

## RESEARCH LETTER

# Analysis of strengths, weaknesses, opportunities, and threats: Analytical hierarchy process based dental waste management in Odisha

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Biomedical and dental waste includes biohazardous, hazardous, pharmaceutical, and non-hazardous materials [1]. Improper disposal poses serious health risks, including infections from Hepatitis B, Hepatitis C, and HIV. In India, approximately 300 dental hospitals and 65,000 dental clinics generate an estimated 0.33 million tons of dental waste annually, with inadequate waste management exacerbating environmental and public health concerns. The COVID-19 pandemic further underscored the need for efficient dental waste management (DWM) strategies [2].

This cross-sectional study employs a structured, data-driven SWOT-AHP (Strengths, Weaknesses, Opportunities, Threats-Analytical Hierarchy Process) approach to assess and prioritize improvements in DWM practices in Odisha. Thirty experts-including dental practitioners, hospital administrators, and public health professionals from urban and rural clinics-were selected through purposive sampling. A structured questionnaire was used to identify SWOT factors in the existing DWM system, and pairwise comparisons based on Saaty's 1–9 scale was conducted to evaluate their relative significance. The AHP method was applied to assign weights and rank the influence of each factor, ensuring logical consistency through consistency ratio (CR) calculations, with values below 0.1 deemed acceptable. The findings highlight key strengths such as regulatory compliance and skilled personnel, while underscoring weaknesses including financial constraints, inadequate segregation, and logistical

issues. Opportunities for improvement-such as digital waste tracking technologies and stronger policy support-were explored, though their lower weight in the analysis indicates underutilization. While purposive sampling was effective for capturing expert insights, the limited sample size restricts generalisability [3]. Future research should consider larger, randomised samples and incorporate real-world DWM performance data to enhance external validity and practical relevance. SWOT analysis categorises internal (strengths and weaknesses) and external (opportunities and threats) factors, while AHP ranks them based on expert evaluations. A purposive sampling technique was employed, involving 30 experts, including academics and dental practitioners. Pairwise comparisons were conducted to assess the significance of various factors, with weights assigned using the AHP method [4, 5].

The SWOT analysis revealed strengths such as administrative support, legal compliance, and trained personnel, especially in tertiary institutions. Weaknesses included inconsistent waste segregation, lack of training at the grassroots level, and high costs of disposal services. Opportunities exist in leveraging digital tracking systems, tapping into public-private partnerships, and adopting newer eco-friendly technologies. However, significant threats remain: limited waste storage space in small clinics, lack of coordination between local bodies, and high initial investment costs for newer waste processing technologies.

**Key messages**

The study assesses dental waste management in Odisha using a SWOT-based approach. Strengths play a key role, while financial and logistical challenges hinder efficiency. Opportunities remain underutilized. Strong management, regulatory compliance, and strategic resource allocation are essential. Future research should refine decision-making for sustainable waste disposal and reduced health risks.

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Table 1 SWOT analysis with key factors and weights

Category	Key Factors	Weight
Strengths	Strong management support, skilled workforce, compliance with legal regulations	0.338
Weaknesses	Logistical complexity, inadequate segregation, financial constraints	0.13
Opportunities	Industry collaboration, environmental policies, new technology	0.094
Threats	Limited space, lack of coordination, high investment risk	0.329

Technological innovations such as real-time waste tracking systems, barcode-based segregation, and automated auditing tools can significantly enhance DWM efficiency. Policy-level initiatives, including stricter enforcement of biomedical waste rules and incentives for eco-friendly disposal units, offer systemic reform possibilities. The inclusion of these elements could lead to scalable improvements. The SWOT-AHP analysis revealed that strengths had the highest weight (0.338), highlighting their dominant role in DWM effectiveness. Threats (0.329) and weaknesses (0.13) were notable concerns, while opportunities (0.094) had the least impact. AHP-based ranking identified financial issues (GW: 0.15), data incompleteness (GW: 0.148), and logistical complexities (GW: 0.14) as the most pressing challenges requiring immediate attention.

The results warrant strong management and regulatory compliance, which is crucial for sustainable DWM. Weaknesses such as financial and logistical constraints hinder effective waste disposal. Opportunities include leveraging technology for waste tracking and fostering industry-government partnerships [1, 6, 7]. Enhancing waste segregation and logistics is essential for reducing health and environmental risks. Global best practices, such as efficient waste management systems, can be adapted to improve Odisha's waste management. The SWOT-AHP approach offers a structured framework for evaluating and refining the process. While strengths provide a strong foundation, weaknesses and threats present key challenges. Strategic resource allocation based on this analysis can enhance waste management practices [1, 6, 7]. Future research should consider additional variables and explore advanced methodologies to improve decision-making policies.

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*Conception or design of the work; or the acquisition, analysis, or interpretation of data for the work:* SM, MD. *Drafting the work or reviewing it critically for important intellectual content:* SM. *Final approval of the version to be published:* SM, MD, SM. *Accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved:* SM.

#### Conflict of interest

We do not have any conflict of interest.

#### Data availability statement

We confirm that the data supporting the findings of the study will be shared upon reasonable request.

#### Supplementary file

None

#### References

- Rath S, Tripathy SK, Dubey D, Swain SK, Panda S. microbial waste management in healthcare settings: A Review. *Int J Adv Life Sci Res* 2024;7(2):1-8. doi: <https://doi.org/10.31632/ijalsr.2024.v07i02.001>
- Myszograj M. Dental Waste – Management and Statistics. *Civil Enviro Engineering Reps*. 2023; 33 (2): 55-63. URL: <https://www.ceer.com.pl/pdf/172514-94698?filename=Dental%20Waste%20%20Management.pdf>
- Gödde D, Nöhl S, Wolf C, Rupert Y, Rimkus L, Ehlers J, Breuckmann F, Sellmann T. A SWOT (Strengths, Weaknesses, Opportunities, and Threats) Analysis of ChatGPT in the Medical Literature: Concise Review. *J Med Internet Res*. 2023 Nov 16;25:e49368. doi: <https://doi.org/10.2196/49368>
- Oliveira RC, Nääs IdA, Garcia S. Combining SWOT with AHP for Analyzing the Adoption of a Circular Economy in the Apparel Industry in Brazil. *Recycling*. 2023; 8 (5):73. doi: <https://doi.org/10.3390/recycling8050073>
- Mishra SS, Dash M, Muduli M, Pumwa J, Kar S. A Swot-Ahp based approach to investigate waste management issues in health care supply chain in Odisha. *International J Mech Eng Tech* 2018; 9(10):1074–1084. [https://iaeme.com/Home/article\\_id/IJMET\\_09\\_10\\_110](https://iaeme.com/Home/article_id/IJMET_09_10_110)
- Mokhtari M, Pourkosari F, Koupal R, Askari R. Design and Development of Hospital Waste Management Strategies Using Quantitative Strategic Planning Matrix Technique: A Case Study in Iran. *J Environ Health Sustain Dev* 2023; 8 (2):2007-2018. URL: <http://jehsd.ssu.ac.ir/article-1-624-en.html>
- Thuyen TTN. AHP-SWOT Analysis of strengths, weaknesses, opportunities, and threats of implementing green innovation. *Thailand World Econ*. 2023; 41(3): 66–87. URL: <https://so05.tci-thaijo.org/index.php/TER/article/view/267624/179584>