SUMMARY

Life Cycle Assessment of a Disposable and Reusable Surgery Instruments Set for Spinal Fusions

by Alexander Leiden, Felipe Cerdas, David Noriega, Jörg Beyerlein and Christoph Herrmann

1. INTRODUCTION AND METHODOLOGY

For lumbar fusion surgeries reusable and disposable instrumentation and implants set are commercially available. Both sets are capable to support one level lumbar fusion surgery. In this study the Neo Pedicle Screw System from Neo Medical is used as an example for a disposable system and the Viper 2 MIS Spine System from DePuy Synthes is used as example for a reusable system. The reusable set is comprehensive and opened before the surgery, while the disposable system comes in a modular box system, whose boxes are opened on demand during the surgery. To compare the environmental impact of these different configurations a comparative Life Cycle Assessment (LCA) was performed to assess the overall environmental impacts of both alternatives. Life Cycle Assessment (LCA) is an internationally accepted and standardized method (DIN EN ISO 14040). It considers environmental aspects and potential environmental impacts of a product or service throughout its whole life cycle – from raw material extraction through production and use up to final disposal, in other words “from cradle to grave”. All material and energy flows related to the product’s life cycle are balanced and accounted for their contribution to environmental impacts like global warming or resource depletion.

2. SYSTEM DEFINITION AND LIFE CYCLE INVENTORY

The functional unit in this study is defined as the specific set of surgical instruments for the realization of one level lumbar fusion surgery (one surgery) including the implantation of four screws and two rods by means of a set of surgery instruments. The scope of this study encompasses the raw material extraction and production of the instrument sets, spare parts and packages, transportation, sterilization, use in hospital and final disposal, as shown in Figure 1.

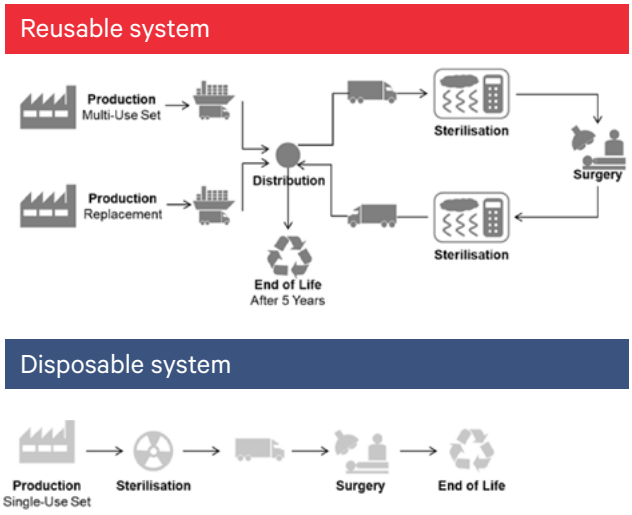

Figure 1. *Life cycle phases of reusable and disposable system.*

For the reusable system it is assumed that it is used for 60 lumbar fusion surgeries per year. Hence, 300 surgeries can be realized throughout the lifetime of one reusable set. According to experience, 10% of the instruments are lost per year. Beyond that, a loaner system for providing the surgical instruments is assumed for the reusable scenario. Thus, the distributor provides the complete set of surgical instruments, which must be sterilized in hospital before the surgery. After the surgery, it is cleaned and sterilized again and sent back to the distributor. There, the set is checked and complemented before return to hospital. Steam sterilization is the typical sterilization method in this case and the dominating sterilization method in German hospitals. Data collection for washing and steam sterilization was specific to a German hospital. For the disposable system a linear life cycle has been assumed. The set is produced, sterilized in a gamma radiation facility, transported to the hospital and finally disposed after use.

3. RESULTS

A summary of the outcomes of the life cycle impact assessment for the reusable set and the disposable set of surgical instruments is shown in Figure 2. They are displayed as percentage of the maximum value of each impact category. It is in evidence that the application of the disposable set of instruments results in an environmental advantage of approx. 85% against the reusable set. The extent depends on the impact category. The main environmental impact of the disposable set is generated in the production phase and that this share is higher compared to the reusable set. In the case of the reusable set the major environmental impacts result from sterilization process. Transportation and disposal processes have minor impacts in both cases.

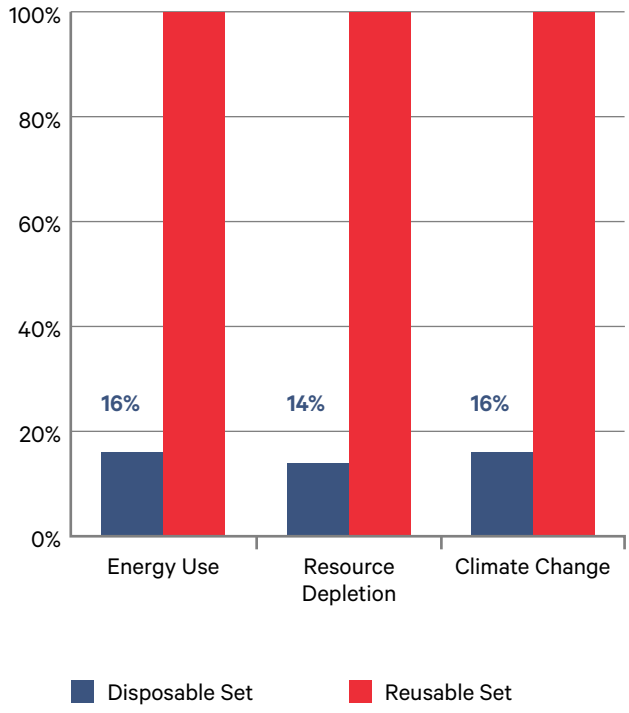

Figure 2. *Environmental impact per FU in percentage related to the reusable set.*

4. AUTHORS AND DETAILED STUDY

This study was conducted by Alexander Leiden[a], Felipe Cerdas[b], David Noriega[b], Jörg Beyerlein[c] and Christoph Herrmann[a]. A detailed study is submitted to the Special Issue on Sustainable Healthcare of the peer-reviewed journal Resources, Conservation and Recycling and is expected to be published soon.

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