

Collection, Disposal, and Management of E-Waste among Medical Students in Chandigarh: A Cross-Sectional Study

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Abstract: Background: E-waste is an emerging environmental and public health challenge. In urban settings, improper disposal can pollute air, soil and water. Medical students are future health professionals and community influencers; understanding how they collect, dispose and manage e-waste can guide targeted interventions. Methods: A cross-sectional study of 400 undergraduate medical and dental students in Chandigarh was conducted using a pre-tested questionnaire. We measured e-waste collection and disposal routes, access to formal services, awareness of recycling hotspots and policies, and preferred solutions to reduce informal recycling. Data were analyzed with descriptive statistics and chi-square tests; $p < 0.05$ was considered significant. Results: Informal routes dominated disposal: 41.5% gave e-waste to scrap dealers and 38.8% returned it to sellers; 18.0% reported formal recycling. Only 22.0% had access to a collection service and 18.5% knew of a recycling hotspot; 51.5% were aware of government policy. Students most often recommended awareness campaigns (44.7%) and stricter enforcement (29.5%). Female students more often agreed that source collection aids formal recycling (OR 2.16; 95% CI 1.42–3.29; $p < 0.001$). Conclusions: Students rely primarily on informal pathways, with limited access to formal collection systems and low awareness of recycling infrastructure. Colleges should install certified collection points, link with authorized recyclers and include practical policy education to strengthen safe e-waste management.

Keywords: E-waste, awareness, medical students, public health, waste management, Chandigarh

1. Introduction

E-waste now grows faster than most municipal solid waste streams¹. Devices are frequently replaced and often discarded through informal channels. Such practices, including open burning and crude dismantling, can release heavy metals and persistent organic pollutants into air, soil and water^{2,3,4}. In academic campuses, students are heavy users of electronics but may not have convenient access to certified collection points^{5,6}. Medical students are a strategic population: they will counsel households and shape institutional practices in the future⁷. Despite policy frameworks for e-waste in India, campus-level collection and user behaviors remain under-documented^{8,9}. This study focuses on a single objective: to determine the collection, disposal and management of e-waste among medical and dental students in Chandigarh. We describe the disposal routes used, access to formal services, policy awareness and students' preferred solutions.

2. Methods

Study design and setting: We conducted a descriptive cross-sectional study among undergraduate medical and dental students in Chandigarh. **Sample and data collection:** A total of 400 students participated. Data were collected using a pre-tested structured questionnaire that recorded disposal routes (formal and informal), access to collection services and hotspots, and awareness of government policy. The instrument also captured students' suggestions to reduce informal recycling. **Analysis:** We summarized responses as proportions with 95% confidence intervals where



appropriate and examined associations using chi-square tests. Statistical significance was set at $p < 0.05$. Ethics: The study was approved by the Institutional Ethics Committee, and informed consent was obtained from all participants.

3. Results

Table 1. E-waste disposal routes reported by students

Disposal method	Percent
Given to scrap dealer	41.5
Returned to seller	38.8
Left at garbage centre	30.0
Landfill	27.0
Incineration	20.0
Given for recycling	18.0
Kept at home	16.5

Interpretation: Informal routes—scrap dealers and seller take-back—account for the largest shares, indicating limited reach of certified recyclers.

Figure 1. Disposal methods for e-waste among students

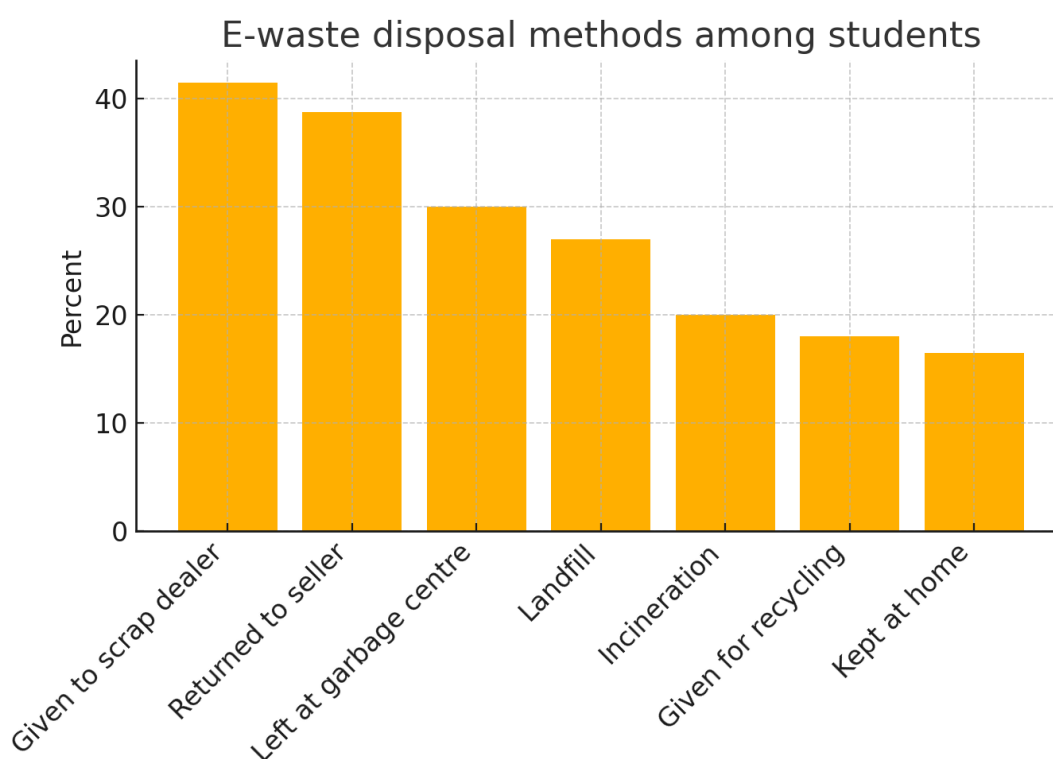


Table 2. Access to collection infrastructure and awareness of policy

Indicator	Percent (Yes)
Aware of govt e-waste policy	51.5

Have collection service	22.0
Aware of recycling hotspot	18.5

Interpretation: Fewer than one-quarter report access to a collection service or knowledge of a recycling hotspot; about half know of policy provisions.

Figure 2. Awareness of e-waste infrastructure and policy

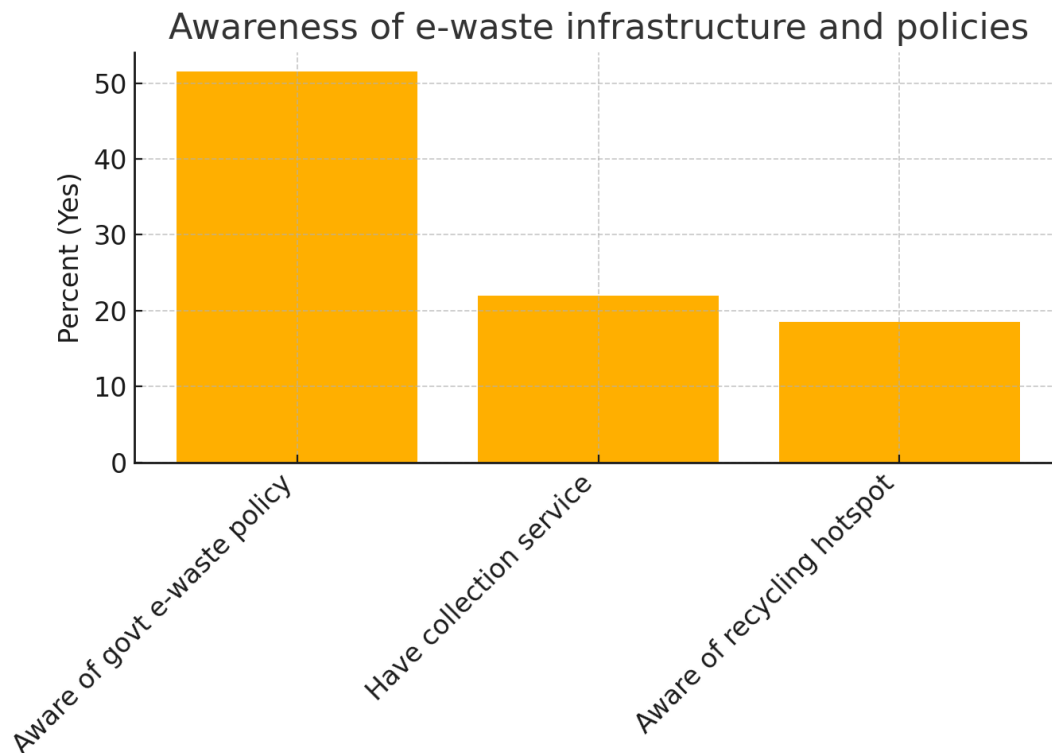


Table 3. Students' preferred solutions to reduce informal recycling

Suggested solution	Percent
Increase awareness	44.7
Stricter rules/regulations	29.5
Adopt current rules by all	25.8

Interpretation: Awareness campaigns are the top choice, followed by stricter enforcement and uniform adoption of existing rules.

Table 4. Association between gender and perceiving source collection as helpful for formal recycling

Group	Agree (n)	Disagree (n)	OR (95% CI)	p-value
Male	98	77		
Female	165	60	2.16 (1.42–3.29)	<0.001

Interpretation: Female students had higher odds of supporting source collection as a means to strengthen formal recycling.

Figure 3. Suggested solutions to improve e-waste recycling



4. Discussion

This study shows that although most medical and dental students in Chandigarh are familiar with the term e-waste, their detailed understanding of its health hazards, safe handling, and formal disposal options is limited^{1,5,12}. Informal methods, such as selling to scrap dealers, remain the dominant disposal route, and protective practices are rarely followed^{2,3,13}. These findings are similar to studies from other regions, which also reported that awareness does not always translate into safe practices^{1,3,10}. Gender and age differences were observed in knowledge and attitudes, highlighting the need for tailored educational efforts⁵. The low level of policy awareness and limited access to recycling infrastructure point to a systemic gap that requires institutional and government action^{10,19}.

Integrating e-waste education into medical curricula, combined with campus-based collection systems, could promote safer practices and reduce reliance on informal recycling^{4,11}. Awareness campaigns and policy enforcement are critical to encourage responsible disposal behavior^{17,18}.

5. Conclusions

While awareness of e-waste among students is relatively high, their practical knowledge and safe disposal practices are inadequate. This gap underscores the need for education, institutional initiatives, and policy support. Medical institutions should include environmental health in training, establish collection systems, and partner with authorized recyclers. Addressing these issues early will not only improve student behavior but also contribute to sustainable e-waste management and public health protection.

Recommendations

- Install certified e-waste collection bins at hostels and academic blocks and publicize their locations.
- Sign MoUs with authorized recyclers for periodic pick-ups and documentation of safe disposal.
- Integrate a short module on e-waste policy and safe handling in the undergraduate curriculum.
- Conduct quarterly awareness drives using student ambassadors and digital channels.

- Create a campus e-waste reporting and take-back helpline linked to the recycler.

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