

Process Mapping as a Key Tool in Identifying Waste in Dermatologic Procedures to Improve Cost-Effectiveness and Sustainability: An Interventional Case Study

Kevin Yang, MD, Goranit Sakunchotpanit, BS, F. Clarissa Yang, MD, MBA, and Bichchau Nguyen, MD, MPH, MBA*

BACKGROUND Dermatologic procedures use many consumable items, resulting in significant financial and environmental costs.

OBJECTIVE To demonstrate process mapping's utility in identifying and reducing consumable waste generated during dermatologic excisions.

MATERIALS AND METHODS Process mapping was used to identify and quantify consumable wastes generated by 20 excisions at a dermatologic surgery clinic. The results were discussed among researchers, clinical support staff, and clinicians to develop waste mitigation interventions. 20 additional excisions were mapped after implementation of these interventions to quantify reduction of consumable waste and associated financial savings.

RESULTS Preintervention, the average total cost of consumables per excision was \$48.02. The average cost of wasted consumables was \$21.69 (45%). Process mapping identified unused items, such as cotton-tipped applicators, and partially used items, including iodine, lidocaine, and gauze. Interdisciplinary discussion of results revealed limitations to waste mitigation such as standard packaging sizes, existing supply chains, hospital and state policies, and workflow efficiency tradeoffs. Waste mitigation strategies included removal of unused products (e.g., cotton-tipped applicators and extra blades), alternative formulations (e.g., betadine swab vs bottles), and smaller packaging sizes. Postintervention, the waste cost per case decreased by 16.9% to \$18.01.

CONCLUSION Process mapping is an effective tool to identify consumable waste in dermatologic surgeries and results in significant cost savings.

Common dermatologic procedures, such as biopsies and excisions, require instruments and consumables. Unnecessary costs accrue from unused surgical instruments, tools, and supplies.¹ Regulated medical waste (e.g., plastics, needles, and electronic equipment) is typically incinerated, contributing to significantly higher disposal expenses compared with nonregulated waste.¹ Reducing medical waste can reduce operating costs of the clinic and minimize the carbon footprint of waste disposal.

Process mapping is a tool to observe and analyze specific steps of a particular workflow or process in a system.² In health care, process mapping has offered valuable insights into identifying inefficiencies and bottlenecks, as well as highlighting opportunities for quality improvement, ultimately enhancing patient care.^{2,3} Few studies have used

process mapping to track resource utilization and waste management in dermatologic surgery. This study applied process mapping to identify waste generated in excision clinics as a proof of principle to demonstrate its utility in conserving resources to reduce financial and ecological costs. By mapping individual components of dermatologic excision, the authors were able to identify wasted supplies and develop a collaborative solution among physicians and clinical support staff to mitigate waste.

Methods

An independent observer, author KY, performed process mapping of 40 excision cases at a dermatologic surgery clinic in an academic center (Figure 1). Mapping started at the time of patient rooming and ended at the time of patient discharge. The following were recorded: instruments and consumables prepared and used, physician and clinical staff involved, and number and length of time of interruptions to procedures because of lack of needed supplies. Purchase orders were reviewed to identify the costs of different consumables. Waste was defined as consumables that were set out but not used. Consumable waste was analyzed based on the percentage and costs of waste. The first 20 cases were assessed during an initial preinterventional period. Clinic staff including practice managers, administrative assistants,

From the *All authors are affiliated with the Tufts University School of Medicine, Boston, Massachusetts

The authors have indicated no significant interest with commercial supporters.

Address correspondence and reprint requests to: Bichchau Michelle Nguyen, MD, MPH, MBA, Department of Dermatology, Tufts University School of Medicine, 800 Washington Street, Suite 114 Boston, MA 02111, or e-mail: Bnguyen2@tuftsmedicalcenter.org

© 2025 by the American Society for Dermatologic Surgery, Inc. Published by Wolters Kluwer Health, Inc. All rights reserved.

Dermatol Surg 2025;51:942–946

<http://dx.doi.org/10.1097/DSS.0000000000004682>

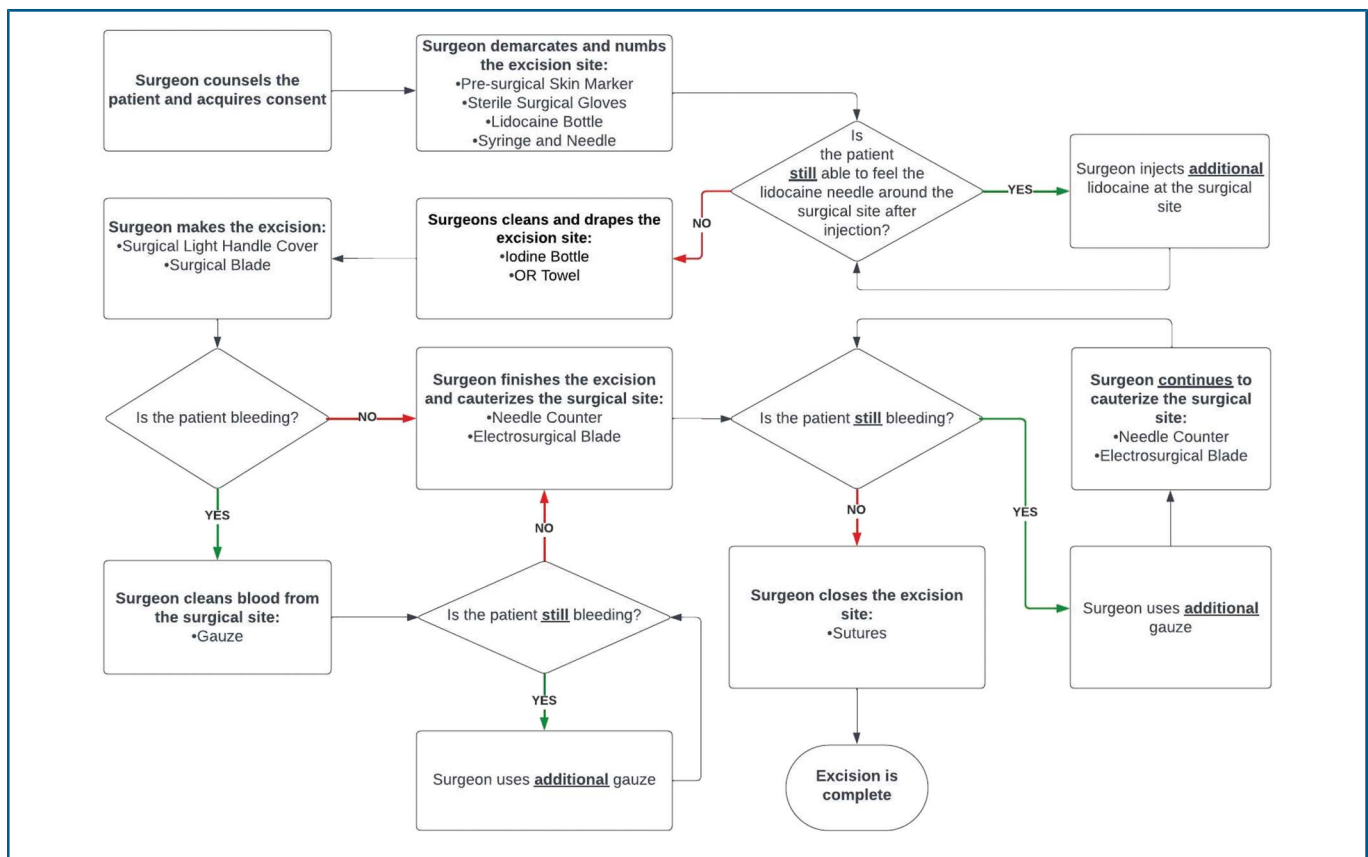


Figure 1. Process map of dermatologic excision.

surgical nurses, researchers, and physicians participated in a debriefing session to review the identified areas of waste and to create interventions to mitigate such waste. Another 20 cases were observed and analyzed with process mapping postimplementation of waste-mitigating interventions. A final debriefing session was held to assess the effectiveness of the waste-mitigating interventions (Figure 2).

Results

During the preintervention period, the average total cost of consumables per excision was \$48.02 (Table 1). The average cost of wasted consumables was \$21.69 (45%). Some items, such as cotton-tipped applicators, had a high cost waste percentage (100%) but low cost (\$1.21) of waste. Consumables, such as iodine bottles and surgical gauze, exhibited similar trends, having sizable cost wastage percentages of 83% (\$1.80) and 54% (\$0.41), respectively. Lidocaine was the most expensive consumable (\$21.89 per 20 mL bottle), accounting for 46% of total cost per case. On average, 73% of lidocaine went unused, resulting in \$15.98 wasted per case. The independent observer also noted noncontaminated trash being placed in biohazard containers.

Interdisciplinary discussion of the preintervention data identified the following strategies for reducing consumable waste. First, uncommonly used items, such as cotton-tipped applicators or extra surgical blades, can be removed from the standard surgical tray setup and be provided on an as

needed basis. Second, alternative packaging and product lines can reduce waste from partially used consumables (e.g., switching from iodine bottle to swabs, 10/pack vs 25/pack gauze, or 10 mL vs 20 mL bottle of lidocaine). Third, staff training on the definition of biohazard waste can reduce the inappropriate placement of common waste in biohazard bins, consequently decreasing waste disposal costs. Biohazard waste was defined as gauze soaked with blood or bodily fluids, human tissues (e.g. removed standing cones), and sharps (e.g., needles, scalpels, and glass slides). Cited costs for biohazard waste disposal ranged from \$0.30–\$1.25 per pound compared with just \$0.02–\$0.06 for regular trash.⁴

The interdisciplinary discussion also revealed constraints on waste mitigation including institutional policies, supply chains limitations, and workflow tradeoffs. For example, hospital policies dictated single patient use for lidocaine bottles irrespective of the bottle size. Supply chains also favored larger bottle sizes available in clinics, limiting cost savings from switching to smaller bottles. Moreover, although lidocaine can be drawn into individual syringes, the syringes must be used within an hour. These lidocaine preparations required staff to delay other necessary tasks. Similarly, reducing gauze pack size can reduce waste but also increase the potential of staff needing to scrub in and out of cases more often to obtain more gauzes as needed. The cost of additional sterile gloves and of interruption to workflow outweighed the benefits of waste reduction. After

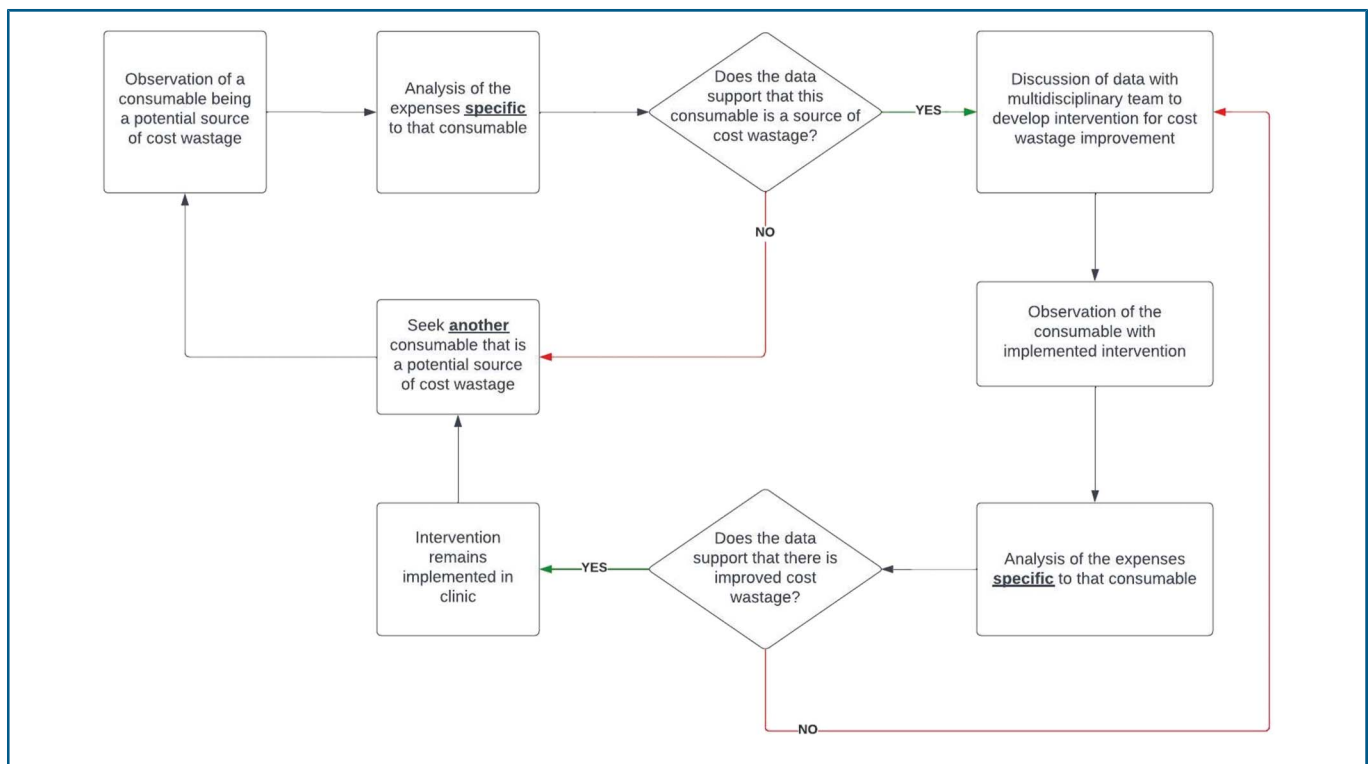


Figure 2. Process map of cost waste intervention development.

considered deliberations, the following interventions were implemented: removing cotton-tipped applicators, substituting whole iodine bottles with iodine prep pads, limiting the number of prepared surgical blades, and placing red bag and regular waste bins next to the operating table so that staff can easily dispose biohazard and regular trash appropriately. For the 20 excisions performed postintervention, the average cost of waste was \$18.01, a 17% decrease from the preintervention period (Table 1).

Discussion

This study demonstrated that the use of process mapping for excision can successfully identify consumable waste and lead to strategies that reduce the costs of waste per case. Through a collaborative deliberative process involving physicians, researchers, and clinical support staff, the authors identified constraints in waste mitigation such as institutional policies, built-in supply chains, and workflow tradeoffs. Process mapping led to staff retraining on what constituted biohazard waste to eliminate inappropriate placement of regular trash in red bags, thus reducing the costs of waste disposal. It also made them aware of the sheer amount of packaging waste generated from sterile procedures. A previous study in one Mohs clinic found that the estimated annual carbon emission from material waste alone was 26 kg carbon dioxide per one treatment center—the equivalent of driving 65 miles in an average passenger vehicle.^{5,6} Most medical waste is often incinerated, an energy intensive process that can release carcinogens and nitrous oxide. Thus, addressing waste management is critical in reducing our overall carbon

footprint.^{7,8} In addition, bio-based materials, such as polyhydroxyalkanoate, are 100% biodegradable and can offer sustainable alternatives to plastic packaging.⁹ However, owing to the higher production costs associated with these eco-friendly materials, manufacturers may opt for thinner packaging film for their products to reduce the amount of raw material used to decrease costs and energy.⁹

One surprising aspect of their findings is that compared with some previous studies examining wastage cost in other surgical specialties, their mean wastage costs were comparable. For instance, Rose and colleagues¹⁰ cited that their average cost of wasted supplies for laparoscopic cholecystectomies was \$19.71. The range of wastage is likely much wider in other surgical subspecialties because pricier equipment, such as the suction irrigators or laparoscopic devices used in cholecystectomies, are unused in dermatologic surgical procedures.^{10,11} It is also important to acknowledge that the processing costs for waste may vary across different hospital sites and practice settings.

The costs of consumable waste in an excision clinic can quickly add up as dermatology is a high volume specialty. Small reductions in per-case costs of consumable waste and waste disposal can accumulate significant savings over time. Process mapping can be repeated at multiple different timepoints depending on changes in workflow or practice. In addition, collaborative efforts between physicians, administrators, and ancillary staff members can drive the development of tailored solutions that meet both the regulatory requirements and unique needs of dermatologic procedures specific to their clinic. With continuing

TABLE 1. Summary of Expenses per Excision Case

	Total Cost of Items	Cost of Wasted/ Unused Items	Cost Waste Percentage	Items	Total Cost of Items	Cost of Wasted/ Unused Items	Cost Waste Percentage	Change in Waste Percentage
Preintervention				Postintervention				
Iodine bottle (118 mL)	\$2.20	\$1.80	83%	Iodine prep pads	\$0.24	\$0.00	0%	−83%
Gauze	\$0.76	\$0.41	54%	Gauze	\$0.76	\$0.32	42%	−12%
Cotton-tipped applicators	\$1.21	\$1.21	100%	Cotton-tipped applicators	N/A	N/A	N/A	−100%
Lidocaine bottle (20 mL)	\$21.89	\$15.98	73%	Lidocaine bottle	\$21.89	\$15.77	72%	−1%
OR towels	\$3.30	\$1.62	49%	OR towels	\$3.30	\$1.53	46%	−3%
Surgical light handle cover	\$0.79	\$0.39	49%	Surgical light handle cover	\$0.79	\$0.39	49%	0%
Surgical blade	\$0.56	\$0.28	50%	Surgical blade	\$0.28	\$0.00	0%	−50%
Presurgical skin markers	\$0.31	\$0.00	0%	Presurgical skin markers	\$0.31	\$0.00	0%	0%
Syringe and needle	\$0.78	\$0.00	0%	Syringe and needle	\$0.78	\$0.00	0%	0%
Electrosurgical blade	\$1.91	\$0.00	0%	Electrosurgical blade	\$1.91	\$0.00	0%	0%
Needle counter	\$0.85	\$0.00	0%	Needle counter	\$0.85	\$0.00	0%	0%
Sutures	\$9.11	\$0.00	0%	Sutures	\$9.11	\$0.00	0%	0%
Gloves	\$0.18	\$0.00	0%	Gloves	\$0.18	\$0.00	0%	0%
Sterile surgical gloves	\$4.17	\$0.00	0%	Sterile surgical gloves	\$4.17	\$0.00	0%	0%
Total	\$48.02	\$21.69	45%	Total	\$44.57	\$18.01	40%	−5%

downward pressures on procedural reimbursements and rising consumable costs, process mapping is a valuable tool for routine assessment of cost-efficiency in dermatology clinics. The same technique can be used to identify bottlenecks and inefficiencies in workflow to increase procedural capacity of the clinics while maintaining the same level of staffing. Although the specific interventions and cost reductions may be particular to this practice, the method of process mapping is applicable across practice settings.

The limitations of this study were tied to its single institutional nature. For example, being affiliated with an academic center, resource-related regulations followed by their outpatient dermatology excision clinic may differ from those followed by private practice clinics, limiting the generalizability of these results. Furthermore, observer bias may have played a role with staff noticing surgical supplies being surveyed.

Conclusion

This study demonstrated that process mapping can accurately identify and quantify consumable waste

generated with excisions and can serve as a valuable tool in making dermatologic surgery practice more cost-effective and eco-friendlier. Collaborative efforts between physicians, administrators, and ancillary staff members can drive the development of tailored solutions that meet both the regulatory requirements and unique needs of dermatologic procedures specific to their clinic. Future studies should evaluate cost wastage and overall carbon emissions from multiple dermatologic institutions, as well as continue to develop additional innovative sustainability initiatives.

References

1. Fathy R, Nelson CA, Barbieri JS. Combating climate change in the clinic: Cost-effective strategies to decrease the carbon footprint of outpatient dermatologic practice. *Int J Womens Dermatol* 2021;7:107–11.
2. Chung RD, Hunter-Smith DJ, Spychal RT, Ramakrishnan VV, et al. A systematic review of intraoperative process mapping in surgery. *Gland Surg* 2017;6:715–25.
3. Antonacci G, Lennox L, Barlow J, Evans L, et al. Process mapping in healthcare: a systematic review. *BMC Health Serv Res* 2021;21:342.
4. Nussbaum GF. Alternative waste management strategies. *Perioper Nurs Clin* 2008;3:63–72.

5. Allwright E, Abbott RA. Environmentally sustainable dermatology. *Clin Exp Dermatol* 2021;46:807–13.
6. *Greenhouse Gas Emissions from a Typical Passenger Vehicle*. United States Environmental Protection Agency. Available from: www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle. Accessed October 13, 2024.
7. Chaplin CL, Wernham AGH, Veitch D. Environmental sustainability in dermatological surgery. *Br J Dermatol* 2021;184:952–3.
8. Butt E. What can Mohs surgery do to help climate change? *Skin Health Dis* 2021;1:e26.
9. Reichert CL, Bugnicourt E, Coltelli MB, Cinelli P, et al. Bio-based packaging: materials, modifications, industrial applications and sustainability. *Polymers (Basel)* 2020;12:1558.
10. Rose ED, Modlin DM, Ciampa ML, Mangieri CW, et al. Evaluation of operative waste in a military medical center: analysis of operating room cost and waste during surgical cases. *Am Surg* 2019;85:717–20.
11. Chasseigne V, Leguelinel-Blache G, Nguyen TL, de Tayrac R, et al. Assessing the costs of disposable and reusable supplies wasted during surgeries. *Int J Surg* 2018;53:18–23.