Hazardous and pharmaceutical waste across European countries.

Synthesis of existing data and publications (2019-2025)

Javier Gonzalez Durio, HEOR, Becton Dickinson and Company

Background

Hospitals are major generators of waste producing complex waste streams that include hazardous clinical waste and pharmaceutical residues. These waste streams pose **disproportionate environmental, economic, and public health burdens** due to their reliance on energy-intensive treatment methods such as high-temperature incineration. Quantifying waste generation and understanding effective national mitigation strategies are essential to inform sustainable healthcare policy and procurement, and supplier innovation roadmaps.

Objective

To provide a structured synthesis of available evidence on healthcare waste generation across European countries, with a specific focus on **hazardous and pharmaceutical waste streams**, including their environmental and economic implications.

The analysis aims to:

- Quantify and compare **waste generation metrics (e.g., kg/bed/day)** across healthcare systems
- Characterize the **relative contribution and impact of hazardous and pharmaceutical waste**
- Identify **key drivers of variability**, including clinical settings such as operating rooms
- Summarize **evidence-based national and institutional strategies** targeting waste reduction, improved segregation, and circularity
- Highlight **opportunities to integrate waste and sustainability metrics into healthcare decision-making**, including health economic evaluations and procurement frameworks

Methods

A narrative synthesis of data from European healthcare sustainability reports, peer-reviewed studies, and national healthcare system analyses (2019-2025) was conducted. Waste metrics were normalized per hospital bed/day where available, with particular attention to hazardous healthcare waste (HCW) and pharmaceutical waste streams.

Results

Across high-income European countries, **total hospital waste generation** typically ranges **from 3 to 6 kg/bed/day**, with substantial inter-country and inter-departmental variability. **Hazardous waste accounts for approximately 10 to 25% of total hospital waste**, corresponding to **0.5 to 2.5 kg/bed/day**, but represents a disproportionate share of costs and carbon emissions due to specialized treatment requirements. In some settings, such as Italy, hazardous waste can reach **5 to 10 kg/bed/day in high-intensity departments** (e.g., operating rooms, intensive care units).

Total hospital waste

3 to 6 kg/bed/day

Hazardous waste

0.5 to 2.5 kg/bed/day

Pharmaceutical waste represents a smaller fraction in weight but a significant environmental and economic burden. Reported pharmaceutical waste generation ranges from **10 to 70 g/bed/day at hospital level**, with much higher concentrations in operating rooms and oncology units. At national scale, including primary care, pharmaceutical waste disposal costs exceed **€50 million annually in Denmark**, **~€100 million in The Netherlands**, and **~€138 million per year in Sweden**, largely driven by unused or expired medicines and single-dose vial wastage.

€50 mln

€100 mln

€138 mln

Countries are adopting diverse mitigation strategies. **The United Kingdom** has implemented a national Clinical Waste Strategy targeting a **50% reduction in waste-related carbon emissions** through improved segregation and reusable alternatives. **The Netherlands** has pioneered pharmaceutical re-dispensing (e.g., the ROAD program), achieving **>65% reductions in oncology drug waste** translated in net cost savings. **Italy** has demonstrated that on-site sterilization can reduce hazardous waste volumes by up to **75%**, converting infectious waste into non-hazardous streams. **Germany and Norway** emphasize regulatory levers, including carbon pricing and mandatory environmental weighting in procurement, while **France and Sweden** focus on operating-room waste reduction, eco-design, and circular procurement.

Conclusion

Hospitals generate substantial waste volumes, with hazardous and pharmaceutical waste representing high-impact targets for environmental and economic optimization. Waste production per bed/day varies widely across countries and care settings, but evidence consistently shows that improved segregation, pharmaceutical waste prevention, reprocessing, and circular procurement can achieve meaningful reductions without compromising patient safety. Integrating waste metrics into health economic evaluations and procurement decisions is critical to accelerating sustainable healthcare transformation across Europe.

Learn more on the BD commitment to sustainable healthcare

BD-MED-12110