Green Healthcare

The Ecological Footprint of Lions Gate Hospital

Susan Germain

The first-ever Ecological Footprint of a hospital was carried out in the summer of 2001 in North Vancouver, British Columbia. Although there has been growing concern in recent years that the healthcare system in Canada might be adversely affecting the environment (and, therefore, potentially affecting human health), there have been few analyses of its environmental impact. Lions Gate Hospital bravely agreed to participate in this study and have its footprint calculated, despite the probability that it would be inordinately large. This displays real leadership, reflecting very positively on the hospital's commitment to becoming more environmentally responsible and its willingness to open up to scrutiny. The study was commissioned by the Canadian Association of Physicians for the Environment (CAPE), on behalf of the Canadian Coalition for Green Health Care, as a way to begin to quantify the environmental effects of a hospital as a first step in decreasing healthcare's environmental impact.

Canadians are beginning to question the effects of our actions on the environment and, conversely, the effects of a polluted or degraded environment on human health. As it accounts for about 10% of Canada's GDP (CAPE 2000), the healthcare sector itself is a significant user of energy and producer of wastes discharged into the environment. This raises a critical issue regarding the ultimate function of the health sector: Is it appropriate for a system that offers healing at the individual level to be creating or contributing to ill health at the community or ecosystem level? It has been argued that "the health care system has an ethical duty to do no harm to health" (Hancock 2001).

Some of the potential adverse effects of the healthcare sector on the environment include production of greenhouse gases from energy production, high levels of resource use and release of toxins such as mercury and some pharmaceuticals into the environment (CAPE 2000). As well, the widespread use of polyvinyl chloride (PVC) in hospitals results in the production of dioxins when medical wastes are incinerated, while the plasticizers present in these items are known to be endocrine disruptors (Sustainable Hospitals Project 1998).

What Is an Ecological Footprint?

The method chosen to analyze the environmental impacts of a hospital in this study was the Ecological Footprint (EF). This method was developed at the University of British Columbia by Dr. William Rees and his graduate student Mathis Wackernagel as a way of quantifying the sustainability of populations (Wackernagel and Rees 1996.). Essentially, an EF is the "total area of productive land and water required on a continuous basis to produce the resources consumed and to assimilate the wastes produced by a specified population, wherever on Earth that land is located" (Rees 2000), or more simply, "an area-based measure of the population's demand for goods and services" (Rees 2000).

This method has been used to determine the footprints of countries, communities and specific behaviours and activities. The average Canadian EF in 1996 was 7.66 hectares (ha) per

person (and 12.2 hectares per capita for the United States), even though there is on average only 2.18 ha per person of available biocapacity on Earth ("Living Planet Report 2000," World Wide Fund for Nature, at www.panda.org). The larger footprint illustrates that North American lifestyles are not sustainable and leads to the disturbing conclusion that if everyone on Earth lived as North Americans do we would need another three to five Earths to accommodate our resource use. [Further information is available at www.rprogress.org, which includes an individual footprint calculator as well as the latest (1997 data) report on the footprint of nations.]

Overview of Lions Gate Hospital

Lions Gate Hospital (LGH) is located in North Vancouver. The North Shore Health Region, in which LGH is the only hospital, was recently ranked first in Canada for the second year in a row by *Maclean's* magazine in its "Where We Get the Best Health Care" Health Report (Marshall 2001).

One of the reasons this hospital was chosen for study was its staff's interest in environmental issues, despite the fact that the hospital itself has no formal environmental policy. Many of the staff have made a commitment to recycling and other environmentally friendly practices. A waste audit in 1997 revealed that the hospital had met its goal of a 5% decrease in general and biohazardous waste. As well, LGH intends to decrease the amount of energy it uses and is currently working with B.C. Hydro to find ways to achieve this goal. Recently, some of the staff have successfully negotiated for the building of a novel waste treatment facility that uses micro-organisms rather than incineration for biohazardous wastes.

During the study period, an average of 591 patients were hospitalized per day, of which approximately 280 were extended care residents and the remainder were on acute care wards.

Methods

The project was carried out between June and August 2001 by the author, using hospital information for the period April 2000 to March 2001. An EF is usually composed of three categories of information: energy use, the goods and services required for ongoing operations and the materials used in the original construction of permanent structures, such as buildings. In this study, an effort to include the footprint generated by the incineration of medical wastes was also made.

Energy, Health and Healthcare

Trevor Hancock

In her article on the ecological footprint of Lions Gate Hospital in Vancouver, Susan Germain notes that a very significant part of this footprint is due to energy use. This serves to highlight the importance of energy use in healthcare, both because of the environmental and human health impacts of that energy use and because of the potential economic benefits that can result from improved energy efficiency – benefits that can be ploughed back into improved patient care.

It is hardly surprising that hospitals are energy intensive operations. They maintain comfortable temperatures in large buildings that operate around the clock and they use a lot of energy-intensive equipment. In announcing the first hospitals in the United States to earn the Energy Star label, EPA administrator Christie Whitman noted, "Hospitals use more than twice as much energy per square foot as office buildings" (www.epa.gov/epahome/headline2_111601.htm). However, an international comparison of energy use in hospitals (CADDET 1997) found that Canadian hospitals are much more energy-intensive than European hospitals, with electricity consumption "almost six times higher than Switzerland and 2.5 times higher than the average," and thermal energy consumption approximately four times that of Sweden and almost twice the average of the nine countries.

All energy use has health impacts, particularly if the primary fuel for space heating, electricity generation or other uses is fossil fuel. The major health impacts result from local air pollution (particulate matter, acid emissions, heavy metals, among others) and carbon dioxide emissions that contribute to global warming and its attendant health impacts. On ethical grounds alone, healthcare facilities have a duty to reduce such impacts. The added incentive is that increasing energy efficiency can result in cost savings. Some examples from Ontario:

- Norfolk General Hospital, winner of the OHA/Canadian Coalition for Green Health Care "Green Health Care Award" for energy conservation, has decreased its overall energy budget 22%, with savings of at least $132,000 per year, every year since 1995. Among other things it has replaced its three boilers and its cooling tower with smaller, more energy efficient versions; used more efficient motors, fans, pumps and lighting; improved roof insulation and lowered the temperature of supply air in the winter and increased it in the summer, without adversely affecting staff and patient comfort levels.
- Orillia Soldiers' Memorial Hospital has operated a natural gas

powered co-generation plant since 1991. The plant supplies 90% of the hospital's electrical power, while providing hot water and steam for the building. The hospital is now licensed to sell surplus power to the Ontario electric grid. The payback time for this plant was five to six years, and annual savings are over $200,000.
- Pembroke General Hospital entered into an energy performance contract with Honeywell and implemented a number of other energy conservation measures, with the result that gas consumption fell by almost 50% between 1993 and 2000, even though the building size increased by almost 30% and the patient load increased by over 45%.

Many other examples from across the country can be found at the Canadian College of Health Service Executives' "Energy Innovators Program" (www.cchse.org/oee1page.htm). This program provides access to information, education, consultation and funding (up to $250,000 in incentives) available through the Office of Energy Efficiency at Natural Resources Canada. However, it is a sad reflection that only 100 or so of the roughly 1,100 hospitals across Canada are currently members of this program.

If the health, economic and healthcare benefits of energy conservation are to be realized, at least two things have to happen:
- Facilities management in general, and energy efficiency in particular, must be seen as a vital component of quality patient care and responsible management of public funds. For those same reasons, energy efficiency should be an essential component of hospital accreditation.
- `Provincial ministries of health need to become proactive in requiring health facilities to be as energy efficient as possible. This includes provision of enhanced capital funding to enable health facilities to invest in energy-efficient construction and equipment. It also means ensuring that some of the savings are retained by the hospital to enhance patient care or working conditions, both during the payback period and afterwards, ensuring an incentive for good environmental citizenship.

By focusing on energy conservation, healthcare facilities can improve patient care, staff working conditions, air quality in their local communities and reduce greenhouse emissions and global warming. Not a bad bargain! HQ

References/Resources

CADDET (1997) *Saving Energy with Energy Efficiency in Hospitals* Sittard, The Netherlands: Centre for the Analysis and Dissemination of Demonstrated Energy Technologies

The Canadian Coalition for Green Health Care has recently released two reports that will shortly be available on their website (www.greenhealthcare.ca). "Doing Less Harm" is a comprehensive overview of green healthcare issues, the other – "Going Green" – is a series of ten case studies of different aspects of environmentally responsible healthcare in Ontario.

Dr. Trevor Hancock is a public health physician and health promotion consultant, Chair of the Board of the Canadian Association of Physicians for the Environment, and one of the founders for the Canadian Coalition for Green Health Care.

The amount of hydroelectricity, natural gas, oil and diesel fuel used by LGH in the study year was determined from hospital records. It is difficult, if not impossible, to estimate how much land was required to produce the energy used, such as the fossil fuels that were formed millions of years ago. Instead, there are two different methods that could be used: the first is to derive the land area that would be required to produce the same amount of energy from a renewable fuel source, such as ethanol from grains. The second method is to determine the area of forest that would be required to completely assimilate the carbon dioxide (CO_2) released during production and combustion of the fuel (assuming that in order to be sustainable, humans cannot continue to increase the CO_2 levels in the atmosphere). Most EF analyses use the latter method, as it results in a more conservative figure.

To determine the materials component of the EF, the author had to quantify all of the goods entering the hospital. The purchase orders of the goods brought into the hospital through Stores were used to classify the goods into one of six categories: paper, plastics and synthetics, latex, metal, glass and cotton. The agricultural land area required to grow natural products or the amount of CO_2 produced during the manufacturing of synthetic materials was determined from the literature. The agricultural land area was then used directly in the computation of the footprint, while the CO_2 was converted to a land area, again using the assimilative capacity of ecosystems.

As most of the buildings were more than 30 years old, the EF of the construction materials could not be calculated from original data. Instead, conversion factors from the Green Building Challenge (Cole 2001) were used together with the floor area of the hospital to calculate the CO_2 resulting from the production of the construction materials. This footprint was then amortized over 30 years, the estimated life expectancy of similarly constructed buildings.

The CO_2 produced from the incineration of biohazardous waste was calculated from the weight of the waste and the

presumed molecular formula of the burned materials. It should be noted, however, that the main health concern surrounding the incineration of medical wastes is not the CO_2 produced, but the dioxins, methyl mercury and other toxins produced from incomplete incineration. The overall EF was then determined by summing the energy, material, incineration and construction footprints.

The Footprint

The total Ecological Footprint of LGH was found to be 2,841 hectares (ha), or 4.9 ha/patient-year. This corresponds to a land area about 719 times larger than its actual area of 3.95 ha. This can be compared to the footprint calculated for the City of Vancouver, which was found to be about 180 times its actual area (Rees 2000), thus illustrating how resource intensive hospitals are, and in what an unsustainable manner they are operating – as, to be fair, are we all. As well, the calculated footprint of Vancouver included many elements that were not available for the calculation of the LGH footprint; had they been available, the hospital footprint would have been even larger.

Other Conclusions

1. *The EF was necessarily a significant underestimate*. EF analyses are designed to err towards more conservative results, or an underestimate. As an example, the method to determine the energy footprint that was described in the methods is an underestimate. It should be noted that the main waste that is considered in this type of analysis is CO_2: other land areas required to dispose of waste are not included, as the land needed for landfill, for example, is small in relation to the CO_2 footprint.

   In this study in particular, the materials footprint was quite incomplete for a number of reasons, as noted below. As well, certain measures that would normally form part of an EF would have been too complex to include in this study, such as determining the food in the hospital that went to patients rather than staff or visitors, and the amount of transportation energy attributed to the institution and its patients.

2. The materials portion of the EF presented the biggest challenge in carrying out the analysis. To begin with, there were well over a thousand purchase orders per month, entered into the computer with cryptic abbreviations that revealed little of their actual composition or weight. Also, many of the goods entering the hospital, including almost all of the products destined for the Operating Room (OR), the pharmacy and the kitchen, as well as medical equipment, furniture and linen, are not channelled through Stores and therefore were not recorded on the purchase orders. In addition, none of the companies contacted for information about their products and the packaging used (with the exception of 3M) were willing to provide any information: all cited proprietary concerns.

   Despite these shortcomings, the data that was collected for the materials footprint was interesting. Table 1 illustrates some of the quantities and weights of medical supplies bought in the year studied:
   - 1,767,900 pairs of gloves were used, contributing over 6.5 tonnes of paper, 7.8 tonnes of latex and 21 tonnes of plastics to the waste stream. Of these gloves, only 26,150 pairs were sterile, while a further 648 pairs were "household gloves." This leaves 1,741,102 pairs of gloves that were not sterile, presumably used for patient care.
   - 135,092 adult disposable diapers and 31,440 disposable incontinence pads were used in this time period. If it is assumed that most of the diapers are used for inpatients (the same assumption is not necessarily true for the incontinence pads), this number corresponds to the use of one diaper each day for two of every three patients. The use of these diapers and pads contributed almost 58 tonnes of materials to the waste flow.
   - Over 6.4 tonnes of sterilization wrap (the polypropylene material used to wrap clean instruments for autoclaving) was used. Some of the OR staff, concerned by the volume of uncontaminated single-use wrap being discarded, have been saving it until they can find someone to recycle it. To date, they have not been successful.

3. *The EF technique does not address the issue of toxics.* The only waste product considered in the EF technique is CO_2. Thus, the environmental impacts of potentially toxic materials in the waste flow are not considered. This includes medications, both discarded and excreted, cleaning materials and other wastes. There is currently no technique used to quantify environmental impacts that includes this evaluation.

4. *LGH has a large energy footprint.*
   The energy portion of the EF was calculated to be 2,493 ha, or 85% of the total footprint. Previous EF analyses have found that energy accounted for about 50% of the total (Rees 2001). While this is in part due to the incomplete materials footprint, it also identifies energy use in the hospital as an area of significant environmental impact. It should be noted that most of the energy used at LGH was derived either from hydro or natural gas: if the same energy had been used in another area of Canada where, for example, oil or coal is used to generate electricity, the EF would have been significantly higher.

TABLE 1: Numbers and Weights of Some Items Purchased by LGH from April 2000 to March 2001

Item	Number of Items	Paper	Synthetics	Latex	Metal	Total Weight
Gloves	3,535,800 (1,767,900 prs)	6,650.4 kg	21,080.4 kg	7,851.9 kg		35,583 kg
Injection and Irrigation Solutions (not incl. H_2O)	35,794.2 L (Inj) + 12,487.2 L (Irrig)	6,662.1 kg	17,632.3 kg			24,294 kg
Diapers, Incontinence Products	Children: 20,880 Adult: 405,276 Incont. Pads: 94,320	31,799.9 kg	25,920.7 kg			57,721 kg
Disposable Surgical Drapes		2,002.3 kg	13,504.1 kg			15,506 kg
Sterilization Wrap		860.5 kg	6,462.7 kg			7,323 kg
Paper, Books, Brochures		95,977.5 kg				95,977 kg
Paper Cups and Plates		5,205.0 kg				5,205 kg
Plastic Cups, Lids, Cutlery, Dishes		1,926.3 kg	8,898.9 kg			10,825 kg
Toilet Paper, Tissues, Paper Towels		42,945.6 kg				42,946 kg
Paper X-Ray Pouches		5,832.0 kg				5,832 kg
Plastic Bags		927.6 kg	14,181.8 kg			15,109 kg
Sharps Containers		63.7 kg	3,224.5 kg			3,288 kg
Skin Staplers 35mm	2,094	90.0 kg	420.9 kg			511 kg
Needles, Syringes		1,460.1 kg	4,753.3 kg		86.5 kg	6,300 kg
Tongue Depressors		1,366.5 kg				1,367 kg
Preassembled Trays	51,072 trays (49,572 included in weights)	2,057.1 kg	4,262.9 kg			6,320 kg
Sutures	27,640.5 metres					
Alcohols	3,705 L					
Peri-Care Cleanser	5,178 L					
Phenokil	13,296 L					

How Can (and Why Should) Hospitals Be More Environmentally Responsible?

If hospitals, and healthcare processes and institutions in general, are to avoid causing ecosystem disruption, adverse human health impacts and gross wastage of energy and materials, what steps must we take, and why? Following are some thoughts gleaned from the experience of doing the EF study:

1. *Do your own footprint.* An ecological footprint is a useful tool to illustrate the environmental impact of your hospital. It can be compared to the EF of LGH, or you can calculate your EF at different times to determine the effects of environmental initiatives at your facility.

2. *Do just your energy footprint.* Because of the complexity of calculating the materials footprint, some facilities might consider calculating only the energy footprint, as the latter is relatively easy to derive. The energy footprint comprised 85% of the total footprint at LGH, indicating that energy use is an important place to make changes to bring about significant environmental benefits.

   Energy use by hospitals is gaining increasing attention. Recently, the EPA in the United States stated: "Hospitals use more than twice as much energy per square foot as office buildings. In total, hospitals consume almost 50 billion kilowatt hours of electricity and spend close to $3 billion each year on electricity alone. If hospitals improved their energy efficiency by an average of 30 percent, the annual electricity bill savings would be nearly $1 billion and 11 million fewer tons of carbon dioxide would be emitted – equivalent to taking 2 million cars off the road " (EPA 2001).

3. *Develop an Environmental Mission Statement for your institution.* As some of the participants in the ISO 14001 certification of Cambridge Memorial Hospital described in a recent *Hospital Quarterly* article (Wright et al. 2001), it is difficult to attain significant change with the efforts of only a few individuals. It is important for the staff to feel that the entire organization is committed to minimizing their institution's impacts. An environmental mission statement details the principles that will govern the operations of an institution, from the purchasing of goods through to waste disposal.

4. *Organize your records.* It is not possible to determine the environmental effects of operations at a healthcare facility if you don't know the extent of the problem. When a business applies for ISO 14001 certification, appropriate record-keeping is one of the prerequisites for success for precisely this reason. In the case of LGH, there was no centralized system for determining all of the goods entering LGH: the purchasing details were spread through many departments

of the hospital. It was sometimes frustrating to discover that different departments didn't know about one another's activities, and that the whereabouts of the records of interest were unknown. As well, as is done by most businesses, goods and wastes were characterized only by price, and not by a measure that could quantify environmental impact, such as packaging or weight. Finally, records concerning waste contracts were poorly organized, and many months of data were missing from these files. Given that hospitals throughout Canada are short-staffed, this state of affairs is undoubtedly not unique to LGH.

5. *Demand better service from medical suppliers.* As noted above, one of the obstacles in determining the precise materials entering LGH was the refusal of companies to supply information regarding packaging and the actual composition of their products. If many institutions express their interest in this information, and organize their purchasing to promote it, manufacturers will be more inclined to reveal this important information.

6. *Include environmental objectives when renovating or building new additions to your institution.* The construction footprint for this study was calculated to be 144 ha; while this was not as significant as the energy use, it still represents a large burden on the ecosystem. There are a number of "Green Building" initiatives in Canada that can help healthcare institutions save money and protect the environment by careful advance planning when designing new buildings.

7. *Learn more about the environmental impacts of your facility and how to avoid them. Doing Less Harm: Assessing and Reducing the Environmental Impact of Canada's Health Care System*, prepared for the Canadian Coalition for Green Health Care, is a publication that includes much of this information along with references (Hancock 2001). The Internet also allows research on the available alternatives and the experiences of other facilities.

8. *It can save you money.* There are both federal and provincial programs in place to encourage healthcare facilities to decrease energy use and increase savings, such as CCHSE and NRCan's "Energy Innovators Initiative" (www.cchse.org and http://oee.nrcan.gc.ca). As well, reusing and recycling can decrease costs and generate income. Buying materials with less packaging and producing less waste decreases hauling fees and the costs of incineration. Finally, some of the environmentally friendly alternatives, while involving higher capital costs, are far cheaper in the long run.

9. *It is the right thing to do.* Hospitals and other healthcare institutions must not be settings that generate harm, either to the ecosystem or directly to humans (the two are, in any case, essentially inseparable). We who work in the healthcare sector must face and then act on the fact that the luxury of ignorance is fast dissipating; we already know too much about the toxins and waste stream we generate, and about the energy we use in prodigious quantities. It is time to *do* something. HQ

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About the Author

Susan Germain, BScH, DipEnvSci, MD, is a General Practitioner who has practiced in British Columbia for eight years. Last year, she returned to school for a diploma in Environmental Science; she carried out the EF analysis with Dr. William Rees (the originator of the method) as part of her degree requirements. Dr. Germain has an interest in issues that involve the environment and human health and is currently working on a project to enable communities to be proactive in the protection of their drinking water. She also serves on the Board of Directors of CAPE and the Environmental Health Committee of the B.C. Medical Association.