FINAL REPORT

SAMPLE REPORT

COMMISSIONED BY:

PREPARED BY:

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EXECUTIVE SUMMARY

A substantial volume and variety of wastes are generated at all Health System facilities. In an effort to better understand the impact waste has on facility operations, this Baseline Waste Assessment was undertaken by Resource Recycling Systems. The goals of this project were to determine baseline volumes and cost by waste type, highlight areas of regulatory compliance, and provide recommendations for a transition to a fully compliant best practices program.

The primary findings of the Waste Assessment are summarized in the two tables below. Using data from waste vendors and system facility staff, the total volume of waste and cost of disposal are projected. Data is provided for each of the following seven waste streams:

- Solid Waste
- Recycling (Non-Confidential)
- Confidential Documents (shredding)
- Regulated Medical Waste
- Universal Waste
- Hazardous and Liquid Industrial Waste
- Pharmaceutical Waste

ANNUAL WASTE VOLUME FOR ENTIRE HEALTH SYSTEM (LBS PER YEAR)

	Solid Waste	Recycling[1]	Confidential Documents	Regulated Medical	Universal Waste[2]	Hazardous Waste/LIW[3]	Pharmaceutical Waste[4]	Grand Total
Hospitals	15,577,709	1,367,545	1,802,100	1,507,694	47,997	103,342	2,392	20,408,778
Medical Centers	2,370,595	105,965	545,010	171,335	2,477	200	600	3,196,182
Other	2,386,735	63,300	314,430	127,754	5,837	4,336	0	2,902,393
Total	20,335,040	1,536,809	2,661,540	1,806,784	56,311	107,878	2,992	26,507,353

[1] Includes cardboard, mixed non-confidential office paper, scrap metal, bottles and cans

[2] Includes combination of actual data, and estimated data

[3] Includes hazardous chemicals and Liquid Industrial Wastes (LIW) such as used oil, aqueous laboratory wastes

[4] Includes only hazardous pharmaceutical waste that is currently captured; additional pharmaceuticals disposed with other current waste streams

ANNUAL WASTE COSTS FOR ENTIRE HEALTH SYSTEM ($ PER YEAR)

	Solid Waste	Non-Confidential Recycling[1]	Confidential Documents[2]	Regulated Medical[3]	Universal Waste[4]	Hazardous Waste/LIW[5]	Pharmaceutical Waste	Grand Total
Hospitals	$396,470	$19,459	$63,074	$129,786	$21,684	$56,430	$11,958	$698,861
Medical Centers	$70,222	$4,473	$43,601	$55,311	$868	$155	$3,000	$177,630
Other	$72,359	$3,644	$25,154	$28,060	$553	$14,747	$0	$144,518
Total	**$539,052**	**$27,576**	**$131,829**	**$213,157**	**$23,105**	**$71,332**	**$14,958**	**$1,021,009**

[1] *Includes cardboard, mixed non-confidential office paper, scrap metal, bottles and cans*
[2] *Estimated based on new vendor contract pricing; estimates may be conservative*
[3] *Does NOT include autoclave operations costs at HFH*
[4] *Includes combination of actual data, and estimated data*
[5] *Includes hazardous chemicals and Liquid Industrial Wastes (LIW) such as used oil, aqueous laboratory wastes*

As shown above, the entire system disposes of more than 26 million pounds of waste per year (or 55,000 pounds per day) at a cost of more than $1 million annually. Some additional findings from this assessment are:

- The three largest waste streams are solid waste, confidential documents, and regulated medical wastes.
- The costliest waste streams are solid waste and regulated medical waste. However, on a per pound basis, pharmaceutical and hazardous waste are the most expensive, costing up to 250 times as much as general solid waste.
- Only 15% of the 91 locations covered in the waste assessment had active recycling programs for materials other than confidential documents, with cardboard recovery representing the bulk of material recycled. All five of the larger hospitals have recycling programs in place.
- A small percentage of waste, mostly in the universal and hazardous waste categories, is not properly captured (i.e. currently disposed to sewer, trash or red bag).

In addition to determining the size and cost of the system's waste stream, the assessment addressed processes and systems currently in place for handling waste. Some of the key findings of an online survey and in-person site visits are as follows:

- The level of organization and knowledge surrounding waste and its associated regulatory issues varies greatly from site to site. Very few sites

have a dedicated "responsible party" able to discuss each component of the waste stream or the waste stream as a whole. None of the sites with the exception of the central hospital are tracking volume and cost of their own respective waste streams.

- Some sites were not meeting basic regulatory requirements, including filing and maintenance of manifests, waste approvals and similar paperwork.
- A variety of vendors provide services for universal and hazardous waste disposal, with some vendors not providing compliant management.
- Universal and hazardous waste programs are not consistent in regards to vendors and costs, and, are therefore more complicated and costly than they could be with system-wide programs and oversight. In some cases, management costs will increase when compliant collection systems are implemented.
- Awareness of regulatory requirements and best practices varies by waste stream.
    - In general awareness of RMW and HIPAA requirements is high with some small opportunities for improvement.
    - The level of knowledge is significantly lower when it comes to universal, hazardous, and pharmaceutical waste. Staff members are generally somewhat aware of the hazards posed by these waste streams, but do not have clear procedures in place for management. Knowledge about disposal of hazardous chemicals and pharmaceuticals is almost universally absent at most facilities.
    - Awareness of recycling programs is uneven. Staff members may believe a recycling program is in place when it is not, or have no knowledge of a recycling program that does exist. At least one facility indicated they thought Stericycle (medical waste disposal) was their "recycling vendor".
- Many of the facilities use a scheduled, weekly collection frequency for their waste compactor service. "Right-sizing" this service through improved management and moving from to an on-call service when the compactor is full will reduce the number of pulls and cost of service.
- Much of the pharmaceutical waste stream is not currently being captured for compliant management because of the low level of awareness and corporate programming.

WASTE ASSESSMENT SUMMARY

KEY VOLUME METRICS

Waste volumes and costs were compiled using both actual and projected estimates for five main waste streams at all locations including: solid waste and recycling, regulated medical waste, universal waste, hazardous waste, and pharmaceutical waste (non-hazardous and hazardous). For solid waste, recycling, and regulated medical waste, the actual volumes and costs were compiled based data from vendor invoices. Hazardous and universal waste data was compiled from actual and estimated data.

It is no surprise that solid waste (consisting of non-hazardous, non-infectious wastes such as packaging, food waste and single-use products) makes up the vast majority (more than 20.3 million pounds per year) of waste across the system. At the same time, this is the least expensive waste to dispose (on a cost per pound basis). Universal, hazardous and pharmaceutical wastes collectively make up about 170,000 pounds per year while regulated medical waste and recycling programs contribute another 1.8 and 1.6 million pounds, respectively.

CURRENT ANNUAL WASTE VOLUME FOR ENTIRE HEALTH SYSTEM (LBS PER YEAR)

Site Type/Name	Recycle[1]	Solid Waste	Conf. Docs	RMW	RMW Incin	Universal	Hazardous	HazPharma Waste	Grand Total
Hospital 1	0	450,940	49,150	24,103	162	1,514	380	30	526,279
Hospital 2	763,805	8,582,240[2]	776,400	963,540	46,303	28,314	55,152	1,500	11,217,253
Hospital 3	167,184	2,079,381	231,000	153,846	7,152	5,364	17,900	250	2,662,076
Hospital 4	78,120	802,656	191,670	71,210	1,253	2,262	5,510	111	1,152,792
Hospital 5	134,400	951,780[3]	228,800	72,742	3,600	4,921	6,100	250	1,402,594
Hospital 6	224,036	2,496,213	299,160	153,661	8,912	4,637	18,300	250	3,205,168
Hospital 7	0	214,500	25,920	1,211	0	985	0	0	242,616
Hospital Total	**1,367,545**	**15,577,709**	**1,802,100**	**1,440,312**	**67,382**	**47,997**	**103,342**	**2,392**	**20,408,778**
Medical Center Total	105,965	2,370,595	545,010	162,193	9,142	2,477	200	600	3,196,182
Other Facilities Total	63,300	2,386,735	314,430	126,578	1,177	5,837	4,336	0	2,902,393
Grand Total	**1,536,809**	**20,335,040**	**2,661,540**	**1,729,083**	**77,701**	**56,311**	**107,878**	**2,992**	**26,507,353**

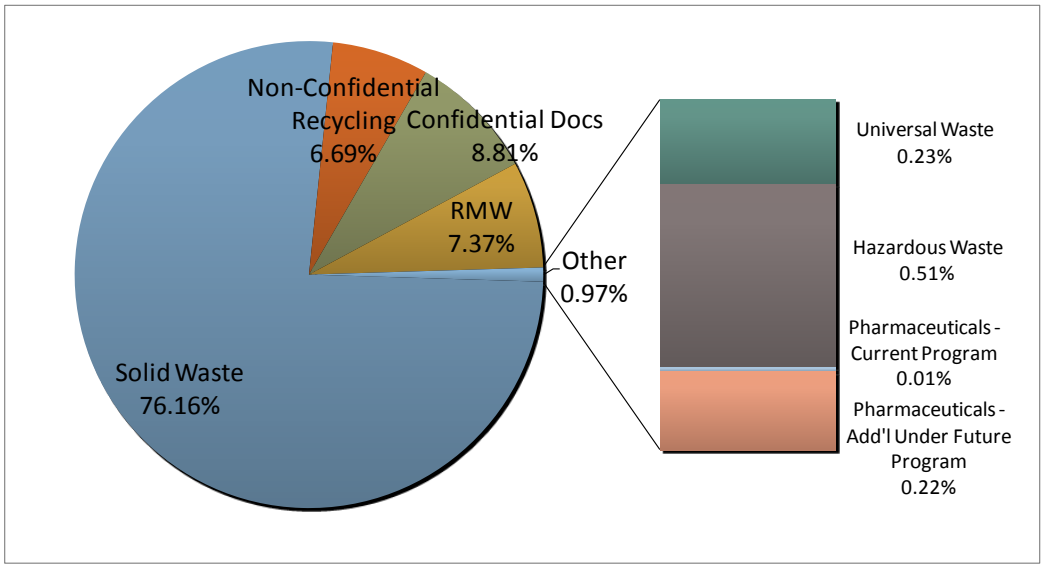
[1] Recycle numbers do not reflect confidential documents, although shredded documents do get recycled by the vendor

[2] Includes approx. 800,000 pounds of decontaminated medical waste

[3] Hospital solid waste based partly on start-up period. Volume will be higher for full-operational hospital.

The seven hospitals generate over 75% of the total waste stream, and an even higher percentage of the most specialized waste types such as hazardous and universal waste. The components of the hospitals' waste streams are shown in the graphs below.

WASTE VOLUME DATA (ALL HOSPITALS COMBINED) % LBS/YR



Differences in volume between hospitals can be explained by a number of factors:

- Hospital 2's high regulated medical waste and hazardous waste percentages are affected partly by the range of programs operating on site, including dialysis, out-patient clinical, clinical and research labs, and a high number of ICU beds. Hospital 2's solid waste also includes about 800,000 pounds annually of decontaminated medical waste because of its autoclave and shredding program (i.e. this volume is "double counted" in two categories, solid waste and regulated medical waste).
- Hospital 5's numbers are skewed due to heavy cardboard recycling during start-up period in 2009, and gradually increasing solid waste volume

Continued monitoring of these hospitals' waste streams will make it possible to see the effects of additional program changes in great detail.

KEY COST METRICS

The costs of waste disposal are heavily skewed towards the most regulated types of waste, as seen in the table below.

SYSTEM ANNUAL WASTE COSTS - CURRENT

Site Type/Name	Recycle	Solid Waste	Conf. Docs[3]	RMW – Autoclaved[1]	RMW Incinerated[2]	Universal	Hazardous	HazPharma Waste	Grand Total
Hospital 1	$0	$17,383	$1,720	$4,322	$0	$710	$1,022	$152	$25,308
Hospital 2	-$6,280	$167,247	$27,174	$12,924	$23,316	$11,831	$44,177	$7,500	$287,890
Hospital 3	$5,424	$61,182	$8,085	$27,408	$0	$2,815	$3,725	$1,250	$109,889
Hospital 4	$1,560	$36,137	$6,708	$11,642	$0	$1,233	$1,830	$556	$59,667
Hospital 5	$10,691	$35,031	$8,008	$19,643	$0	$2,090	$1,903	$1,250	$78,617
Hospital 6	$8,064	$69,093	$10,471	$26,647	$3,584	$2,440	$3,772	$1,250	$125,321
Hospital 7	$0	$10,396	$907	$300	$0	$564	$0	$0	$12,168
Hospital Total	**$19,459**	**$396,470**	**$63,074**	**$102,886**	**$26,900**	**$21,684**	**$56,430**	**$11,958**	**$698,861**
Medical Center Total	$4,473	$70,222	$43,601	$51,392	$3,919	$868	$155	$3,000	$177,630
Other Facilities Total	$3,644	$72,359	$25,154	$27,215	$845	$553	$14,747	$0	$144,518
Grand Total	**$27,576**	**$539,052**	**$131,829**	**$181,493**	**$31,665**	**$23,105**	**$71,332**	**$14,958**	**$1,021,009**

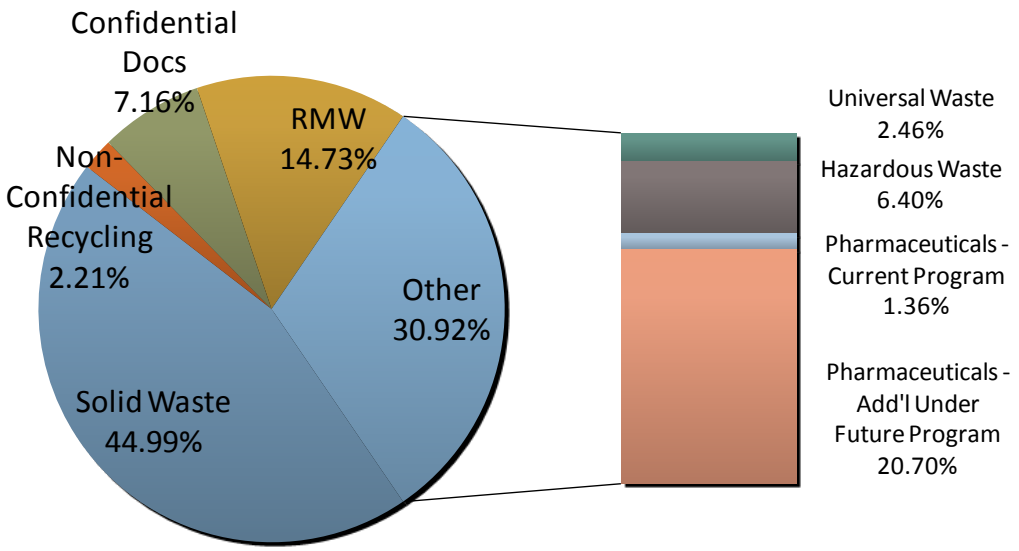
[1] Includes only costs of transport and disposal of red bags and sharps to an off-site autoclave, not including the autoclave costs

[2] Includes trace chemo and pathological wastes that are incinerated off-site

[3] Estimated. Actual numbers may be higher

For the seven hospitals taken as a group, solid waste makes up less than 50% of waste disposal costs, although it accounts for over 80% of the volume. Hazardous and pharmaceutical wastes, which together account for less than 1% of the waste stream, make up over 10% of the costs. With an expanded pharmaceutical program in place, these wastes will likely account for over 30% of the hospitals' waste costs.

HOSPITAL WASTE COSTS - ALL HOSPITALS - COMBINED



The average cost per pound of waste at the combined hospital locations is shown below. This cost includes some, but not all, fixed costs such as stop fee or transportation charges, in addition to the cost per pound or per ton rate charged by the vendor. For pharmaceutical waste, the cost per pound shown estimates the costs of a fully compliant program, including collection, transportation and disposal, but not the initial cost of setting up a fully compliant program.

AVERAGE DISPOSAL COST PER POUND FOR HOSPITAL WASTE STREAMS*

Recycling	$0 to 0.02	Hazardous Waste - Mixed Flammable	$0.16
Solid Waste	$0.03	Liquid Industrial Waste - Formalin	$1.23
Confidential Documents	$0.035 to $0.10		
Regulated Medical Waste - Autoclave	$0.27	Liquid Industrial Waste - AEC/DAB	$0.14
Regulated Medical Waste - Incineration	$0.48	Hazardous Waste - Lab Packs	$4.29
Universal Waste - Batteries	$0.45	Liquid Industrial Waste - Used Oil	$0.14
Universal Waste - Lamps	$0.25	Pharmaceutical Waste - Hazardous	$5.00
Universal Waste - Electronics	$0.30	Pharmaceutical Waste - Non-Haz	$4.00

**excludes most labor, handling, supplies, transportation*

UNCAPTURED VOLUMES AND COSTS

The locations covered in the Waste Assessment use vendors contracted by the health system for solid waste, confidential documents, and regulated medical waste. However, the system does not pay directly for general waste at all of its locations. The five medical centers listed below use solid waste services provided by the building owner or manager; the costs of these services are incorporated into the location's rent. The additional volume of waste generated at these locations is estimated in the table below. In addition, we have provided an estimate of the cost of waste at each facility, were the system to provide waste services instead of the building owner.

Medical Center	Estimated Waste Volume (lbs/year)	Estimated Disposal Cost ($/year)
Center 1	21,995	$660
Center 2	208,792	$6,264
Center 3	496,425	$14,893
Center 4	88,202	$2,646
Center 5	96,045	$2,881

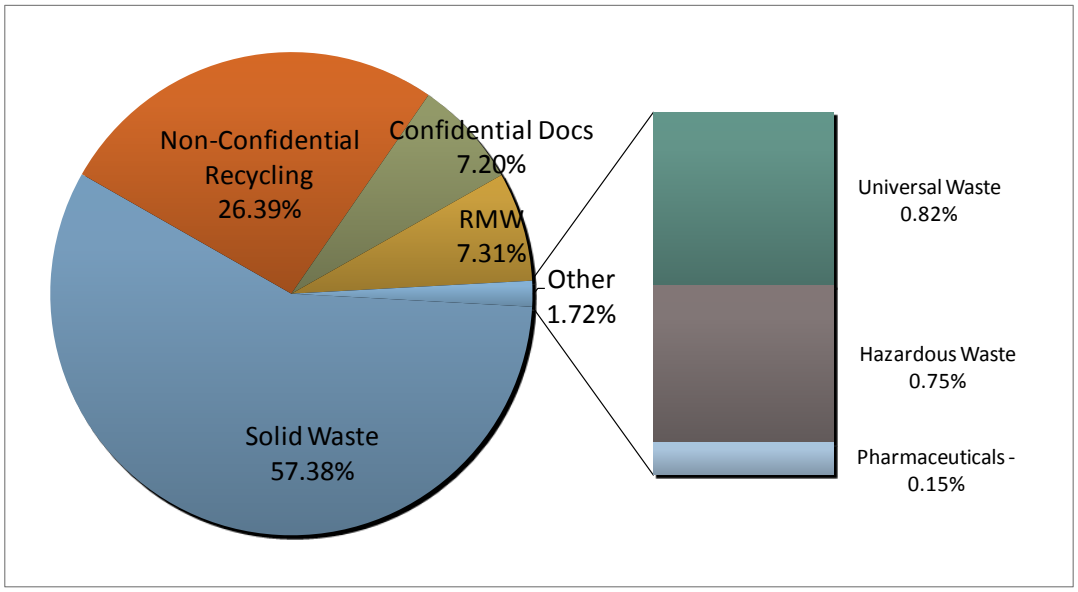
In addition to these medical centers, many smaller physician's offices, school based clinics, and other locations use a waste dumpster provided by the building owner. These locations also do not pay directly for their waste; it is a "hidden cost" included in their rent. These waste volumes and costs are not included in the waste assessment, but they are important to keep in mind regardless of who pays for them directly.

KEY RECOMMENDATIONS AND PLAN FOR IMPROVEMENT

SOLID WASTE, RECYCLING AND CONFIDENTIAL DOCUMENTS

Of the 91 locations covered in the Waste Assessment, only the five large hospitals and eight other locations have recycling programs for materials other than confidential documents, such as cardboard, bottles and cans, or non-confidential mixed paper. A typical hospital waste profile projects that at least 25% of the overall waste stream consists of recyclable material in addition to confidential documents, as shown in the chart below. Achieving this level of recycling, however, would require a highly dedicated program, with adequate resources including labor and space dedicated to the effort.

BENCHMARK VOLUME DATA (POTENTIAL PROGRAM) % LBS/YR



Recycling is a less costly way to dispose of wastes such as cardboard and paper, due to the value of the recovered material. Whether this value is actually rebated back to the hospital, or simply passed through in the form of a lower collection/transportation rate for recycling, recycling programs should be expected to cost less ($0.01 to $0.02 per pound) than solid waste on average throughout the health system. The five hospitals with cardboard and other recycling programs on average recycle 9.1% of their solid waste volume. If the remaining system facilities could match this rate, an additional 497,000 lbs of waste would be recycled, saving approximately $7,400 per year. An increase in the system-wide recycling rate to the benchmark of 26% would result in an additional 4.9 million pounds of recycled material, with a cost savings of over $74,000 annually.

Additionally, a low-hanging fruit to save costs in solid waste disposal is to actively manage the waste compactor service levels and frequencies. Many of the system hospitals have a weekly scheduled waste compactor pull, so the collection of the waste occurs whether or not the container is full. By pulling the container when full would reduce the number of pick-ups from, for example, 4 per month to 3, or typically about 25%.

Key recommendations for improvement for solid waste and recycling are:

- Add collection programs for non-confidential paper (newspaper, office paper, journals, junk mail, magazines); currently some of this material is being captured in the confidential document shred program, but at a higher cost than may be necessary. Only two facilities have active

programs for capturing non-confidential paper, although one of these programs is limited.

- "Right-size" the waste compactor service frequencies by moving from scheduled, weekly collection frequencies to an on-call service when the compactor is full to reduce the number of pulls and cost of service.
- Increase cardboard dumpster service at satellite locations; space allocation will have to be reviewed, but many sites could accommodate a dedicated recycle dumpster.
- Evaluate packaging waste reduction projects involving Supply Chain and Materials Management, including asking suppliers to reduce packaging waste, provide for more "recyclable" packaging, or take-back programs.
- Consider other waste reduction measures, including switching from disposable to more durable products; an example are reusable linen bags which can reduce the volume of linen accidentally disposed with trash while reducing liner waste and costs.

REGULATED MEDICAL WASTE

Regulated Medical Waste is handled throughout the health system primarily by Stericycle. The generation rates for system are very close to the benchmark rates for hospitals. A recent effort to promote waste reduction (keeping trash out of red bags) was noted during the survey, as consistent signage was observed at Health System facilities to educate staff on avoiding use of the expensive red bag disposal process for general solid waste. RRS is currently conducting a separate opportunities analysis on RMW disposal, including options such as on-site processing, and satellite transportation/collection.

Key Recommendations:

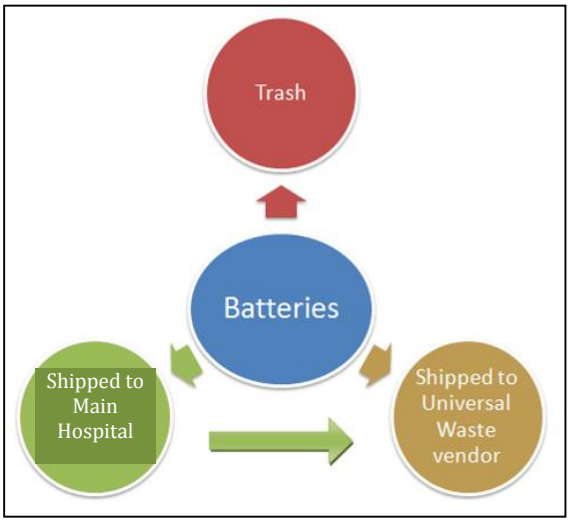
- Continue to promote red bag volume reduction, as well as improper use of oversize sharps containers (these containers are disposable/one-time use and the costs of these disposables are not reflected in this disposal cost assessment, but are significant).
- Reduce transportation costs and stop charges by "right sizing" waste pick-ups and possibly using courier/transportation system to shuttle tubs of waste back to central location.
- Improve compliance problems through regular audits, especially to note areas where safety and regulatory issues are at stake (such as improper closure of containers, lack of documentation/record keeping, lack of locked storage, medical waste mixed with trash).

UNIVERSAL WASTE

The processes in place for disposing of universal waste vary both from site to site, and between the different universal waste streams. The paths of these waste streams are shown in the graphics below.

Batteries

For batteries, most Medical Group facilities utilize a satellite process where batteries collected on site are shipped to the central hospital through the courier service, then recycled by the hospital's universal waste vendor. This program has widespread use and staff awareness. However, this process does mean that the costs of disposing this material are borne almost entirely by the central hospital. Also, batteries transported in this fashion may not meet regulatory (DOT) requirements for packaging, labeling. To ensure the sustainability and success of this program, a tracking and charge-back system may need to be developed to bill the satellite locations for this service.



The larger sites are collecting batteries and using a variety of different vendors and pricing for disposal. Most of the sites, however, are not compliantly separating lithium batteries for proper packaging/labeling/transport (DOT requirement).

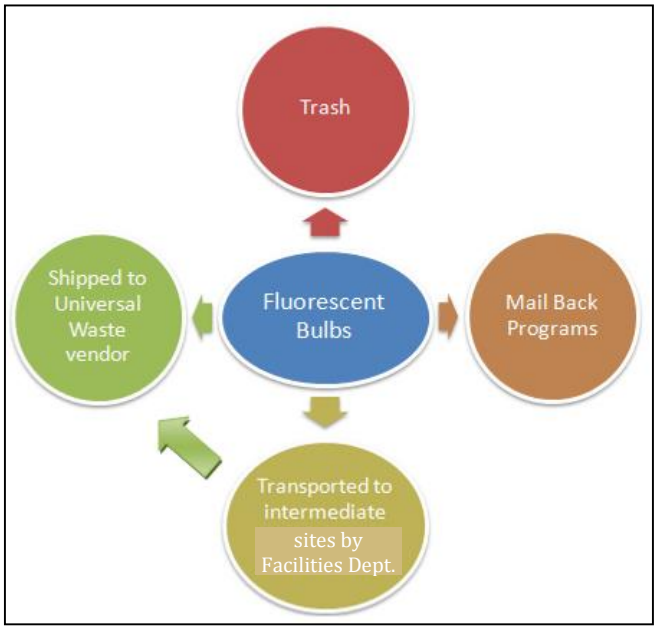
Key Recommendation:

- Set up "milk run" for collection from small satellites
- Negotiate system contract with one vendor
- Educate facilities on compliant labeling, packaging, transport

Fluorescent Bulbs

The process for disposing of fluorescent bulbs varies much more from site to site, with the result that we anticipate the capture rate of these items is lower. Some sites use a mail back program to return their fluorescent tubes for recycling. Many sites have no idea what happens to the fluorescents after the Facilities staff takes them away.

The convenience of a mail back program is desirable for small to mid-size facilities. It may be beneficial for the system to secure a contract for a mail back program to be used system wide, at a lower rate than each site purchasing boxes individually.

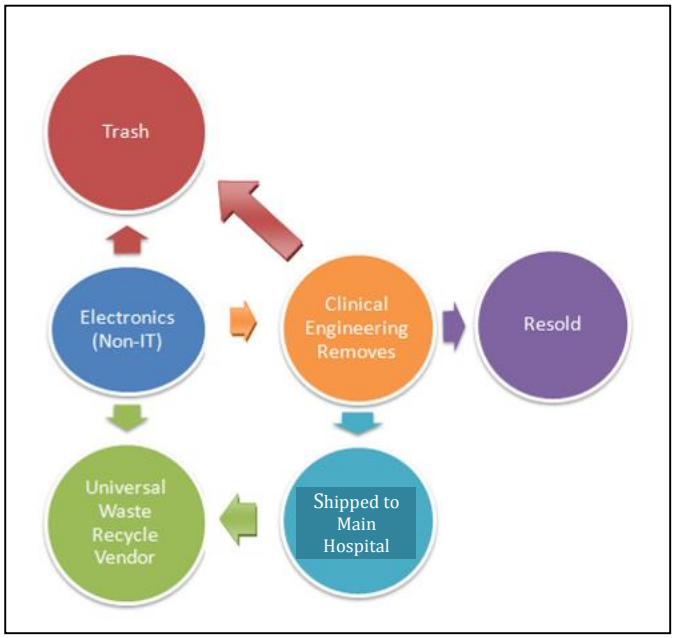


Key Recommendations:

- Initiate milk-run collection (possibly in conjunction with other Universal Wastes and/or medical waste)
- Evaluate charge-back tracking program to equitably distribute costs
- Education facilities about proper labeling and packaging.

Electronics

The disposal process for electronic items (aka "E-Waste") is the least well known and this Baseline Assessment estimates that only a small percentage of these items end up being recycled. The capture rate for electronics is estimated to be the lowest of the three types of universal waste. Electronic waste includes virtually any equipment with a circuit board, and ranges from computers, to medical devices, to laboratory instruments to printers and copiers. Clinical Engineering resells some legacy or end-of-life equipment with financial value, but only a small percent of the remaining items make it to the recycling vendor. Other hospitals do not have vendors set up to handle these items and it is likely that electronics are improperly disposed with regular trash. Securing a system-wide contract for these services would ensure that a greater percentage of this waste stream is recovered.



Note: Computers and other IT items are disposed of through an entirely separate process, and are not included in this assessment.

Key Recommendations:

- Contract with system vendor for service
- Educate facilities about proper recycling requirements
- Review system practices with Clinical Engineering, although this department represents only part of the larger e-waste picture.

HAZARDOUS WASTE

Compliant management of hazardous waste requires a high level of technical knowledge on the part of both vendors and staff. Through the site visit process, several vendors were noted whose documentation of hazardous waste pickups and disposal was insufficient and at times inaccurate. System staff also do not consistently understand complex hazardous and liquid industrial waste regulations, including recordkeeping, training, waste characterization, labeling, accumulation and other requirements. An additional problem exists at very small satellite sites, which have very small and only periodic amounts of hazardous chemicals (mostly expired products) and have no knowledge or system set up for management.

Key Recommendations

- Discontinue the use of non-compliant and costly vendors.
- Securing a system-wide contract for hazardous waste with defined performance specifications.
- Consider milk-run service for extremely small generators (satellites)
- Manage all waste characterization and service scheduling through one central manager, but with each site responsible for monitoring day-to-day accumulation and staging at their own site.
- Audit sites quarterly to ensure compliance and review all potential sources of hazardous material generation (labs, pharmacies, facilities departments, specialty clinical functions).

PHARMACEUTICAL WASTE

Pharmaceutical waste is a newly targeted area of regulatory compliance. System hospitals currently capture almost 3,000 pounds of RCRA-designated hazardous pharmaceuticals per year, as listed in "Key Waste Metrics" above. These are disposed of through the hazardous waste process, although labeled as "Universal Waste" to avoid exceeding generation limits (allowable under State of Michigan regulation). Based on the level of various activities at system hospitals and medical centers, an additional 5,400 pounds of hazardous pharmaceutical waste would need to be captured throughout the health system to fully comply with hazardous waste regulations.

Other pharmaceuticals, while not designated as hazardous waste, still pose a threat to drinking and ground water when disposed of through the sewer. The volume of these pharmaceuticals (classified as Liquid Industrial Waste) is estimated at 50,000+ lbs per year.

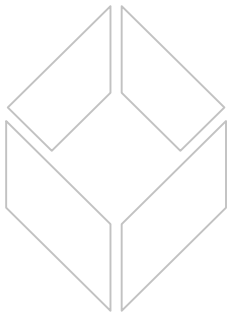
The disposal, collection, transportation costs of a fully compliant pharmaceutical waste program at is estimated a $4.00/lb for non-hazardous waste, and $5/lb for hazardous waste. This does not include not the initial cost of setting up a fully compliant program, but instead covers ongoing costs to collect, transport and dispose of the waste.

PROJECTED VOLUME AND COSTS OF COMPLIANT PHARMACEUTICAL PROGRAM

	Hazardous Pharmaceutical Waste		Non-Hazardous Pharmaceutical Waste		Total Additional Cost – Not Including Program Set Up
Site Type/Name	Volume (Lb/year)	Cost ($/year)	Volume (Lb/year)	Cost ($/year)	
Hospital 1	67	$337	422	$1,686	$2,023
Hospital 2	3,000	$15,000	27,000	$108,000	$123,000
Hospital 3	600	$3,000	4,000	$16,000	$19,000
Hospital 4	247	$1,236	1,546	$6,182	$7,419
Hospital 5	500	$2,500	3,000	$12,000	$14,500
Hospital 6	500	$2,500	3,000	$12,000	$14,500
Hospital 7	66	$332	415	$1,661	$1,993
Hospital Total	**4,981**	**$24,906**	**39,382**	**$157,529**	**$182,435**
Medical Center Total	455	$2,275	2,398	$9,590	$11,865
Other Facilities Total	60	$300	580	$2,320	$2,620
Grand Total	5,496	$27,481	42,360*	$169,439	$196,920

Key Recommendations

- Negotiate a system disposal partner/service to assist in setting up a compliant, cost-effective program system-wide
- Begin immediate collection of target hazardous pharmaceuticals at all system pharmacies; gradually add additional clinical locations (nursing units, clinics)
- Evaluate long-term cost and impact of collecting all LIW pharmaceuticals



MANAGING CHANGE IN A RESOURCE-CONSTRAINED WORLD

RRS is a consultancy with a vision. We see a world where resources are managed to maximize economic and social benefit while minimizing environmental impact. A world where abundance keeps pace with societal needs.

We have assembled a unique team of strategists, engineers, economists and communications specialists with core strengths in materials and recovery, coupled with expertise in life cycle management and applied sustainable design. These experts operate confidently across the supply chain, identifying the most leveraged opportunities to affect change, and developing pathways to long-term value.

RRS has been working toward this vision since 1986. Our clients are leaders in materials management, and in partnership we have achieved outstanding results. We remain nimble and responsive, providing informed, innovative, actionable solutions to the sustainability challenges of our time.