

**Healthy Hospitals:
Environmental Improvements
Through Environmental Accounting**

**Submitted to:
US Environmental Protection Agency
Office of Prevention, Pesticides
and Toxic Substances**

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Resource and Environmental Strategies

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All opinions expressed herein are those of the authors. Any errors of fact or interpretation are the sole responsibility of the authors.

Discussion of or reference to particular hospitals and health care organizations in no way implies endorsement of these institutions by or their environmental practices by US EPA.

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1. Introduction

Health care is increasingly recognized as a material- and resource-intensive service activity. This is particularly true of hospitals. Open 24 hours a day, 365 days a year, hospitals also function as offices, photographic laboratories, commercial laundries, lodging establishments, food service providers — and, in many cases, as energy generators and waste treatment enterprises. Each of these activities demands the mobilization of resources and generates a set of characteristic waste streams.

Hospitals in the US produce approximately 2 million tons of solid waste each year — about 1 percent of the US municipal solid waste stream, or approximately 15 pounds per patient per day.¹ About 85 percent of this amount is commercial waste (e.g., food, paper and plastic). The remainder is largely “red-bag” waste — waste composed of body tissues, or materials contaminated with blood, body fluids or cultures, and considered potentially infectious. Hospitals also generate a small volume — but complex mix — of hazardous waste.

Waste generation rates for the sector have nearly doubled since 1955, due at least in part to increasing use of disposable products. Waste disposal costs per unit have escalated, and promise to continue to do so. Construction requirements for new landfills (e.g., double liners), more stringent siting requirements, community resistance and closure of existing fills all serve to increase landfill fees and transport costs. Incinerator regulations are requiring expensive retrofits of existing units, or their closure altogether. Further, medical waste has become a contentious and sensitive political issue — the simple acceptance of medical waste by a landfill or incinerator often engenders substantial local resistance. The operations of medical incinerators are similarly controversial.

These factors have served to increase awareness on the part of health care providers of the waste streams generated by their activities, and their environmental impacts. Waste minimization and toxics use reduction are preferred responses — both from a business and community relations perspective, and because a profession whose first charge is to “do no harm” is increasingly aware that this responsibility must extend to the environmental impacts of its activities.

1.1. Mercury — a key area for improvement

The environmental and public health impacts of mercury use by the health care sector constitute a particularly clear case for redress via waste minimization and toxics use reduction approaches. The healthcare industry is recognized as a significant source of mercury in the environment. Mercury is a persistent, bioaccumulative pollutant with toxic and developmental effects on wildlife and humans.

Historically, mercury-containing products have abounded in hospitals, ranging from thermometers, sphygmomanometers (blood pressure measurement devices) and fluorescent bulbs, to laboratory chemicals and lesser known sources such as bleach. MASCO (Medical Academic and Scientific Community Organization, Inc.), an organization servicing several Boston area hospitals and research

¹ Environmental Working Group/Health Care Without Harm. “Greening” Hospitals: An Analysis of Pollution Prevention in America’s Top Hospitals, 1998.

institutions, has compiled an electronic database of over 5,000 products used by hospitals and institutions. Approximately 780 products thus far have been confirmed to contain some level of mercury.

The incineration of mercury-containing products makes medical waste incinerators a significant source of atmospheric mercury emissions. Disposal of mercury-containing products in the sewage stream results in mercury wastewater plant discharges to rivers and streams. Regardless of whether mercury enters water bodies directly or indirectly (i.e., through atmospheric deposition), once released, it bioaccumulates in the food chain. Neurological development may be impaired in children consuming mercury contaminated fish, as well as in fetuses exposed through the mothers' consumption of contaminated fish. Mercury is the most frequent cause of fish consumption advisories in the U.S. – forty states have issued fish advisories for one or more bodies of water, while nine states have issued state-wide advisories.²

1.2. EPA-AHA waste minimization agreement

It seems clear that waste minimization and toxic use reduction opportunities do exist in the health care sector. Mercury-free alternatives to many products and instruments exist, and experience in other sectors indicates that many more are technically feasible. Because the largest portion of a hospital's waste is commercial waste — paper and paperboard, plastics, metals, and glass — numerous opportunities *should* exist for reducing and recycling this component of a hospital's waste stream. The success of individual institutions in implementing mercury and solid waste reduction efforts testifies to this sector-wide potential (sidebar).

To achieve this potential, health care organizations must bring to bear a set of waste minimization and toxics use reduction tools and concepts that are relatively new to the sector. And they must change practices and find product alternatives in an environment highly constrained by regulations and cost control pressures — and, most importantly, without compromising patient care.

Recognizing both (1) the potential for waste and mercury minimization; and (2) the potential of a public-private partnership to facilitate learning, overcome barriers and make necessary tools available, the US EPA Office of Prevention, Pesticides and Toxics (OPPT) and the American Hospital Association (AHA) signed a Memorandum of Understanding (MOU) in June 1998. The MOU established two key goals:

- virtual elimination of mercury-containing waste from the health care industry waste stream by the year 2005, and
- reduction in the total waste generated by hospitals by 33% by 2005 and 50% by 2010.

Institutional success stories: Waste and toxics reduction

- Thomas Jefferson University Hospital in Philadelphia realized savings of \$150,000 per year in avoided landfill costs through aggressive waste recycling and reduction efforts.³
- Kaiser Permanente estimates it saved \$550,000 over 10 years by replacing mercury-containing thermometers and sphygmomanometers with mercury-free alternatives (see Appendix B).

² U.S. Environmental Protection Agency Region 1. *The EPA Mercury Challenge Pocketbook*.

³ Environmental Working Group/Health Care Without Harm, 1998.

Through joint efforts under the MOU, EPA and AHA are developing virtual elimination plans for mercury waste, a model waste volume reduction plan, compiling pollution prevention (P2) information for the health care industry, and making recommendations to AHA on educational and outreach activities to facilitate waste minimization goals.

To support member institutions in achieving these goals, 12 workgroups were established. These included an Environmentally Preferable Purchasing (EPP) workgroup to explore opportunities for introducing environmental criteria into purchasing decisions and an Environmental Accounting (EA) workgroup, whose chief aim is identifying and reducing the cost of waste.

1.3. Environmental accounting (EA)

Environmental accounting (EA) is a broad-based term that refers to the incorporation of environmental costs and information into a variety of accounting practices.⁴ As shown in Figure 1, at the macroeconomic level, environmental accounting may account for the flow of renewable and non-renewable resources through a region (natural resource accounting) or the flow of goods and services through an economy (national income accounting).

On a different scale – microeconomic, or organization/firm level – EA is applicable to two accounting frameworks: financial accounting and managerial accounting. Financial accounting provides information about a firm or organization’s financial condition to an *external* audience (e.g., shareholders). Reporting requirements are governed by rules set by the U.S. Securities and Exchange Commission (SEC) and Financial Accounting Standards Board (FASB), which includes requirements for disclosure of environmental liabilities and certain environmental costs.

Managerial accounting provides information to *internal* decision-makers in support of various internal management decisions. This application of EA (also known as environmental managerial accounting) is the focus of this report. Unlike financial accounting, disclosure of managerial accounting information to an external audience is totally discretionary and practices are not regulated. As a result, the extent to which environmental costs are incorporated into managerial accounting varies widely between organizations, and even between different divisions of the same firm or organization.

Information necessary for managerial accounting may include both material flows through a facility (materials accounting) as well as costs (cost accounting), including environmental costs. Meaningful cost accounting rests on accurate materials accounting – that is, accounting for the flow of materials and

Key Terms:

Environmental accounting (EA) refers to the incorporation of environmental cost and benefit information into a variety of accounting practices. This report focuses on one particular practice – managerial accounting.

Environmental costs are impacts, both monetary and non-monetary, incurred by a firm or organization resulting from activities affecting environmental quality. These costs include conventional costs, potentially hidden costs, and less tangible costs.

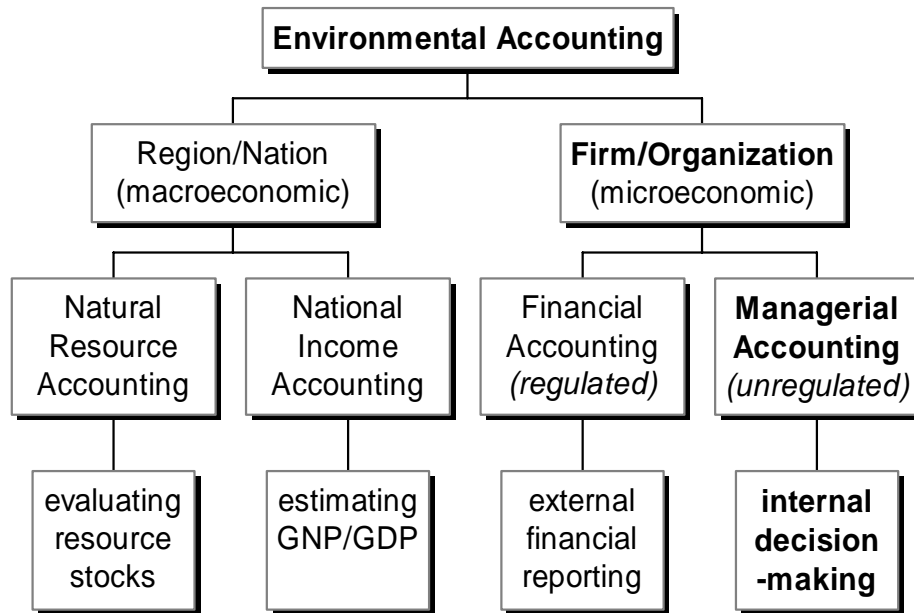
Life cycle of a product is the series of stages spanning the product's useful life from acquisition, use, reuse, and final disposition.

Life cycle costs are the costs accrued throughout the life cycle stages of a product.

⁴ For further information, see U.S. EPA *An Introduction to Environmental Accounting as a Business Management Tool: Key Concepts and Terms* (EPA 742-R-95-001), 1995.

resources through a product, process, or activity. To quantify the cost of waste disposal for a particular department (cost accounting), for example, one needs to know how much waste is generated by that department (materials accounting).

Figure 1: Accounting Frameworks



What is an environmental cost?

Environmental costs are impacts, both monetary and non-monetary incurred by a firm or organization resulting from activities affecting environmental quality.⁵ These costs include conventional costs such as buildings, equipment, materials, labor, and utilities, as well as potentially hidden (these costs are typically assigned to overhead accounts) and less tangible costs (costs that may be more difficult to measure because they are contingent, e.g., potential future liability, or are difficult to quantify, e.g., corporate image). Examples of costs in these latter two categories are shown in Table 1.

⁵ Graff, R.G., et al. *Snapshots of Environmental Cost Accounting*, prepared for US EPA OPPT, 1998.

Table 1: Examples of Potentially Hidden and Less Tangible Costs

Potentially Hidden Costs	Less Tangible Costs
Up-front: site preparation, permitting, installation	Liability: Superfund, personal injury, property damage
Back-end: site closure, disposal of inventory, post-closure care	Future regulatory compliance costs
Regulatory: training, monitoring, recordkeeping	Employee safety and health compensation
	Organizational image

Thus, for hospitals, environmental costs may include costs of disposal, personal protective equipment necessitated by product toxicity, or staff compliance training and spill kits. They may also include a set of contingent costs — e.g., environmental liability, or the costs of incident response and follow-up treatment, such as those resulting from mercury exposure. Environmental costs are in many cases driven by regulation — for example, disposal costs of a certain product may be high because regulations specify that the product must be disposed of in a particular way.

How can EA support decision-making in hospitals?

EA has emerged as a useful approach for internal decision-making. Effective business management depends on an accurate understanding of an organization’s cost structure, not simply of its revenues. EA provides a better understanding of the true costs of many aspects of business operations. Sound business management undertakes to control and minimize costs where possible. Where “costs” include explicit environmental costs, cost reduction efforts will tend to reduce as well the environmental impacts represented by environmental costs. EA is thus an approach for environmental performance improvement in businesses and organizations.

The utility of EA for business decision-making in manufacturing industrial sectors has been well-demonstrated. Identifying environmental costs assists decisions regarding product and process design, material use, capital investments, for example. However, to date, EA applications in the service sector have been limited.

The health care sector has a distinct social mission — healing and preventing illness. But health care institutions, whether for-profit or non-profit, are also businesses. Further, they are businesses under severe pressure to control costs, and often constrained as to their ability to raise revenues. In this context, environmental accounting would seem to have significant potential for identifying and controlling costs while simultaneously focusing decision-making on environmentally preferable outcomes.

EA can support improved decision-making in hospitals in at least three types of applications:

- 1. Capital budgeting.** Capital budgeting is the process of analyzing alternative investments and deciding which investment(s) to pursue using standard financial benchmarks (such as return on investment, payback period, and internal rate of return) that consider the stream of revenues and costs generated over the life time of the investment. By including environmental costs in capital budgeting decisions, especially for environmental projects or projects with sizeable environmental

ramifications, hospitals can evaluate investments in a manner that more accurately reflects their potential profitability.

- 2. Product selection.** Hospitals routinely make decisions about which products to procure based upon their cost. These costs include not only the initial acquisition fee, but also costs incurred for using and disposing of the product at the end of its useful life. Identifying environmental costs associated with the life cycle of a product – acquisition (e.g., disposal of bulk packaging) use/reuse (e.g., personal protective equipment) and disposal (e.g., incineration) – can assist materials managers in selecting products with the lowest life cycle costs, i.e., the costs accrued throughout the life cycle stages of a product.
- 3. Waste management.** Hospitals generate large quantities of waste whose treatment and disposal options are dictated by the waste stream’s composition. Because disposal costs *are* environmental costs, attempts to minimize these costs can benefit from environmental accounting. Additionally, by allocating, or tracking waste management costs back to the products or activities generating waste, managers can make more informed decisions about the products they procure or the activities they undertake.

EA in the latter two applications — product procurement and waste management decisions — are the focus of this report.

1.4. Goals of this study

For the reasons discussed above, EA was identified as a potentially useful approach within the EPA-AHA MOU for identifying opportunities for waste and toxics reduction in hospitals. Such investigation is a prerequisite to potential adaptation or development of specific EA resources and tools for the health care context. The EA workgroup under the EPA-AHA agreement was formed to advance these ends.

With funding from US EPA OPPT, Tellus Institute has collaborated with the Environmentally Preferable Purchasing and EA workgroups formed under the EPA-AHA agreement. The primary goals of this collaboration were two-fold:

- (1) to examine current environmental accounting (EA) practices in the health care industry, with a particular focus on hospitals, and
- (2) explore whether EA is a useful approach for uncovering waste minimization opportunities, including opportunities for influencing upstream procurement practices and supply chain issues in general.

In addressing these two goals, considerable attention was devoted to describing hospital procurement and waste-management systems and decision-making. This effort was made for two reasons:

- EA concepts must be applied within the context of hospital procurement and waste-management systems and decision-making. Barriers and opportunities for EA are tied directly to this institutional context.
- We sought to create a resource establishing a common reference point for (1) health care professionals attempting to introduce EA concepts to their institutions, and (2) environmental agency staff attempting to translate EA concepts into an unfamiliar institutional environment.

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Clear explanations and illustrations of procurement and waste management in the hospital context are a central part of building such common ground.

Consistent with our resource-provision approach, the study focuses on illustrations and examples. The purchasing and waste management profiles of nine hospitals/hospital networks are provided. The application of EA principles in two areas — mercury minimization and ethylene oxide (EtO) sterilant elimination — is illustrated in two case studies.

In addition, we sought to provide insights into application of EA in the broader service sector. To date, EA has been little applied in the service sector. As the economic and environmental importance of service sector activities continues to grow, however, delivering tools to improve the sector's environmental performance will become increasingly important. This examination of EA in one part of the services sector is a step in this direction.

2. Methodology

By design, this study was a preliminary inquiry into the potential and practice of EA in hospitals, with a particular focus on the barriers to and opportunities for EA created by regulatory and institutional context. The study focused on practices in a limited number of hospitals; it was not intended to be a comprehensive or benchmarking study of EA as practiced in the health care sector. In support of the study goals enumerated in the previous section, the research process was as follows:

- Tellus developed a questionnaire to guide discussions with materials/purchasing managers and environmental staff at nine hospitals (Appendix C). The questionnaire was reviewed by the EPP and EA work groups. The questionnaire focused on an overview of purchasing practices, any environmental criteria used in purchasing, costs considered in purchasing decisions, what waste streams are generated, how waste is tracked, and what waste disposal and treatment costs are tracked and allocated.
- Tellus conducted phone interviews with materials managers and environmental staff at nine hospitals. Hospital candidates and contacts were solicited from the EA and EPP workgroups and other project contacts. Note that since a benchmarking study was not part of the research plan, we cannot determine whether these hospitals represent “best practices.” Selection bias is likely to favor hospitals with practices superior to the sector norm. A purchasing and waste management profile of each hospital was generated from the interview (Appendix A).
- Information from the interviews was used to characterize the means by which hospitals and hospital networks make purchasing and waste management decisions, with particular attention to the functions involved, and the types of costs and factors considered. The extent of EA practice and the source of EA barriers and opportunities were assessed.
- Working in collaboration with two institutions, we conducted two case studies illustrating the application of EA concepts in the areas of mercury minimization and EtO elimination.

3. Advancing Environmentally Preferable Purchasing through EA

3.1. Overview of purchasing practices

In a typical hospital, the majority of purchasing is centralized. Like a human resources department, the purchasing or material management department is a centralized administrative function serving the medical and non-medical departments in the hospital. The department acts to turn material requisitions generated in the various departments into purchase orders placed with vendors and suppliers. For healthcare providers operating multiple hospitals and facilities, purchasing tends to be at least partially centralized across the system.

Some hospital departments commonly operate outside the centralized purchasing system. Pharmacy departments, for example, often conduct their own purchasing, as purchasing must be conducted by a registered pharmacist. The food service division of a hospital also frequently self-procures, as dieticians often must make technical decisions specific to the department. (Note that food services and housekeeping are often outsourced. In this case, the service provider will typically have its own source of supply.) Because the facilities department requires unique products, it too typically procures its own supplies.

Interactions with vendors

The purchasing or material management department is the principal vehicle through which a health care provider interacts with vendors and manufacturers of medical supplies, equipment and materials.

Group purchasing organizations (GPOs). Most hospitals enter into a procurement contract with one or more group purchasing organizations (GPOs). GPOs are middlemen, reselling a variety of health care materials, instruments and supplies from a number of different vendors. GPOs give hospitals one point-of-contact for procuring a large number of different items. By aggregating orders from a number of different health care providers, GPOs can negotiate lower purchase prices from manufacturers, typically reselling products at a lower price than an individual hospital would obtain if buying direct from the manufacturer.

Both because of (1) the administrative savings afforded by a single point of contact and (2) the unit price economies which GPOs frequently deliver, most hospitals purchase a large majority of their products through one or more GPOs. Most hospitals have an exclusive or semi-exclusive contract with one national GPO for between three and five years.

GPOs do exert considerable influence over the sets of product alternatives from which hospitals have to choose. GPOs typically offer a particular product from only one (or a very limited set) of manufacturers, so as to maintain the price advantages of volume purchasing. GPOs also practice bundle pricing,

providing discounts both for volume of purchase, and the purchase of groups of related products from a single manufacturer.⁶

On the other hand, GPOs must be at least moderately responsive to desires of their member health care providers. For example, if a GPO does not offer a specific environmentally preferable product, if enough health care institutions (a) request the product, or (b) purchase the product outside the GPO, the GPO will have significant incentive to incorporate the product into its offerings.

Non-GPO Purchasing. Some systems of allied hospitals (or multiple hospitals operated by a single entity) generate large enough purchase volumes to conduct procurement directly, bypassing the GPO intermediate. Purchasing departments for these organizations develop national RFPs, evaluate bids, and interact directly with manufacturers and vendors.

Even at hospitals that conduct procurement via “exclusive” multi-year contracts with a single GPO, a small number of products are still purchased outside of GPOs. Products often falling into this category are those for special clinical or research purchases, products for outsourced departments, furniture, office supplies, and/or products for food services and housekeeping that can be acquired through local vendors for lower prices.

Interactions with internal users

The purchasing or materials management department is also the organizational function that centralizes, coordinates, and processes material, equipment and supply requests from users within the health care facility.

Generating requisitions. The degree to which the requisition and order process is automated varies significantly between health care providers. Some providers have sophisticated IT systems that track both supply inventory (with supplies being barcoded and scanned as they are used) and generate purchase orders with the relevant vendor or GPO automatically. Others are far more reliant on paper-based systems, manual inventory, and central stores. More sophisticated requisition and inventory control systems are generally intended to reduce costs of inventory and obsolescence. That is, they attempt to (1) maintain a smaller inventory and thus reduce cash that is “locked up” in supply stocks and unavailable to the institution, and (2) promote “first in/first out” practice to reduce the incidence of expired supplies which must be disposed of.

Whether more or less automated, however, orders are generated by user departments. For commodity items with consistent and predictable use rates, the purchasing department will often have standing orders with a vendor.

Purchases of capital equipment are far less automatic and require review and approval from a number of different functions.

Evaluating product alternatives. From a business perspective, health care providers have significant incentives to standardize product specifications across individual user departments. (Similar supplies, for

⁶ The product-bundle incentives a GPO offers can be powerful enough to discourage many kinds of product changes and/or substitutions. One hospital cited this example: a particular type of heavily-packaged syringe is not efficient from a waste disposal standpoint, but is included in their GPO’s product bundle incentive. If the hospital purchases a more efficiently packaged syringe from another supplier, the hospital would lose the substantial rebate on all products included in the bundle.

example, will frequently be used in departments such as surgery, internal medicine, and the emergency room.) Ordering one specific product in volume — rather than smaller numbers of very similar products — allows institutions to obtain lower unit prices through their GPOs or in their direct contracts, whose pricing policies reward volume purchasing.

Both for purposes of coordinating product specifications, and for evaluating the merits of product alternatives more generally, many hospitals set up a committee process to oversee product selection decisions. Committees are typically composed of representatives from both business and clinical/research departments — e.g., material management, business/marketing, surgery, internal medicine, etc. In the case of a committee overseeing product choice for a system of hospitals, representatives from member hospitals are part of this committee.

Typically, the clinical effectiveness of a product is the most important decision criterion.

Other purchasing criteria focus mostly on the costs incurred by the purchase and use of a product. Costs potentially evaluated in a purchasing decision include the following:

- **cost of acquisition** — unit purchase price, plus distribution fees, if any.
- **cost of storage**— maintaining warehouse space incurs real costs, which may be allocated across products in inventory. Storage costs increase substantially for products requiring special storage conditions (e.g., refrigeration). Storage costs may also include assumed costs of pilferage.
- **cost of utilization** — for reusable goods, this may include the costs of cleaning and sterilization. For capital equipment, this includes the cost of calibration, maintenance and repairs, as well as utility costs.
- **cost of obsolescence** — incurred when a substance or product in inventory expires and must be disposed of.
- **cost of disposal** — disposal of various hospital waste streams incurs a real cost per unit of weight or volume. Costs are significantly higher for products which must be disposed of as regulated medical waste or hazardous waste.
- **labor cost** — includes labor costs not elsewhere captured. Examples include labor to collect or segregate waste (usually housekeeping), receiving and warehousing, or staff training or instruction incurred from switching to a new product.
- **regulatory costs** — some items and substances incur costs associated with regulatory reporting and compliance (e.g., radioactive materials).
- **return on investments, or avoided costs**, such as savings from mercury spill cleanup associated with switching to mercury-free devices.

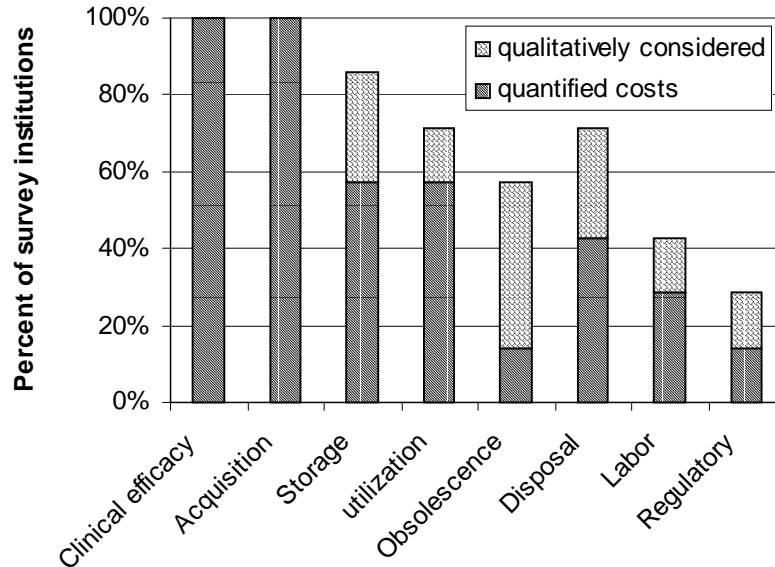
Capital equipment, which is not our principal concern in this study, incurs a unique sets of costs — e.g., cost of installation, permitting, design engineering, etc.

Thus, the purchasing decision *may* take into account downstream costs such as disposal (e.g., cost of incineration, autoclaving, landfill), end-of-life regulatory costs, etc. More typically, however, a hospital

will consider only costs incurred between acquisition and use — purchase cost, clinical efficacy, and storage.

The chart below illustrates those costs considered by the hospitals and health care networks in our survey group.

Figure 2 : Costs considered in purchasing decisions



Environmental and downstream criteria generally have lower priority in the purchasing decision process and are usually not automatically incorporated unless a clear regulatory driver exists. In most cases, a hospital’s EH&S department is involved in the purchasing process only on an informal and ad hoc basis.

One environmental issue that is having significant impact on product procurement decisions is mercury. Mercury-containing products for which proven, mercury-free alternatives exist — e.g., thermometers and sphygmomanometers — are no longer being procured in many hospitals. The American Hospital Association has entered into a Memorandum of Understanding with US EPA, committing to virtual elimination of mercury from the health care industry waste stream by 2005. Even predating this agreement, however, many providers had changed procurement practices.

3.2. Environmental accounting applications in health care purchasing

As described in Section 1.4, EA can support decisions about which products to procure. Environmental costs in this context are the costs incurred by the health care provider which (1) derive directly from the storage, use and disposition of the product, and (2) are related to the product’s environmental impacts or attributes.

Thus, environmental costs associated with purchasing decisions may include disposal costs, personal protective equipment or EH&S training costs necessitated by product toxicity, or labor for tracking use of hazardous materials. They may also include any of a set of contingent costs — e.g., environmental liability, or the costs of incident response and follow-up treatment, such as those resulting from mercury exposure. Environmental costs are in many cases driven by regulation — for example, disposal costs of a certain product, such as mercury, may be high because regulations specify that the product must be disposed of in a particular way.

Current use

Environmental accounting is an emergent practice in industry, and this is all the more true in the health care services sector. The interviews conducted for this project (Appendix A) and a survey of current literature regarding health care purchasing practice/decision-making reveal very limited application of EA in the sense that few health care providers attempt to systematically identify even a subset of environmental costs.

Where EA concepts are employed, it is usually on an ad hoc, rather than a systematic, basis to inform or justify specific product changes. For example, a number of health care organizations have conducted some extended cost analyses comparing mercury-containing to mercury-free product alternatives. Mercury minimization is a current focus of environmentally preferable purchasing in many health care organizations. (See Kaiser Permanente case study, Appendix B)

Underlying this limited and ad hoc application of EA is an environmental or total cost *awareness* which seems much more widespread. This is the qualitative awareness that the environmental costs discussed above do exist, and potentially constitute a significant portion of total costs for a large number of products. Total cost awareness drives ad hoc efforts to quantify environmental costs in particular cases. It underlies efforts observed in a number of health care institutions to constitute cross-functional evaluation teams for key procurement decisions.

Barriers

The health care services sector is under enormous pressure to control costs. EA experience in other economic sectors indicates that EA can provide a framework for understanding the total, real costs an organization incurs by using a particular product, and that environmentally superior decisions often flow from decisions to minimize total — not just purchase — costs. Conceptually, EA is compatible with cost minimization based on sound knowledge of total costs.

However, an additional element of EA experiences in other sectors is also borne out in the health care sector: in the absence of easily available cost information, cost control pressures translate into a narrow focus on the unit price of product. Further, the belief often exists that the marginal cost of obtaining requisite data exceeds its marginal benefit. A vicious circle thus exists: EA framework is not applied because the data are not easily available, and the data are not acquired because the belief exists that the costs of doing so exceed the benefits.

The data deficiencies lie both in cost accounting and in *materials accounting* — the characterization or material flows into and out of the facility. As discussed in Section 1.4, materials accounting underlies sound *cost accounting*. We observe that while most facilities have quite detailed knowledge available regarding costs and quantities of products *entering* the facility, there is far less awareness of the contribution of each product to the materials streams *leaving* the facility.

Efforts to gather data, where they are initiated, are made more difficult by hospital accounting systems which make extracting and tracking costs back to products, for example, quite difficult. Disposal costs, for example, are typically aggregated, and rarely tracked back either to products or departments. While this situation manifested clearly in our interviews, it is by no means unique to health care providers.

Beyond data availability issues, the institutional or organizational character of health care institutions can also impede decision-making based on an awareness of life cycle product costs. There is little formal linkage between purchasing and EH&S departments, or between purchasing decisions and waste management decisions. Accounting systems tend to be structured so that neither downstream savings nor downstream costs accrue to those making the original purchase. Again, this situation is by no means unique to health care providers.

Finally, the product alternatives effectively available to health care institutions are typically limited to those offered by their GPO(s). A single health care institution may not have sufficient purchasing volume to achieve change in a GPO's product portfolio. Relying on the GPO catalogue may in addition restrict *awareness* of environmentally preferable product alternatives.

The barriers discussed above are common to a number of economic sectors, and not rooted in the specific nature of health care services. The nature of the health care sector poses at least one barrier, however that is more unique: The necessary emphasis on clinical efficacy of a product creates heightened barriers to switching to products which are (or are seen to be) less proven. The consequences of adopting a product with reduced clinical efficacy are potentially severe — both for the health of patients, and in liability for the health care provider.

Opportunities for advancing EA

EA requires two enabling conditions: (1) availability of cost data, and (2) total cost awareness. We observe significant awareness of the total cost or life cycle cost concept. This awareness should be fostered, and channels provided so that total cost awareness can influence purchasing decisions. Inclusion of cross-functional staff (e.g., EH&S, housekeeping, food services, accounting) in committees responsible for purchasing decisions is a widespread practice which can serve both these ends.

Data availability in general is greatly facilitated by modern accounting information systems and cost tracking. The health care services sector exhibits significant diversity in the sophistication of these systems. Provision of frameworks and guides for estimating environmental costs for typical product decisions can help purchasing or cross-functional teams in making product decisions. For example, some hospitals are connecting materials safety data sheet (MSDS) management systems to their electronic purchasing system in order to flag certain products.

Data are also provided to hospitals by manufacturers and GPOs. Currently, this information stream contains little regarding life cycle costs of products. If GPOs were to market products to hospitals in terms which focused on life-cycle costs, not simply purchase cost, this could facilitate EA significantly.

Certain trends exist which are likely to give impetus to consideration of environmental costs. Costs of waste disposal are generally increasing, and medical incineration and waste disposal generally are contentious political issues. This tends to create a greater awareness of their potential impact on the bottom line.

4. Advancing Waste Minimization Through EA

4.1. Overview of hospital waste streams and waste disposition

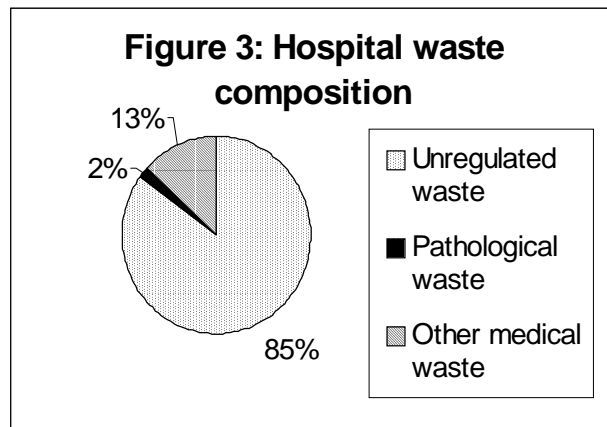
By their nature, hospitals are relatively energy and waste-intensive service entities. Medical services themselves generate a waste stream consisting both of organic matter and a complex array of highly engineered chemicals and materials — many of which are hazardous, infectious or contaminated. Open 24 hours a day, 365 days a year, hospitals also function as offices, photographic laboratories, lodging establishments and food service providers, generating the waste streams characteristic of each of these activities.

Hospitals in the U.S. produce approximately 2 million tons of waste per year. It is estimated that each patient generates roughly 15 pounds of waste per day — a number that has more than doubled since 1955, roughly in pace with the increase in per capital household waste generation, and reflecting the growing use of plastic and disposable medical products.⁷ The 6600 tons per day of waste generated by more than 9,000 hospitals in the U.S. constitute approximately 1% of the US municipal solid waste stream⁸.

The diversity of the sector's waste streams and waste-generating activities is mirrored in the diversity of regulatory organizations with whose waste-related rules and standards hospitals must comply. Federal EPA and state environmental agencies, local water and solid waste agencies, and departments of health all establish statutory requirements affecting hospitals (see sidebar, next page).

Composition and Regulation of Hospital Waste Streams

Commercial waste. About 85 percent of hospital waste is “typical” commercial solid waste — office paper, food service wastes, packaging, etc. This waste tends to have a higher plastic content than most municipal or commercial waste streams (15–30 percent by weight), due the extensive use of disposable plastic supplies and packaging.⁹ About half of a hospital's solid waste stream is paper and cardboard. A hospital's food service can be a significant waste generator as well: a typical 500-bed hospital may serve up to 3000 meals



Source: Environmental Work Group, 1997.

⁷ The Environmental Working Group/Health Care Without Harm, *First, Do No Harm*, March 1997.

⁸ Bisson, C.L., McRae, G., and Shaner, H.G., 1993. *An Ounce of Prevention: Waste Reduction Strategies for Health Care Facilities*. American Society for Healthcare Environmental Services.

⁹ *ibid.*

per day.¹⁰ In addition to containing plastic, metal and glass, the organic content of cafeteria waste is usually heavy.

Red-bag waste. By volume, most of the remaining 15 percent of the waste stream is “red bag” or regulated medical waste (RMW). This category of waste is considered potentially infectious, and is segregated at the time of generation, being placed into red plastic bags (hence the name) or in other special receptacles such as the sharps (used syringes) container. There is no uniform national definition of RMW; its definition and attendant requirements for disposal are typically determined by state environmental or health agencies. Most typically, RMW includes cultures and stocks of infectious agents, pathological wastes (human organs or tissues), human blood and blood products, sharps, animal wastes, and isolation wastes. Individual health care facilities may adopt definitions in practice that are far broader than regulatory language. In addition to *disposal* requirements, the *handling* of potentially infectious material is regulated by OSHA. Hospitals in addition typically follow guidelines and standards related to waste handling and infection control issued by the Centers for Disease Control (CDC) and the Joint Commission for Accreditation of Healthcare Organizations (JCAHO).

Hazardous waste. Various clinical departments, as well as research facilities at hospitals, generate hazardous wastes. Though a small volume component of the waste stream, the diversity of different substances presents waste management challenges. Hazardous wastes are subject to national and state regulations regarding handling, transportation and disposal. Prominent hazardous hospital wastes, their typical

Regulatory and standard-setting bodies affecting healthcare facilities (Non-exhaustive)

CDC (Centers for Disease Control)

- Federal. Not a regulatory body. Standards and guidelines for infection control and related areas.

EPA (Environmental Protection Agency)

- Federal. Regulates and permits emissions to air (e.g., incinerator emissions) and water and disposal of hazardous waste.

JCAHO (Joint Commission on Accreditation of Healthcare Organizations)

- National. Not a regulatory body. Establishes standards and guidelines for a wide range of healthcare practices.

OSHA (Occupational Safety and Health Administration)

- Federal. Regulates worker safety, including exposure to range of physical, chemical radiological and infections hazards (includes handling of potentially infectious material).

NRC (Nuclear Regulatory Commission)

- Federal. Regulates medical use of reactor-produced materials, including radiopharmaceuticals.

Solid waste agencies (Departments of Public Works, Solid Waste Districts, etc.)

- Local/regional. Local standards for classes of waste (e.g., RMW); recycling mandates; landfill disposal fees

State Environmental Agencies

- State. Implement many EPA rules and programs, as well as state regulations. May include: waste

State/local health agencies.

- State/local. Certification, facility licensing, quality-of-care requirements. Classification of waste, regulation of disposal practices, including RMW. Infection control and food hygiene.

Water agencies

- Local/regional. Regulate discharges to sewer, including pretreatment standards and discharge limits.

¹⁰ *ibid.*

disposition, and some health effects of concern are listed below:¹¹

- *Chemotherapy and antineoplastic chemicals.* Chemotherapy wastes make up the largest volume of hazardous waste among three hospitals surveyed by the EPA. Most of the waste volume consists of lightly contaminated items such as personal protective clothing and gauze pads. Among the surveyed hospitals, an average of 2 to 8 cubic feet of such waste was generated each week, and is either transported to a Class I landfill (a practice that, according to EPA is discouraged or prohibited in many areas of the U.S.) or incinerated as infectious waste.¹²
- *Formaldehyde.* Also a significant constituent of the hazardous waste stream at many hospitals, formaldehyde is used in pathology, autopsy, dialysis, embalming, and nursing units. When used in dialysis, it is purchased as a 37% solution with water, commonly known as formalin. Discharge of formaldehyde to the sewer may be prohibited by sanitation authorities.¹³
- *Photographic chemicals.* Generated in the radiology department, these chemicals often contain hydroquinone, potassium hydroxide, silver; glutaraldehyde, and acetic acid. Effluent silver-containing solution can be treated to recover the silver. The remaining liquid, containing less than 2% glutaraldehyde, hydroquinone, and potassium hydroxide, is typically discharged to the sewer.
- *Radionuclides.* Generated in nuclear medicine and clinical testing laboratory departments in the hospitals surveyed at the rate of about 800 cubic centimeters per week, this material is retained on site for a number of half-lives until it is decayed to nonhazardous levels (medical radionuclides typically have a short half-life).
- *Solvents.* Various hospital departments generate solvent wastes, including halogenated compounds such as methylene chloride, chloroform, freons, and trichloroethylene. Non-halogenated solvents in common use in hospitals include xylene, acetone, methanol, isopropanol, ethanol, toluene, ethyl acetate, and acetonitrile. Among the hospitals in the EPA survey, xylene, acetone and methanol were the most frequently used solvents. While the latter two are usually evaporated or discharged to the sewer, xylene wastes are normally handled as hazardous materials. Solvent wastes are typically stored in 30- or 55-gallon drums and are either recycled on- or off-site or transported off-site for incineration.
- *Mercury.* Mercury-containing products include thermometers, sphygmomanometers, Miller Abbot Tubes, and florescent lamps. Mercury is a particular threat to public health when it is incinerated with other medical waste and subsequently released into the atmosphere.

¹¹ U.S. EPA, Office of Research and Development. *Guide to Pollution Prevention: Selected Hospital Waste Streams*. EPA/625/7-90/009, June 1990.

¹² *ibid.*

¹³ *ibid.*

- *Waste anesthetic gases.* These include nitrous oxide and the halogenated agents halothane, enflurane, and isoflurane. Exposure to these gases may lead to acute toxic effects and potential reproductive disorders and carcinogenesis.
- *Other toxic, corrosive, and miscellaneous chemicals.* One example of such a substance is ethylene oxide (EtO). EtO is a colorless and odorless gas that is used to sterilize medical devices. It can cause acute toxic reactions and is a probable human carcinogen. It is purchased in cartridges or cylinders to be attached to specially designed sterilizers. After equipment has been sterilized, it is transferred to an EtO aeration chamber connected to ventilation systems directing the exhaust to ambient air. Used EtO cylinders are then returned to the supplier.

Waste Tracking In the Hospital

Typically, the housekeeping and environmental services departments are together responsible for waste collection, disposal, and any recycling effort, handling both solid and infectious wastes.

Waste tracking — knowing how much waste is generated and where it is generated — is an important component of waste management and important for identifying waste minimization opportunities. Waste tracking can either be performed on a routine basis, or through occasional waste audits. The intensiveness of a waste audit may vary from a survey of the hospital's trash cans and dumpsters to a more elaborate procedure, possibly involving outside consultants, which attempts to develop a profile of waste generation by department and activity, and to assign waste disposal costs accordingly. In a survey conducted by Healthcare Without Harm, 76 percent of 54 hospitals responding had conducted a waste audit within the last three years.¹⁴ Based upon our interviews with hospitals, most hospitals do not track waste generation by department on a continuing basis.

Waste can be tracked by volume (number of disposal containers), or by weight (e.g., tons). In general, liquid waste is tracked by volume, while solid waste is tracked by weight.

Waste treatment/disposal options for RMW

As noted, the definition and disposal of RMW is regulated at the state level. Treatment and disposal options for RMW include:¹⁵

On-site Incineration. Approximately 2400 hospital/medical/infectious waste incinerators exist in the US, the majority of which are owned by and located at hospitals.¹⁶ Their combined incinerating capacity is estimated to be 900,000 pounds per hour, nationwide. Medical incinerators have only recently come under Clean Air Act regulation, and states are just now promulgating standards in response to EPA rule-making. Only a few states had pre-existing medical incinerator emissions regulations. These incinerators are a source of concern because of both dioxin and mercury emissions. EPA expects its new rules to force the closure of 50–80 percent of existing incinerators; many hospitals have begun to shut down their

¹⁴ Environmental Work Group/Health Care Without Harm, 1998.

¹⁵ Environmental Work Group/Health Care Without Harm, 1997.

¹⁶ Davies, Terry and Adam I Lowe. *Environmental Implications of the Health Care Service Sector* (Resources for the Future Discussion Paper 00–01). Resources for the Future: Washington, DC, 1999.

onsite incinerators in recent years, either in anticipation of regulation or in response to community pressures. Outsourcing of RMW treatment has thus been increasing, a trend expected to continue.

Off-site waste disposal contract. Hospitals that elect to not have their own waste treatment on site contract out red bag waste disposal to commercial waste management companies, who will haul the waste offsite, to be treated by either autoclaves or incineration.

Autoclaving. The most commonly used medical waste treatment alternative in the country, autoclaving sterilizes red bag wastes at high temperature and pressure. Because it does not release toxic byproducts such as dioxin and mercury, autoclaving poses less health and environmental risks than incineration. Once autoclaved, the once-biohazardous waste can then be disposed of as solid waste.

Microwaves. This method uses microwave energy to heat to the boiling point water sprayed onto the waste. This method is shown to disinfect medical waste, although it does not completely sterilize it. The more heat-resistant strains of bacteria may survive this treatment.

Chemical treatment. This method grinds medical waste with chemicals to sterilize the content. After treatment, the ground-up waste can be sent to a landfill and/or recycling operation, while the used chemicals are sent to a chemical waste treatment facility. This is the least preferred alternative waste treatment method, as it does not perform as well as autoclaving or microwaves, and the chemicals used for treatment pose risks to both workers and the environment.

4.2. EA applications in waste minimization

The previous section summarized hospital waste generation and management practices. The text illustrated that the collection and disposal of waste in the medical context is highly constrained by rules, laws, regulations, and standards, deriving from a number of regulatory and standard-setting bodies.

These constraints are becoming tighter, not looser — waste disposal is becoming increasingly costly for health care providers. Construction requirements for new landfills (e.g., double liners), more stringent siting requirements, community resistance and closure of existing fills all serve to increase landfill fees and transport costs. Incinerator regulations are requiring expensive retrofits of existing units, or their closure altogether. The acceptance of medical waste by a landfill or incinerator is often a contentious political issue.¹⁷

Escalation of unit disposal costs and a continuing emphasis on cost control are increasing awareness of disposal as a cost center on the part of health care providers. Most institutions have made some efforts to minimize these costs. Because disposal costs *are* environmental costs, attempts to minimize these costs can benefit from environmental accounting, or at least of environmental cost *awareness*.

The effective degree of application of EA and its ability to achieve waste minimization varies significantly, however, among the three general waste minimization approaches most commonly available to health care providers. A discussion of these approaches (below) is followed by an assessment of the degree of application of EA to each.

¹⁷ For example, see Appendix A, Beth Israel Medical Center/Continuum Health Partners Profile.

Waste minimization approaches

Procurement. Procurement of products which produce less waste volume or reduced waste toxicity is an effective way to reduce waste generation. This may involve, for example, decisions regarding reusable versus disposable products, phase-out of mercury-containing products, identifying products which minimize packaging, or working with vendors to achieve take-back of delivery and shipping containers. Examples of all these approaches were observed in our survey group.

Where substitution of products used in patient care are contemplated, clinical efficacy of the substitute is of paramount concern. However, substitution of reusable food service items or linens for disposable products may be more straightforward.

Some vendors, responding both to customer preferences and to reduce their cost of delivering product, have begun to market “reduced packaging” items.

Inventory management. Inventory management practices attempt to minimize the stock of expendable products and supplies held by a hospital, reduce losses from inventory, and reduce the incidence of product expiration and obsolescence. Inventory management, including just-in-time inventory systems or following first in/first out (FIFO) use of inventory, is pursued to control costs. However, to the extent that such systems reduce the incidence of expired or otherwise wasted inventory, they do act to minimize waste.

Waste segregation. The ultimate goal of waste minimization is not only to minimize the *volume* of waste, but also the aggregate *impact* of waste. To this end, waste segregation helps to ensure that each waste stream is handled in the most appropriate manner. In some cases, improper segregation may in addition lead to environmental harm/public health risks — as when broken mercury thermometers or NiCd batteries are incinerated with RMW waste. Effective recycling programs also depend on waste segregation.

Recycling and reuse. The largest fraction of hospital waste — paper, plastic and cardboard — lends itself in principle to recycling. Recycling rates vary significantly from hospital to hospital.¹⁸ The more commonly recycled items at hospitals include paper and cardboard, silver, toner cartridges, xylene and NiCd batteries. Fluorescent bulbs and plastics #1-6 are recycled by far fewer numbers of hospitals.

Hospitals do face some unique difficulties in achieving high recycling rates:

- While bulk packaging is typically opened outside operating rooms and patient care areas, individual item wrappings (e.g., sterility barriers) are typically opened *in* such areas. Operating and emergency rooms are difficult places to institute waste segregation practices. Bulk packaging recycling is thus much more widespread, with bulk packaging and pallet take-back occurring on a limited basis in a number of facilities.
- Further, even when used plastics do not constitute RWM, recyclers are reluctant to accept any item from a medical facility that appears at all contaminated.

¹⁸ Environmental Work Group/Health Care Without Harm, 1998. In this recent survey, the total number of items recycled per hospital ranged from 0 to 31, with an average of 12 items.

Additionally, items such as furniture, linens, and medical equipment while surplus or obsolete at a particular facility, may be of use to other organizations. Finding reuse options for surplus or obsolete equipment is a waste minimization strategy.

Reprocessing. An increasingly popular cost control strategy, reprocessing is the practice of refurbishing and sterilizing medical supplies marketed by the manufacturer as one-time use devices. Devices commonly refurbished, usually by 3rd-party reprocessing firms under contract to a health care provider, include certain kinds of catheters, laproscopic instruments, and drills, bits and blades. Reprocessing — a type of remanufacturing — does reduce the environmental impacts associated with the manufacture of new product, and removes certain types of disposable devices from the hospital waste stream. However, the practice is controversial, with concerns centering around the safety of reprocessed devices.¹⁹ It is beyond the scope of this report to assess these issues; we thus do not address reprocessing further.

Current use of EA in waste minimization

Procurement. Section 3.2 discussed the very limited use of EA in health care purchasing practices and decision-making. Formal accounting for downstream and disposal costs in purchasing decisions is generally limited, and ad hoc rather than systematic. As we noted, however, total cost *awareness* — especially awareness of disposal costs — is far more widespread.

Waste segregation. Achieving proper segregation of RMW or “red bag” waste from the solid waste stream is the most widespread disposal cost reduction effort. Compared to “regular” solid waste, RWM is approximately 5 times more expensive to dispose of per unit — a fact widely and readily appreciated by the management of health care institutions. Many hospitals have initiated staff educational programs to ensure that only wastes meeting red bag regulatory criteria go into red bags. Unfortunately, the environmental impacts of reducing red bag generation are minimal, as the total volume of waste being disposed of is unchanged.²⁰

Waste segregation for other waste streams is usually conducted for one of two reasons, neither of which is primarily cost-driven:

- in support of recycling initiatives (below), which are only secondarily cost-driven
- to remove regulated hazardous materials from the waste stream, such as mercury or NiCd batteries.

Recycling. Reducing disposal costs has been an impetus to hospital recycling programs in some cases. However, two motivations seem much more prominent: (1) local recycling mandates for commercial establishments/large-volume generators; and (2) general environmental commitment on the part of the health care establishment — recycling of at least some products is an obvious “first step” in fulfilling more general statements of environmental principles.

¹⁹ For an introduction to the debate, see for example (Weinberg, Neil, 1999. “Blood Money,” *Forbes Magazine*. March 22) and (Weller, Sam, 1998. “Patient Wrongs,” *Newcity magazine*. September 7).

²⁰ Reduced generation of red bag waste does in most cases have some environmental benefits — sterilizing red bag waste is an energy (or chemical-) intensive process. The environmental footprint embodied in the manufacture, distribution and use of the products is unchanged, however.

Barriers

Procurement. Barriers to EA in procurement decision-making were discussed in Section 3.2. Key barriers included the focus on unit purchase cost in the absence of available cost data; poor integration between EH&S and purchasing departments; poor cost accounting systems; and restricted sets of product alternatives.

Waste segregation and recycling. Most waste managers in our survey hospitals have a good awareness of the costs incurred and avoided by recycling programs; lack of total cost awareness is generally not the principle barrier to improving recycling rates. Indeed, costs and benefits of these programs are relatively straightforward to calculate. Rather, changing staff waste segregation practices — the foundation of a recycling program — requires significant and ongoing staff education efforts. Given the relatively marginal economic returns to most recycling efforts, high-level commitment to intensive recycling efforts may be difficult to obtain. Such commitment is needed to allocate resources to initiate the program, educate staff, and achieve changes in duties of the housekeeping department. (Improved red bag waste segregation has been successfully instituted in a number of hospitals because the economic rewards are obvious and significant.)

In addition, achieving high recycling rates depends to some extent on purchases of recyclable products. Barriers affecting the use of EA in procurement are in this way relevant to recycling.

Encouraging improper disposal. Several EH&S managers in our surveyed hospitals noted that even if hospital accounting systems enabled waste disposal costs to be tracked back to the departments generating the waste, charging these costs against the departments budgets may encourage improper waste disposal.

Opportunities for advancing EA in waste minimization

With regard to implementing waste minimization through procurement changes, the EA procurement opportunities identified in section 3.2 also apply. These include cross-functional purchasing committees, provision of decision-making frameworks, and cost guides.

Improved product markets for recycled goods will increase the economic return to recycling efforts and will tend to increase the persuasiveness of EA-based arguments for recycling.

Changing the incentive structure between hospitals and their contracted waste disposal providers through an emerging contracting mechanism, resource management (RM), is yet another opportunity for advancing waste minimization. Contractual relationships between hospitals and their waste disposal contractors are typically based upon waste volume or tonnage disposed. More waste thus translates into more revenue for the disposal contractor. In such arrangements, the financial incentives of the hospital and the solid waste contractor are at odds; while the hospital has an incentive to decrease waste quantities, the contractor benefits from handling continuously increasing quantities of waste. These conflicting incentives work to impede serious progress in waste reduction, especially in hospitals lacking the resources to undertake waste audits or to institute recycling or waste minimization programs.

RM contracts are structured to de-couple the quantity of waste disposed from the contractor's profit, and provide financial incentives to waste disposal contractors for efficient material use and recovery. For example, RM contracts may cap disposal costs (based on current costs) and then include a cost sharing arrangement for successful waste minimization programs that are initiated by the contractor. When compensation is tied to the value of material related services (the focus being on prevention, reuse and

recycling waste, with disposal as the last resort) rather than the quantities of waste disposed, contractors receive the right price signals and their incentives align with the customer's.

EA provides the underpinnings to RM as hospitals must first have accurate estimates of the full cost of their waste management activities and contracts, including potentially hidden costs arising from managing, administering, and handling waste internally. These costs can then be used for informing and developing mutually beneficial contracts with waste disposal contractors.

5. Conclusions and Recommendations

The purpose of this study was to assess the current application of EA in hospitals and networks of health care facilities, and to evaluate the applicability of EA for pursuing waste minimization and environmental supply chain management. In particular, we focused on EA for improving decision-making in hospitals in two applications:

Product selection. Hospitals routinely make decisions about which products to procure based upon their cost. Identifying environmental costs associated with the life cycle of a product can assist materials managers in selecting products with the lowest life cycle costs, i.e., the lowest costs accrued throughout the life cycle stages of a product.

Waste management. Hospitals generate large quantities of waste whose treatment and disposal options are dictated by the waste stream's composition. Because disposal costs *are* environmental costs, attempts to minimize these costs can benefit from environmental accounting. Additionally, by allocating, or tracking waste management costs back to the products or activities generating waste, managers can make more informed decisions about the products they procure or the activities they undertake.

5.1. Environmental accounting vs. cost awareness

Current EA application very limited

One conclusion which emerges clearly from our interviews with purchasing and waste managers for hospitals and health care networks is that EA concepts are not in widespread use. Few health care providers attempt to systematically identify or quantify even a subset of environmental costs. To the extent that an EA framework is applied, it is usually on an ad hoc, rather than a systematic, basis to inform or justify specific product changes.

Total cost awareness is far more widespread

We did, however, observe far more widespread *total cost awareness* — that is, an awareness that products *do* incur real costs to an organization beyond their purchase cost. These costs relate to activities such as labor, storage, and maintenance — as well as environmental costs. Total cost awareness is the necessary foundation for environmental accounting. Total cost awareness drives ad hoc efforts to identify and quantify environmental costs in particular cases. It underlies efforts observed in a number of health care institutions to constitute cross-functional evaluation teams for key procurement decisions.

5.2. Incentives and Barriers to EA

Opportunities do exist for increased use of environmental accounting information. Waste managers consistently noted that more accurate information on environmental costs and benefits would be useful for advocating waste minimization actions to management, and in identifying waste minimization opportunities.

Incentives

The health care sector is currently subject to a number of strong influences which should tend to encourage EA:

- Cost control pressures continue to be strong; EA is a mechanism for cost control.
- The costs of hospital waste disposal continue to increase, due in part to stronger incinerator regulations forcing expensive upgrades or closure of many medical waste incinerators. This serves to focus management attention on waste costs.
- Processing and disposal of medical waste remains a politically sensitive one, especially for communities in which landfills and incinerators are located — for some hospitals and networks, simply locating landfills to accept their waste is difficult. This is a significant incentive to waste reduction.

Generic and specific barriers

However, barriers to EA exist. Some barriers are identical to those observed in a number of other industries:

- **Poor information/inadequate accounting systems.** Information regarding environmental costs is poor. Accounting systems — ideally, the principal source of cost information — are generally inadequate to the demands of EA, which benefits from disaggregation of environmental costs from overhead accounts in order to track costs back to the products or activities generating the costs.

In the presence of pressures to control costs, poor information regarding environmental costs leads to either (1) a narrow focus on reduction of unit purchase price; or (2), a focus on those changes — usually unrelated to environmental costs — for which information is available, and for which savings are perceived to be high. Examples include changes in staffing or task allocations, such as increasing utilization of nurse practitioners, rather than physicians; or reductions in nursing staff.

- **Few connections between procurement and EHS.** Institutional connections between purchasing or procurement and the EH&S functions are typically weak. While the use of cross-functional product procurement teams seems to be increasing, these tend to be focused on effectively integrating clinical criteria into procurement decisions, particularly standardization efforts. EH&S input tends to be specifically solicited only for decisions with obvious environmental aspects — e.g. waste management contracts.
- **Procurement constraints.** Like facilities in many other sectors, health care facilities are frequently subject to procurement constraints that tend to reduce the product alternatives from which they may effectively choose. Facilities or networks which purchase through GPOs are subject to product-choice constraints arising from GPO bundling practices. Hospitals or networks of comparatively small size possess limited market power and are unlikely to be able to assert environmental preferences effectively to manufacturers or purchasing organizations.

Several other barriers to EA arise from the specific nature of health care services:

- **Clinical efficacy.** In the health care sector, the clinical efficacy of any product used in clinical care is the principal procurement criterion. This can create a significant barrier to switching to a product or practice which may be environmentally preferable, but is perceived to be less proven.
- **Environmental risks are often not key drivers.** In general, clinical efficacy and infection control (control of health risks to staff and patients), tend to present far larger costs, liabilities, and concerns than the disposition of end-of-life wastes OR other narrowly environmental concerns.

In some cases — e.g., mercury minimization — there is significant overlap between reductions in the environmental impacts produced by health care facilities and reductions in risk to staff and patients. When EA is applied to such cross-cutting issues, it can support decision-making with multiple benefits — producing results which reduce environmental impacts as well as reducing key risks for staff and patients. However, in many other cases, EA, narrowly construed, may not address these principal drivers of decision-making.

5.3. Getting started – first steps a hospital can take

Although there may be numerous barriers for EA, several opportunities exist for applying EA concepts in hospitals:

1. Educating procurement and management staff

As noted above, the interactions between procurement and EH&S staff tend to be weak, occurring chiefly on an ad hoc basis. Yet, many purchasing decisions with attendant EH&S impacts remain beyond the purview of EH&S staff. One hospital cited an example of such a decision – the switch from a minimally packaged syringe to a syringe with bulkier packaging increased the hospital’s waste generation, therefore increasing housekeeping labor costs as well as disposal costs.

One opportunity is educating purchasing and management (i.e., any staff responsible for procurement decisions) on the EH&S implications and costs resulting from their actions. Resource materials developed under the AHA-EPA MOU can assist in this effort. EH&S staff need to assume a proactive stance to ensure inclusion of EA information. In the current health care climate where hospitals are under pressure to control costs, it is important for environmental health staff to demonstrate the costs/savings of environmentally preferable purchasing and waste minimization activities.

2. Incorporating environmental information in the value analysis process

The use of cross-functional product procurement teams that includes EH&S representation is one way of bridging the EA information gap that often exists in hospitals. Many hospitals use value analysis committees to collect information, including costs, when assessing alternative products. Developing a standardized template for collecting information on product alternatives can encourage the consideration of costs other than unit price and clinical effectiveness (the costs most commonly considered in purchasing decisions). It is important to address clinical liability and health risks for staff and patients, in addition to environmental costs, in these templates. To do otherwise is to turn a blind eye towards the business drivers — and health outcomes — that most concern health care providers.

3. Incorporating environmental information in procurement systems

Some hospitals directly link databases on environmental attributes of products to their electronic procurement system. Examples include mercury content of products and product MSDSs. Doing so can facilitate environmentally preferable purchasing, especially when a range of product alternatives exists. (As previously discussed, for products purchased from GPOs, product choices may be more limited.)

4. Conducting periodic waste audits

Waste audits (an application of materials accounting) identify the waste streams generated, their composition, and current waste management practices. Waste audits are an essential ingredient for identifying opportunities to minimize waste and for assessing the effectiveness of current waste minimization efforts.

Waste audits also present an opportunity for informing environmentally preferable purchasing decisions. For example, waste audits can uncover products with excessive packaging (such as the previously cited example of a hospital that switched from a minimally packaged syringe to a syringe with bulkier packaging,) that increase a hospital's waste generation, thereby increasing housekeeping labor costs and disposal costs.

5. Changing the incentive structure of contracted services

Many hospitals outsource specific services such as housekeeping, dietary, and waste disposal. These contracts are typically structured using a flat-fee (e.g., flat fee for providing housekeeping services) or a fee for providing services (e.g., fee based upon the number of meals served). However, typically there are no incentives in the contract for the supplier to minimize material use and/or waste generation.

One opportunity for incorporating such incentives is through resource management (RM), an emerging contracting mechanism. As described in Section 4.2, RM contracts are structured to de-couple the quantity of waste disposed from the contractor's profit, and provide financial incentives to waste disposal contractors for efficient material use and recovery. For example, RM contracts may cap disposal costs (based on current costs) and then include a cost sharing arrangement for successful waste minimization programs that are initiated by the contractor. When compensation is tied to the value of material related services (the focus being on prevention, reuse and recycling waste, with disposal as the last resort) rather than the quantities of waste disposed, contractors receive the right price signals and their incentives align with the customer's.

References

Note: References for purchasing and waste management profiles are attached to each profile.

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Healthy Hospitals: Environmental Improvements Through EA

Appendix A: Procurement and waste management profiles

- ***Beth Israel Medical Center/Continuum Health Partners***
- ***Catholic Healthcare West/Dominican Santa Cruz Hospital***
- ***Contra Costa Regional Medical Center***
- ***Dartmouth Hitchcock Medical Center***
- ***Dana Farber Cancer Institute***
- ***Halifax Medical Center***
- ***Kaiser Permanente***
- ***New England Medical Center***
- ***St. Vincent's Hospital***

Beth Israel Medical Center/Continuum Health Partners

Organizational profile

Beth Israel Medical Center (BIMC), a non-profit institution in New York City, consists of three major hospitals, as well as groups of clinics and care centers. With over 1300 acute care beds, BIMC is the largest provider of inpatient care in New York state. Continuum Health Partners was formed in January 1997 by a partnership agreement between BIMC and St. Luke's–Roosevelt Hospital Center, and enlarged by addition of Long Island College Hospital in 1998 and the New York Eye and Ear Infirmary in 1999. In total, the non-profit Continuum system incorporates approximately 3400 beds within New York City.

Purchasing is largely centralized across the Continuum member institutions (a corporate function), but waste management is not. Thus, the discussion of purchasing that follows is applicable to Continuum Health Partners generally, but the description of waste handling is particular to BIMC.

Purchasing practices

Continuum has centralized purchasing operations for six of its hospitals and associated smaller and specialized facilities within its system; this has been a priority at the corporate level. (Work has begun to include the New York Eye and Ear Infirmary, which joined Continuum this year.) All purchases greater than \$300 must be routed through the corporate purchasing office; purchase requests originate with department heads or designated subordinates.

Though Continuum (through BIMC) was a founding member of the Premier GPO, it founded and now purchases through Healthworks, a regional for-profit GPO. Continuum formed this GPO because (1) it believed its large size should allow it to negotiate volume purchasing economies beyond those that national GPOs offer to smaller institutions, and (2) it wished to derive from its purchasing organization value-added services specific to needs of the individual hospitals.

Healthworks differs from the usual GPO model in several ways. Warehousing is a centralized function provided off-site by a third party logistics provider. Continuum does not pay distribution fees; instead, the manufacturers absorb this and other activity-based costs.²¹ Manufacturers accept this arrangement as they realize economies by shipping to a centralized location. Items are delivered from the warehouse to the hospitals in reusable plastic totes in the quantity requisitioned; Continuum hospitals thus now have a stockless supply system. Healthworks allows patients and individual practice physicians to purchase the same GPO products via catalogue (at a discount off retail prices).

The majority (65-70 percent) of Continuum purchasing is conducted through Healthworks. Procurement outside of Healthworks consists principally of local services, waste management, capital equipment, and some physician-preference items. Most pharmaceuticals are directly purchased; about 20% of pharmaceuticals (principally from producers who do not contract directly with hospitals) are purchased through Joint Purchasing Corporation, a local GPO.

²¹ Activity-based costs are those incurred by the sale and distribution of medical supplies, and by scrappage of obsolete stock.

Centralizing purchasing across the various Continuum Partners and the establishment of Healthworks has placed significant emphasis on standardizing product specifications. Standardization increases volume purchasing economies and reduces costs associated with frequent product changes such as obsolescence and staff re-training. Continuum employs standards committees consisting of a single representative from each hospital; there is a standing general nursing committee; other committees are formed on an ad hoc basis. Members of the standing committee have responsibility for discussing issues relevant to a particular specialty area with relevant individuals in their institutions and obtaining “buy-in.”

A number of environmentally preferable purchasing criteria have been developed within the Continuum system — principally at BIMC — and efforts have been made to extend these throughout the system:

- Mercury minimization is an established practice; the Healthworks catalogue is essentially mercury-free, though phase-out of mercury-containing equipment will continue for some time. (Department heads are asked to request funds for replacement of mercury-containing equipment.) Fluorescent lights are the remaining mercury-containing product in widespread use; while BIMC has recently signed a bulb recycling contract, there is not yet consistent treatment across the Continuum system.
- Continuum and Healthworks RFPs contain a statement of the organizations’ environmental commitment and a request for environmental information from vendors. The request for information covers the vendor’s environmental mission statement, information regarding product reuse or recycling options and packaging reduction, and a labeling requirement for mercury and hazardous materials content. Purchasing agents have received environmental awareness training.
- Supplies are delivered to floors/departments in plastic totes, which are reclaimed and reused.

Because of its size, and its “captive” GPO, Continuum is able to exercise significant market power and can assert environmentally purchasing preferences to vendors and manufacturers.

Outsourcing in the Continuum system is relatively limited; food services and housekeeping are in-house functions while waste management, laundry, and construction are outsourced. Warehousing and inspection functions have been outsourced to a logistics provider and the need for warehousing on hospital property has been reduced through just-in-time inventory practices. Contract term varies, although most GPO contracts are for at least three years. Several contracts are on a fee-for-service basis and contain efficiency or cost savings incentives.

Cost accounting for purchasing decisions

Clinical efficacy is the primary consideration in product selection; price/costs are considered when a decision must be made between essentially comparable products. Continuum/Healthworks only purchase market leaders, not generic or “no-name” products.

In comparing costs, an effort is made to include elements of total or lifecycle costs incurred by product alternatives beyond unit purchase price — e.g., disposal costs, training, and maintenance costs. For example, a decision was made to purchase silver-lined urinary catheters. The unit purchase cost of these catheters was higher than those without the silver lining, but the lining reduces the incidence of urinary tract infection by nearly a factor of 10. Not only is this a substantial improvement in clinical efficacy, but

the choice also provides substantial cost-savings when the costs of treating urinary tract infections are taken into account.

Purchasing typically attempts to practice “total cost awareness” rather than formal numeric analysis. More quantitative assessment of extended costs may be conducted if a formal case must be made for a particular product alternative.

Via Healthworks, Continuum follows a just-in-time inventory system in an attempt to reduce obsolescence and storage costs. OmniCells with automated billing and ordering have been instituted for high-value, compact items (OmniCells are locked storage devices that track product use – see Catholic Healthcare West profile for more description) and have significantly reduced the inventory held.

Waste streams and practices

A full-service medical center, BIMC generates the expected full complement of health care waste streams. Note that, per OSHA guidelines, staff are trained to handle all waste — not only red-bag waste — as potentially infectious.

- **Red bag waste.** BIMC follows the New York State Department of Health definition for “red bag” or infectious waste. By this definition, lab cultures, blood-caked or blood-soaked items, and pathological wastes, among others, are “red bag “ waste. Blood-tainted waste, IV bags and tubing, and isolation ward waste is not red-bagged. Red-bag waste is autoclaved off-site and landfilled. Formerly, red-bag waste was autoclaved on site and placed in the solid waste stream. Medical waste has become a sensitive issue, however, and red-bag waste— even when rendered harmless —will not now be accepted by waste management vendors concerned with how medical waste in their waste stream may appear to the public or landfill operators (see discussion under solid waste, below). Red bag treatment and disposal is on a weight basis; BIMC is invoiced monthly.
- **Solid waste** (office, packaging, and food waste). Solid waste is compacted on site and then hauled away for incineration. Compaction equipment is provided as part BIMC’s waste management contract. Previously, BIMC’s waste was landfilled out-of-state, but the issue of medical waste in landfills is a sensitive one, especially for waste originating in New York. Waste haulers are unwilling to accept for landfill waste streams that may even occasionally be contaminated by “red bag” items. Even with the best segregation procedures, BIMC’s solid waste stream cannot be 100% free of red bag items.

Some recyclables are segregated from the solid waste stream by users (see below). Solid waste is charged at a flat rate per “pull” (change-out) of the compactor containers; total tonnage is tracked to ascertain that containers are relatively full when they are pulled.

- **Sharps.** BIMC has a comprehensive service agreement to manage its sharps waste stream; the service provider supplies reusable collection containers and container collection and replacement labor. Sharps are autoclaved, ground, and landfilled. Containers are cleaned, sterilized, and reused. When costs are narrowly considered, the service is more expensive than assigning sharps collection and container replacement to housekeeping staff. However, the sharps service does reduce needle-sticks, improves housekeeping staff morale, and creates a safer environment as the

reusable containers are stronger than disposables and less prone to being overfilled. BIMC thus believes that under the service extended costs are lower and intangible benefits are considerable.

- **Radiological waste.** BIMC does not generate high-level radiological waste; material half-lives are short and decay times to background levels are 5 hours to 30 days. Once waste has decayed, it is disposed of in the regular solid waste stream. Compactor containers are equipped with radioactivity alarms which warn when a “hot” load has been placed in the compactor. Soiled diapers from patients who have undergone a nuclear medicine procedure are the most common cause of alarms; improper disposal of unused nuclear medicine materials rarely occurs.
- **Cytotoxic/chemotherapy waste.** Handling and disposal of these wastes is heavily regulated; cytotoxic drugs dispensed by the pharmacy have a color-coded label, and yellow-coded disposable containers are provided for collection of used drugs and wastes. By law, these wastes are incinerated; the service is provided off-site under contract.
- **Other hazardous or potentially hazardous waste.** Battery recycling is in the process of being implemented. Xylene was previously recycled on site until the practice was stopped due to concerns over purity of the reclaimed solvent. Used xylene is now collected for fuel-blending off-site. Silver is reclaimed onsite from photodeveloper; BIMC has recently signed a contract for recycling of its used fluorescent bulbs.
- **Office equipment/furniture.** Those surplus items that cannot be used in another facility within the network or sold are donated to “Materials for the Arts,” a New York City agency that provides surplus and second-hand equipment, furniture, and materials to arts and community organizations in the city.

BIMC has conducted waste and waste cost minimization efforts in a number of areas, as described below.

Red bag waste minimization has been a principal focus, due to its high cost of disposal — approximately five times more than solid waste per pound. Red bag waste generation has been reduced nearly 75 percent via education and container placement and labeling. (This effort has resulted in better segregation and lower costs, but not a reduction in the overall volume of waste.)

A number of solid waste reduction efforts have been or are being implemented. Collection containers are provided for mixed grade office paper; paper recycling is handled by the solid waste management vendor. Corrugated boxes are collected by housekeeping and baled for recycling. Plastic recycling is not extensive. Unsoiled plastic items from patient admission kits are collected by the vendor and reprocessed into new items. A program to recycle plastic surgery trays is being implemented. Options are being examined for alternative disposition of food wastes (currently, surplus food meeting certain criteria is donated to City Harvest, a program that distributes food to shelters).

Cost accounting for waste management

BIMC does not track waste generation by department or activity, or allocate waste disposal costs on this basis. Total disposal costs and weights/volumes are tracked, but waste generation rates are not adjusted using any normalization factors (e.g., # admissions/month) .

Waste disposal costs are, however, a bottom-line concern for BIMC. Waste streams and handling are also social responsibility concerns for BIMC:

- BIMC’s Medical Waste Manager was hired with the mandate to achieve cost savings. Total waste disposal costs are tracked. Efforts to implement changes on the basis of “total cost” considerations can be difficult, however, as the net savings to BIMC may not be reflected in the budget of the department being asked to institute changes in practices or procurement.
- As a non-profit health care provider with a distinct social mission, BIMC also has an institutional commitment to environmental responsibility.

Environmental accounting practices

BIMC and Continuum practice what may best be described as “total cost awareness”, though formal analysis of certain life cycle costs has been pursued in a small number of cases.

While attribution of disposal and other end-of-life costs to departments or activities would potentially be a very useful means to focus waste minimization efforts, gathering the necessary data is perceived as a challenge.

Summary of costs considered in purchasing and waste decisions

Purchasing

Cost	Yes?	No?	Comments
cost of acquisition	x		
cost of storage	x*		
cost of utilization	x*		
cost of outdated product	x*		Continuum has moved to JIT inventory to minimize these costs.
disposal costs	x*		
labor costs	x*		
regulatory costs	x*		
clinical effectiveness	x		primary criterion

Costs marked with “*” are often considered qualitatively. More formal, numeric analysis may be conducted if required.

Waste disposal

Cost	Yes?	No?	Comments
supply costs	X		includes cost of contract vendors
labor costs		X	not specifically segregated from housekeeping budget
licensing/permitting		X	a portion of the duties of a set of salaried staff — not independently accounted

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environmental reporting		X	as above
staff compliance training	X		
environmental staff labor	X		
environmental insurance	X		
potential liability	X		in some cases

On-site waste treatment—not applicable

Sources

Brown, Janet (Medical Waste Manager, Beth Israel Medical Center). Personal interview, October 26, 1999.

Continuum Health Partners/Beth Israel Medical Center website. <http://www.wehealny.org>

Foulke, Joanne (Corporate Director of Materials Management, Continuum Health Partners). Personal Interview, October 25, 1999.

Catholic Healthcare West/Dominican Santa Cruz Hospital

Organizational profile

Catholic Healthcare West (CHW) is a not-for-profit health care system based in northern California. With more than 10,000 acute care beds, its 46 member hospitals have about 38,000 employees and 8,600 active medical staff in California, Arizona, and Nevada. CHW has nine religious sponsors and partnerships with seven community and district hospitals.

Increasingly, purchasing is becoming a centralized function while waste management remains in the purview of each hospital. Thus, this profile describes the system-wide purchasing practices and purchasing practices at one of CHW's member hospitals – Dominican Santa Cruz Hospital. Waste management practices are exemplified by Dominican Santa Cruz Hospital.

Purchasing and cost accounting practices — system-wide

CHW's goal is to centralize its purchasing process to achieve both purchasing economies and administrative efficiencies. Currently the system's 46 hospitals are at different stages of integration. As part of this initiative, CHW's Shared Business Services (SBS) unit was established and is responsible for centralized supply chain management.

Shared Business Services recently negotiated a contract with Premier, Inc., a GPO. Premier will provide greater than half of CHW's supply contracts. Typically contracts are in effect for three to five years. During negotiations CHW brought its environmental commitment, adopted in part from the operating principles of the Coalition of Environmentally Responsible Economies (CERES), to the negotiation table. The result was the inclusion of environmental commitments in the operating principles governing the CHW-Premier relationship (sidebar).

Product standardization is a key element of CHW's centralized purchasing process and is achieved through a Council decision-making process. Councils are comprised of regional clinician representatives, SBS team members and administrative leadership. For products procured directly from suppliers, Council members establish product criteria such as safety requirements and SBS creates a request for proposal (RFP). Manufacturers submit proposals to Shared Business Services which conducts product criteria and financial analysis. Financial analysis includes: unit price, distribution fees, shipping, storage, labor and occasionally disposal costs. A monetary methodology has not yet been

Environmental commitments in the CHW-Premier operating principles

- Premier and Catholic Healthcare West will support the Coalition for Environmentally Responsible Economies (CERES), the Health Care Without Harm campaign, and the reduction of the volume and toxicity of the medical waste stream.
- Premier will assist Catholic Healthcare West in identifying products that contain mercury and PVC.
- Premier will consider the environmental impact of a product or service when selecting goods and services.
- Premier will communicate the desire for environmentally favorable products to manufacturers.
- Premier will work with Catholic Healthcare West to resolve conflicts between Catholic Healthcare West's environmental policies and Premier's policies.

finalized for environmental impact of purchase evaluation. However, it is discussed during development of criteria or during the selection process. Proposal results are presented to the Council for final product evaluation, as needed, and selection. Council decisions are then implemented throughout the organization. Powder-free latex exam gloves are a recent example of standardization utilizing the Council process.

SBS is currently deploying a centralized materials management/accounts payable information system, SAP. SAP will feature a standardized product catalog and facilitate supply ordering, standardized pricing and contract implementation tracking. Currently, two member hospitals have implemented SAP. CHW envisions SAP information as a tool to monitor product and price standardization, and contract compliance.

SAP will also be used to support CHW's system-wide goals to reduce PVC and eliminate mercury in its purchased products. At present, CHW staff are contacting suppliers to obtain information on PVC and mercury content in their products. The resulting data will be input into SAP. SAP's data will be utilized in product selection decision-making that will support PVC reduction, mercury elimination goals and future environmental initiatives. Other than mercury and PVC, other environmental concerns SAP will facilitate considering are utility costs, packaging, and, in some cases, the reusability of operating room supplies. Bulk packaging is removed by CHW's distributor before the products are delivered.

Purchasing and cost accounting practices—CHW's Dominican Santa Cruz Hospital

Dominican Santa Cruz Hospital (DSCH) is one of the 46 hospitals in the Catholic Healthcare West network. With a staff of 1300, Dominican has 275 beds.

At DSCH, the medical/surgical supply product selection process can follow two paths. The first and primary method is to adopt the CHW-standard product as identified via CHW Shared Business Services Council decisions, or central GPO contract commitments (Premier, Inc.; see above).

The alternative selection process begins with submission of a new product request to the Chairperson of Dominican's Supply Process Improvement Team. The team is comprised of a cross-section of clinical and non-clinical Dominican employees. The product champion presents the need and benefits of purchasing the new product. Team members discuss the benefits and potential pitfalls of such a new product for patients and staff. Key areas of discussion revolve around the safety, impact to patients, product quality, ease of use, ability to replace existing products or streamline a process for staff, acquisition cost, product availability, maintenance and repair, storage and environmental impact. Team members may reject the product, elect to evaluate the product or, accept/reject a product based upon the results of a cost analysis as outlined by team consensus. The infection control and security departments may be consulted in regard to certain product decisions.

Almost all products at the hospital are purchased centrally through the GPO. The few exceptions are specialized products not available from the GPO, such as equipment new to the market or exceptional purchases. In the future, when the purchasing process is centralized throughout the CHW system, there will be no outside purchases. Repair and construction services are outsourced.

Capital equipment requests are initiated by completing a Capital Cost Guide, which considers a wide range of issues such as warranty service, installation information, energy requirements, and environmental impact.

In an effort to centralize materials management and improve management oversight of product purchasing, storage, inventory, and dispensing, DSCH has begun to use an automated storage inventory system. This system uses OmniCell units — locked storage devices resembling refrigerators. The units require users to enter a user ID, product ID, and quantity before opening the door to the device and removing the products or equipment requested. As products are removed from OmniCells, updated inventory information — including stock levels, time of use, user, etc — registers on the system wide database.

DSCH has replaced most mercury-containing sphygmomanometers and thermometers with aneroid and digital alternatives. Although a limited number of mercury thermometers are still in use for infants due to concerns for infection control, mercury-containing products have been mostly eliminated from the hospital. In addition, DSCH is considering purchasing PVC-free IV bags from a vendor, as well as purchasing NiCd batteries that can be taken back by the vendor.

Although not all environmental attributes of products (e.g., product packaging) are explicitly considered in procurement decisions due to constraints of purchasing from a GPO, they nonetheless can be targets for improvement. For example, after realizing that many items in patient admit kits were not used, the hospital reduced the sizes of items (such as toothpaste) included in the kit.

Waste streams and practices at Dominican Santa Cruz Hospital

Dominican Hospital's waste can be classified in three categories:

- **Solid waste** (paper, cardboard, general trash)
- **Medical waste** (red bag, pathological waste, chemotherapy waste)
- **Hazardous waste** (mostly heavy-metal-containing substances, including batteries)

Waste is tracked hospital-wide by type and by weight in pounds. Solid waste is tracked per shipment and reported by Waste Management, the contract hauler, on an annual basis. Soon DSCH hopes to increase this tracking frequency to a monthly basis. Medical waste is tracked monthly by BFI, the disposal service provider, which allows the hospital to also track savings associated with a newly implemented waste segregation program. Per pound, hazardous waste is the most expensive stream to dispose of; it is collected on an as-needed basis. Waste generation rates are normalized using adjusted patient days.²² In tracking waste costs, aggregate, hospital-wide costs are used; they are not allocated to individual departments generating the waste.

Radioactive materials arrive from a supplier at the hospital twice a day. Unused doses are returned to the supplier, where they are tracked and disposed after undergoing monitored decay as required by regulations. Obsolete pharmaceutical inventory is sent back to the manufacturer, while obsolete metal equipment, such as parts from bed tables, is disposed of by a metal hauler. Old office furniture, such as desks and filing cabinets, is disposed of as obsolete inventory.

A particularly successful waste program implemented at DSCH was a red bag waste program. Initiated by an operating room nurse, the program began by surveying actual red bag waste to determine if they contained a significant amount of waste that did not need to be segregated from general solid waste. This

²² To arrive at total number of adjusted patient days, \$500 worth of outpatient services are counted as one patient day.

was followed by a focused program for educating health care professionals on the proper segregation of waste. Because red bag waste is significantly more expensive to dispose of, the program saved the hospital \$90,000 in its first two years of implementation, reducing red bag waste by 50%.

Environmental accounting practices

Issues relevant to environmental accounting, such as the life cycle costs of products, arise in discussions at the regular meetings of the Council. Greater attention to environmental accounting is precluded by the simple limited availability of staff time to carry out analysis as well as set up and maintain the information systems that would be required to support such analysis.

Summary of costs considered in purchasing and waste decisions

Purchasing

Cost	Yes?	No?	Comments
cost of acquisition	x		includes a fee to the distributor
cost of storage	x		
cost of utilization	x		defined as maintenance costs and repairs
cost of outdated product		x	
disposal costs	x		
labor costs	x		considered only to limited extent
regulatory costs		x	ways to incorporate this cost are being developed
clinical effectiveness	x		defined as "product quality"
other	x		has a Cost Guide for Capital Equipment considering a wide range of issues including energy requirement and environmental impact

Waste disposal – information unavailable

On-site waste treatment – not applicable

Sources:

Leziejewski, Mary Ellen (Ecology Program Coordinator, Catholic Healthcare West). Personal interview, June 16, 1999 and October 25, 1999.

Washburn, Tim (Purchasing and Department Material Management, Catholic Healthcare West). Personal interview, June 2, 1999 and October 22, 1999.

<http://catholichealthcarewest.org/aboutchw/whois.htm>

Contra Costa Regional Medical Center

Organizational profile

Contra Costa Regional Medical Center (CCRMC) is a 160 bed facility located in Martinez, California. The Medical Center is a teaching hospital, affiliated with the University of California Davis School of Medicine. The hospital is operated by the Contra Costa County Health Services Department, which also operates numerous clinics throughout the county and offers a managed health care plan to county residents.

Purchasing practices

CCRMC has a centralized purchasing system. Requests for products are initiated by department managers and go through the purchasing department. The purchasing department then creates requisitions and purchase orders, and, when necessary, obtains signature approval from the finance department. Requests for items under \$500 require no additional approval; items above \$3000 generally require four or more signatures and may involve up to 5 pages of forms.

CCRMC had contracted with the GPO AmeriNet for the last five years. Effective July 1, 1999, it switched to UHCVA/Novation, bringing CCRMC 20–23% savings over the previous GPO contract. UHCVA/Novation is serving as CCRMC's only GPO.

A GPO contract typically lasts about 3 years. In addition to the GPO, CCRMC also has a 5-year contract with a medical distributor. The distributor, which sends a representative onsite about twice weekly, re-supplies items in the hospital supply carts, which are delivered daily on an exchange basis.

CCRMC uses a real-time inventory system to track its product usage. When hospital supply carts are refilled by the distributor, an inventory for all the items in the cart is given to the hospital. Products in the supply carts are bar coded. As these cart items are used, their bar codes are scanned in by staff nurses; the inventory system acquires this usage data in real time and allocates costs for each item to the appropriate patient. This inventory system has supplanted an older system where employees were required to punch in product and user information into an enclosed storage box to obtain access to the enclosed products. The old system was more labor-intensive and inaccurate; users would often enter partial information to gain access. The new, real-time system is more cost-effective and can accurately and fully account for the \$16 million of products actually used by the hospital. In making the decision to switch to the new system, environmental considerations were not a factor.

Most of the hospital's products, including all of its medical supplies and even food items, are purchased through its GPO. Exceptions include furniture items and miscellaneous products procured locally. The local, non-GPO procurement is due to savings these vendors will offer to CCRMC as a teaching hospital. Office supplies are procured through the single supplier for the county.

There are only a few situations where hospital departments independently handle purchasing, as when a product is needed immediately. These requests still come through the Materials Management Department.

Product specifications used by CCRMC are the result of gradual standards development over a number of years, rather than the result of a single standardization effort. When specifications for a new product are

needed, a request is brought to and discussed in CCRMC's New Product or Standardization Committee, which consists of doctors, nurses, and material managers. An example of a new product that has undergone this process is the "Safe Needle," a syringe whose needle retracts after use so as to reduce the incidence of needle sticks among health care workers. Under new California legislation, safety needles are now required in hospitals. After the Standardization Committee discussed the relative merits of different types of safety needles, a particular type was selected and purchased through the GPO. If improved or next generation safety needles later come onto the market, the Standardization Committee may then weigh the benefits of switching to a newer model.

Cost accounting for purchasing decisions

In purchasing decisions, the following costs are considered:

- **Cost of acquisition** (including cost of service)
- **Clinical effectiveness**
- **Cost of storage**
- **Cost of disposal**

Of these, acquisition cost and clinical effectiveness are given the greatest weight in purchasing decisions. Storage costs can also be a significant consideration, as CCRMC has very limited storage space. CCRMC avoids purchasing through standing re-orders because of their tendency to cause product back-up. Knowing its storage capacity limitations while gathering some information from the product vendors regarding shelf life, CCRMC assesses storage and disposal costs qualitatively, rather than quantitatively. Labor costs, obsolescence costs, and regulatory costs are rarely considered.

Environmental criteria such as minimizing packaging material and hazardous material content have also been considered in some purchasing decisions. Procurement of mercury-containing products is being phased out (see below). This includes not only thermometers and sphygmomanometers, but also chemicals and dyes that contain mercury.

Waste streams and practices

The six major waste streams generated by CCRMC are:

1. **Sharps**
2. **Infectious waste**
3. **Pathological waste**
4. **Trace chemotherapy waste**
5. **Pharmaceuticals** (expired or dispensed to patient room)
6. **Solid waste**

The first four waste streams are incinerated at a facility located in Oakland. Most expired pharmaceuticals are returned to the pharmaceutical companies who provide CCRMC with a refund of 80% of the purchase price. The remainder are incinerated. CCRMC recycles cardboard, metal cans from

the cafeteria, and white paper; a new vendor will be initiating collection of various plastics (#1-5 and 7). The hospital's waste hauler recently completed a waste stream audit to further identify waste that could be targeted for recycling. CCRMC does not estimate the percent of waste recycled. Remaining solid waste is compacted prior to collection and then landfilled.

The hospital does not operate any on-site waste treatment equipment. Patient records are held for 25 years and then disposed by shredding and recycling.

Trace chemotherapy waste (e.g., residual chemotherapeutic agents in syringes or IV bags) is handled as medical waste and incinerated. Each morning, hospital staff prepare chemotherapeutic agents required for use that day. If a patient fails to appear for an appointment, the agents must be disposed of. This waste, along with any spills of chemotherapeutic agents, must be handled by a licensed hazardous waste disposal service. CCRMC was not able to provide information on generation or disposal of low-level radioactive waste (if any) associated with radiation therapy treatment, as all such treatment is through the local Veteran's Administration hospital.

In addition to the above waste streams, the hospital generates hazardous waste including xylene and formaldehyde from pathology labs, disinfectants (predominantly glutaraldehyde, used for disinfecting endoscopes), acids and solvents from labs and the engineering department (boilers), liquid paint (mostly latex-based; dried latex paint can be disposed as solid waste), and oils and solvents used for equipment maintenance. This waste is collected by a licensed hazardous waste disposal service. In an effort to reduce hazardous waste generation, CCRMC is currently testing a new disinfectant as a replacement for glutaraldehyde. Alkaline batteries are disposed of in the hospital's solid waste stream. Other batteries are collected for reprocessing or disposal as hazardous waste.

CCRMC has been phasing out use of some mercury-containing devices. Most mercury-containing sphygmomanometers have been replaced with aneroid devices. The mercury sphygmomanometers were disposed of as hazardous waste because it proved impossible to reclaim the mercury prior to disposal. Similarly, most mercury-containing thermometers have been replaced with either digital thermometers or Tempa-DOTs[®] (a disposable thermometer marketed by 3M). Although CCRMC did not conduct a formal cost analysis, the mercury-free alternative products were not much more costly, and CCRMC was concerned with protecting patients and staff from spills and exposure. Fluorescent light bulbs are collected and shipped off-site for recycling; this will soon be legally required for businesses in California.

Nursing staff training on red bag waste segregation was delivered in Summer 1999. Patient rooms contain two receptacles — one for red bag waste and one for solid waste. EH&S staff believe that opportunities exist to reduce red bag waste by educating nursing staff, thereby improving waste segregation between these two receptacles. Supplementing this program is a statewide EPA grant providing stickers and posters that identify what waste streams should be placed in red bag receptacles.

Cost accounting for waste management

CCRMC tracks the total quantity of medical waste generated, but does not track this waste by subcategories. Because the hospital's waste haulers bill by tonnage, aggregated waste generation data are available. In 1998, CCRMC generated approximately 200,000 pounds of medical waste and 600,000 pounds of non-hazardous solid waste. Many waste streams are department-specific, enabling an estimate of the relative contributions from various departments. Medical waste generation rates are normalized using in-patient days as a denominator. CCRMC medical waste reduction efforts appear to have been

effective: in 1993/94, medical waste generation was 6.56 pounds per patient day. By 1996/97, this had dropped to 4.43 pounds per patient day. Disposal of medical waste costs about 7½ times disposal of non-hazardous solid waste; this cost differential was the primary driver for reducing medical waste generation.

CCRMC tries to use the “First In, First Out” rule in its inventory, which minimizes obsolete inventory from product expiration. It does not otherwise keep track of obsolete inventory. Many of the costs associated with waste disposal are not individually tracked. For example, supplies such as bags, containers, and gloves are not tracked and janitorial labor required for waste disposal is not tracked. A medical waste permit fee, waste manifesting costs, and environmental staff labor are tracked but not allocated to departments.

Environmental accounting practices

Environmental accounting has been used by CCRMC in limited applications to inform waste disposal costs and upstream purchasing practices. For example, formaldehyde was being purchased in large containers for use by pathology. However, small pathology samples do not require these large containers. By quantifying formaldehyde disposal costs, EH&S staff were able to justify purchasing two container sizes for formaldehyde to meet the requirements of pathology staff.

In general, more extensive tracking of environmental costs is viewed as labor intensive and burdensome in the current budget-constrained climate. Quality of patient care and JCAHO (Joint Commission on Accreditation of Healthcare Organizations) requirements and reviews necessarily receive top management priority.

Summary of costs considered in purchasing and waste decisions

Purchasing

Cost	Yes?	No?	Comments
cost of acquisition	x		
cost of storage	x		
cost of utilization	x		
cost of outdated product		x	
disposal costs	x		
labor costs		x	
regulatory costs		x	
clinical effectiveness	x		

Waste disposal

Cost	Yes?	No?	Comments
supply costs		x	
labor costs		x	
licensing/permitting	x		
environmental reporting	x		
staff compliance training	x		
environmental staff labor	x		
environmental insurance		x	
potential liability	x		e.g., in mercury

On-site waste treatment — not applicable

Sources:

Friedman-Vasquez , Lacey (Contra Costa County Regional Medical Center). Personal interview, June 22, 1999 and follow up e-mails.

Frith, Betty (Materials Management, Contra Costa County Regional Medical Center). Personal interview, July 27, 1999.

Dartmouth Hitchcock Medical Center

Organizational profile

Dartmouth-Hitchcock Medical Center (DHMC) is an academic medical center located in Lebanon, NH. Its member institutions are the Dartmouth Medical School, founded in 1797; Mary Hitchcock Memorial Hospital, founded in 1893; The Hitchcock Clinic, founded in 1927; and the Veterans Affairs Medical Center in White River Junction, Vermont, which opened in 1938. With 6000 employees and volunteers, the DHMC-Lebanon campus houses 400 licensed beds.

Purchasing practices

DHMC purchases from one GPO, VHA, which provides DHMC with the majority of its purchase volume. DHMC implemented environmental procurement practices several years ago, eliminating, for example, the purchase of mercury sphygmomanometers in 1990. Its Materials Safety Data Sheet (MSDS) Management System and its Hazardous Chemical Management System are both connected to the electronic purchasing system, allowing DHMC to identify banned or restricted products, thereby eliminating or curtailing their purchase.

More recently, due to mergers and acquisitions, resources have been directed towards coordinating materials management functions throughout DHMC rather than environmental procurement. However, DHMC is implementing a new “value analysis” strategy that will facilitate a more strategic approach to procurement, including environmentally preferable procurement.

DHMC's mercury purchasing policy prohibits purchasing of mercury-containing products without prior approval. In addition to replacing mercury sphygmomanometers, DHMC substituted water for mercury in its Miller Abbot tubes. By eliminating the mercury, DHMC reduces its environmental liability and expends less time and resources in manifesting used tubes as hazardous waste. DHMC has also phased out all mercury thermometers.

Waste streams and practices

DHMC generates the following waste streams:

- **Infectious waste.** Treated in an autoclave on-site, infectious waste constitutes 14–17% of DHMC's total waste stream.
- **Hazardous waste.** Most hazardous waste is hauled away and disposed off-site by a waste handler. Some hazardous waste, such as xylene and alcohol from labs, is recycled in solvent stills on-site.
- **Pathological waste** is incinerated off-site.
- **Chemotherapy waste.** This waste stream consists of chemotherapeutic agents and materials used in administering chemotherapy including PVC tubing, contaminated gowns, gloves, and bags. It is collected in buckets and incinerated off-site.

- **Low-level radioactive waste** is stored in a decay room in the radiology department. After decaying to safe levels, it is subsequently disposed of as solid waste.
- **Radiology films** are recycled, and silver from developing chemicals is recovered on site.
- **Potentially recyclable waste and potentially reusable waste** includes white paper; mixed glossy paper; cardboard; glass; tin; aluminum; plastics #1, 2, and 4; text books; cartridges; overhead transparencies; computer CDs; and videotape. Paper goods and metals are substantially recycled.
- **Solid waste**, which excludes traditionally-defined solid waste that can be recycled or reused, is sent to a landfill.

DHMC tracks all of its waste streams by weight on a monthly basis, except for reusable/donated items. Waste figures are not normalized by activity and are not tracked by departments, as waste containers are not barcoded to allow such tracking. Fifty-five percent of DHMC's monthly waste stream is solid waste and 35% of the total waste stream is recycled. Each month, DHMC generates 8–9 tons of white paper, 7–12 tons of mixed glossy paper, and approximately 15 tons of cardboard for recycling.

For potentially reusable items in the solid waste stream, DHMC provides an on-line “trading post” to facilitate locating uses for discarded furniture, electronics, etc. Discarded items that cannot be reused on-site by other employees are donated to community centers. DHMC's outdated IV bags can sometimes be donated to a wild life center; outdated liquid food can be donated to farms. Blankets, sheets, and towels with slight stains and/or tears, opened but unused bandages, etc., are donated to medical facilities in developing countries.

The handling of obsolete pharmaceuticals is highly case-dependent. Some are returned to the manufacturer; unregulated, over-the-counter drugs are disposed of as regular trash. Regulated drugs such as narcotics can be disposed of only after the state or national board of pharmaceuticals has been notified, and are handled as a separate stream.

One challenge DHMC faces is educating its staff on the proper disposal methods for all wastes. At one point, for example, 47% of DHMC's waste was being incinerated in red bags. To reduce red bag content, Dartmouth offered training courses to staff, improved waste labeling, and removed red bag receptacles from patient rooms. With these efforts in place, red bag waste decreased by 20% in one month, and was eventually cut down to just 15% of DHMC's total waste volume.

DHMC operated an on-site incinerator until 1995. The incinerator was removed from service because of damage to the stack caused by thermal shock from frequent start-up and shut-down. (DHMC's permit allowed the incinerator to run only 16 hours per day). After a full cost assessment, DHMC found that repairs and continued operation were not cost effective. An on-site autoclave now provides on-site treatment for 99% of DHMC's infectious waste, and the remaining 1% is sent off-site to be incinerated.

Cost accounting for waste management

DHMC tracks its waste costs by waste stream types. Autoclaved waste is tracked in tons. Pathological and chemotherapy waste costs were formerly tracked in tons but are now tracked by number of boxes under a new waste contract. Hazardous waste disposal costs are obtained from the waste hauler, either by

weight or by volume. Recyclable waste such as white paper and metals is tracked by weight; sale of these materials also generates revenue.

DHMC informally tracks obsolete inventory. A capital equipment management system tracks equipment depreciation. A more rigorous tracking of obsolete inventory — both in terms of product value and labor costs—has not yet been implemented due to resource constraints.

In order to avoid creating incentives for improper disposal, hazardous waste disposal costs are covered by the EH&S budget and are not allocated to individual departments. DHMC does, however, educate the departments regarding costs of disposal for all waste streams.

The following costs are tracked and accounted for:

- **Supply costs for waste disposal** (e.g., bags, containers, gloves). Some of these costs, such as spill supplies, are allocated under EH&S. Routine supply costs (e.g., bags, gloves) are allocated to the housekeeping department.
- **Labor for waste disposal.** Besides its housekeeping staff, who dispose of waste in the course of their duties, DHMC funds waste management activities under its “Environmental Program Management” (EPM) unit. This includes three full-time employees in the waste management center, who process the waste. Waste disposal labor also includes labor for weekly hazardous waste inspections, autoclaving, and recycling. Also included is the labor time for the Biosafety and Environmental Programs manager, whose responsibilities include obtaining all relevant environmental permits.
- **Licensing/permitting costs for waste treatment/disposal.** These costs are also allocated under EPM.
- **Staff training costs for environmental compliance.** Allocated under EPM.
- **Environmental staff labor time,** allocated under EPM.

The following waste treatment costs are accounted for in operating the on-site autoclave:

- **Equipment cost**
- **Maintenance cost.** This includes spare parts, labor, and autoclave quality control (quarterly bacterial culture test).
- **Supply costs.** This includes the cost of autoclave bags (allocated to the housekeeping department), and the cost of protective gowns, gloves, and masks (allocated to waste management).
- **Labor costs,** allocated to housekeeping.
- **Cost of emissions testing** for both water and air.

Energy costs for the autoclave are not routinely tracked, although they were taken into account when DHMC considered alternatives to its incinerator.

Waste disposal costs are not allocated to individual departments (as could be accomplished, for example, via department-by-department waste tracking). DHMC believes that the best waste minimization strategy — the one that presents the fewest incentives for improper disposal — is repeated and persistent education of its staff.

Environmental accounting practices

Despite the potential barrier of finding computer resources to support general application of an environmental accounting tool, DHMC feels that it would benefit from such a tool. In the recent past, environmental accounting was used by DHMC in deciding to decommission its on-site incinerator and to replace it with an autoclave. To continue operating the incinerator, DHMC would have been required to replace the incinerator stack. The hospital also considered potential cost of violations resulting from incinerating mercury-containing products. In its decision-making, the following costs were considered:

<i>Incinerator</i>	<i>Autoclave</i>
Replacing incinerator stack	
Air emissions testing	
Potential air emissions violations, including mercury	Equipment and supplies
Ash testing	Maintenance
Maintenance	Labor
Labor	Air emissions testing
Energy	Energy
Equipment and supplies	

Mercury minimization is another area that has benefited from environmental accounting. For example, DHMC assessed the costs and savings of switching from mercury to water in Miller Abbott tubes. In doing so, DHMC considered both hazardous waste disposal costs and potential liability costs (fines) resulting from the incineration of improperly segregated tubes.

Currently, DHMC is phasing out ethylene oxide (EtO), a gaseous sterilant. Environmental accounting has been employed in support of this decision (see case study, Appendix B).

Summary of costs considered in purchasing and waste decisions

Purchasing — information unavailable

Waste disposal

Cost	Yes?	No?	Comments
supply costs	x		Some costs (e.g., spill kits) allocated to EH&S; routine supplies (e.g., bags, gloves) allocated to housekeeping
labor costs	x		
licensing/permitting	x		allocated under Environmental Program Management
environmental reporting			—
staff compliance training	x		
environmental staff labor	x		
environmental insurance		x	
potential liability			—

On-site waste treatment — autoclave

Cost	Yes?	No?	Comments
equipment costs	x		
maintenance costs	x		
supply costs	x		
labor	x		
utility costs		x	not routinely tracked, but was considered in analysis comparing incineration costs to autoclaving
other	x		air and water emissions testing

Sources:

Brannen, Laura (Environmental Program Coordinator, Dartmouth Hitchcock Medical Center). Personal interview, August, 1999.

Dartmouth Hitchcock Medical Center website: <http://www.hitchcock.org>

Dana Farber Cancer Institute

Organizational profile

The Dana Farber Cancer Institute (DFCI), located in Boston, is a teaching affiliate of the Harvard Medical School. An independent institution also affiliated with Partners Healthcare, DFCI has over 2,000 staff members. Dana-Farber specializes in cancer research and provides care to children and adults with cancer while advancing the understanding, diagnosis, treatment, cure, and prevention of cancer and related disease. In February 1997, DFCI licensed its beds to the neighboring Brigham & Women's Hospital and became an outpatient facility.

Purchasing practices

DFCI has a centralized purchasing department, which oversees purchasing for both its clinical area and its research labs. All departments subscribe to the central purchasing process.

Purchase requisitions are initiated by the department of the end-user and sent to purchasing, which converts them into purchase orders. Items that are less specialized can be purchased by employees in DFCI's general store, using a purchasing code assigned to each department. Such purchases may be subject to spending limits, depending on the position of the purchaser.

A Standards Committee for Patient-Related Quality Assurance reviews clinical product specifications. A Research Purchasing committee was recently formed to review research products purchased by DFCI laboratories. The Safety Department also reviews some items for both the laboratory and clinical settings.

DFCI contracts directly with one GPO, AmeriNet, and also utilizes GPO contracts held by Partners Healthcare. DFCI purchases about 60% of its products — mostly clinical — through these GPOs. GPOs are not utilized for procuring laboratory supplies due to the unique mixture and relatively small volumes of products required. Most of the GPO contracts are of two years duration, though some are as many as five. In the last two years, DFCI has devoted significant attention to cost control.

Since the beginning of 1999, Dana Farber has been taking part in several efforts to examine environmentally preferable purchasing, including the Healthcare Environmentally Preferable Purchasing Roundtable through Massachusetts' Executive Office of Environmental Affairs, a DFCI Business Managers Group and the DFCI Recycling Committee. The recycling committee consists of the purchasing director, facilities managers, DFCI's EH&S specialist, Environmental Services, Communications, a Research representative, and other interested parties. This committee, working with the business managers and purchasing roundtable, hopes to make changes to an existing on-line purchasing tool in order to inform the user of alternative, less toxic products, as well as provide the user with information on the shelf-lives of products to avoid unnecessary waste. Other non-cost factors considered in purchasing include recycled content and recyclability and disposal costs.

Involvement by the EH&S department in procurement decisions is mostly informal and self-motivated. For example, EH&S personnel may talk to employees about the safety concerns of unlaminated mercury thermometers and suggest alternative products, or may bring a list of toxic chemicals to the attention of the purchasing department.

Mercury thermometers are still used by some practitioners in the Pediatric Oncology department for oral measurements; blood pressure cuffs are still mercury-based for accuracy. Mercury thermometers used in labs are coated with Teflon to prevent breakage. Among all the mercury-containing products, DFCI is focusing on phasing out thermometers, which are more prone to breakage and subsequent spills, and placing less emphasis on phasing out sphygmomanometers, which are less breakage-prone and hence pose fewer risks. The switch to mercury-free thermometers is posing a challenge for the Pediatric Oncology department. Care in this department requires temperature measurements of very high precision; physicians believe that the currently available digital and tympanic thermometers have an unacceptably high standard deviation. (Tympanic thermometers are being phased in for some applications.) Although the majority of thermometers in research departments have been switched to alcohol thermometers, irregularly shaped thermometers are still of the mercury type and most of these are unlaminated. Purchasing notifies EH&S when mercury thermometers are being purchased so that alternatives may be discussed.

DFCI is also turning its attention to phasing out chemicals with mercury-containing ingredients. The first product to be phased out was a bleach that was found to contain 1 part per million mercury. This was a difficult product to phase out, as the replacement had to meet EPA standards for tuberculocidal capability *and* be mercury-free. After an extensive search and sampling, a replacement was found. DFCI is paying especially close attention to “hidden” mercury sources such as the ingredient thimerosal, which is present in very small amounts in many testing kits and is used as a fungicide and preservative in experiments. Because thimerosal is usually present in portions of less than 1%, it often is not listed on material safety data sheets (MSDSs). DFCI has tested over 30 other products that enter the sewer system to determine if they contain similar sources of “hidden” mercury. In some cases, as in tissue samples received from another hospital and preserved in a mercuric chloride solution, DFCI is neither the upstream procurer nor downstream user of mercury-containing products, and therefore has relatively little say in substituting mercury-free counterparts.

The amount of packaging contained in a product has become a criterion in purchasing decisions. To minimize packaging waste, DFCI works with vendors to try to aggregate the shipment of smaller items into larger boxes and to use reusable plastic totes for products whenever possible. Because DFCI is small and interested in reducing the amount of solid waste produced as a result of its actions, it has greater flexibility to consider packaging and resulting waste disposal costs in its materials management decisions.

Among DFCI’s services, housekeeping, food service (DFCI’s cafeteria), security, and most construction services are contracted out. Housekeeping and food service contracts are both of five years duration. Housekeeping is responsible for all sanitation duties, including collection of biohazardous and regulated waste. The housekeeping contract is based on an annual fee per building; DFCI’s EH&S department has worked with the housekeeping services provider in switching to all aqueous, odorless cleaning products. In general, the housekeeping department is environmentally conscious and works closely with purchasing, EH&S, DFCI’s recycling committee, and other vendors. For example, DFCI’s waste hauler provides red bags for collecting biomedical waste. Housekeeping is working with the waste hauler to identify non-cadmium-containing red bags.

Cost accounting for purchasing decisions

The costs considered in purchasing decisions include the following:

- **Cost of acquisition** (i.e., unit purchase price of an item)

- **Storage costs**, which are informally accounted for, include space and moving costs associated with stock inventory.
- **Cost of obsolescence.** While not traditionally considered, this cost is beginning to be addressed by EH&S.
- **Labor costs** are not extensively considered, although stock room and delivery labor is considered.
- **Clinical effectiveness** is an important concern and is addressed in the purchasing procedures.

In making purchasing decisions, DFCI also considers indirect costs of products such as their lifespan, end-of-life costs, and any end-of-life trade-in value. With the recent formation of the purchasing committees and the Recycling Committee, regulatory costs are beginning to be considered.

Waste streams and practices

As an outpatient research institution, DFCI generates the following waste streams:

1. **Hazardous chemicals.** Generated mostly by laboratories, these are manifested monthly.
2. **Radioactive waste.** This waste is also generated mostly from laboratories. It is tracked monthly and stored for ten half-lives to drastically reduce its radioactivity. It is subsequently disposed of as regular waste.
3. **Biological waste.** Tracked monthly, this waste is further divided into two sub-categories, depending on its source. The orange-bagged waste from laboratories (approximately 70% of total) is autoclaved on-site and then incinerated off-site, while the remaining 30% (red-bagged clinical waste) is directly incinerated. Massachusetts biotechnology waste laws require this separate treatment; the rationale is to immediately inactivate live laboratory cultures.
4. **Chemotherapy waste.** This is tracked monthly and treated separately.
5. **Construction waste.** This is tracked on an as-needed basis by number of dumpsters filled.
6. **Municipal solid waste**
7. **Paper and pallets.** Clinical patient records are shredded and recycled. Although no full recycling program is currently in place, DFCI is trying to lay the groundwork for a future initiative. All other paper is recycled through the solid waste hauler. As phone books are difficult to recycle and the service provider will not take them back, DFCI is working on delivering phone books on an as-needed basis only. An on-line phone book is now available to employees with access to a computer.
8. **Universal waste.** Defined by the Universal Waste Law, this waste stream includes oil, batteries, and fluorescent light bulbs — items that are generated by ordinary households but are nonetheless hazardous. This waste is separated by a disposal service company and recycled.
9. **Dietary waste.** This includes food; styrofoam; and glass, steel, and tin containers, which are recycled. Food waste becomes part of the municipal solid waste stream.

10. **Mixed waste.** This laboratory waste stream consists of a mixture of hazardous chemicals and radioactive chemicals.
11. **Laboratory instruments, furniture, and appliances.** This waste stream is collected as it is produced and re-distributed.
12. **Laser toners.** These are taken back for remanufacturing.
13. **Styrofoam shipping containers.** These are returned to the shipper or re-used on site for transport of cold materials.

Obsolete instruments and equipment are treated in a number of ways. Some instruments and equipment are donated to hospitals in South America through a program sponsored by the American Medical Research Foundation. Some are resold to a dealer, with the proceeds benefiting the Jimmy Fund. In addition, DFCI is exploring the possibility of remanufacturing some of these obsolete instruments.

Expired clinical drugs are taken back by the manufacturer or, when less than 2 years past the expiration date, given to researchers to use for experiments. Experimental drugs used for research purposes, when expired, are not taken back, but incinerated.

DFCI operates its own on-site autoclave, acid neutralization sewer pre-treatment systems, and storage facility for radioactive waste. Under Massachusetts' mandate for biotechnology waste, labor and energy costs must be accounted for in operating the on-site autoclave.

In some cases, the EH&S department cannot treat hazardous chemicals directly because the laboratory that generates the hazardous chemicals is defined as a "generator" by hazardous waste law and must itself treat the waste. Where possible, EH&S encourages laboratories to include waste treatment (e.g., ethidium bromide inactivation, mitomycin C inactivation, and acid and base neutralization) into their standard operating procedures (SOPs). If treatment is not included in SOPs, (lab research staff have no financial or regulatory incentives to do so, and treatment may be time-consuming), then these wastes are handled as hazardous waste through DFCI's hazardous waste program.

DFCI is a WasteWise participant; WasteWise is a voluntary US EPA voluntary solid waste reduction program that assists DFCI in tracking its waste reduction. DFCI's 1999 WasteWise goals were met and exceeded. Goals for 2000 include red bag waste reduction, glass and plastics recycling, and paper reduction through the use of DFCI's "intranet" for circulating manuals and forms.

Cost accounting for waste management

The most significant cost item for waste management is the labor associated with disposal. Both this cost and the costs of waste disposal supplies are allocated to the housekeeping department. Other items such as licensing/permitting costs for waste treatment/disposal, environmental reporting costs, environmental compliance training costs, and environmental staff labor time are allocated to the environment, health, and safety (EH&S) department. DFCI is highly attentive to proper disposal of biological waste and sharps, because improper disposal may result in high costs to public health and is extremely damaging to its institutional image. Thus, DFCI considers potential liability costs associated with disposal of these waste streams. Liability is also considered in DFCI's choice of hazardous waste hauler. Before a contract is signed with the transport, storage, and disposal facility (TSDF), DFCI staff visit the contractor's facility and examine its compliance record.

Disposal costs for the above waste streams are not tracked by departmental activity, nor are they allocated to the department that generated them. One exception is the disposal cost of radioactive waste, which is charged to the department using the materials; radioactive waste is closely monitored throughout its life cycle. Another exception is the maintenance cost of certain laboratory suites, including waste disposal costs; these are charged to the department renting the particular suite.

DFCI recently instituted a Recycling Committee to work with vendors and discuss the recyclability of products such as mercury-containing fluorescent light bulbs. The recycling committee is allocated a small budget for costs incurred from recycling programs and initiatives. For example, previously when CRTs were being disposed, disposal costs were allocated to DFCI’s disposal budget. Now that CRTs are being recycled, costs for recycling CRTs are charged against the recycling committee’s budget.

As the Institute becomes more cost-conscious, it is becoming aware of the cost of red-bag waste. DFCI is examining opportunities for reducing red bag waste without compromising public health.

The implementation of EPA’s Charles River Initiative had a direct effect on DFCI. To improve awareness of environmental regulations among DFCI researchers, the EH&S department conducted mock EPA inspections. These mock inspections have improved compliance in the laboratories.

Environmental accounting practices

At DFCI, the systematic use of environmental accounting to inform decision-making is limited. Inter-departmental communication requisite for environmental accounting is the main barrier, in DFCI’s opinion. A key to successful EA would be to educate those making decisions across departments, especially in the lab, and to allocate costs back to respective areas and departments.

Because of the renewed interest in justifying operating costs, DFCI believes that environmental accounting practices can be incorporated into its procurement program under development. Other disposal issues, such as radioactive waste disposal and the use of environmental services in laboratory suites, also present possible issues that can lend themselves to the tool of environmental accounting.

Summary of costs considered in purchasing and waste decisions

Purchasing

Cost	Yes?	No?	Comments
cost of acquisition	x		
cost of storage	x		informally considered
cost of utilization		x	
cost of outdated product		x	
disposal costs		x	
labor costs		x	only stocking costs
regulatory costs	x		considered only recently, after the formation of a purchasing committee
clinical effectiveness	x		
other	x		lifespan, disposal costs, and trade-in value

Waste disposal

Cost	Yes?	No?	Comments
supply costs	x		allocated to housekeeping
labor costs	x		allocated to housekeeping
licensing/permitting	x		allocated to EH&S
environmental reporting	x		allocated to EH&S
staff compliance training	x		allocated to EH&S
environmental staff labor	x		allocated to EH&S
environmental insurance		x	
potential liability	x		

On-site waste treatment — autoclave

Cost	Yes?	No?	Comments
equipment costs	x		mandatory in MA for biotechnology waste
maintenance costs	x		
supply costs	x		
labor	x		
utility costs	x		

Sources:

Forrest-Bowes, Louise (Purchasing, Dana Farber Cancer Institute). Personal interview, August 10, 1999.

McCullough, Melissa (Environmental Compliance, Dana Farber Cancer Institute). Personal interview., July 19, 1999.

Halifax Medical Center

Organizational profile

Halifax Medical Center (HMC) is a 545-bed, 2000-employee community hospital in Halifax, Florida. The hospital is a secondary referral center for a population of about 300,000 in North Central Florida. HMC is a part of an Integrated Delivery Network (IDN) with its own 46,000-member HMO. A designated Level II trauma center, HMC also incorporates a neonatal intensive care unit and an inpatient pediatrics unit. HMC is a public hospital chartered by the Florida Legislature; its 7-member Board of Commissioners is appointed by the Governor.

Purchasing practices

Product specifications for medical and surgical items are determined by each department. Purchasing of these products, as well as non-clinical, generic products (e.g., office supplies) is initiated by department managers and/or nurses. HMC maintains an electronic requisitioning system. A staff delegate from each department enters purchasing requests into the system. Buyers from the centralized materials management department review these requests and generate purchase orders electronically. A few of HMC's departments, however, purchase independently. The pharmacy department, which buys almost all of its drugs through Novation, handles its own purchasing. The Plant Services department, for whom required commodities such as air conditioner filters or boiler supplies are not available through GPOs, purchases independently. However, single-item purchases exceeding \$10,000 must be ordered through the materials management department.

Seventy to eighty percent of HMC's purchases are from VHA-Novation, one of the largest GPOs. Purchases outside the GPO, in the form of locally negotiated contracts, are driven by clinical needs, price advantages, or, sometimes, physician preferences. For example, non-latex gloves may be procured for staff with latex allergies. Similarly, physician preferences for orthopedic implants or pacemakers may drive purchasing outside the GPO. Many products — such as produce and housekeeping chemicals and supplies — can be acquired for lower prices through local vendors. For example, the dietary department issues six-month bids for fresh produce and the materials management department procures the remainder of the dietary department's supplies from various vendors.

Novation uses a carrot, rather than a stick, to encourage its customers to purchase on an exclusive basis as possible. Rather than requiring committed purchase volumes, Novation offers an "opportunity" bundle of products. HMC receives a 6% rebate on purchases of products that are included in this bundle. However, in order to receive the rebate, the hospital must purchase each and every product included in the bundle.

HMC's supply process distribution (SPD) system serves as a centralized inventory system to maintain supplies on a par level, with most supplies replenished once per week. Accessing the same database as the electronic requisitioning system, the SPD system prevents duplication of supply orders and ensures that supplies do not linger in inventory, thereby minimizing obsolescence.

Among HMC's purchasing criteria, the primary concern is a product's clinical effectiveness, followed by product cost. Other factors — such as environmental impact — do not generally affect purchasing decision-making significantly, although some environmental costs, as described in the next section, are

considered in purchasing decisions. HMC is, however, attempting to phase out mercury-containing products such as thermometers and sphygmomanometers by replacing them at end-of life with digital or aneroid counterparts. Mercury thermometers are still in use by the pediatrics department, with some exceptions, such as when temperature is taken from the ear.

Most services departments at HMC are in-house, with the exception of the information systems department, which is outsourced. Contract lengths vary from three to five years, but typically are three years in length.

Cost accounting for purchasing decisions

A Product Cost Containment Committee at HMC oversees decisions on product purchasing changes that would affect multiple departments and evaluates and keeps track of cost savings resulting from product changes. It also takes responsibility for educating personnel on product issues such as proper disposal. The committee is comprised of staff from multiple departments, including materials management, clinical departments, and laboratories. Environmental staff are included on an as-needed basis to review Material Safety Data Sheets, product disposal issues, cleaning supplies that may affect employee or patient safety, and spill kits for mercury thermometers.

In a recent example of cost tracking, a compression sleeve that used to be single-use is now refurbished, re-sterilized, re-certified, and brought back to the original specification by its manufacturer. The manufacturer then only charges half the price for a reprocessed compression sleeve, generating significant cost savings for HMC.

In evaluating the cost advantages of purchasing changes, the committee focuses on marginal costs and savings associated with the change. For example, in a recent evaluation of reusable versus disposable surgical trays, the committee looked at changes in labor costs and reprocessing costs (e.g., wrapping for the trays, sterilization indicators, and water and chemicals required for reprocessing).

HMC's value analysis process for evaluating product alternatives considers the following costs:

- **Clinical effectiveness** is the primary consideration in purchasing decisions.
- **Cost of acquisition** includes utilization rate, freight cost, and actual product unit costs, which are all annualized and examined.
- **Cost of storage** can be difficult to quantify and has been estimated to be about 10% – 15% of total product cost. For HMC this includes the opportunity cost of money, square footage cost (8% –10%), and the cost of theft and pilferage from the products' shelf.
- **Cost of utilization** is calculated using a utilization factor, defined as the rate at which an item is used annually.
- **Obsolescence cost** is usually a small part of storage cost, whose calculation is facilitated by HMC's inventory database. Products can be characterized as either "slow-moving" or "no-moving." Obsolescence is further avoided by a "first-in, first-out" policy.
- **Disposal costs** were not an important factor in the past, as HMC operated an on-site incinerator with heat recovery that incinerated all of HMC's waste. Recovered steam offset energy

purchases. However, disposal costs are becoming more important as regulatory costs drive up the cost of incinerators. Ordinarily, this is relevant mostly in cases of choosing between disposable and reusable products.

- **Labor costs** are less likely to be considered, as they are only meaningful when full-time equivalent positions (FTEs) are eliminated, not when labor time is incrementally reduced (unless overtime costs are reduced).
- **Regulatory costs** are not formally considered.

Waste streams and practices

HMC's waste stream consists of:

- **Solid waste**
- **Biomedical waste** (waste that has been in contact with patients or is otherwise potentially infectious)
- **Hazardous waste** (e.g., paints, oils, xylene, and formalin)
- **Confidential patient records** (paper waste)
- **Low level radioactive waste**

Solid waste is compacted and taken to a landfill. Biomedical wastes (wastes from red bags in patient rooms and operating rooms) as well as pathological wastes (e.g., laboratory specimens and unsaturated bandages) and chemotherapy wastes, are burned in an on-site incinerator, or are incinerated off-site when onsite disposal is unavailable.

HMC is a small quantity generator of hazardous waste. The hospital recycles xylene and some formaldehyde; the remainder of the hazardous waste stream is collected by a licensed hazardous waste disposal company.

The suppliers of radioactive materials take responsibility for removing and disposing radioactive waste.

In addition to the above waste streams, HMC's radiology department generates film and silver wastes. Both are picked up by a vendor for recycling. Spent chemicals used in film development are disposed of, under permit, as part of wastewater. In the past, HMC collected cardboard for recycling. As the process was too labor intensive, cardboard recycling was suspended. Fluorescent light bulb ballasts are also segregated from the waste stream and collected by a vendor for recovery or disposal as hazardous waste.

To help prevent non-biomedical waste generated in patient rooms from being placed in red bags, HMC is installing red bag dispensers in each patient room to be used by medical staff. Upon completion of the procedure, the staff person will remove the red bag to a utility room.

Halifax maintains an on-site incinerator, licensed to incinerate 1350 pounds of non-hazardous material per hour. Prior to mid-1999, Halifax incinerated confidential patient records, generated in the hospital at the rate of 25,000 pounds per week, as well as solid waste and biomedical waste. However, due to relicensing, the incinerator can now only burn biomedical waste. This has necessitated establishing waste

segregation programs to drastically reduce the amount of waste going into the incinerator. Currently, patient records are separately collected and shredded on-site and solid waste is compacted and landfilled. Incinerator activity is logged continuously; stack emissions are monitored every six weeks by the EPA. Incinerator ash is collected and disposed of as regular waste off-site. Currently, just over 40,000 pounds of biomedical waste are incinerated each week.

Currently, systematic waste tracking is performed only for obsolete inventory, through the supply process distribution system. Activities that HMC considers overly labor-intensive, such as waste tracking at the department level and tracking of packaging waste, are not implemented. However, as HMC moves away from incinerating all its waste and toward greater degree of waste segregation, waste tracking — most likely by weight in each waste category — will likely prove to be more rewarding.

Cost accounting for waste management

Various waste-related costs are tracked. Supply costs for waste disposal (e.g., bags, gloves) are tracked, as are labor costs for waste collection on annual, weekly, and daily bases. Licensing/permitting costs for waste treatment (i.e., for the incinerator) are also tracked. These costs are allocated to the Facility Operations department. Environmental reporting costs are allocated to the EHS department. None of these costs are allocated back to the departments generating the waste.

The incinerator is the only waste treatment equipment operated by HMC. The operations and maintenance costs of the incinerator are tracked by a central computer program called “AIMS” identifying each machinery part by an ID number and tracking maintenance work orders. Costs for operator training and labor, incinerator maintenance, stack emission testing, and ash disposal are allocated to the Plant Operations department. Fees for a complete test of stack emissions are approximately \$2000 annually. Hauling fees for incinerator ash are \$900 per month. Other fees include operating permits, to be renewed every five years. HMC experiences significant incinerator down-time due to maintenance and repair of the incinerator's scrubbers. When the incinerator is inoperative, HMC incurs additional disposal fees for waste that would otherwise be incinerated. At \$500,000 annually, these extra disposal fees represent a significant cost.

In addition to additional disposal fees incurred when the incinerator is down, Halifax has another strong incentive to operate its incinerator: the steam generated therein is used to sterilize medical equipment, is used to operate an on-site laundry, and can also substitute for one of the facility's three boilers. It is estimated that the annual cost savings from reduced boiler operation is \$50,000.

Environmental accounting practices

While HMC, in the past, tracked its waste generation by waste stream types, tracking efforts were suspended since the hospital's on-site incinerator was handling all waste streams (except for hazardous waste). However, the relicensing of the incinerator, which now limits the incinerator to burn biomedical waste only, is driving a renewed interest in waste tracking. HMC is likely to reinstate waste tracking, although it probably will not track waste generation by department as this is viewed as too labor intensive.

Summary of costs considered in purchasing and waste decisions

Purchasing

Cost	Yes?	No?	Comments
cost of acquisition	x		
cost of storage	x		estimated
cost of utilization	x		
cost of outdated product	x		included in storage costs
disposal costs		x	only considered when choosing between disposable and reusable products
labor costs		x	
regulatory costs		x	
clinical effectiveness	x		

Waste disposal

Cost	Yes?	No?	Comments
supply costs	x		
labor costs	x		allocated to Environmental Services department
licensing/permitting	x		allocated to Facility Operations dept.
environmental reporting	x		allocated to Environmental Services
staff compliance training		x	
environmental staff labor	x		
environmental insurance		x	
potential liability		x	

On-site waste treatment -- incinerator

Cost	Yes?	No?	Comments
Equipment costs			not relevant
Maintenance costs	x		
supply costs			not relevant
Labor	x		includes operator labor and training
utility costs	x		avoided costs of operating boiler
Other	x		includes stack emissions testing, operating permits, and ash disposal

Sources:

Beal, Tom (Manager, Materials Management, Halifax Medical Center). Personal interview, June 8, 1999.

Stohler, Al (Assistant Manager, Plant Operations, Halifax Medical Center). Personal interview, June 14, 1999.

Norton, Mitch (Manager, Safety, Health & Environment, Halifax Medical Center). Personal interview, June 28, 1999.

“About Halifax Medical Center.” <http://www.halifaxfrp.org/hospital.htm>

Kaiser Permanente

Organizational profile

Kaiser Permanente, the country's largest not-for-profit Health Maintenance Organization, serves 8.6 million members in 17 states and Washington, D.C.; 5.8 million members are located in California. With more than 90,000 employees and 10,000 group practice physicians, Kaiser Permanente's integrated health delivery system owns and operates 30 hospitals and 360 clinics.

Purchasing practices

Kaiser Permanente purchases about \$5 billion of commodities and services annually, with national, regional, and facility-based procurement. Major items (other than pharmaceuticals) are purchased via direct national contracts with the manufacturer, managed by Kaiser Permanente's national purchasing organization (NPO); this national level procurement accounts for about 35% of all Kaiser Permanente purchasing on a dollar basis. Kaiser Permanente's large size and direct relationship with clinical and business users allows its NPO to negotiate better than GPO-like economies in its direct purchasing; Kaiser in effect has an internal GPO. Kaiser Permanente facilities must purchase commodities that are contracted on a national basis via the national procurement process. Procurement at the regional and local levels is generally limited to either those products and services that are not considered strategic or are not provided nationally (e.g., hazardous waste disposal services), or items procured in small quantities nationally, and thus not subject to significant economies of scale.

National contracts for outsourcing of services varies somewhat by region. For example, while laundry and linen service is covered by a national contract, food service is generally outsourced regionally.

Specifications for items covered by national contracts may be set in one of a few ways: (1) for items that result in only minor changes from current procurement, a project-based commodity manager may make the necessary decisions; (2) a sourcing and standards team (SST) may use a prescribed approach to formulate product specifications and select potential suppliers; or (3) a national functional group (standing committees) may make these decisions. Both functional groups and SSTs include experts representing a range of those affected by a particular product choice (e.g., clinical staff, EHS personnel, commodity managers).

Kaiser Permanente has initiated a Resource Conservation program at the national level. Its objectives are "to minimize waste, prevent pollution, conserve natural resources, reduce costs, and model environmental protection practices within the health care industry." This program is overseen by the Resource Conservation Manager (RCM), who has broad authority for assuring that resource conservation goals are incorporated in Kaiser Permanente decision making. The RCM is jointly sponsored by the national facilities, national purchasing, and national environmental, health, and safety offices.

Kaiser Permanente's commitment to mercury reduction in its operations is formalized by its subscription to the Mercury-Free Pledge spearheaded by Health Care Without Harm, a national collaborative campaign. This commitment led to a new clause in Kaiser Permanente's Requests for Proposal (RFPs) last year requiring suppliers to either warrant their products as mercury-free or specify the amount of mercury contained therein and indicate if a feasible mercury-free alternative is available. Although Kaiser Permanente's operations still include some mercury-containing products (e.g. thermometers in

take-home cold kits), it has addressed over 95 percent of its mercury usage by switching to digital thermometers and aneroid sphygmomanometers. Additionally, Kaiser Permanente has begun a recycling program for its mercury-containing fluorescent light bulbs. (For more details regarding mercury minimization activities, see Kaiser Permanente case study in Appendix B.)

Cost accounting for purchasing decisions

For some products, procurement options are limited, due to constraints arising from geographic distribution, quantity of purchase, etc. These limitations make detailed analysis of a wide range of internal costs of little value. When warranted, however, Kaiser Permanente's procurement process looks carefully at a wide range of internal costs.

Thus for some products, only unit costs are considered. For others, such as medical exam gloves, a range of internal environmental costs are considered, and some external costs are also given qualitative consideration. For example, potential dioxin release to the atmosphere upon incineration might be considered qualitatively in contemplating a switch to PVC-free alternative products. When costs for switching from mercury thermometers were assessed, the associated costs of mercury spill kits, hazardous waste disposal, training, and treating potential mercury exposure were collectively considered. In such cases, "soft" costs such as mercury exposure are not expressed as a contingent value, but as a statement of the upper-limit estimate of costs for a worst case scenario. Representing some costs in this fashion has proven effective in incorporating less tangible costs into the decision-making process.

Beyond unit acquisition costs, other costs routinely considered in the procurement process include:

- **Transitional costs.** These represent costs in changing over to a new product, including costs and installation of all requisite accessories, freight, and storage. Transitional costs also include the cost of obsolescence of previous products, such as expired drugs. To reduce the latter, Kaiser Permanente's pharmaceutical suppliers often take back expired products.
- **Freight and storage costs.**
- **Disposal costs** (when they are internal costs).
- **Labor costs.**
- **Return on investments.** Calculations are carried out on some commodities to quantify savings from purchases. For example, with the purchase of digital thermometers, savings from avoiding mercury spill cleanup can be counted as a return on investment.

Regulatory costs are not generally taken into account, but sometimes regulatory changes drive procurement decisions. For example, California's bloodborne pathogens regulations changed to require hospitals to use "safe needle" devices by July 1, 1999.

Accounting staff do not typically participate in procurement decisions. Instead, the NPO obtains information directly from accounts payable databases, suppliers, and other sources to derive cost figures.

Waste streams and practices

According to its calculations, Kaiser Permanente generates 70 million pounds of waste each year. Although regulations applying to waste differ somewhat throughout the system, Kaiser Permanente broadly groups solid waste into three categories: (1) infectious/biohazardous; (2) hazardous; (3) non-hazardous. Many Kaiser Permanente hospitals treat infectious waste on site with steam sterilization, although some send this waste off-site to be treated. Hazardous waste disposal is in accordance with the strict protocols in place under applicable regulations, and is generally contracted by Kaiser Permanente on a regional basis. Non-hazardous waste disposal is generally handled at the facility level. Waste disposal costs are paid for by each facility and are decoupled from system-wide procurement. Kaiser Permanente is developing a plan to monitor these costs using the same reporting system used to monitor utility costs.

Cost accounting for waste management

At Kaiser Permanente, the following costs are generally known:

- **Supply cost for waste disposal**
- **Licensing/permitting costs of disposal**
- **Environmental reporting costs**
- **Staff training costs** (absorbed under general operating costs because training is pervasive across many activities)
- **Environmental staff labor time** (part of facility-level budget)
- **Environmental insurance**

Waste disposal costs are generally not allocated at the department level.

Environmental accounting practices

As noted above, Kaiser Permanente has incorporated environmental costs in a number of procurement decisions. However, Kaiser Permanente's Resource Conservation Manager believes that current environmental accounting (EA) methods and guidance are tailored for manufacturers, not for the service sector. She finds it especially difficult to find guidance that applies to the health care industry.

Summary of costs considered in purchasing and waste decisions

Purchasing

Cost	Yes?	No?	Comments
cost of acquisition	x		
cost of storage	x		
cost of utilization	x		includes installation
cost of outdated product	x		considered part of "transitional cost"
disposal costs	x		
labor costs	x		
regulatory costs		x	not ordinarily considered; however, California's safe needle regulation made this issue a consideration
clinical effectiveness	x		
other	x		

Waste disposal

Cost	Yes?	No?	Comments
supply costs	x		
labor costs	X		
licensing/permitting	x		
environmental reporting	x		
staff compliance training	x		allocated under general operating costs
environmental services (housekeeping) staff labor	x		part of facility-level budget
environmental insurance			
potential liability	x		
other	x		

Sources:

Gerwig, Kathy (Resource Conservation Manager, Kaiser Permanente). Personal interview, June 2, 1999.

"About Kaiser." <http://www.kaiserpermanente.org/newsroom/fastfacts.html>

"NPO Policies and Procedures," Kaiser Permanente, 9/28/98

New England Medical Center

Organizational profile

The 410-bed New England Medical Center (NEMC) in Boston is the principal teaching hospital for Tufts University School of Medicine. A full-service hospital, NEMC became a partner institution of Lifespan in 1997. Lifespan is a regional, non-profit healthcare alliance. Incorporating nearly 1700 beds in Rhode Island and Massachusetts, Lifespan was founded in 1994 by Rhode Island Hospital and Miriam Hospital, also of Rhode Island. NEMC incorporates Boston's Floating Hospital for Children.

Purchasing practices

High volume supplies at NEMC are maintained at a par level via a barcoding system that tracks and reports product use to NEMC's purchasing department. These supplies are delivered via an automatic delivery schedule from vendors. For other supplies, the purchasing process is initiated by housekeeping, clerical and clinical departments, who generate purchase orders. For clinical products, the department closest to the clinical operation will initiate the purchasing process: for example, products in the operating room are ordered through the surgery department. Purchase orders are processed by NEMC's centralized purchasing department. All purchase costs are allocated to the department utilizing the product.

NEMC contracts with two GPOs -- VHA and Amerinet. VHA is the principal GPO; any supplies that cannot be provided by the GPO are ordered from Amerinet. Contracts are typically 2 years in length and the medical center purchases 80-90% of its supplies from these GPOs. Products purchased outside of GPOs are typically those exempted from group purchase for clinical reasons, or those products procured via sole source contracts with minority vendors (e.g., paper). NEMC's pharmacy purchases 90% of its supply from VHA, but procurement is directly conducted by the department rather than the central purchasing department. The facilities department (which includes maintenance, environmental health, medical engineering, and security) and research departments, whose product needs are too technical to be provided by GPOs, directly contract with vendors.

NEMC's Value Analysis Committee is responsible for standardizing the supplies utilized throughout the hospital. The committee is chiefly staffed by clinical representatives, but representatives from administration, environmental health, finance, and medical engineering are consulted on an ad hoc basis..

As a member of a recently formed health care system, NEMC's purchasing practices are currently transitioning from hospital-based purchasing to system-wide purchasing. Under system-wide purchasing, products will be standardized across system hospitals, although NEMC will still retain a Value Analysis Committee. The committee will provide research to inform the system-wide committee's decisions and can potentially override the system level committee's decisions.

Product environmental attributes are factored into purchasing decisions. For example, products with less packaging are considered preferential. In considering alternative products, NEMC places highest priority on clinical effectiveness. When an alternative product is environmentally preferable but of lesser or less proven clinical effectiveness than the product currently in use, NEMC must choose to stay with the clinically proven product. In such cases, efforts are focused on assuring staff safety and environmentally responsible use and disposal of the existing product.

Regulated by strict Massachusetts Water Resource Authority (MWRA) water emissions standards for mercury, NEMC is pursuing strategies to reduce mercury-containing products in its facilities, thereby generating a "mercury-free" waste stream. Thermometers, sphygmomanometers, and fluorescent lights are targeted mercury-containing products. Currently, about 80% of NEMC's sphygmomanometers have been replaced with aneroid types. To reduce mercury emissions associated with disposal of fluorescent bulbs, NEMC has initiated a bulb recycling program. All incoming new products are tested for nominal mercury content which may not be revealed on product labels.

NEMC has ceased purchasing mercury thermometers. One of the last uses of mercury-containing thermometers was in the hospital's infectious units where infection control guidelines prohibit sharing of thermometers between patients. These thermometers were collected and sent off-site for recycling. A challenge was finding suitable non-mercury thermometers as portable digital thermometers used elsewhere throughout NEMC (the thermometer is attached via a cord to a base unit which is either hand-held or on a rolling cart) could not be used in infectious units because the wire cord and base unit could not be disinfected. NEMC thus had to acquire stand-alone digital thermometers that also provide the higher accuracy of mercury thermometers.

Outsourced services at NEMC include servicing of radiology equipment, waste disposal, and maintenance services for elevators, fire alarms, biological hoods, air filtration systems, and chillers. Management of housekeeping and dietary services is outsourced as well; however, the personnel providing these services are NEMC employees. Typical contract length is three years, utilizing either flat fees and fee for services. In overseeing the environmental impact of housekeeping services, NEMC's Environmental Health Officer personally screens the cleaning products used along with Infection Control.

Cost accounting for purchasing decisions

A product's clinical effectiveness is paramount in product selection; cost and environmental safety are secondary and tertiary concerns, respectively. Clinical trials are conducted by the Value Analysis Committee for new products that will be utilized in a clinical setting. While there is no standardized form for collecting data, including costs, during these trials, all trials are supervised by a single person to ensure consistency. Data are reported to the committee via formal minutes.

Other than direct price (i.e., acquisition cost), purchasing decisions consider costs such as:

- **Storage costs** (NEMC pays for square footage at a warehouse due to on-site space constraints)
- **Utilization costs** (e.g., if gloves or other protective equipment are needed during product use)
- **Cost of outdated product** (longer shelf-life products are preferentially selected)
- **Disposal costs**
- **Labor costs**
- **Regulatory costs** (e.g., monitoring costs)
- **Clinical effectiveness** (which is determined from product trials and is costly owing to labor)
- **Potential liability**

Waste streams and practices

NEMC generates seven main waste streams:

- **solid waste**
- **recycled waste**
- **medical waste**
- **pathological waste**
- **cytotoxic waste**
- **hazardous waste**
- **pharmaceutical waste**

All waste except solid waste is tracked daily by shipments, and records are kept on an annual basis and reviewed twice per year. Other kinds of waste such as packaging waste is “tracked” informally and qualitatively via active feedback from nurses in different departments. Waste generation rates are not adjusted through any normalization factors (e.g., number of admissions/month) as the extra effort is deemed futile.

Solid waste is compacted, picked up by a waste hauler, and landfilled or incinerated

Until four years ago, NEMC operated an on-site incinerator for its pathological waste at a cost ranging from \$0.28 to \$0.44 per pound. However, the incinerator was voluntarily shut down after conducting a cost analysis of operation versus off-site disposal.

Medical waste at NEMC is treated in an on-site autoclave at a processing cost of \$0.08 per pound. Housekeeping is responsible for delivering red bag waste to the autoclave operator, who then enters the shipment time and department origin into a log book. Prior to treatment, bag contents are inspected for inappropriate waste (glass, syringes, and closed containers). Autoclave logs are kept in 24 hour cycles, and biological tests are performed weekly to ensure that all potentially infectious organisms are killed. After the bags of medical waste are autoclaved, they are tagged as noninfectious waste and shipped by a hauler to a landfill as non contaminated waste. A few years ago, NEMC tried to further reduce waste volume by shredding autoclaved medical waste prior to compacting it. However, the shredder, located one floor above a patient wing, was too noisy and required additional labor. It was therefore abandoned.

Most patient rooms have two receptacles – red bag and black bag (i.e., solid waste). High traffic areas of the hospital (e.g., emergency room) only have red bag receptacles because the majority of the waste generated in the area is medical waste and further segregation is not warranted in these busy areas due to NEMC’s low autoclaving costs.

Pathological waste and trace cytotoxic waste from chemotherapy (collected in labeled yellow buckets) are collected hospital-wide and incinerated at an appropriate off-site facility.

Per pound, hazardous waste is the most expensive waste stream to dispose. Chemical waste is picked up by a licensed disposal service every six to eight weeks or as needed. Bulk chemicals collected from laboratories are stored in barrels, which are collected more frequently. Radioactive waste generated in laboratories is stored onsite to decay prior to disposal.

To reduce disposal costs for hazardous chemicals, NEMC's on-site xylene recycling program was implemented about 3 years ago. NEMC operates a permitted distillation machine that can handle 4-8 gallons of waste xylene per day generated by the histology and pathology departments. The machine separates waste xylene into waste ethanol, waste paraffin, and re-purified xylene. Currently, NEMC is also considering a formalin recycling program to handle the 25 gallons per week of waste formalin generated by the pathology department, as well as an alcohol recycling program. (A prior attempt to recycle alcohol was unsuccessful as alcohol was being reused several times prior to its collection for recycling. Because the collected alcohol was "spent," it could not successfully be recovered.)

Several types of batteries are recycled, including lithium, lead acid, alkaline, nickel-cadmium, and a small number of mercury batteries.

The manufacturer collects outdated pharmaceutical products; credit is given to the pharmacy for expired inventory. Other pharmaceuticals are shipped off-site for disposal by a licensed treatment, storage and disposal facility.

To obtain timely feedback on waste management, NEMC conducts periodic waste surveys to assess waste management practices such as proper waste segregation; proper disposal of sharps, cytotoxic waste, bulk fluids, and mercury products; hazardous waste, battery, and fluorescent bulb collection; and recycling. When indicated, personnel from the Environmental Health Department visit laboratory staff and educate them on regulations and proper waste disposal methods. Laboratory personnel are trained annually along with other personnel using hazardous materials. The Environmental Health Department audits all satellite hazardous waste storage areas on a monthly basis and generators inspect on a weekly basis.

Recently, NEMC hired a consultant to conduct a waste survey of its commercial waste stream and identify opportunities for reducing waste costs by increasing recycling and reducing waste generation.. The contract established a 50/50 shared savings -- i.e., the contractor and NEMC evenly split the savings realized by implementing the contractors recommendations.

In selecting waste disposal services, NEMC makes an effort to contract only with reputable waste disposal vendors. Criteria include good compliance records, service-orientation that includes education programs or written material, and willingness to suggest alternative practices that meet regulatory requirements and have appropriate liability insurance.

Cost accounting for waste management

At NEMC, the following costs are generally known and tracked:

- **Supply cost for waste disposal**
- **Environmental staff and housekeeping staff labor costs**
- **Licensing/permitting costs of disposal**
- **Environmental reporting costs**
- **Staff compliance training costs**
- **Environmental insurance**

Potential liability costs are routinely considered in waste management decision-making.

In order to encourage departments to dispose of waste properly, and to use the services provided by the Environmental Health Department, NEMC does not allocate disposal costs to individual users and departments.

Centralized on-site autoclave operations have proven to be more cost effective than separate, department-based autoclaves used in the 1980's. Cost analysis was used to justify centralized autoclave operations.

Major costs for operating the onsite autoclave include the following:

- **Utility costs** (steam and electricity)
- **Protective gear** for the employees (including face shield, gloves, booties, etc)
- **Plastic bags**
- **Quality control equipment**, i.e., biological indicators
- **Incubator** for biological indicators (to be replaced every 2 years)
- **Maintenance costs** (lubrication, gaskets, repairs)
- **Staff training**

All of these costs are tracked, although steam and electricity costs are "guesstimated." Because labor is required regardless of which treatment and disposal method is used, labor costs are not considered part of the cost of autoclave operation.

Environment accounting practices

NEMC is aware that the costs incurred throughout a product's life cycle (i.e., from purchasing through disposal) are important for determining the true cost of using a product. In its approach to product selection, NEMC feels that a hospital must "think like industry," to maintain careful scrutiny over changes to the bottom line. Based upon NEMC's experience, this can be accomplished via three efforts:

1. Educating Value Analysis Committee. As this committee has oversight on which products are used throughout the whole hospital, it is important to educate committee members on the benefits of EA, especially since product decisions are based upon (in rank order): (1) clinical effectiveness, (2) cost, (3) safety/EHS. The committee is comprised chiefly of clinicians; however, it is important to supplement the committee with administrative, safety, finance, and medical engineering staff. (Some of these representatives may be brought in on an as-needed basis.)
2. Educating purchasing managers (i.e., anyone who has power to veto/approve products). For clinical products, physicians and nurses determine product specifications. If the product will be used throughout the hospital, product specifications are reviewed by the Value Analysis Committee. Therefore, it is important to educate, and work with these purchasing managers.

The hospital's Facilities department (which encompasses Maintenance, Environmental Health, Medical Engineering, and Security) conducts its own purchasing due to the technical nature of the products it procures. Thus, similarly, it is important to work with the Facilities director.

3. Maintaining a proactive stance. In the current health care climate where hospitals are under pressure to control costs, it is important for environmental health staff to demonstrate the costs/savings of purchasing and waste minimization activities. Common barriers in waste minimization include resistance to change based on the often incorrect perception that “this will cost too much,” the perception of not having enough space, or not wanting to implement procedures that are not regulatory requirements.

Summary of costs considered in purchasing and waste decisions

Purchasing

Cost	Yes?	No?	Comments
cost of acquisition	x		
cost of storage	x		
cost of utilization	x		
cost of outdated product	x		
disposal costs	x		
labor costs	x		
regulatory costs	x		
clinical effectiveness	x		
potential liability	x		

Waste Disposal

Cost	Yes?	No?	Comments
supply costs	x		
labor costs	x		
licensing/permitting	x		
environmental reporting	x		
staff compliance training	x		
environmental. staff labor	x		
environmental insurance	x		
potential liability	x		

On-site Waste Treatment—Autoclave

Cost	Yes?	No?	Comments
equipment costs	x		
maintenance costs	x		
supply costs	x		
labor		x	
utility costs	x		"guesstimated"

Sources:

Lifespan web site: <http://www.lifespan.org>

New England Medical Center website: <http://www.nemc.org>.

Plante, Michele (Environmental Health Officer, New England Medical Center). Personal interview, June 3, 1999 and April 6, 2000.

Plante Michele. "Pollution Prevention (P2) in the Hospital Setting." (presentation, Conference on Preventing Pollution from Medical Facilities, West Springfield, Massachusetts). May 21, 1999.

St. Vincent's Hospital

Organizational profile

St. Vincent's Hospital in Birmingham, Alabama, is a non-profit acute care hospital with 338 beds. A member of the Daughters of Charity National Health System, the hospital operates independently. Founded in 1986, the Daughters of Charity National Health System incorporates more than 80 member and affiliate facilities in 15 states and the District of Columbia.

Purchasing practices

Purchasing is initiated by department personnel submitting a written requisition to the department head, who is responsible for approving it and forwarding it to the purchasing department. St. Vincent's contracts with two primary GPOs, Consorta and AmeriNet, from whom it purchases 85 to 90 percent of all commodities. A typical contract is of 3 years duration. The dietary and pharmacy departments use Consorta and handle their own purchasing. Purchases are made outside the GPOs in cases where products are less expensive locally and for certain physician preference items.

St. Vincent's uses an electronic purchasing and database system as its information system. This system, which is monitored by Daughters of Charity system headquarters, tracks purchases from the time they are entered into the system for ordering, through delivery at the receiving dock, accounting, and purchasing.

St. Vincent's Value Analysis Team develops standardized product specifications and evaluates product procurement. Chaired by the Administrative Director of Finance, the team has 17 members representing the major clinical and non-clinical departments at the hospital.

St. Vincent's has begun to look at the issue of mercury in procured products, particularly in nursing care. It has switched to some mercury-free sphygmomanometers, and most of its thermometers are digital (although a sizable number of mercury thermometers remain in use around the hospital). Mercury-containing thermometers and sphygmomanometers are still preferred by some physicians, who are concerned that the digital devices are less accurate than their mercury-containing counterparts. This is more likely to be the case in critical applications, such as use of thermometers in the neo-natal intensive care unit.

St. Vincent's outsources anesthesiology, dialysis, and grounds maintenance. The contracts for these services contain no explicit environmental incentives. These service contracts are renewed on an annual basis. Two commonly outsourced services — food services and housekeeping — are performed in-house at St. Vincent's.

Cost accounting for purchasing decisions

The highest-priority concern of the value analysis process is a product's clinical effectiveness. The process also takes into consideration product price, product turnover, and shipping costs. For large-quantity purchases, disposal costs are also considered. No other costs are typically considered.

Waste streams

Waste generated at St. Vincent's is segregated into several categories: general waste, paper/cardboard (which is recycled), medical waste (made up of chemotherapy waste, pathological waste, and infectious waste), and hazardous waste.

Generation of general waste is tracked hospital-wide by volume and weight on a monthly basis. General waste is disposed of approximately three times a week through a 40 cubic yard compacting dumpster and subsequently sent to a landfill. Medical waste is tracked on a daily basis. Hazardous waste is collected on an as-needed basis (approximately once per year) and tracked by shipment. Waste generation rates are normalized based on adjusted patient days. On-site inspection of waste (e.g., to assure general waste is not disposed in medical waste containers) is minimal.

Neither packaging waste nor obsolete inventory is tracked separately. The facility works with manufacturers to take back any obsolete stock or donates it for use by charities.

Due to capacity constraints, only about a third of the medical waste (600 – 800 pounds per day) can be handled by the on-site incinerator. The remaining two-thirds is hauled to a commercial autoclave. Ash from the on-site incinerator is disposed of as special non-hazardous waste. This ash is analyzed annually to assure that it is not hazardous. Incinerator stack gasses are monitored for temperature only. Alabama's Department of Environmental Management is awaiting EPA approval of new incinerator regulations that may be implemented as early as Spring 2000. If approved, these regulations would drive up incinerator costs significantly, as they would require investments in a baghouse and additional monitoring. Anticipating these new regulations, St. Vincent's estimates that building an on-site autoclave to treat medical waste might be cost effective, as it would allow autoclaved waste to be disposed of as special non-hazardous waste.

Cost accounting for waste management

Waste disposal costs are typically not allocated to individual departments, except for disposal supplies such as sharps containers and gloves. St. Vincent sees little overall benefit in allocating disposal costs to individual departments, as doing so might encourage improper disposal.

Thus, most waste disposal costs are assigned to overhead: The housekeeping department absorbs costs for waste disposal labor, environmental staff labor, and supply and labor costs for waste treatment equipment; the risk management department absorbs costs for environmental insurance; and the facility management department absorbs costs for waste disposal licensing/permitting, environmental reporting, and staff training for environmental compliance.

Environmental accounting practices

One product that was evaluated using environmental costs was Isolyzer, a powdered product that disinfects and solidifies liquid medical waste, allowing it to be classified as a special non-hazardous and thus landfilled at a significant cost savings. This product comes in pre-packaged amounts, all of which must be used at once. As part of the evaluation process, the value analysis committee developed rules for

the minimum amount of waste that must be in a liquid waste bottle to make using Isolyzer cost effective.²³

St. Vincent's has also used EA to evaluate wastewater treatment chemicals, purchase of a formaldehyde substitute, and low-mercury batteries. However, EA has thus far been used on an ad hoc basis rather than systematically.

Summary of costs considered in purchasing and waste decisions

Purchasing

Cost	Yes?	No?	Comments
cost of acquisition	x		
cost of storage		x	
cost of utilization		x	
cost of outdated product	x		qualitatively considered as "turnover"
disposal costs	x		considered only for large quantity products
labor costs		x	
regulatory costs		x	
clinical effectiveness	x		
other	x		shipping costs

Waste disposal

Cost	Yes?	No?	Comments
supply costs	x		absorbed in housekeeping costs
labor costs	x		absorbed in housekeeping costs
licensing/permitting	x		absorbed by risk management department
environmental reporting	x		absorbed by risk management department
staff compliance training	x		absorbed by risk management department
environmental staff labor	x		absorbed in housekeeping costs
environmental insurance		x	
potential liability		x	

²³ Because this product was not approved for use by US EPA, St. Vincent has ceased using it. Another product that also solidifies the liquid waste is now being used instead. The treated waste is then disposed of as medical waste either via on-site incineration or off-site autoclaving.

On-site waste treatment — incinerator

Cost	Yes?	No?	Comments
equipment costs	x		
maintenance costs	x		
supply costs	x		
labor	x		
utility costs	x		

Sources:

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St. Vincent's Hospital website <http://www.stv.org/>

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Appendix B: Case Studies

- ***Mary Hitchcock Memorial Hospital (Dartmouth Hitchcock Medical Center)—EtO elimination***
- ***Kaiser Permanente — Mercury Minimization***

Mary Hitchcock Memorial Hospital (Dartmouth Hitchcock Medical Center) — EtO elimination

Organizational Profile

Dartmouth-Hitchcock Medical Center (DHMC) is an academic medical center whose principal campus is in Lebanon, NH. Its member institutions are the Dartmouth Medical School, founded in 1797; Mary Hitchcock Memorial Hospital, founded in 1893; The Hitchcock Clinic, founded in 1927; and the Veterans Affairs Medical Center in White River Junction, Vermont, which opened in 1938.

The case study that follows concerns the Mary Hitchcock Memorial Hospital (MHMH) specifically. MHMH has about 6000 employees and volunteers, and houses 400 licensed beds.

For details regarding DHMC's procurement and waste handling practices, see its profile in Appendix A.

Background: medical instrument disinfection and sterilization

Proper cleaning and disinfection or sterilization of reusable medical instruments is critical in a hospital environment. Over their lifetime, such instruments are used on a progression of patients. Inadequate destruction or inactivation of pathogens (bacteria, fungi, viruses, spores, and other microorganisms) left on an instrument by one patient can result in serious adverse clinical outcomes, including death, in the next patient. The risk is particularly acute for instruments used invasively.

As the sidebar indicates, disinfection is a relative term and sterilization an absolute one. Sterilization, the focus of this case study, requires the absolute elimination or destruction of all forms of microbial life.

A number of sterilization technologies exist. The FDA certifies (1) appropriate levels of disinfection or sterilization, and (2) appropriate sterilization techniques on an instrument-by-instrument basis. Disinfection and sterilization practices are also the subject of extensive guidelines issued by the Centers for Disease Control and (CDC) and the Joint Commission on Accreditation of Healthcare Organizations (JCAHO).

Definitions

Sterilization — eliminates or destroys all forms microbial life

High-level disinfection — should destroy all microorganisms, except for bacterial spores present in high numbers

Intermediate level disinfection — does not necessarily kill bacterial spores or some more resistant microbial forms

Low-level disinfection — kills most bacteria, some viruses, and some fungi, but does not have tuberculocidal activity

Cleaning — removal of all foreign material such as soil and organic materials and residues from objects

For instruments insensitive to heat and unaffected by the corrosive and dielectric effects of steam (this includes the most traditional surgery instruments), autoclaving is the sterilization method of choice. Autoclaves subject their contents to high-pressure, high-temperature steam.

However, increasing number of medical instruments are made of highly engineered mixed media — including rubber, plastics and glass — and cannot be subjected to high heat or steam. Laproscopic and fiber optic devices, for example, play an increasingly important role in surgery and diagnosis. For a number of years, the sterilization technology of choice for such instruments has been ethylene oxide

(EtO) gas sterilization. EtO is an extremely effective biocide and, additionally, penetrates the narrow channels and small-diameter tubes and cavities characteristic of such devices. Because EtO breaks down in the presence of oxygen at room temperature, EtO sterilization equipment must remove or displace air. Expanded EtO is vented to the outdoors.

Unfortunately, EtO represents a serious, OSHA-regulated occupational exposure hazard: it is toxic (central nervous system depression, eye and mucous membrane irritations), a reproductive hazard for both genders, and a suspected human carcinogen. The odor detection threshold for EtO is well above what are thought to be harmful concentrations for chronic exposure. Practically odorless, colorless and flammable, its vapors are heavier than air.²⁴ Under the Clean Air Act Amendments of 1990, EtO is a listed hazardous air pollutant, with control technology requirements pertaining in many cases.

For these reasons, ethylene oxide is being specifically considered as a substance for emission reduction under the AHA-EPA cooperative waste minimization agreement.

A small number of alternative sterilization technologies exist, each of which can replace some EtO applications. Two are in use at MHMH. One, marketed under the Johnson & Johnson brand name “Sterrad,” relies on plasma phase hydrogen peroxide as a sterilizing agent. This is an acceptable alternative for EtO in a number of cases. The second technology (brand name “Sterris”) has been piloted in the urology department and employs peracetic acid as its sterilant.. This is a “just-in-time” technology; sterilized items must be removed from the unit and immediately used, which makes its use impractical in certain applications.

Disinfection and sterilization at MHMH

Medical instrument cleaning, disinfection and sterilization at MHMH is a centralized support function. MHMH’s Central Sterile Reprocessing unit (CSR) serves the various hospital and clinical departments.ⁱⁱ From the 1960s through the 1980s, DHMC relied primarily on a mixture of autoclaves and EtO for sterilization. Glutaraldehyde has been employed for a number of years as a high-level disinfectant.

As DHMC was designing and constructing its new facility (opened in 1991), the CSR staff was grappling with persistent glutaraldehyde spills from disinfection equipment. The physical layout of MHMH’s old facilities made access to the equipment difficult to control, and cleaning cycle interruptions and improper addition of glutaraldehyde to the equipment contributed to persistent spills. Both from environmental and disinfection quality assurance perspectives, the new facilities presented a welcomed opportunity to eliminate unauthorized access to sterilization and disinfection equipment. This prompted environmental staff to consider aspects of sterilization and disinfection operations other than glutaraldehyde, in particular EtO.

At about the same time, Title V regulations under the Clean Air Act were coming into effect. Title V of the Clean Air Amendments of 1990 required applicable facilities (major stationary sources) to apply for emissions permits, similar to those issued for many years under the Clean Water Act’s National Pollutant Discharge Elimination System (NPDES). DHMC opted to apply for a Title V permit — not because it was required to do so, but because securing the operating permit would allow it to, in effect, obtain

²⁴ Until the 1990s, most EtO gas sterilization machines used a mixture of 12% EtO and 88% CFC (as a stabilizing agent). Sterilization using “12/88” machines was conducted at 2 atmospheres of pressure. The spent mixture was vented to outside air. Release of CFCs is now banned; newer devices use 100% EtO at partial atmospheric pressure, or an alternative stabilizing gas. By January 1997, DHMC had phased out its 12/88 machines.

regulatory pre-approval for up to four additional planned facilities on the DHMC campus. With the shut-down of MHMH's incinerator in 1995, EtO sterilization equipment were the only hazardous emissions sources remaining on the DHMC campus. Particularly given the control technology investments required to maintain EtO operations (below), this served to further focus environmental and CSR manager attention on EtO.

EtO elimination commitment

As noted above, the design of DHMC's new facility brought about a general evaluation of disinfection and sterilization operations. The Title V permit process led to specific focus on the costs and risks associated with EtO operations. Together, these two factors provided sufficient leverage for MHMH's Biosafety and Environmental Programs manager and the CSR Manager to build support for an institutional commitment to EtO elimination by the year 2000, except in those applications for which no approved alternative technique exists. Operating in a decentralized decision-making environment (see below), this two-person core working group worked with a large number of individuals in departments and functions which would be affected by EtO elimination.

This commitment was placed in DHMC's June 1996 Title V permit application. (The application, representing about 2 years of negotiation with the New Hampshire Department of Environmental Services, was accepted in March 1999.) The commitment was reiterated in internal environmental policy.

EtO elimination at DHMC was thus a bottom-up initiative that obtained buy-in from diverse departments and functions in the hospital. Buy-in was obtained largely on the basis of two arguments:

- Eliminating the serious occupational exposure hazard posed by EtO.
- Reducing DHMC's environmental impact and toxic "footprint," consistent with the mission of an organization devoted to healing.

EtO elimination process

The first step in moving to EtO elimination at MHMH was ascertaining which medical instruments from which medical departments were currently EtO-sterilized. This exposed shortcomings in MHMH's inventory records and inventory control, and in access control to sterilization processes. In part as a consequence of this effort, MHMH now has an on-line inventory control system containing digital images of each instrument and the ability to ascertain its status (e.g., in use, available, in processing).

Once the list of 400 EtO-sterilized instrument types was known, CSR staff could begin the task of finding ways of reducing this list towards zero:

- In some cases, alternative sterilization technologies were appropriate for the instruments in question. During the EtO elimination process, MHMH has tested and implemented a plasma-phase hydrogen peroxide sterilization technology. A peracetic acid technology has been piloted and is now being implemented.
- In other cases, an EtO-processed instrument could be replaced with a newer or alternative device serving the same function, and for which a non-EtO sterilization technology was appropriate.

To assist in the process, CSR staff conducted a benchmarking process, checking MHMH sterilization procedures for particular instruments with those of other institutions.

As decision-making at MHMH is extremely decentralized, members of the working group staff were forced to obtain individual consent from affected departments for the practice changes and instrument replacements involved. (The support of the Medical Director was instrumental in gaining access to physicians and heads of department.) The working group made a commitment to clinicians that EtO elimination would result in no reduction in the existing level of sterile processing given any particular instrument. Other institutional stakeholders whose buy-in was required included Central Sterile Reprocessing Staff, Risk Management, Infection Control, and operating room and outpatient clinics. Costs incurred by EtO elimination—e.g., purchase of replacement instrument compatible with alternative sterilization techniques, for example—were generally borne by the department involved.

Role of environmental accounting

In this decentralized decision-making setting, the environmental staff employed a number of lines of argument in building support for EtO elimination, including ethical, safety, liability, environmental-compliance, and cost-based arguments.

Cost analysis of sterilization treatment options (table below) provided one tool which environmental staff employed in the process of building consensus and obtaining buy-in. Analysis showed that continuing EtO operations were not significantly cheaper than eliminating EtO altogether. When the contingent costs (and health consequences) of an EtO exposure incident were considered, the costs of an continuing EtO operations *could* indeed be significantly more. Costs are presented in the table below:

Costs — EtO alternatives (Switch to hydrogen peroxide and peracetic acid alternative technologies, EtO outsourcing if needed as an interim measure)	Costs — EtO option (Maintain on-site EtO operations, at maximum 1 load/day level)
<ul style="list-style-type: none"> • Additional and replacement instruments: \$50K–75K over 2 years Range is uncertain; depends on FDA approval of sterilization techniques and upgrade/replacement decisions to be made by the Medical Director. Replacement instruments are needed in some cases to accommodate alternative sterilization techniques. Additional EtO-sterilized instruments are required in some cases to ensure adequate availability when EtO sterilization takes place off-site. • Capital costs for 2 “Sterrad” hydrogen peroxide plasma sterilization units: \$212K • Sterrad operating costs: \$2K/year • Capital costs for 2 “Sterris” peracetic acid sterilization units: \$35K • Operating costs for Sterris units: \$80K This is the cost of two new CSR staff positions to operate Sterris technology in the OR clean core. Staff will also operate OR autoclaves, and are generally needed due to increasing workload. • EtO outsourcing costs: \$80/load, 60 loads 	<p>COSTS for EtO operations ONLY:</p> <ul style="list-style-type: none"> • Emissions control equipment: \$25K capital expenditure, \$10K annual operating expenses) Per Title V requirements, if EtO operations were continued, MHMH would be required to install a direct exhaust line and catalytic combustor control technology on hospital roof. • Renovation and lost time costs. \$40K Installing EtO abatement equipment on the hospital roof would require disruptive construction work through several floors in the “clean core” of the building to install a direct exhaust duct, as well as construction of a roof enclosure. The cost of the construction itself was estimated at \$20K. The cost of “lost time” due to construction disruption and false alarms was estimated at \$20K • Spill response— staff training and equipment; \$5K annual operating expenses • Alarm system maintenance, testing, EtO monitoring: \$5K annual operating expenses • PLUS contingent costs of an actual EtO

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<p>projected in the first six months After 6 months, the intent is to eliminate outsourcing and be completely EtO-free.</p>	<p>“incident” (not quantified)</p> <p>Because EtO operations would be limited to one load/day under the Title V permit, alternative technology (e.g., “Sterrad” hydrogen peroxide plasma sterilization) would still be required. , Further, generally increasing workload would have required additional CSR staff positions <i>in any case</i>.</p> <p>Thus, costs of continuing EtO operations should reasonably include the capital and operating costs for “Sterrad” units (\$212K and \$2K/yr, respectively), and at least one additional staff position</p>
<p>TOTALS:</p> <ul style="list-style-type: none"> • Capital costs: \$297K–\$322K • Operating costs: \$82K/year 	<p>SUBTOTALS:</p> <p>EtO operations:</p> <ul style="list-style-type: none"> • Capital costs: \$65K • Operating costs: \$20K <p>Non-EtO operations:</p> <ul style="list-style-type: none"> • capital costs: \$212K (“Sterrad” units) • operating costs: \$42K/yr <hr/> <p>TOTALS:</p> <ul style="list-style-type: none"> • Capital costs: \$277K • Operating costs: \$62K+/yr

*MHMH's “12/88” EtO unit (operating with a mixture of 12% EtO and 88% CFC) were replaced with 2 hydrogen peroxide plasma units in 1995. Environmental staff had documented savings attendant to this switch. The 12/88 unit was the most frequent source of hazardous materials incidents in the hospital, and considerable environmental staff and budget was devoted to managing it.

It should be noted that the presence of the Title V operating permit served to make a number of these costs real. As a memo from the working group noted, the “continued use of ethylene oxide in any amount from the date of federal permit issue” would trigger catalytic combustor control equipment requirements and limit EtO operations to 1 load/day.” Members of the working group were able to leverage the control requirements attendant to the Title V permit to help obtain further buy-in by disparate departments.

In at least one case, analysis of actual costs associated with EtO elimination reversed staff resistance: The peracetic acid technology that is partially replacing EtO is a “just-in-time” technology; the sterilization equipment must essentially be located at point-of-use. Nursing staff were resistant to this idea, as equipment operation was seen to take time away from patient care.

The working group determined that circulating nurses actually spent significant time tending to small autoclaves in the OR clean core. Placing central sterile personnel on the operating floors to operate both the autoclaves and the peracetic acid equipment would result in significant efficiency gains, allowing circulating nurses to devote more time to more productive activities.

However, a number of the costs and benefits incurred by the EtO elimination effort are difficult or impossible to quantify. Examples include:

- Transaction costs of reduction effort, which are extremely decentralized

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- The benefit of increased inventory and sterilization process control (which presumably translate to superior infection control)
- Instrument upgrade/replacement costs, as some level of upgrade and replacement would have happened absent the impetus provided by the EtO elimination effort
- The benefits of the growth of institutional linkages between disparate DHMC departments which the effort engendered
- The benefit of the avoided possibility of a critical EtO exposure incident
- The benefit of increased efficiency of circulating nurses due to placement of CSR personnel on OR floors to operate autoclaves and peracetic acid sterilization technology.

Current status

As of mid-December, 1999, DHMC-Lebanon has reduced its use of EtO sterilization to 2 small machines processing about 16 loads a month (each load consumes one 4-oz disposable canister of 100% EtO). This compares to 3 machines running at least daily loads in the mid-90s, including 1 large 12/88 unit which consumed both CFCs and much larger volumes of EtO. In-house EtO operations will cease in January 2000.

Currently, 11 instruments exist which continue to be EtO-sterilized. As a temporary measure, EtO sterilization of these instruments will continue, but on an outsourced basis. This has required purchases of some additional instruments to ensure availability. At this writing, two central sterile personnel positions are in the process of being approved for operation of the peracetic acid technology on the operating floors. Once the peracetic acid units are on line, only 5 EtO-sterilized instruments will remain.

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Kaiser Permanente — Mercury Minimization

Organizational Profile

Kaiser Permanente, the country's largest not-for-profit Health Maintenance Organization, serves 8.6 million members in 17 states and Washington, D.C.; 5.8 million members are located in California. With more than 90,000 employees and 10,000 group practice physicians, Kaiser Permanente's integrated health delivery system owns and operates 30 hospitals and 360 clinics.

Kaiser Permanente purchases about \$5 billion of commodities and services annually. According to its calculations, Kaiser Permanente generates 70 million pounds of waste (solid and infectious) each year.

Kaiser Permanente's Resource Conservation Management (RCM) program is a two-year-old initiative at the national level to integrate issues surrounding supply chain management, environmental health and safety (EH&S), and facilities management. The goals of the initiative are to minimize waste, prevent pollution, conserve natural resources, reduce costs, and develop model environmental protection practices within the health care industry.

For additional detail on Kaiser Permanente's procurement practices, see profile, Appendix A.

Issue and actions to date: Mercury minimization

Since October 1998, Kaiser has had a mercury minimization policy for national contracting and procurement. RFPs and terms and conditions state:

Kaiser Permanente is committed to minimizing the amount of mercury utilized in its operations, and desires to avoid the acquisition of products that contain mercury whenever feasible alternatives exist that do not compromise patient care.

Potential vendors or suppliers submitting contract bids must identify any mercury contained in the product they are offering and indicate if a "feasible" mercury-free alternative is available. This policy predates the mercury reduction commitment of the EPA/AHA voluntary partnership.

Under this policy, Kaiser Permanente has pursued mercury reduction principally through three procurement items:

- **Thermometers** — Switch to digital thermometers. Kaiser Permanente has implemented a national standard specifying that only mercury-free thermometers shall be procured; mercury-free thermometers have almost entirely replaced the previous stock of mercury thermometers. (One exception is that mercury thermometers are included in the existing stock of "cold kits" given to patients for home care. When the 1998–99 stock of cold kits is depleted, mercury-free kits will be procured.)
- **Sphygmomanometers** (blood pressure measurement devices) — Mercury-containing devices are no longer being procured; aneroid alternative devices are being procured instead. While some facilities have completely replaced their mercury sphygmomanometers, most are doing so

gradually. When facilities are remodeled or renovated, any existing mercury sphygmomanometers are replaced.

- Fluorescent lamps — Kaiser Permanente has signed a national contract with a fluorescent lamp recycler. Large-scale lamp disposal associated with facility lighting efficiency retrofits fall under this contract; Kaiser is attempting to divert lights replaced in the course of normal maintenance to its recycler as well.

(See discussion of mercury as a component of the hospital waste stream in Section 3.3)

Decision-making

Senior management in Kaiser Permanente's National Purchasing Organization considered the mercury reduction decision a clear one — mercury was an obvious bad environmental actor, clear product or practice alternatives existed for the largest mercury sources in the waste stream, and a national procurement policy would formalize policy which was in many cases being pursued in a de facto manner by individuals responsible for different procurement areas, both nationally and at specific facilities.

Product procurement areas targeted so far are straightforward — mercury-free substitutes were previously demonstrated and posed no patient care issues. Further mercury reduction is likely to be more difficult, and involve far more debate and conscious weighing of tradeoffs. The mercury free alternatives available for product classes such as fixatives, reagents, vaccines, and dental amalgams are less proven, do pose efficacy issues, and for these reasons are controversial in many cases.

Role of EA — contributions, considerations

The mercury-free alternatives and practices under consideration would address 95% of Kaiser Permanente's mercury waste stream. Underlying management's willingness to make the mercury reduction commitment was at least an awareness that these alternatives and practices would not involve insupportable costs.

Kaiser Permanente's Resource Conservation Manager did employ EA principles in preparing a supportive analysis of the mercury reduction decision. This analysis and Kaiser Permanente's experience with changes in procurement cost structures arising from mercury-reducing product and practice changes are presented below. They are of interest for two reasons:

- They provide an example of the application of EA principles, and
- They clearly illustrate that the hard cost consequences of these waste reduction decisions cannot be captured simply by assessing differences in unit purchase costs.

In addition, they point to the type of analysis which may be necessary for situations in which tradeoffs between alternative products and practices must be more seriously assessed.

Avoided costs for mercury-containing devices (thermometers and sphygmomanometers)

Eliminating procurement of mercury thermometers and sphygmomanometers is expected to result in a set of cost reductions associated with reduced incidence of spills, exposure incidents and liability, and staff

toxics training. The savings detailed in the table below were calculated across Kaiser Permanente’s system.

Total avoided cost: \$550K over next 10 years

Avoided cost category	Amount	Sources of cost avoidance estimate
Spill preparation/response	\$20K/yr	The cost of a mercury spill kit is known, as is the cost of a spill response by Kaiser Permanente’s contractor. These costs, combined with the average historical number of spill incidents from broken devices in a year, permit an avoided cost estimate to be made.
Compliance/liability	\$15K/yr	Use of mercury-containing devices necessitates staff spill/exposure training, an estimable cost. Further, even given staff training, careful use and appropriate spill procedures, the presence of mercury-containing devices gives rise to the possibility of fines from facility inspections or spill incidents. The probabilistic costs of mercury-related penalties were estimated using representative statutory and regulatory penalties multiplied by the probability of a fine being assessed for any particular violation.
Treatment of exposure	\$20K/yr	A probabilistic cost. Even assuming very high standards of appropriate and careful use, some small number of mercury exposures from broken devices are likely when mercury-containing devices are employed throughout the Kaiser system. Cost is determined from the expected yearly cost of long-term treatment of a single pediatric exposure case (\$100,000-plus), and the probability of an exposure incident within a given year.
Additional soft savings (environmental staff were aware of these costs, but they were not quantified)	—	“Soft cost” savings were not estimated, but could, for example, include: Environmental contamination from mercury release and subsequent health impacts, negative media attention.

Changes in per-unit purchase costs (thermometers and sphygmomanometers)

The avoided costs detailed above are essentially changes in *lifecycle* costs associated with the products *not* reflected in their purchase prices. Movement to mercury-free alternatives also changed unit purchase costs and cost structures:

Thermometers. Mercury thermometers are purchased, used for some expected number of cycles, and subsequently disposed of, usually when broken. Yearly acquisition costs are thus essentially determined by:

$$\text{unit price} * (\text{number of units required to replace breakage}) + (\text{number of units required to meet expansion needs, if any})$$

An important point, however, is that the purchase of a mercury thermometer almost necessarily incurs the cost of a spill kit/spill response incident at some future point. At the least, it incurs the incremental cost associated with disposal of the thermometer as hazardous waste.

Digital thermometers themselves, on the other hand, are provided at no initial cost by the manufacturer. Each use of the thermometer, however, requires a sterile, disposable cover. These covers are purchased on a per-unit basis.

The cost structure of the two thermometer alternatives is thus quite different. Digital thermometers incur a clear cost with each use (“pay as you go”). When treated as a current expenditures item, the use of mercury thermometers is effectively “free” after the billing period in which they were bought, until they are broken or disposed of, at which point another set of costs is incurred.)²⁵

Sphygmomanometers. The traditional blood pressure device measurement device registers pressure via a mercury column; at \$230/unit, the aneroid alternative is significantly more expensive to purchase on a unit basis. When associated lifecycle costs are included (including the avoided cost categories detailed in the table above), total costs per unit drop to about 1/3 the total costs of the mercury unit.

Cost considerations: lighting

Kaiser Permanente has a facility lighting upgrade program targeted at achieving energy efficiency gains, with resulting cost savings and environmental benefits. Generally, the program focuses on upgrading existing fluorescent systems with more efficient bulbs and ballasts. The upgrade program follows EPA Green Lights program protocols²⁶. Rather than focus on procurement of “environmentally preferable” lamps — a problematic determination (e.g., what is the tradeoff between reduced energy use (and hence, reduced air emissions from power plants) from using fluorescent systems versus the presence of mercury in these systems?) — Kaiser Permanente has focused on proper end-of-life treatment of lamps.

A national contract for lamp recovery and recycling has been tied to the upgrade program; lamps removed during the course of upgrades are packed and shipped to or picked up by the recycler. Under RCRA, many fluorescent and other lamps must be handled as hazardous waste, either being recycled or disposed of in a hazardous waste landfill. The relative costs of recycling versus hazardous waste landfill disposal vary significantly by location, and type of lamp (e.g., fluorescent tubes vs. high intensity discharge lamps). In both cases, end-of-life treatment is a small fraction of total lifecycle costs, which are dominated (90% on average) by energy use.

Detailed economic studies have been performed by other parties on lighting upgrade projects in general, notably by EPA’s Green Lights program – Green Lights provides lighting project assessment tools to evaluate upgrade costs and expected return. EPA figures indicate that incremental costs incurred by lamp recycling programs make relatively little difference in the lifetime *savings* realized from reduced energy use in upgrade projects. (That is, the additional cost of recycling is small compared to avoided costs of energy resulting from installation of higher-efficiency lighting.) This reasoning does not apply, of course, to ongoing maintenance, which involves piecemeal replacement of burned-out lamps with identical new

²⁵ It is possible to view both digital and mercury thermometers as having an incremental cost of use — for digital thermometers, this is the cost of the sterile, disposable cover. For mercury thermometers, this incremental cost is: (unit purchase cost + unit disposal cost)/ (expected number of uses).

(This omits discounting and spill, compliance, and treatment costs.)

²⁶ Green Lights is a US EPA voluntary program. Its goal is to improve the energy efficiency of the nation’s commercial and institutional lighting, thereby reducing greenhouse gas emissions and providing savings to participants. Participants commit to completing a lighting survey and upgrading 90% of eligible space, where profitable, within five years. Deployed originally as a stand-alone program, it now constitutes the first stage of EPA’s Energy Star Buildings program, which targets building energy efficiency more generally.

ones. Kaiser Permanente’s efforts to integrate ongoing maintenance replacements into its lamp recycling program does add a small increment to total lifecycle costs.

The following table gives average EPA cost data for fluorescent lighting end-of-life options:

Fluorescent lamps

End-of-life option	Cost
Municipal landfill	Average \$0.05/lb (>\$0.10 per four-foot tube)
Recycling	Average \$0.10/foot (\$0.40 per 4-foot tube)*
Hazardous waste landfill	\$0.25–\$0.50 per 4-foot tube*
Compare: Expected lifetime energy operating cost for one 4 foot lamp	\$64 (\$0.07/kwh, 20,000 hr bulb life)

*plus packaging & shipping costs

Source: *Lighting Waste Disposal*

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Appendix C: Hospital Interview Questionnaire

Purpose

Tellus Institute used this questionnaire to guide discussions (either via phone or in person) with hospitals and health care networks regarding: purchasing and waste disposal practices, exploring whether EA is a useful tool for uncovering waste minimization opportunities, and whether EA information can be used to influence upstream procurement practices.

1. Purchasing practices

1. Briefly describe the purchasing process at your hospital.
2. Do you use general purchasing organizations (GPOs)?
3. How many GPOs does your hospital contract with?
4. What is the typical length of term for these contracts?
5. What portion of your products are purchased through GPOs?
6. Which products are purchased outside the GPO and why?
7. Which departments in your hospital independently handle purchasing (i.e., do not go through a centralized purchasing department)? Do they also purchase via GPOs?
8. Who triggers the procurement process (e.g., department heads)? Who determines product specifications? How are specifications for similar products standardized?
9. Which other departments do hospital procurement personnel (i.e., both purchasing department staff as well as departmental purchasing staff) consult? Do they interact with environment, health, and safety or accounting staff?
10. What costs other than direct price are considered in purchasing decisions (e.g., storage, disposal)?
11. Are any environmental criteria used in purchasing decisions? If yes, please describe.
12. Is the amount of packaging/packaging waste associated with a product considered in purchasing decisions? If yes, please describe how this information is collected and used in decision making.
13. Is your hospital seeking to reduce the procurement of mercury-containing products? If so, which products are specifically targeted? Briefly describe phase-out plans and progress.
14. What hospital services are contracted out (i.e., outsourced)?

15. What is the typical length for these contracts?
16. What, if any, environmental criteria and environmental costs are used for selecting suppliers?
17. What is the structure of these contracts (e.g., flat fee, fee for service)?
18. Are there any incentives in the contract for the supplier to minimize material use and/or waste generation (e.g., shared cost savings)?

2. Waste streams

19. What waste streams do you generate?
20. How is waste generation tracked:
 - by type (e.g., infectious/biohazardous, pathological, etc.) -- please list/define
 - by department/activity (e.g., radiology, chemotherapy, etc.) -- please list
21. Is any attempt made to characterize waste stream contents (e.g., by chemical content, non-hazardous waste contained in red bags)?
22. How are each of these waste streams treated (on-site) and/or disposed?
23. For each waste stream, what units are used for tracking waste (weight, volume)
24. Over what time period is waste tracked (per shipment, week, month, year)
25. Are waste generation rates adjusted using any normalization factors (e.g., # admissions/month)?
26. Is packaging waste tracked, or do you have any estimate of what percentage of your hospital's waste stream is comprised of packaging waste?
27. Does your hospital track disposal of obsolete inventory?

3. Cost accounting

28. Which of the following costs are typically considered in purchasing decisions/value analysis process:
 - cost of acquisition (please define)
 - cost of storage (please define)
 - cost of utilization (please define)
 - cost of outdated product (e.g., product beyond expiration date) (please define)
 - disposal costs (please define)

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- labor costs (please define)
 - regulatory costs (please define)
 - clinical effectiveness (please define)
 - other (please define)
29. Does your hospital use an IS system or standardized form for collecting the above data? If so, can you share the protocol with us?
30. How are waste disposal costs tracked (e.g., by hauler, by waste type)? Are any of these costs allocated to the department/activity generating the waste? Do you think there is any benefit to allocating these costs?
31. Are any of the following costs tracked? Are any of these costs allocated to the department/activity generating the waste? Which of these costs are most significant?
- Supply costs for waste disposal (e.g., bags, containers, gloves)
 - Labor for waste disposal
 - Licensing/permitting costs for waste treatment/disposal
 - Environmental reporting costs (e.g., waste manifesting)
 - Staff training costs for environmental compliance
 - Environmental staff labor time
 - Environmental insurance
32. If your hospital operates waste treatment equipment (as identified in question #22 above), which of the following costs are tracked:
- equipment costs
 - maintenance costs
 - supply costs
 - labor costs
 - other costs (e.g., incinerator ash disposal)
33. Are and of the above costs allocated to the department/activity generating the waste? Do you think there is any benefit to allocating these costs?
34. Does your hospital track handling (e.g., labor) and disposal costs for obsolete materials?

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35. Are there any examples at your hospital of using environmental cost accounting to inform product decision-making?
36. Are there any examples at your hospital of using environmental cost accounting to inform waste disposal practices/changes?
37. If your hospital has experience in tracking environmental costs, has it assessed the costs and quantifiable benefits of collecting this information?