Assessing the Environmental Impact of Autoinjectors

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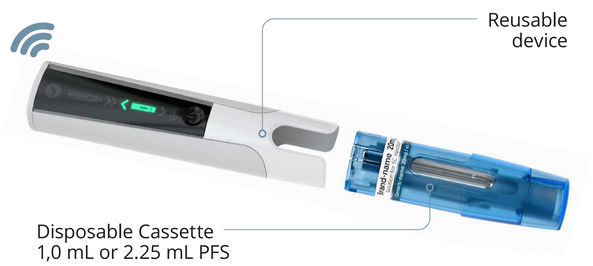
INTRODUCTION

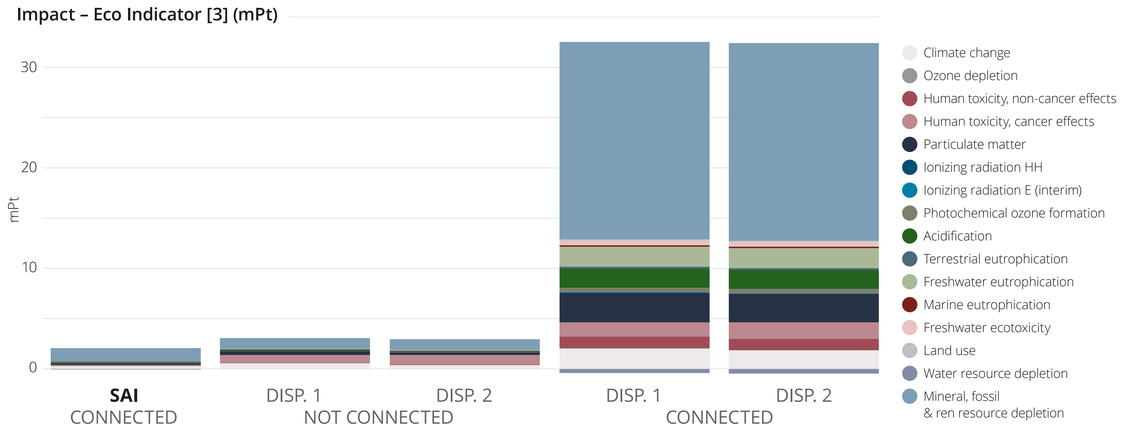
There has been a focus on disposable devices to support patient self-administration, driven by a need to optimise safety and usability as well as meet regulatory requirements. However, how well does this approach align with growing concern around environmental impact?

All products require materials and energy in manufacture, so there is no such thing as an environmentally friendly product: only environmentally friendlier products. Life Cycle Assessment (LCA) provides a methodology (as described below) for assessing the environmental impact of a product, process, or service, considering the complete life cycle from raw material extraction and processing, through manufacture, distribution, use, recycling or final disposal. It therefore allows comparisons to be made between different approaches and also to optimize a particular product. In the current study, an LCA comparison is made between reusable and disposable autoinjectors. The study assesses current disposable autoinjectors assuming disposal as hazardous waste.

The environmental impact of this approach is compared to that of a new autoinjector (SAI) consisting of a reusable electronic module and a disposable cassette containing the pre-filled syringe. It is assumed that the cassette follows the same waste stream as a single use autoinjector, with the non-hazardous reusable device going to electronic recycling at end of life. Preliminary results of the analysis are presented in this poster.

Smart Auto Injector – SAI





LCA METHOD

- We have used the Impact assessment method, LICD 2011 Midpoint EU27 2010 (version 1.10) [2].
- Calculations are produced in SimaPro with the EcoInvent 3.0 database.
- Lifetime of reusable device is assumed to be 156 injections (bi-weekly over 3 years).

COUNTRIES – SELECTED FOR SUITABLE VARIANCE IN CONDITIONS [1]

- Denmark
- Germany
- Spain

END-OF-LIFE SCENARIOS

- Incineration (electricity production)
- Incineration (electricity and district heating)
- Incineration (disposal)
- Recycling (material recovery)
- Landfilling (hazardous waste landfill)

LIFETIME – EXPECTED NUMBER OF INJECTIONS OVER 3 YEARS

- Monthly injection: 36
- Bi-weekly: 78
- Weekly: 156
- Twice per week: 312
- Maximum for SAI device: 550 (planned obsolescence)

CURRENT STATUS

- LCA completed: comparison of SAI vs. two marketed disposable autoinjectors (1 mL)
- Completeness approximation factor = 80%
- Results: good quantitative indication of sustainability factors
- SAI is considered more sustainable than disposable autoinjectors due to the high reusability and lower waste generated (SAI 2.1 vs 3.0)
- Adding a low cost BLE connectivity module to a disposable AI will theoretically have a significant impact on the sustainability of these (2.1 g Printed Circuit Board + 0.9 g battery assumption used as an example)

LIMITATIONS (TO BE INVESTIGATED FURTHER)

- Data for 2.25 mL versions of autoinjectors
- Packaging material and size not yet investigated – more scenarios
- Transport and storage of filled cassettes and autoinjectors (potentially cold chain) is not yet investigated. Given the reduced size and weight of the cassette, both aspects will likely add significantly to the SAI advantage
- Reusable sleeve solutions for disposable autoinjectors
- Charger and cable not assumed to be included

CONCLUSIONS AND NEXT STEPS

- Using the approach outlined here, the development team within Phillips-Medisize can take into account the different aspects of the LCA in order to optimize the SAI device design.
- Furthermore, the model can be used to assess manufacturing and distribution for the reusable device and disposable cassette to reduce environmental footprint.
- In the continuing analysis, different disposal scenarios for incineration, recycling, landfill etc. will be investigated for the different countries selected, which then will give a usable global perspective on the LCA optimization.
- Focus on minimizing the disposable part to include only the syringe, and reuse of the drive train will significantly reduce the environmental footprint of the drug delivery.
- It is evident that integrating electronics into disposable autoinjectors has a significant impact to the sustainability, as the complete device typically will be disposed as hazardous waste.
- Reusable add-on's to disposable autoinjectors have not yet been assessed in this LCA work. Although they improve sustainability over integrated devices, they present other challenges around reliability and ease of use that may result in them not being used by the patient.
- Consideration of the benefits of connectivity on sustainability through potential reductions in travel for healthcare consultation or hospitalization arising from non-adherence should be made.

REFERENCES

[1] Drivers for waste-to-energy in Europe, EU, 2011 and Eurostat 2017
[2] European Commission, Joint Research Centre, Institute for Environment and Sustainability, 2012
[3] Environmental indicator, Wikipedia 2020

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