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Short communication

Sustainable and green pharmacy: the role of secondary packaging in pharmaceutical sustainability

Katerina Zafirova Georgievska*

REPLEK AD Skopje, Kozle str. 188, 1000 Skopje, Republic of North Macedonia

Introduction

The concept of Green Pharmacy promotes the development and use of pharmaceutical products in ways that minimize environmental impact throughout their lifecycle. While considerable attention has been directed toward pharmaceutical manufacturing processes and active pharmaceutical ingredients, packaging remains an important but often overlooked contributor to environmental burdens (Daughton, 2003).

Secondary pharmaceutical packaging encompasses folding cartons, package inserts, labels, and grouping materials used to protect, identify, and provide information about medicinal products. Although these components do not come into direct contact with the product, they consume substantial quantities of paper, board, inks, adhesives, and energy (Bassani et al., 2022). Consequently, improving the sustainability of secondary packaging has become an important objective for pharmaceutical companies seeking to align with environmental, social, and governance (ESG) goals (Bade et al., 2024).

Recent European regulatory initiatives, particularly Packaging and Packaging Waste Regulation 2025/40 (PPWR), further emphasize the need for packaging systems that support waste prevention, recyclability, and circular economy principles (European Union, 2025).

Sustainable approaches to secondary packaging

One of the most effective strategies for reducing environmental impacts is the selection of sustainable packaging materials. Eco-design principles also play a crucial role in sustainable packaging development. Packaging optimization includes reducing carton dimensions, minimizing material usage, and eliminating unnecessary packaging components. These measures decrease raw material consumption while simultaneously improving transportation efficiency and reducing greenhouse gas emissions. Studies have shown that packaging lightweighting and material optimization can significantly reduce the overall environmental footprint of packaging systems (Bassani et al., 2022).

Implementation of circular economy principles provides packaging design towards facilitation of recycling and material recovery at the end of its life cycle. The use of mono-material structures and clearly recyclable materials can improve recycling rates and support the transition toward a more sustainable packaging system. Although pharmaceutical regulations limit opportunities for direct reuse, significant environmental benefits can still be achieved through improved recyclability and responsible material sourcing (European Commission, 2025).

*katerina.zafirova@replek.mk

Evaluation of sustainable packaging

The environmental performance of secondary pharmaceutical packaging can be assessed using Life Cycle Assessment (LCA), a standardized methodology that evaluates impacts from raw material extraction through manufacturing, distribution, use, and disposal. A comprehensive LCA considers not only the material's degradability but also the energy consumption, water footprint, greenhouse gas emissions, and social implications. This holistic approach informs material selection, design, and decision-making, ensuring that the pursuit of biodegradability does not inadvertently cause other environmental burdens (Ashiwaju et al., 2023). LCA allows identifying and assessing the environmental impacts and improving the packaging environmental performance, to support eco-design (Bassani et al., 2022).

In addition to environmental assessment, pharmaceutical companies must ensure that sustainability initiatives do not compromise product quality or patient safety. Therefore, packaging changes should be evaluated through risk-based approaches consistent with Quality Risk Management principles described in ICH Q9(R1) guidelines (ICH, 2023). Such evaluations consider potential impacts on packaging functionality, supply chain performance, and regulatory compliance.

Key sustainability indicators may include packaging weight reduction, percentage of recycled content, recyclability rates, and reductions in greenhouse gas emissions associated with packaging materials. These metrics enable organizations to monitor progress toward sustainability objectives and support evidence-based decision-making (Niero, 2023).

Conclusion

Secondary pharmaceutical packaging represents a practical opportunity to implement Green Pharmacy principles and reduce the environmental impact of medicinal products. Through sustainable material selection, eco-design, circular economy approaches, and appropriate evaluation methods such as Life Cycle Assessment and Quality Risk Management, pharmaceutical companies can improve packaging sustainability while maintaining product quality, safety, and regulatory compliance. As regulatory requirements and sustainability expectations continue to evolve, the adoption of environmentally responsible packaging solutions will play an increasingly important role in the future of the pharmaceutical industry.

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