Pharmacists as Champions in Environmental Antimicrobial Stewardship: Reducing Antibiotic Waste and Disposal Impact

'Responsible today,healthier tomorrow:Pharmacists safeguarding our environment and future from AMR'

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INTRODUCTION

Antimicrobial resistance (AMR) is a worldwide health issue of concern, which is not merely triggered by the incorrect use of antibiotics, but also caused by environmental contamination due to improper disposal of unused, unwanted, and expired antibiotics. Pharmaceutical residues that find their way into water bodies, soil and landfills promote the process of selection and spread of antibiotic resistance genes (ARGs) among environmental bacteria, promoting the One Health crisis.

Community pharmacists are uniquely positioned to lead the environmental antimicrobial stewardship (eAMS) campaign through responsible dispensing, patient education, and promotion of safe disposal practices.

AIMS & OBJECTIVES

AIM

To evaluate the impact of a pharmacist-led eAMS intervention on reducing antibiotic waste and improving appropriate disposal practices among patients in community pharmacies.

OBJECTIVES

- To reduce the quantity of leftover antibiotics through exact-quantity dispensing and adherence counseling.
- To increase the return of unused antibiotics to pharmacies.
- To improve patients' knowledge and adoption of appropriate disposal methods.
- To reduce the environmental load of antibiotic active pharmaceutical ingredients (API).

RESPONSIBLE DISPENSING → PATIENT EDUCATION → SAFE DISPOSAL → HEALTHIER ENVIRONMENT

METHODS

STUDY DESIGN
Prospective interventional study

SETTING
Community pharmacies

DURATION
12 months

PARTICIPANTS
1,248 patients on antibiotic therapy

INTERVENTION (eAMS COMPONENTS)
- Pharmacist training on eAMS concepts
- Exact-quantity dispensing
- Adherence counseling
- Education on handling of leftover medicines
- Provision of safe disposal options (take-back programs, deactivation kits, educational materials)

DATA COLLECTION
Pre- and post-intervention data collected using structured surveys and direct measurement of waste.
- Quantity of antibiotics prescribed & dispensed
- Volume of antibiotics returned
- Patient disposal practices
- API load removed from waste stream

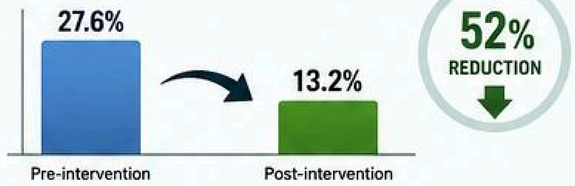
OUTCOME MEASURE
Reduction in API load released to the environment and improvement in safe disposal practices.

RESULTS

SIGNIFICANT IMPACT OF PHARMACIST-LED eAMS INTERVENTION

1. REDUCTION IN ANTIBIOTIC LEFTOVERS

52% decrease in the quantity of leftovers
(27.6% to 13.2% of dispensing quantity per prescription)
$p < 0.001$

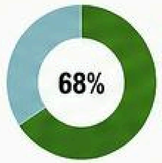


2. INCREASE IN ANTIBIOTIC RETURNS

124% increase in returns to pharmacies

3. IMPROVED DISPOSAL PRACTICES

Proper disposal practices increased to 68%



4. REDUCTION IN UNSAFE DISPOSAL

Unsafe disposal (flushing in toilets or dumping in domestic garbage) decreased by 44% to 12%

5. ENVIRONMENTAL IMPACT

11.4 kg of antimicrobial API safely removed from the environment through deactivation and diversion.

11.4 kg
API DEACTIVATED & DIVERTED

DISCUSSION

This study demonstrates that community pharmacists can drive meaningful environmental impact through eAMS practices integrated into daily pharmacy operations.

Exact-quantity dispensing and adherence counseling significantly minimized leftovers, the primary source of antibiotic waste.

The marked increase in returns and proper disposal indicates improved patient awareness and trust in pharmacist-led initiatives.

By removing 11.4 kg of API from the waste stream, the intervention contributed to reducing pharmaceutical pollution and the spread of antibiotic resistance genes (ARGs).

These results align with the One Health approach, addressing the interconnected health of humans, animals, and the environment.

CONCLUSION

Community pharmacists are effective champions of environmental antimicrobial stewardship. By integrating waste-minimization strategies into practice, pharmacist-led eAMS programs offer a viable, sustainable, and cost-effective solution to reduce the environmental footprint of antibiotics and combat AMR.

Supportive policies and multi-sector collaboration are strongly recommended to scale and sustain such impactful programs.

STRENGTHS & LIMITATIONS

STUDY STRENGTHS

- ✓ Real-world intervention in community settings
- ✓ Comprehensive approach combining education, dispensing & disposal solutions
- ✓ Measurable environmental impact

LIMITATIONS

- ✗ Single-region study
- ✗ Reliance on patient self-report for disposal practices
- ✗ Long-term environmental impact beyond 12 months not assessed

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UN-SUSTAINABLE DEVELOPMENT GOALS (SDG)

ALIGNMENT WITH SUSTAINABLE DEVELOPMENT GOALS (SDGs)

PRIMARY ALIGNMENT

3 GOOD HEALTH AND WELL-BEING — This research directly supports SDG 3 by reducing environmental contamination, limiting the spread of AMR, and promoting responsible antibiotic use—ensuring healthy lives and well-being for all.

CONTRIBUTION TO OTHER SDGs

6 CLEAN WATER AND SANITATION — Reduces pharmaceutical pollution in water bodies through proper disposal.

11 SUSTAINABLE CITIES AND COMMUNITIES — Promotes safe waste management practices in communities.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION — Encourages responsible use and disposal of medicines.

13 CLIMATE ACTION — Reduces environmental burden and supports climate resilience.

17 PARTNERSHIPS FOR THE GOALS — Strengthens collaboration among pharmacists, patients, communities, and policymakers for sustainable impact.

SUSTAINABLE DEVELOPMENT GOALS

TAKE-HOME MESSAGE

Every returned antibiotic, every safe disposal, and every informed patient brings us closer to a healthier planet and a future free from antimicrobial resistance.

PHARMACISTS LEAD · PATIENTS PARTICIPATE · ENVIRONMENT BENEFITS · TOGETHER FOR ONE HEALTH