept (see Bandoophanit et al. (2014b)). Key practices include increasing use of renewable energy (e.g. wind and biogas), green areas, local food materials etc. In addition, some healthcare standards were revised and updated such as the policy to reduce the cost of medicine and medical supply by 10% (Ministry of Public Health 2013). Since the progress of environmental performance is linked with hospital accreditation (HA) and budget allocation (NHSO 2011), the number of public hospital who have opted to join this campaign has steadily increased. According to the report of GREEN and CLEAN, a number of hospitals presented positive outcomes particularly the minimization of total carbon emissions. In contrast, various studies presented poor control of resource management as well as habits of excessive use contrasting with a poor finance are largely found (e.g. Wanichsun 2012). Several hospitals faced problems such as insufficient green products/suppliers, qualified persons/organizations (e.g. logistics managers and waste handlers), knowledge and awareness as stated by Singkarin et al (2012). GSCM concept is rarely adopted in its true sense. When discussing waste control in Thailand's hospitals, Manowan (2009) claimed the factors resulting in poor waste management are the type of hospital and insufficient knowledge. Other studies point to insufficiencies of monitoring by the Director, budget and insufficient protections (Panyaping and Okwumabua 2006; Niyompanitpatana and Bonollo 2012; Tangpaitoon 2012; PCD 2013).

Because of these issues as highlighted by previous studies, a more focused approach to effective hospital waste management is necessary. Therefore there is a need for research to identify key areas

of development for GL in Thai hospitals, to identify best practice in those areas and to include best practice to promote and implement GL best practice.

Methodology

This research aims to identify the Green Logistics (GL) practices that effectively manage resources and waste. To achieve the aim above, four sub-questions were formulated and delivered to:

1. What are the most important GL study areas in Thai public hospitals?
2. How should we measure the GL performance of resources and waste management?
3. What are the critical success factors that support green practice delivery in Thai public hospitals?
4. What are the barriers to addressing environmental programmes in Thai public hospitals?

Although to effectively addressing green in healthcare activities should consider all units in the supply chain as stated by various authors (e.g. Xie and Breen 2012), narrowing the focus of this research to focus on hospital internal logistics, from purchasing resources to waste disposal is more appropriate since Thai healthcare supply chain linkages are very weak. In a complex organization like healthcare facilities, to use mixed methods in collecting data from the field can effectively explore the GL adoption (e.g. Voss et al. 2002; Ubeda et al. 2011). Various tools including documentation, interviewing, observation and checklist (including floor plan) were recommended for exploring and understanding the operations of healthcare resources and waste selected (Bisson et al. 1993). Six case hospitals agreed to participate in this study (called "A", "B", "C", "D", "E" and "F"), due to having different types/sizes (30 beds – more than 500 beds), locations and a range of environmental performance issues. All names of case hospitals, research participants, and their locations (provinces) remain anonymous. Visiting hospital sites were undertaken during January to July 2014 to obtain data. Purposive respondent sampling was undertaken to ensure that data was collected from staff with experience of key resources and waste. 'Content analysis' method was selected to scrutinise the data collected and best practices were identified using 'cross case analysis' method.

Findings

1. What are the most important GL study areas in Thai public hospitals?

In order to answer this question the data collected was sorted using the following key areas (as informed by the GL literature): (i) resources (e.g. medical supplies, food materials, linen), (ii) waste (e.g. general/reusable waste –GW/RW, infectious waste-IW, sharps, hazardous waste-HW), (iii) hospital departments, (iv) all rankings and (v) human factors. These were developed from several studies (HCWH 2011; Pungpeng 2011; Singkarin 2012; WHO 2012; Bandoophanit et al. 2014a).

2. How should we measure the GL performance of resources and waste management?

The concept of best practice refers a technique or method or process delivers a more effective outcome than any others (Frontex RDU 2012: 19). According to McKinnon (2010), good GL practices as applied in this study must be able to (i) reduce the amount of resource used/waste generated/other environmental impacts, and/or (ii) increase cost reduction/improved revenue, and/or (iii) offer well-beings, and/or (iv) provide fast logistical movement. More detail on this is presented in the literature.

3. What are the critical success factors that support green practice delivery in Thai public hospitals?

The hospitals within this study had varying factors which influenced the scale and pace of the introduction of new initiatives such as the hospital location, size, readiness for change and budget, and this affected the uptake of GL practices. As per the findings these were reported as examples of key practices for promoting an environmentally-friendly hospital (see Table 1). For instance, **Medical devices**: The hospital should select using more ‘multiple-use’ medical devices especially glass and metal devices, rather than increasingly using single-use ones. Another example, **Effective Microorganism (EM)**: It can disinfect metal medical devices and floors of operating theatres and should therefore be used more widely in hospitals. It can replace importing chemical sterilisation liquid, which 60-bed hospital can save greater than 400,000 Baht.

Table 1. Best GL Physical Practice Recommended and Applicability.

| Item | Proposed new GL practice | Impact |
|---------------------------------|--|--|
| 1. Medical device management | Select using more ‘multiple-use’ medical devices especially glass and metal devices, rather than increasingly using single-use ones. | Reduction in cost, assurance of quality (inhouse), less waste, less products to landfill (non-recyclable) |
| 2. Organic Foods | Grow own organic products/ or purchase organic products locally, in order to increase the proportion of organic foods in the hospital menus | Support health promotion, use local product and support local economic (SEP), and reduce cost (save up to 25%) |
| 3. Effective Microorganism (EM) | Use waste from vegetables, fruits, raw meat and cooked foods for EM production. High-quality of EM liquid – as a sterilisation liquid | Use all food waste/ resource effectively, reduce use/import of chemical liquid, improve wastewater management |
| 4. Biogas | Large-sized hospitals should have biogas plant, while small-sized hospitals should use Blanket biogas plant | Reduce energy use (at least 25-50% of LPG), and all hospital food waste; and get EM liquid and solid fertilizer from biogas production |
| 5. Electricity | Implement hardware-systemware-peopleware concept, create energy-saving team to monitor their responsible areas, and promote good air ventilation rather than using the air conditioner | Reduce electricity usage and cost, improve infection and disease control |

Source: By Authors.

4. What are the barriers to addressing environmental programmes in Thai public hospitals?

The barriers identified when undertaking this cross case analysis included hospital budgets, time taken to adopt and use robust environmental practices, hospital size, and human resources.. For instance, the city hospital with limited space was unable to grow large quantities of organic food materials. A lack of environmentally responsible/accredited suppliers for e.g. medical devices and food materials, were stated by all case hospitals. The insufficient knowledge, budget, technology and awareness of this practice undermined the successful adoption of such a practice. Government regulations at times also provided further obstacles for example at the governmental level, several existing regulations/policies/systems present a negative impact on GL practice and they should be reviewed and updated. For instance, the government policy regarding medical devices stated that

hospitals should: ‘increase the use of single-use medical devices’. However if applied this practice would increase the volume of waste especially plastic medical devices that require specific incineration. A better and more green proposition would be that hospitals should increase the use of multiple-use medical devices and improve the sterilisation process and quality assessment (QA) associated with recycled medical devices.

Discussion

GL adoption is a human-based system, so its implementation would be seriously compromised without full commitment from the entire organization (Martinsen and Høgebrodin 2014; McKinnon et al. 2015). Within the Thai healthcare system and more specifically hospitals, SEP must be the principal vehicle of GL adoption (see Figure 1).

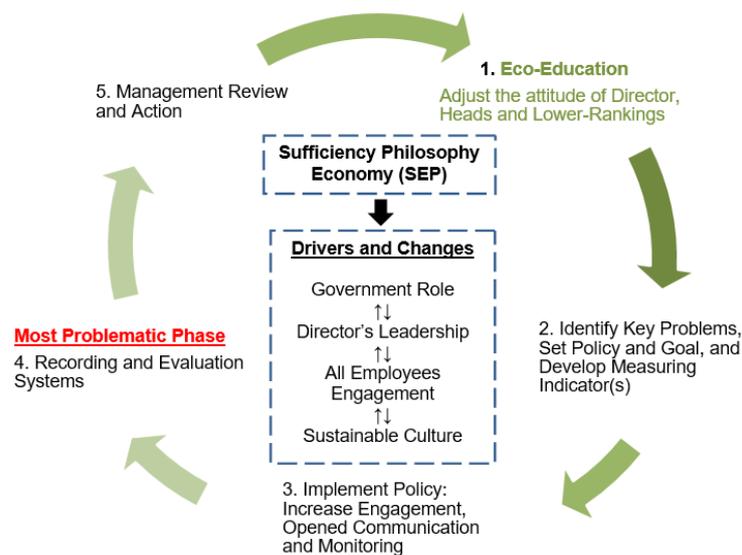


Figure 1: The recommended cycle for effectively addressing GL.

Source: Modified from US EPA (2013).

As such the involvement of all staff in the SEP strategy deployment and the delivery of GL practices is imperative to its success and longevity. The Director holds a particular pivotal role in support GL adoption and awareness of its purpose and success in Thai hospitals. At a governmental level, solving problems based on the hospital feedback should be considered. Moreover, policy development should be cooperated with a public hospital network, and ensuring the effectiveness of new system/guideline before its deployment into policy. Therefore there is a need for research to identify key areas of development for GL in Thai hospitals, to identify best practice in those areas and to include best practice to promote and implement GL best practice.

Limitations

A small respondent sample (6 case hospitals) can result in low generalizability. The researcher attempted to negate this by her extensive interview database with staffs of case hospitals, by using one-to-one interviews with all grades of hospital staff. There was limited access to some hospital documents, which can affect the accuracy of identifying best practices.

Conclusions

The study aims to identify GL practices to better control the volume of resources used and waste generated. This was achieved via a review of key logistical processes and lifecycle of resources and waste within Thai hospitals. Many green practices were revealed including reusing medical devices, producing EM sterilization liquid and embedding biogas plant. On their own they cannot successfully reduce environmental impacts, but they can contribute to increased cost savings and support the improvement of logistical operations. In addition, key findings were that green initiatives need to be supported by: sufficient environmental education; two-way communication; effective evaluation and recording systems; and Director-level support. Thus, effectively introducing and managing GL within these settings requires the coordination of all staff (clinical and other), and the consideration of all environmental impacts from product purchasing through to waste disposal. Importantly, GL adoption in the Thai context should be grounded in the Sufficiency Economy Philosophy concept (e.g. moderation, wisdom, and happiness), as well as contemporary hospital logistics theory and practice. On a final note for Thai hospitals to operate in a sustained sustainable manner, the current Hospital Accreditation and related government regulations and standards should be reviewed to determine their compatibility with and support for such sustainable development.

References

- Bandoophanit, T., Breen, L. and Barber, K. (2014a) Mapping the logistics flows of Thai public hospitals: Can resource use and waste generation be better controlled? In *Post-graduate research conference 2014*. University of Bradford, UK.
- Bandoophanit, T., Breen, L. and Barber, K. (2014b) Undertaking a holistic examination of Green Logistics theory and practice. Learning from the past and moving forward. 2014.
- Bisson, C. L., McRae, G. and Shanner, H. G. (1993) *An Ounce Of Prevention: Waste Reduction Strategies For Healthcare Facilities*. Chicago, Illinois: American Society for Healthcare Environmental Services of the American Hospital Association.
- Chin, T. A., Tat, H. H. and Sulaiman, Z. (2015) Green Supply Chain Management, Environmental Collaboration and Sustainability Performance. *Procedia CIRP* 26, 695-699.
- DOH (2012) *GREEN and CLEAN Hospitals*. <http://carbonfootprint.anamai.moph.go.th/> Accessed 05/06/2013.
- ESC (2003) *Greener Hospitals: Improving environmental performance*. Germany: <http://www.bms.com/Documents/sustainability/downloads/greenh.pdf>
- Frontex RDU (2012) *Best Practice Operational Guidelines for Automated Border Control (ABC) Systems*. European Agency for the Management of Operational Cooperation, Research and Development Unit, <https://bit.ly/2KYBXhz> Accessed 9/05/2013.
- HCWH (2011) *Global Green and Healthy Hospitals: A Comprehensive Environmental Health, Agenda for Hospitals and Health, and Systems Around the World*.
- HCWH and WHO (2011) *Global Green and Healthy Hospitals: A Comprehensive Environmental Health, Agenda for Hospitals and Health, and Systems Around the World*.
- Lapsuwansakul, K. and Kunkum, D. (2012) *Accounting Cost and Economics Cost, Thammasat University Hospital*. Thammasat University Hospital Research Project for Performance Development. <https://bit.ly/2rJGDzj>
- Manowan, V. (2009) *Awareness and management of hospital waste in developing countries: A case study in Thailand*. The George Washington University.
- Martinsen, U. and Hüge-brodin, M. (2014) Environmental practices as offerings and requirements on the logistics market. *Logistics Research* 7 (1), 1-22.
- McKinnon, A., Browne, M., Whiteing, A. and Piecyk, M. (2015) *Green logistics: Improving the environmental sustainability of logistics*. Kogan Page Publishers.
- McKinnon, A. C. (2010) *Green logistics : improving the environmental sustainability of logistics*. London: Kogan Page.
- Ministry of Foreign Affairs Thailand. (2016) *A Practical Approach toward Sustainable Development: Thailand's Sufficiency Economy Philosophy*. <https://bit.ly/2rDG0bd>

- Ministry of Public Health. (2013) *The framework of inspection and supervision: 10% Cost reduction policy*. <http://203.157.186.16/gauge/index.php>
- NESDB. (2017) **National Economic and Social Development** Office of the National Economic and Social Development Board. Bangkok: http://www.nesdb.go.th/more_news.php?cid=230&filename=index Accessed 04/07/2017.
- NHS (2013) *NHS, Public Health and Social Care Carbon Footprint 2012*. http://www.sduhealth.org.uk/documents/carbon_footprint_summary_nhs_update_2013.pdf Accessed 16/08/2015
- NHSO (2011) *The outcomes of promoting service development, the budget allocation according to quality criterion*. Accessed 17/06/2015.
- Ninlawan, C., Seksan, P., Tossapol, K. and Pilada, W. (2010) The implementation of green supply chain management practices in electronics industry. 2010. Vol. 3.
- Niyompanitpatana, T. and Bonollo, E. (2012) A Design Study of Sustainable Infectious Waste Management Systems for Small Healthcare Providers in North-Eastern Thailand. *OIDA International Journal of Sustainable Development* 4 (4), 65-76.
- Panyaping, K. and Okwumabua, B. (2006) Medical Waste Management Practices in Thailand. *Life Science Journal* 3 (2), 88-93.
- PCD (2010) *An Overview of Hazardous Waste Management & Prevention in Thailand*. <https://bit.ly/2lBzlbl> Accessed 04/06/2015.
- PCD (2013) *Report of infectious waste situation in Thailand year 2013*. Bangkok: <https://bit.ly/2rlm71S> Accessed 17/05/2015.
- Punpeng, T. (2011) *GREEN and CLEAN Hospitals Project*. Department of Health. Thailand:
- Rattanaumpawan, P. (2015) Perception, attitude and knowledge of antimicrobial resistance, appropriate antimicrobial use, and infection control among the sixth year medical students in three medical schools. *IDWeek*. San Diego, CA, USA, 2015. The Infectious Diseases Society of America (IDSA).
- Singkarin, D. (2012) *The development of the 2nd National Logistics and Supply Chain Research Strategies (2012-2016)* (รายงานยุทธศาสตร์วิจัยโลจิสติกส์แห่งชาติ (พ.ศ.2555-2557)). Bangkok: RDG5450013. http://elibrary.trf.or.th/project_content.asp?PJID=RDG5450013
- Tangpaitoon, S. (2012) *The management of electronic waste in Thailand*. <http://www.thailandindustry.com/guru/view.php?id=16560§ion=9> Accessed 21/05/2015.
- Ubeda, S., Arcelus, F. J. and Faulin, J. (2011) Green logistics at Eroski: A case study. *International Journal of Production Economics* 131 (1), 44.
- US EPA (2013) *Environmental Management Systems (EMS) and ISO 14001*. <http://www.epa.gov/EMS/> Accessed 30/03/2015.
- Voss, C., Tsiriktsis, N. and Frohlich, M. (2002) Case research in operations management. *International Journal of Operations & Production Management* 22 (2), 195-219.
- Wanichsun, G. (2012) *Review of beneficial use of resources*. <http://www.urnurse.net/ur-review-example.html> Accessed 29/05/2015.
- WHO (2012) *Overview of Wastes from Health Care Activities*. <http://webcache.googleusercontent.com/search?q=cache:SE00BsW-eCAJ:www.unep.org/ietc/Portals/136/Events/HealthcareWasteWorkshop-July2012/1-Wilburn.ppt+&cd=3&hl=en&ct=clnk&gl=uk> Accessed 07/03/2015.
- WHO and HCWH (2009) *Healthy hospitals, healthy planet, healthy people: Addressing climate change in healthcare settings*. World Health Organization. http://www.who.int/globalchange/publications/healthcare_settings/en/
- Xie, Y. and Breen, L. (2012) Greening community pharmaceutical supply chain in UK: a cross boundary approach. *Supply Chain Management* 17 (1), 40-53.