Waste Management Optimization: Recycling Implementation and Training

Site: Warszawski Uniwersytet Medyczny (WUM), Warsaw, Poland.

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Life Cycle Assessment Support

Life Cycle Assessments were conducted by Dr James Larkin, Postdoctoral Researcher and Sustainability Officer at Trinity College Dublin.

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Why did you start?

Problem Description

The hospital lacked proper waste segregation, with most rooms containing only general waste bins. Staff members had limited awareness and training regarding recycling best practices. By introducing new waste bins for different categories and conducting structured training sessions, the initiative will promote better waste disposal habits and reduce the volume of general waste.

Specific Aims

Following the SMART Goals framework, the project aimed to:

- **Specific:** Implement a structured recycling program in all hospital departments.
- **Measurable:** Reduce general waste by 25% within six months, measured by waste audits.
- **Achievable:** Utilize existing waste disposal resources and integrate additional recycling bins.
- **Relevant:** Contribute to hospital-wide sustainability efforts and environmental responsibility.
- **Time-bound:** Fully transition to the new system within six months.

What did you do?

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Context

The dialysis station serves approximately 90 patients, generating a significant amount of medical and general waste. Additionally, the nephrology department operates at a scale of 1,000 patient-days per month, necessitating an efficient and sustainable waste management system.

The following waste streams were identified as available under the waste contract:

Infectious medical waste (red bags, incineration), non-infectious medical waste (blue bags, municipal treatment), general waste (black bags, mixed municipal waste), and recycling streams (paper and plastics). The term mixed waste is used to refer to the baseline condition in which most waste streams were not segregated and were disposed of either as general waste or infectious waste.

Intervention

Before beginning the change project an initial assessment of waste segregation practices was carried out. Based on this, the project involved the implementation of three interventions: procurement of waste segregation bins, staff training, and monitoring of waste segregation.

Procurement of waste segregation bins

Bins designated for different waste categories were installed across the unit, including general waste, recycling (paper and plastics), infectious medical waste (red bags), and non-infectious medical waste (blue bags). All bins were clearly labelled to support correct disposal.

As part of the initiative, the new category of waste bags (blue bags) was introduced for non-infectious medical waste. Previously, most medical materials were disposed of in

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red infectious-waste bags requiring high-temperature incineration. Under the new system, items not meeting infection-risk criteria (e.g. packaging, non-contaminated materials, items used outside the sterile field) were segregated into blue bags.
Non-infectious medical waste collected in blue bags is treated via municipal solid waste processes but remains separate from general waste due to its healthcare origin and associated regulatory requirements.

Real-time support and guidance was provided to address initial challenges.

Staff training on waste segregation practices

Educational materials on proper waste segregation were created and distributed. Educational workshops were delivered to approximately 30 doctors, 20 nurses, and 10 cleaning staff to improve awareness of correct waste segregation. Pre- and post-training knowledge assessments were conducted. Waste segregation training is being embedded into the onboarding process for new staff.

Monitoring waste segregation efficiency

Waste segregation practices were monitored through regular audits, recording the weight and distribution of waste across different streams. Staff compliance and bin usage were assessed to track adoption. Feedback was gathered from staff and training materials refined accordingly.

Measures

Patient outcomes

Assessed through direct observation of patient areas to evaluate cleanliness and organization improvements following the waste segregation initiative.

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Environmental sustainability

Regular waste audits were carried out, recording the mass (kg) of each waste stream (infectious, non-infectious, general, and recycling). These data were annualized and used as inputs for the life cycle assessment.

Economic sustainability:

Reduction in hospital spending on waste disposal was estimated using European averages.

Social Sustainability

Social impact was assessed using the KitNewCare modelling framework, including estimates of forced labour medium-risk hours In addition, staff perceptions were gathered through open-ended feedback.

Patient acceptability of this intervention was explored through a focus group study conducted with European Kidney Patients' Federation (EKPF) representatives, where this change was included among those discussed.

What did you find?

Results

Results are presented for the combined haemodialysis and nephrology activity, with per-patient values normalised to the haemodialysis population for consistency across case studies.

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Patient outcomes

No negative impact on patient care or safety was observed.

Environmental sustainability

Before the intervention, the dialysis and nephrology units generated approximately 600 kg of waste per week, with less than 1% recycled, and the majority disposed of via infectious (red bag) or mixed waste pathways.

Following implementation of colour-coded waste streams, staff training, and the introduction of blue bags for non-infectious medical waste, segregation improved substantially.

The table below shows the change between baseline and post-implementation conditions.

Waste stream	Before (kg/year)	After (kg/year)	Waste Processing
Infectious medical waste (red bags)	28,800	23,040	High-temperature incineration
Non-infectious medical waste (blue bags)	0	5,760	Municipal solid waste treatment
General waste (black bags)	2,400	1,920	Municipal solid waste treatment
Recycling (paper and plastic)	Not modelled (<1%)	2,160	Recycled

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Residual waste / contamination	1,200	960	Landfill

Carbon emissions associated with waste management decreased from approximately 72,803.36 kg CO_2e to 60,453.49 kg CO_2e, representing a reduction of 12,349.88 kg CO_2e (17%) annually. Water use impact decreased from 4,401.59 m^3 to 3,620.94 m^3, corresponding to a reduction of 780.65 m^3 (18%).

At patient level, this corresponds to an estimated reduction of approximately 137.22 kg CO_2e and 8.67 m^3 water use impact per haemodialysis patient per year.

These reductions were driven primarily by a decrease in medical waste requiring incineration, with a greater proportion of waste diverted to non-hazardous or recycling pathways.

Economic sustainability

Using representative European cost ranges (500–1000 €/tonne for infectious waste and 100– 200 €/tonne for municipal and recycling pathways), the shift from high-cost incineration to lower-cost waste streams is estimated to result in annual cost savings of approximately €2,000–€5,000, with a central estimate of around €3,500 (approximately 15,480 PLN). At patient level, this corresponds to an estimated saving of approximately €22.22–€55.56 per haemodialysis patient per year, with a central estimate of €38.89.

Social sustainability

Staff reported a cleaner workspace and greater clarity regarding waste segregation responsibilities. Modelled social impact, expressed as forced labour medium-risk hours, decreased by approximately 38 hours annually. Findings from the patient focus group

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study indicated that improved waste segregation was generally perceived as low risk and acceptable to patients.

What does it mean?

Summary

The project successfully enhanced waste segregation by increasing recycling and introducing blue non-infectious medical waste bags, reducing the reliance on red incineration bags. The unit achieved measurable environmental and economic benefits without creating operational burdens.

Key learning points:

- Infrastructure drives behaviour: bin placement and colour coding were as important as training.
- Regular reinforcement prevents early contamination issues.
- Staff adopt sustainable practices readily when expectations are simple and practical.

Key contributors to success:

- clear bin infrastructure and colour coding,
- targeted staff training,
- strong engagement from nursing, medical, and cleaning teams,
- alignment with organisational sustainability objectives.

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References and Resources

Report of the Supreme Audit Office on medical waste: https://www.nik.gov.pl/najnowsze-informacje-o-wynikach-kontroli/odpady-medyczne-covid19.html (polish)

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