Source Reduction

A Hospital Case Study

Facility:

Itasca Medical Center

126 First Avenue SE

Grand Rapids, MN 55744

The Itasca Medical Center is a 108-bed community hospital with an attached 35 bed convalescent nursing care facility. The hospital staff made a commitment to source-reduce the hospitals waste as much as possible. Secondarily, what they could not reduce they committed themselves to recycle.

The project demonstrates that source reduction is a viable waste management method for hospitals. Measurement of cost changes and waste prevented took place on a product-by-product basis. Product waste was measured through the hospital's use and disposal of a product and did not attempt to measure waste produced through the manufacturing process of the product. The hospitals goal was simple: Reduce the amount of solid waste generated by the facility.

As a result of reduction actions alone, the hospital personnel is preventing **238 cubic yards** and over **10,700 pounds** of waste. Not including the savings from avoided disposal fees, these actions result in a **$11,030 yearly cost savings** for the hospital.

Reduction is defined as any activity that reduces waste at its source. The staff members examined their own waste stream and brainstormed ideas to accomplish reduction. As they looked at their waste stream, they asked themselves the following questions:

- Where can I **reduce** the amount or the toxicity of material used to accomplish any task?
- Are there existing or new products I can reuse over and over again?
- Are there existing or new products that are repairable, refillable or more durable to give a **longer useful life?**

These are the three pillars on which they based their efforts to reduce the amount of solid waste generated by their facility. The specific measures they identified are contained within this report.

This project was a team effort involving virtually all of the supervisors and staff at the hospital and had complete support of the director, David Triebes. Without their suggestions and implementation of the actions reported here, unnecessary waste would continue. Jim Thibodeau of purchasing and Judy Mager of dietary gave outstanding leadership for the project. Without this leadership the project would not have been possible. Technical support for the case study was provided by Kenneth Brown 612-649-5743, Minnesota Office of Waste Management.

Use reusable instead of single-use cafeteria salad plates

Although reusable plates are used to serve most food, the cafeteria served salads on single-use plates. Now salads are served on reusable dishes as well. As a further measure to reduce waste, cafeteria customers pay by the ounce for the salad they serve themselves, cutting down on food waste.

Volume of waste avoided: 36 cu yd/yr: A 99% volume reduction

- **Single-use:** 8" single-use plate; 55 cases/yr x 3,316 cu"/case = 182,389 cu" shipping volume. Actual disposal volume of 25 plates is 1,760 cu" for 25 plates.

  6" single-use plate; 9 cases/yr 2,100 cu"/case = 18,900 cu" shipping volume; Actual disposal volume of 32,000 plates was calculated to be 32,000 ÷ 25 = 1,280 x 1,760 cu" = 2,252,800 cu"/yr, x 90% to allow for dumpster settling = 2027,520 cu"/yr. Percent increase from shipping todisposal volume = 2,027,520 - (182,380 + 18,900) ÷ 2,027,520 = 90% increase.

- **Reusable:** measures 8.5" diameter x .375" thick. $\pi r^2 h = v$; 3.14 x 4.24 ÷x .375" = 21.26 cu" ea; 21.26 cu" x 72÷3 yr life = 510 cu"/yr

  Net: 2,027,520 - 510 = 2,027,010 cu" ÷ 56,656 cu"/cu yd = 35.8 cu yd/yr

  2,027,520 - 510 ÷ 2,027,520 = 99% volume reduction

Weight of waste avoided: 1,235 lbs/yr: 99% weight reduction /yr

- **Single-use:** 8" single-use plate; 20 lbs/case of 500,55 cases/yr = 1,100 lbs

  6" single-use plate; 15 lbs/case of 500, 9 cases/yr = 135 lbs; 1,235 total lbs/yr

- **Reusable:** plate weighs 5.625 oz x 72 ÷ 3 yr life = 135 oz/yr

  Net: 1,235 lbs - (135 oz ÷ 16 oz/lb) = 1,226 lbs/yr reduction;

  1,226 ÷ 1,235 = 99% weight reduction

Cost savlngs, not including avoided disposal fees: $2,126/yr: 94% cost savings/yr

- **Single-use:** 6" plate, $275/yr + 9" plate, $1,980/yr = $2,255/yr
- **Reusable:** 72 plates purchased @ $2.08 ea = $150, ÷ 3 yr life = $50/yr

  Washing cost: 14 plates /rack; 2.5 gallons of water is used /rack; 1/15$ of electricity /rack; 3.5¢ of soap /rack. 32,000 single-use plates were used/yr,÷ 14 plates/rack = 2,285 racks/yr.

  Water: 2,285 racks x 2.5 gallons = 5,713 gallons/yr x ($2.47 per 1000 gallons for water and sewer combined) = $14.11/yr

  Electricity: 2,285 racks x 1/15c (.0066) = $15/yr

  Soap: 2,285 racks x 3.5¢ (.035) = $79.97/yr

  Net: Single-use $2,255 -(Reusable $50 + $14 + $15 + $80) = $2,126 savings/yr

- **Indirect costs:** Old reusable plates are given to Goodwill for reuse; no disposal cost. On large volume days, maintenance was called to empty cafeteria trash cans one to two extra times per week. With reusables, extra pick-ups have ceased. A reduction of 36 cu yd/yr x $6.25/yd gives a theoretical savings of $225/yr. However, contracted hauling volume was not decreased due to this action alone.

There was a decrease in labor for purchasing and maintenance departments in managing and handling this waste. There was an increase in labor for dietary to handle the reusables. The existing staff integrated this action. There were no staff changes for the hospital as a whole.

Reusable desert dishes replace single-use

Small ceramic dishes are now used instead of plastic, single-use desert cups. Nurses report that patients appreciate the change to the use of the more substantial ceramic dishes because they convey a more positive feeling than the thin plastic trays.

Volume of waste avoided: 62 cu yd/yr: 99% volume reduction

- **Single-use:** Two sizes were replaced. Tray one: 138 /day x 365 days/yr = 50,370 dishes/yr with a shipping volume of 80 cu" versus 1,430 cu", actual disposal volume for 50 trays. (A 94.4% volume increase). 50,370 trays/yr ÷ 50 = 1007.4, x 1,430 cu" for 50 trays, x 90% (dumpster settling allowance) = 1296,524 cu"/yr

  Tray two: 246 /day x 365 = 89,790 dishes/yr with a shipping volume of 65 cu" versus 1,375 cu", actual disposal volume for 50 trays. (A 95.3% volume increase). 89,790 trays/yr ÷ 50 = 1,795.8, x 1,375 cu" for 50 trays, x 90% (dumpster settling allowance) = 2,222,302 cu"/yr

  1,296,524 + 2,222,302 = 3,518,826 cu"/yr
- **Reusable:** 400 needed, measuring 4" x 2.75" x 1.5" = 16.5 cu in each. Life is 3 years, 400 ÷ 3 = 133.3/yr, x 16.5cu" = 2,200 cu"/yr

  Net: 3,518,826 cu" - 2,200 cu" = 3,516,626 cu"/yr ÷ 56,656 cu"/yd = 62 cu yd/yr volume reduction; 3,516,626 ÷ 3,518,826 = 99% reduction

Weight of waste avoided: 1,230 lbs/yr: 96% weight reduction

- **Single-use:** Tray one; 6.1 oz for 50; 50,370 used /yr ÷ 50 = 1007.4, x 6.1 oz = 6,145 oz/yr

  Tray two; 8 oz for 50; 89,790 used/yr ÷ 50 = 1,795.8, x 8 oz = 14,366 oz/yr

  6,146 + 14,366 = 20,512 oz/yr
- **Reusable:** 6.26 oz each x 133.3 /yr = 833 oz/yr

  Net: 20,512 - 833 = 19,679 oz/yr ÷ 16 oz/lb = 1,230 lbs/yr weight reduction; 19,679 oz/yr ÷ 20,512 oz/yr = 95.9% weight reduction

Cost savings, not including avoided disposal fees: $904/yr: 60% cost savlngs/yr

- **Single-use:** Cost; $64.40/case x (8.4 + 15) cases = $1,507/yr
- **Reusable:** Cost 23.95 a dozen; 400 needed, ÷ 12 = 34 dozen, x $23.95 = $814; ÷ 3 yr/life = $271/yr

  Costs of water, sewer, electricity and soap: 400 dishes washed /day ÷ 21 dishes on a rack = 19 racks run/day.

  Water and sawer for 2.5 gallons/rack is 19 x 2.5 gal = 47.5 gal/day x 365 days/yr = 17,338 gal/yr, x $2.47/1000 gal = $42.82/yr

  Electricity is .0066¢ /rack x 19 racks/day x 365 = $45.77/yr

  Soap is 3.5¢ /rack x 19 racks/day x 365 = $243/yr

  Net: $1,507 - ($271 + $43 + $46 + $243) = $904 cost savings/yr; $904 ÷ $1,507 = 60%

Indirect costs: A reduction of 62 cu yds of waste /yr theoretically translates into 62 x $6.25/cu yd = $387 /yr. However, contracted hauling volume was not decreased due to implementation of this measure alone. Labor for purchasing and maintenance decreased due to less management and handling of single-use dishes. Labor for dietary increased or due to washing of reusables. Implementation of this action was integrated by existing labor. The hospital as a whole did not experience an increase in labor cost.

Change to rechargeable batteries

For minimal disruption of patients' sleep, nursing staff used "D" cell flashlights to check on patients during the night. This practice was appreciated by patients but resulted in large quantities of spent batteries. Rechargeable flashlights are now used. Purchased over four years ago, the original sample still performs very well.

Volume of waste avoided: 1,272 batteries or .074 cu yd each year; 98% volume reduction

- **Disposable:** "D" cell battery purchased dropped from 120 per month to 14 per month, a decrease of 106 batteries per month.

Net change in battery volume; 106/mo x 2.77 cu"/battery x 12 = 3,523 cu"/yr

- **Reusable:** 7" x 2.25" = 17.5 cu" x 18 flashlights ÷ 4 yr life = 78.75 cu"/yr

Net: 3,523 - 79 = 3,444 cu" ÷ 46,656 cu"/cu yd = .074 cu yd/yr; 3,444 ÷ 3,523 = 97.76% volume reduction

Weight of waste avoided: 394 lbs each year; 99% welght reduction

- **Disposable:** "D" cell weighs 5 oz, 106 x 5 oz x 12 = 6.360 oz per year ÷ 16 oz for one pound = 398 lb/yr.
- **Reusable:** rechargeable flashlight weighs 1 lb x 18 flashlights purchased = 18 lbs,÷ 4 yr life = 4.5 lb/yr

Net: 398 lbs - 4.5 lbs = 393.5 lb/yr reduction; 393.5 ÷ 398 = 98.9% weight reduction.

Cost savings, not including avoided disposal fees: $260 each year: 86% cost savings

- **Disposable:** 106 batteries/mo x 12 = 1,272 /yr x 23.7¢ ea = $302 /yr
- **Reusable:** $207 was spent purchasing 18 reusable flashlights.

Flashlights are guaranteed for one year, but a four year life has been experienced. Over four years, 5,088 batteries and $1,208 in disposable battery purchase cost is avoided. Electricity used to recharge the batteries is reported insignificant compared to total hospital usage.

Net: $1,208 - $207 = $1,041 ÷ 4 years for an average of $260 saved each year; $1,041 ÷ 1,208 = 86.2% cost reduction

Indirect costs: Currently, hospitals must manage alkaline batteries as hazardous waste. Significant reduction in volume and weight reduces disposal costs.

Issues: Staff must be trained on use of recharger. Electrical outlets must be convenient for nursing staff. Rechargeable flashlights with "low battery" indicators are recommended. With these measures in place, implementation has been successful.

Note:
Minnesota statute 115A.9155 applies to disposal of industrial batteries. Mercuric oxide and silver oxide as well as nickel-cadmium and lead-acid batteries purchased for use by government, industry, communications and medical facilities are covered. Manufacturers selling these batteries to these facilities are responsible for ensuring a system of collection and processing of these batteries by August 1, 1990.
Pilot collection for all other rechargeable batteries and appliances (primarily from households) must be in place by April 15, 1992. Rechargeable tools and appliances must have a rechargeable battery that can be easily removed after July 1, 1993.

Alkaline batteries sold in Minnesota may contain no more than 0.025 percent mercury by battery weight as of February 1, 1992. Although rechargeable batteries result in substantially less solid waste than their alkaline or carbon-zinc counterparts, it is difficult to compare the complete environmental impact of these three battery types. However, in Minnesota rechargeable batteries are subject to mandatory collection which ultimately results in recycling or controlled hazardous waste disposal while low-mercury and carbon-zinc batteries can be disposed in municipal solid waste.

Use reusable, not single-use, pitchers on patient floors

Nurses must have individual pitchers of water available for patients on each floor of the hospital. Reusable, color-coded pitchers for each department are now used.

Volume of compacted waste avoided: 19 cu yd/yr; 99% volume reduction

- **Single-use:** The hospital threw out 5,500 single-use pitchers every year, 11 cases of 500/case. Assembly of container and handle required, separate components.

The volume of one container (πr^2h = v) 3.14 x 2.5^2 x 8 = 157 cu". x 5,500 pitchers/yr = 863,500 cu"

Handle - solid plastic, must be assembled, not autoclavable (steam sterilization), case 80" x 23.5" = 1,880 cu" x 11 cases/yr = 20,680 cu"/yr

Lid - solid plastic, not autoclavable, case 60" x 14" = 840 cu" x 11 cases/yr = 9,240 cu"/yr

863,500 + 20,680 + 9,240 = 893,420 total cu"/yr, minimum volume

- **Reusable:** The volume of the autoclavable, reusable pitcher is 170 cu". It has a minimum life expectancy of 3 years. 180 were purchased. 180 x 170 cu" = 30,600 cu" every 3 years; ÷ 3 = 10,200 cu"/yr.

Net: 893,420 cu" - 10,200 cu" = 883,220 cu"/yr ÷ 46,656 = 18.9 cu yd/yr volume reduction;

883,220 ÷ 893,420 = 98.8%

Weight of waste avoided: 414 lbs; 94% weight reduction

- **Single-use:** One 500-count pitcher case has the following weights:

Pitchers, 10 lbs

Handles, 20 lbs

Lids, 10 lbs

40 lbs x 11 cases used /yr = 440 lbs/yr

- **Reusable:** Pitcher weighs 7 oz x 180 purchased ÷ min. 3 yr life = 420 oz ÷ 16 oz/lb = 26 ibs/yr.

Net: 440 - 26 = 414 lbs avoided /yr.; 440 - 26 ÷ 440 = 94.1%

Cost savings, not including avoided disposal fees: $1,445 /yr: 81% savings /yr

One 500 count case of each of the following costs:

Pitchers, $49

Handles, $69

Lids, $43

- **Single-use:** Cost = $161 x 11 = $1,771 /yr = $148 /mo.
- **Reusable:** Cost = $1.77 ea x 180 needed = $318,÷ 3 yr life cycle = $106 /yr = $8.83 /mo.

Water, electricity and soap is calculated to cost approximately $225 /yr

Net: Single-use ($148 x 12) - ($8.63 x 12 + $225) = 1,445/yr savings

$1,445 ÷ $1,776 = 81% savings /yr

Indirect costs: There was a decrease of labor in ordering, stocking and delivering for the purchasing and maintenance departments. No significant labor change to get reusables to kitchen because taken with other food cart items. Increase in loading/unloading dishwasher. No change in overall staff for the hospital due to implementation of this action.

Issues: Color-coding assures pitchers are returned to correct department. Reusable pitchers are stackable and are stored where single-use pitchers used to be kept.

Change from disposable to reusable pads

When nursing staff changed from plastic-lined, fiber-filled disposable under-pads used on patient beds to a reusable cotton under-pad, patients repotted an increase in comfort.

Volume of waste avoided: 44 cu yds each year: 92% volume reduction

- **Single-use:** 300 fewer cases of disposable Pads are used each year. The cases measure 21" x 14" x 15"= 4410 cu" /case x 300 = 1,323,000 cu" ÷ 46,656 cu"/cu yd = 28 cu yd. This volume represents manufacturer's shipping volume, a minimum volume for the Product. Actual disposal volume after use was observed to be a minimum of 70% greater. 28 cu yd ship. vol. x 70% = 19.6 cu yd., 28 cu yd + 19.6 cu yd = 47.6 cu yd/yr

- **Reusable:** Each Pad measures 24" x 36" x 172" = 432 cu in., 768 pads were purchased. Pad life is estimated to be a minimum of 2 years. 432 cu in. x 768 = 331,776 cu in of waste every 2 years, ÷ 2 = 165,888 cu in of waste/yr. 165,888 ÷ 46,656 cu in/yd = 3.55 yards/yr. When worn out, these pads will be reused as rags and rag Pads. When they are eventually thrown out net waste volume will be 47.6 cu yds - 3.55 cu yds = 44.05 cu yds net volume reduction&.
  47.6 - 3.55 ÷ 47.6 = 92.5% volume reduction&r

Weight of waste avoided: 5,537 Ibs each year. 97% weight reduction

- **Single-use:** Unused, disposable pads from one case weigh 19 Ibs; 300 x 19 Ibs = 5,700 total Ibs. Due to fluid absorption, actual disposal weight would be higher. Minimum weight used.

- **Reusable:** 6.8 oz each, 768 purchased for 2 yrs = 2,611.2 oz/yr ÷ 16 oz/lb = 163.2 Ibs/yr
  Net: 5,700 Ibs - 163 Ibs = 5,537 Ibs net weight reduction&r
  5,700 - 163 ÷ 5,700 = 97% weight reduction&

Cost savings, not Including avoided disposal fees: $5,021 each year: 67% cost reduction

- **Single-use:** Approximately 16,000 single-use pads, a cost of $7,466, were thrown out each year.
- **Reusable:** $4,440, reusable pad purchase cost ÷ 2 yr Pad life = $2,220 /yr plus $225 in water, soap and electricity/yr = $2,445/yr.
  Net: $7,466 - $2,445 = $5,021 /yr cost savings ÷ $7,466 = 67% cost reduction&

Indirect costs: Reduction in disposal of 44 cu yds of single-use pads at $6.25 per cu yd = $275/yr. However, this figure was not included in savings because contracted hauling volume for the facility was not changed. Labor cost of purchasing, checking-in, moving, storing and disposing of 16,000 single-use pads/yr decreased for purchasing and maintenance departments. Labor cost of washing and folding reusable pads increased for laundry department. These changes were not incorporated into the cost figure because, though labor for individual departments changed, labor costs for the hospital as a whole did not change. This action was integrated by the existing staff,

Exit sign conversion

There are 18 exit signs throughout the facility, all lit continuously. Existing incandescent bulb sockets were converted to fluorescent. Fluorescent bulbs were found to last 10 times longer (2.5 yrs) than the hospitals incandescent exit sign bulbs (1/4 of one yr). Although most exit signs have 2 incandescent bulbs per exit sign, the hospitals fixtures contained one. It is worthy to note that conversion to fluorescent was still beneficial.

Percent reduction of this waste stream: 89%

Incandescent count; 67 used/yr in facility
Fluorescent count; 18 needed for 2.5 yr; 7.2/yr; 89% count reduction

Volume of waste avoided: .0034 cu yd 80% volume reduction of exit lighting waste

15-watt incandescent bulbs = 3 cu" x 67 = 201 cu"/yr
7-watt fluorescent bulb = 3.75 cu" x 18 used in 2.5 yr = 27 cu"/yr
Ballast; 4 cu", life 5 yrs, 1 yr = 19% of total life, 4 cu" x 18 count = 72 x 19% = 14 cu"/yr
Net: 201- 27 - 14 = 160 cu" ÷ 46,656 cu"/yd = .0034 cu yd/yr
201 cu" - (27 + 14 cu") ÷ 201 = 79.6% volume reduction

Weight of waste avoided: 24 oz; 40% weight reduction of exit lighting waste

15-watt incandescent bulb; .8 oz x 67/yr = 54 oz/yr
7-watt fluorescent bulb; 1.15 oz x 18 bulbs for 2.5 yr ÷ 2.5 = 8.3 oz/yr:
Ballast; last 45,000 hrs (5 yrs); magnetic ballast wt. 7 oz; 19% life use/yr; 19% x 7 oz = 1.33 oz/yr/fixture.
Net:18 x 1.33 = 24 oz/yr for total
54 oz/yr - (8.3+24) ÷ 54 = 40%

Cost savings, not including avoided disposal fees: $6/yr: 11% /yr cost savings

Incandescent bulbs cost $0.64 ea x 67 = $43/yr
Fluorescent bulbs cost $2.50 ea x 18 = $45 for 2.5 yrs, $18/yr
Retrofit kits cost $12.70 ea x 18 = $228; conservative 10 yr life = $23/yr

Electricity cost savings: $3.85; 46% electricity cost savings
Incandescent; $.05 /kWh x 15 watts = $01.01/1,000hrs. x 8.760 (8760 hr/yr) = $8.45 /yr
Fluorescent: $.05 /kWh x 8 (7 watts for bulb + 1 watt for ballast) = .525 /1,000 hrs x 8.76 = $4.60
Net: ($43 + $8.45) - ($18 + $23 + $4.60)= $5.85/yr
$5.85 ÷ $51.45 = 11.4% /yr cost savings

Indirect costs: Labor - Each bulb change costs $8 in labor. Replacing 67 incandescents costs $536/ yr. Replacing 18 fluorescents every 2.5 yrs costs $144; or $58/yr. Net labor cost change; $478 savings. However, no staff changes were made at the hospital as a direct result of implementation of this action.

Issues: Although the hospital's incandescent bulbs listed a 2,500-hour life, that proved to be a maximum. Although fluorescents listed a 10,000-hour life, in continuous-bum applications they have lasted over 2 years (22,000 hrs). Loop type PL and straight tube mini bi-pin fluorescent lamps are both available for exit sign conversion.

Replace incandescent floodlights with fluorescent floodlights

During remodeling, the hospital installed 87 compact fluorescent, recessed ceiling floodlights instead of recessed incandescent floodlights. Reported benefits of the change were source reduction, less heat build-up, lower maintenance costs and improved light quality.

The fixtures have been in place over 2 years. No bulbs have burned out. Approximately half are continuously lit and half are on a computerized timer.

Volume of uncompacted waste avoided: .1 cu yd; 94% volume reduction

Incandescent; a 60-watt bulb measured 7 cu" displacement, life 1000 hrs
Fluorescent; a 13-watt bulb measured 4 cu" displacement, life 22,000 hrs (over 2 yrs)
Ballast; last 45,000 hrs (5 yrs) and measures 8.9 cu".
Usage for 45,000 hours of one light:
Incandescent; 696 bulbs x 7 cu" = 4,872 /yr cu"
Fluorescent; 34.8 bulbs x 4 cu" = 139 cu"/yr
Ballast, 1 = 8.9 cu"; 5 yr life; 87 fixtures; 87÷5= 17.4 prorated use/yr; 17.4 x 8.9 = 155 cu"/yr
Net: 4,872 -139 - 155 = 4,578 cu" avoided ÷ 46,656 cu"/yd = .098 cu yd/yr
4,872 - 155 ÷ 4,872 = 94%

Weight of waste avoided: 26.5 lbs/yr; 64% weight reduction

Incandescent; 60-Watt bulb weighs .95 oz x 696 used/yr = 661 oz/yr waste
Fluorescent; a 13-watt bulb weighs 1.75 oz; .5 life used /yr x 87 fixtures = 76.5 oz/yr/waste
Ballasts; life 45,000 hrs:
Magnetic ballast weighs 9.75 oz; 19% life used /yr = 1.85 prorated oz/yr x 87 lights = 161 oz/yr waste
Electronic ballasts weighs 2.30 oz; 19% life used /yr = .437 oz/yr x 87 lights = 38 oz/yr waste.

- Fluor. bulb (76.5) + Mag. bal. (161) = 237.5 oz/yr
- Fluor. bulb (76.5) + Elec. bat (38) = 114.5 oz/yr

Net: 661 - 76 - 161 = 424 oz ÷ 16 oz/lb = 26.5 lbs/yr
661 oz - 238 oz ÷ 661 oz = 64%

Cost savings, not including avoided disposal fees: $268 /yr: 36% cost savings /yr

- Incandescent bulbs cost $0.64 ea x 696 = $445/yr
- Fluorescent bulbs cost $2.51 ea x 34.8 prorated bulbs/yr = $87/yr
- Ballast cost $12.70 ea for conservative 10 yr life = $1.27 prorated cost/fixture x 87 fixtures = $110/yr
- Electricity savings; 60-watt incandescents (cost $3/1,000 hrs) were replaced by 14 watt fluorescent (cost $.70 / 1000 hrs);

8760 hrs in one yr ÷ 1000 = 8.76 kwatt; Yearly incandescent cost $3 x 8.76 = $26/yr; Yearly fluorescent cost $0.70 x 8.76 = $6/yr; $26 - $6 = $20/yr savings = 77% electricity cost savings.
Net: ($445 + 26) - (87 + 110 + 6) = $268 cost savings/yr; $268 ÷ ($445 + $26) = 36% savings/yr

Indirect costs: Labor for changing incandescent bulbs; $8/change x 696 = $5,568/yr. Labor for changing fluorescent bulbs; $8/change x 34.8 = $278/yr. A significant labor decrease for the maintenance department results from this action. However, no change was made in staff due to this action alone.

Issues: The maintenance staff discovered that some compact fluorescent units are sold with the ballast and bulb glued together as one unit. When the bulb bums out the entire lens and ballast must be thrown out. To avoid this unnecessary waste and expense, make sure the bulbs can be replaced.

Use efficient flow shower heads

There are 33 showers in the hospital and long-term care center. By changing to efficient-flow fixtures, the hospital conserves water, energy and capital.

- The old shower heads used 3.5 gallons /min.
- The new shower heads use 1.5 gallons /min.

Volume of waste water avoided: 103,000 gallons /year. 57% volume reduction

Approximately 2,100 showers lasting an average of 7 minutes each are taken at the facility each year.
Old: 3.5 gal./min x 7 min = 24.5 gal./shower x 2,100 showers = 51,450 gal/yr
New: 1.5 gal./min x 7 min = 10.5 gal/shower x 2,100 showers = 22,050 gal/yr
Net: 29,400 gallons saved: 29,400 ÷ 51,450 = 57% volume reduction

Cost savings, including avoided waste water treatment cost: $89/yr: 57% cost reduction

Water cost is $1.70 /1,000 gal. Sewer charge is pegged to the number of gallons of water used and is $.77 /1,000 gal. Total cost of water used is $2.47 /1,000 gal.
29,400 ÷ 1,000 x $2.47 = $73 /yr

It takes 22 watt-hours to heat one gallon of water to 120 ÷ F x # gal heated (29,400 ÷ 2 = 14,700 gal heated) = 323,400 ÷ 1000 (for kilowatt hours).= 323.4 kilowatt hours x watt hourly rate of $0.05 /kilowatt = $16; $73 water and sewer savings + $16 electricity savings = $89
Old: 51,450 gal/yr x $2.47/1,000 gal = $127/yr
New: 22,050 gal/yr x $2.47/1,000 gal = $54/yr
Net: $127 - $54 ÷ $127 = 57% cost reduction

issues: Although shower heads were replaced by efficient-flow fixtures, the timing of replacement was determined by existing shower head life-cycle maintenance. The hospital replaces shower heads when corrosion and mineral build up impair function. Old shower heads are given away for reconditioning and reuse. Aerators are used on faucets.

Toxicity reduction by developing solution change

X-ray image quality was not compromised when the hospital changed to non-toxic "T2" chemistry. The new developer contains no hexavalent or trivalent chromium, is 95 percent acid-free, has no irritating fumes and does not damage clothing. The fixer is borate-free and the developer starter has a neutral Ph.

Percent reduction of this toxic waste stream: 100%

The hospital no longer uses acidic developer or fixer.

Volume of toxic waste avoided: 810 gallons /year

10 gallons of fixer is used every 18 days = 203 gal/yr

10 gallons of developer is used every 6 days = 608 gal/yr

Cost savings, not including avoided disposal fees: Break even

Issues: Improved worker safety and eliminating over 800 gallons of toxic waste were the reasons for the change. The product is manufactured by White Mountain Imaging, Webster, NH 03303 (603) 648-2124. It is handled by medical supply distributors nationwide.

Change from straight to circular tubes for x-ray view boxes

Some X-ray view box models contain four straight fluorescent X-ray tubes, and all must be replaced when one bulb bums out. Updated versions contain only one circular tube. Life expectancy is the same, 2 years.

Volume of waste avoided: .01 cu yd/yr: 24% volume reduction /yr

Straight tube: measures 1" dia x 17.25" long = 54.2 cu", x 4 tubes /fixture = 217 cu" x 18 fixtures ÷ 2 year life = 1,953 cu"/yr.

Circular tube: measures 1.25" dia x 33.5" circum = 165 cu", x 18 fixtures ÷ 2 year life = 1,485 cu"/yr.

Net: 1,953 cu" - 1,485 cu" = 468 cu", ÷ 46,656 cu"/cu yd = .01 cu yd/yr

1,953 cu" - 1,485 cu" ÷ 1953 cu" = 24% volume reduction

Weight of waste avoided: 1 lb/yr: 22% weight reduction

Straight tube: 2.1 oz ea x 4 tubes/fixture x 18 fixtures fixtures ÷ 2 year life = 76 oz/yr

Circular tube: 6.5 oz ea x 18 fixtures ÷ 2 year life = 59 oz/yr; 76 - 59 = 17 oz, ÷ 16 oz/lb = 1.1 lb

17 oz ÷ 76 = 22% weight reduction

Cost savings: $71 /yr: 44% annual cost savings

Straight tube: 4 required /fixture x $2.24 ea x 18 fixtures = $161

Circular tube: 1 required /fixture x $4.97 ea x 18 fixtures = $90

Net: With replacement life the same, $161 - $90 = $7l/yr, $71 ÷ $161 = 44% cost savings /yr

Indirect costs: Less labor is required to service circular tube units than 4 tube units.

Change to reusable cups

Use of single-use styrofoam cups by staff was eliminated. The hospital provided high-quality, reusable plastic mugs embossed with the hospital's logo for all employees. Employees are responsible for their own mugs. Reusable cups are provided for all meetings. The hospital plans to phase out single-use cups in the facility in 1993.

Volume of waste avoided: 26 cu yd/yr. 99.8% volume reduction

- **Single-use cups:** Shipping volume is 6,084 cu" /case of 1000; Measured disposal volume of 50 cups is 1,287 cu"; 20 x 1,287 = 25,740 cu" for 1,000 cups (76% increase from shipping to disposal volume.) A minimum of 1,000 single-use cups were used/week. Allowing for settling in a dumpster, 90% of the measured disposal volume is used for calculations. 90% x 25,740 cu" = 23,166 cu" x 52.14 wks/yr = 1,207,941 cu"/yr

- **Reusable cups:** Since cups are the property of individual staff, and they must be replace at their own expense, it is not anticipated that they will be throws away. However, a 4-year functional life was assigned to the cups. Cups measure 3" dia. x 5" ht = 35.4 cu"; 200 cups were distributed, ÷ 4 yr life = 50 disposed/yr; 35.4 cu" x 50 = 1,770 cu"/yr
  Net: 1,207,941 cu"/yr - 1,770 cu"/yr = 1,206,171 cu"/yr ÷ 46,656 cu"/yd = 25.85 cu yd/yr; 1,206,171 ÷ 1,207,941 = 93.8% volume reduction

Weight of waste avoided: 69 lbs/yr: 82% volume reduction

- **Single-use:** 7 lb/case of 1,000; 12 cases/yr x 7 lbs = 84 lbs/yr lbs/yr

- **Reusable:** 4.75 oz x average of 50 disposed/yr = 237.5 oz, ÷ 16 oz/lb = 14.8 lbs/yr
  Net: 84 lbs - 14.8 lbs = 69.2 lbs/yr avoided; 69.2 ÷ 84 = 82.3% volume reduction

Cost savings, not including avoided disposal fees: $94 /yr: A 58% cost savings/yr

- **Single-use:** Cost $13.50/case x 12 = $162/yr
- **Reusable:** Cost $1.35 ea x 200 = $270, however future cost of purchasing single-use cups is eliminated. If the hospital decides to purchase new cups in 4 years (estimated life) instead of having employees purchase their reusable cups as is now the policy, the hospital cost savings would be $162 x 4 = $648, - $270 = $378 savings over 4 yr, = $94 /yr savings; $94 ÷ $162 = 58% cost reduction.

Indirect costs: 26 cu yd waste abatement x $6.26/yd = $162 cost reduction. However, due to implementation of this measure alone, no change was made in the hospital's contracted hauling volume. The maintenance department has a considerable reduction in labor expense due to decrease in volume and weight of waste managed. Staff are responsible for washing out their own mugs, 1 minute per day. No staff changes.

Change to bulk milk dispenser

Milk was served to patients in half-pint, plastic coated, gable-top milk cartons. The containers composed a major element of food service's waste. An average of 205 milk cartons were thrown out each day, 74,825 each year. Food service staff reduced this by changing to reusable cups and a bulk milk dispenser.

Volume of waste avoided: 1.9 cu yds/yr: 7% volume reduction

- **Single-use:** One 8-oz carton takes 17 cu in x 74,825/yr = 1,272,025 cu in/yr. Cartons are plastic coated cardboard, not locally recyclable. Actual disposal volume is greater than stacked volume used here.
- **Bulk container:** One 3-gallon (128-oz) container measures 11.5" x 8.25" x 8" = 759 cu in. Plastic liner separates from cardboard box, cardboard is locally recyclable. 8 oz x 74,825 = 598,600 oz/yr, ÷ 128 oz/gal = 4,676.6 gal/yr, ÷ 3 gal/container = 1,559 containers. 759 cu in x 1,559 = 1,183,170 cu in/yr.

Reusable glass measures 3.25" dia x 3.25" high = 8.58 cu in ea. x 105 disposed/yr = 901 cu in/yr

Single-use lid measures 3.25" dia x .081" thick = .0026 cu in ea. x 205 used/day x 365 = 195 cu in/yr; 60% increase in disposal volume observed, 60% x 195 = 117, + 195 = 312 cu in disposal volume/yr

Net: carton use, 1,272,025 cu in/yr - Bulk use (1,183,170 + 901 + 312) = 87,642 cu in/46,656 cu in/cu yd = 1.88 cu yd, 6.89%

The cardboard is recycled but 59,158 cu in of currently non-recyclable plastic remains. Because the cardboard of the bulk containers is locally recyclable while the cartons are not, 26 cu yds/yr, a 95% volume reduction, is kept from the dumpsters through the use of bulk milk.

Weight of waste avoided: 740 lbs/yr. 32% weight reduction

- **Single-use:** One 8-oz carton weighs .5 oz x 74,825/yr = 37,415 oz, ÷ 16 oz/lb = 2,338 lbs/yr.
- **Bulk container:** One 3-gallon (128-oz) container weighs .81 lbs of cardboard and .015 lb of plastic for a total of .825 lbs, x 1,559 containers/yr = 1,286 lbs/yr.

Reusable glass weighs 2.1 oz ea., 205 used, life 2 yrs = 103 disposed/yr. 103 x 2.1 oz = 216 oz ÷ 16oz/lb = 13.5 lbs/yr

Single-use glass cover weighs .20 lb for 50,205 used/day 365 = 74,825/yr ÷ 50 = 1,497, x 20 lb = 299 lbs/yr

Net: 2,338 lbs/yr - 1,286 -13.5 - 299 = 739.5 pounds prevented, ÷ 2,338 lbs = 31.6% weight reduction due to source reduction. Because virtually all of the weight of the bulk milk containers is recycled, the change represents a 99% disposal weight reduction due to recyclability.

Cost: A $98/yr increase: 1% cost increase

- **Single-use:** Cost 12¢ a carton x 74,825/yr = $8,979/yr
- **Bulk container:** One 3-gallon (384-oz) container costs 11.6 cents/serving; 74,825 servings ÷ 48 = 1,559 3 gal containers/yr, x $5.57 = $8,683/yr. The dispenser furnished by the milk distributor

Reusable glasses cost $48/case, 80 to a case or 60¢ ea., 205 used/day. Two year life; 103 x .60 = $62/yr

Single-use cup lids are used to cover glasses, $9.15 a case of 3,000 = .00305¢ ea x 205 used/day = .62¢ x 365 = $228/yr

Washing, soap, water and energy use for 8 additional racks run/day = $104/yr

Net: $8,683 + $62 + $228 + $104 = $9,077/yr

$8,979 for cartons - $9,077 for bulk = $98, a 1% cost increase

Indirect costs: Because the hospital's recyclable material is picked up without charge and the bulk milk container is recyclable, 26 cu yds of waste is not disposed. 26 cu yd x $6.25 cu yd = $162/yr savings. However, implementation of this measure alone did not result in a decrease in contracted hauling volume for the facility. Labor for handling 75,000 cartons is replaced by handling 1,600 three-gallon containers plus the 75,000 glasses and lids a year. More labor is spent using bulk milk; however, the change was integrated by the existing staff.

Issues: Bulk milk may be more cost-effective at other facilities. Cartons usually range in price from 12 to 13 cents each. They are 12 cents for this facility. 3-gallon bulk can be less than $5.57 each.

Change to milk pouch

The cafeteria changed from 8 oz milk cartons to milk pouches. Staff members puncture the self-sealing bag with a small straw before serving.

Volume of waste avoided: 6.2 cu yd/yr: 87% volume reduction

- **Cartons:** 50 cartons used/day x 365 = 18,250 cartons/yr x 17 cu in/carton = 310,250 cu in/yr. Straws are paper-wrapped, a box of 400 measures 9" x 5.5" x 6" = 279 cu in., 18,250 ÷ 400 = 45.6 boxes of straws/yr, x 279 cu in/box = 12,729 cu in/yr. 310,250 + 12,729 = 322,979 cu in/yr

- **Plastic pouches:** 50 Pouches used/day x 365 = 18,250 pouches/yr x 2.3 cu in = 41,975 cu in/yr. Straws are .056194 cu in ea. including Packaging, 18,250 x .056194 = 1,025.5 cu in/yr.
  Net: 41,976 + 1026 = 43,002 cu in/yr
  332,979 - 43,002 = 289,977 cu in/46,656 cu in/yd = 6.2 cu yd/yr, 87% volume reduction

Weight of waste avoided: 472 lbs/yr: 78% weight reduction

- **Cartons:** 18,250 cartons/yr at .5 oz = 9,125 oz/yr., 18,250 straws, 400 weight 12.8 oz, 18250 ÷ 400 = 45.6, x 12.8 oz = 584 oz., 9,125 + 584 = 9,708 oz/yr

- **Plastic pouches:** 18,250 pouches/yr at .11 oz = 2,007 oz/yr., 18,250 straws, 400 weigh 3.3 oz, 18,250 ÷ 400 = 45.6, x 3.3 oz = 150 oz., 2007 + 150 = 2,157 oz/yr
  Net: 9,708 - 2,157 = 7,551 oz ÷ 16 oz/lb = 472 lbs/yr.; 7,551 oz ÷ 9,708 oz = 77.8% weight reduction

Cost savings: $276/yr: 12% cost reduction

- **Cartons:** Cost 12¢ each x 18,250 = $2,190; Straws cost $2.03 for 400, 18,250 ÷ 400 = 45.6, x $2.03 = $92.57/yr; $2,190 + $93 = $2,283/yr

- **Plastic pouches:** Cost 11¢ each x 18,250 = $2,007; Straws are included;
  Net: $2,283 - $2,007 = $276/yr; $276 ÷ $2,283 = 12% cost reduction

Indirect costs: A reduction in disposal of 6.2 cu yd of waste x $6.25 = $39/yr. Contracted hauling volume was not changed for the facility due to implementation of this measure alone. More pouches fit into a smaller space in the walk-in cooler, more efficiently using space. No appreciable labor change for dietary department. Due to less waste, there is a labor savings for the custodial department. No staff changes.

Reusable decubitus care mattresses

"Egg-crate" mattresses are designed to distribute pressure so that decubitus ulcers do not develop on patients' skin. Typical egg-crate mattresses cannot be reused by another patient. The reusable mattresses accomplish the same goal but create much less waste, do not require mattress pads and save money.

Volume of waste avoided: 43 cu/yds: 97% volume reduction

- **Single-use:** 26 cases of 12 thrown out each year = 312; 30" x 80" x 2.75" ea = 6,600 cu" x 312 used/yr = 2,059,200 cu"/yr
- **Reusable:** The dense foam decubitus-care insert is warranted for 5 years. They measure 27" x 72" x 3.25" = 6,318 cu in. Eight were purchased to serve the average need. standard egg-crate mattresses will be used if need exceeds supply of reusable. Over time, the hospital will replace all standard mattresses with reusable, Bio Gard Therapeutic Mattresses. To be conservative, a 1-year life was assigned to the decubitus care component of the mattress, even though it is warranted for 5 years.

  8 needed ÷ 1 year life = 8 /yr, x 6,318 cu" ea = 50,544 cu"/yr. Only the volume of the decubitus-care insert and single-use egg crate overlay are used for calculations. Note: The whole Bio Bard mattress has replaceable components, so disposal volume is likely to be less than that of a whole, standard mattress.

  Net: 2,059,200 - 55,544 = 2,003,656 cu" ÷ 46,656 cu"/cu yd = 42.9 cu yd/yr; 2,0003656 ÷ 2,059,200 = 97% volume reduction.

Weight of waste avoided: 601 lbs: 96% weight reduction

- **Single-use:** 2 lb x 312 = 624 lb
- **Reusable:** 2.8 lb for decubitus care portion x 8 /yr = 22.4 lb

624 - 23 = 601 lb/yr; 601 ÷ 624 = 96% weight reduction

Cost savings, not including avoided disposal fees: $879 /yr: 62% cost reduction /yr

- **Single-use:** Cost $4.56 ea x 312/yr = $1,423 /yr
- **Reusable:** Cost of entire mattress $230 each x 8 = $1,840 ÷ 5 yr life = $368 /yr; Cost of inserts, $22 ea x 8/yr = $176 /yr

Net: $1,423 - ($368 + $176) = $879 cost reduction; $879 ÷ $1,423 = 62% cost reduction

Indirect costs: Volume and weight waste reduction results in lower disposal costs, (43 cu yd x $6.25/yd = $269); however, contracted hauling volume was not decreased due to implementation of this measure alone. Purchasing and maintenance departments have decreased labor demand because of the change. No staff changes resulted, however, so overall labor costs for the hospital did not change. The reusable decubitus-care mattress does not require use a mattress pad. When all old-style mattresses are changed over, the change will result in an additional $2,445 /yr savings, the current cost of using underpads.

Reusable diapers

Although the hospital supported this action, implementation was delayed. Several styles of reusable diapers were considered; however, commercial reusable diapers that would hold up to the hospital's laundry procedures, did not stain with meconium and were consistent in preventing leakage were not found. The hospital is continuing its search for a reusable diaper.

Reusable soup bowls

The dietary department is phasing in the use of reusable tableware over time to assure that existing staff can integrate the changes. The change to reusable bowls from single-use ones looks functional at this point, and implementation is expected to take place.

Reink printer ribbons

Reinking of ribbons and remanufacture of photocopy and printer cartridges were identified as viable source reduction measure. The hospital is currently researching remanufacturers and expects savings of 33 to 50% over current costs.

Senior citizens make use of old electronic equipment

The hospital collects from others and also gives its own old electronic equipment to nursing home residents who disassemble, sort and recycle the components. Though this use of old electronic equipment results in the end of its functional life, reuse of the equipment in this way gives valued activity to the residents and accomplishes recycling of the components.

The hospital has also had these source reduction measures in place:

- **Reusable bed pans**
- **Reusable emesis basins**
- **Reusable male urinal basins**
- **Reusable patient eating utensils**
- **Reusable sterilization trays**
- **Double-sided copying**
- **Reusable isolation and surgical gowns**

In addition

As a result of the hospital's source reduction and recycling efforts, contracted garbage hauling services were decreased from one 6-cu-yd dumpster five times a week to two times a week. This is a 60 percent decrease in contracted garbage hauling service volume. Yearly garbage hauling expense decreased $5,244.

All changes took place without additions to hospital staff. In fact, after implementing their integrated waste management program the hospital eliminated two staff positions in the maintenancedepartment.

As a result of reduction actions alone, the hospital is preventing 238 cubic yards and over 10,700 pounds of waste. Not including the savings from avoided disposal fees, these actions result in a $11,030 yearly cost savings for the hospital.

When the $5,244 hauling expense savings due to implementation of reduction and recycling is added to the $11,030 savings due to reduction, the total savings for the hospital is over $16,270 each year.