DESIGN FOR SUSTAINABLE HEALTHCARE

The Eco-Dialysis Project

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Systemic Design | Methodology

Balanced involvement of all stakeholders

Local networks

Wastes are resources
Systemic Design | Methodology

https://vimeo.com/77479026
Systemic Design | Projects

SUSTAINABILITY IN

- EN.FA.SI. - Energia e Fagiolo in Sistema (Italy), 2011/14
- The territory of Ahuacuotzingo (Mexico), 2013/15
- The territory of Lea Artibai (Spain), 2014/15
- Agrindustria (Italy), 2013/15
- Poult System (France), 2015/17
- Alcotra Dégust‘Alp (Italy), 2014
- Specch.io (Italy), 2015/16
- Design4Autism (Italy), 2013/14
- Digital Systems For Diabetic Children (Italy), 2014
- EcoDialysis (Italy), 2014/16
**Sustainable Healthcare**

Promotion of proper **waste sorting**  
(Grose et al., 2012)

**Green Public Procurement** schemes  
(Walker & Brammer, 2009)

**Educational programmes** for staff  
(Richardson et al., 2014)

**Systemic Design**

**Input > output**

**New eco-products**

**Users’ interaction tools**
THE ECODIALYSIS PROJECT
Hemodialysis

- environmental impact
- economic burden
- behaviour problem
Starting from waste

Analysis of different treatment methods

- in-center bicarbonate dialysis
- in-center hemodiafiltration
- home ultrafiltration dialysis

Politecnico di Torino
Dept. of Architecture and Design
EcoDesign Team

University of Torino
S. Luigi Gonzaga Hospital
SS Nephrology
Starting from waste

Analysis of different treatment methods

- in-center bicarbonate dialysis
- in-center hemo-diafiltration
- home ultrafiltration dialysis

OBSERVATORY ECO-PACK
Starting from waste

Analysis of different treatment methods

- in-center bicarbonate dialysis
- in-center hemodiafiltration
- home ultrafiltration dialysis

**QUANTITATIVE ANALYSIS**
- weight
- materials
- hazardous/non-contaminated

**QUALITATIVE ANALYSIS**
- functionality
- sustainability
- communication
Quantitative Analysis

WEIGHTS

NON CONTAMINATED WASTE

- careful
  - 0.8 kg/treatment

- careless
  - 4.2 kg/treatment

MATERIALS

- 47% made from composite polymers

CONTAMINATED WASTE

- careful
  - 1.3 kg/treatment

- careless
  - 2.7 kg/treatment

- 40% made from composite polymers

- 21% made from different easily-separable materials

- 39% made from one material
Quantitative Analysis: results

Non Contaminated Waste

Contaminated Waste

Waste Production
330 kg - 1080 kg/patient/year

Waste Disposal Cost
670 € - 1500 €/patient/year
Qualitative Analysis

Example of packaging analysis

- Flexible bags optimize space within the secondary pack
- The pack provides good preservation of product
- The pack is easy to connect but cannot be emptied after use
- No overpackaging
- Bag made from three layers of different polyolefins; components non-separable
- The packaging is lightweight and proportionate to the content

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>MATERIAL</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bag</td>
<td>Clear-Flex (polyethylene; nylon; polypropylene)</td>
<td>22.5 g</td>
</tr>
<tr>
<td>Luer lock connector</td>
<td>Polymer</td>
<td>&lt;1 g</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>22.5 g</td>
</tr>
</tbody>
</table>
# Qualitative Analysis

Example of packaging cross comparison

<table>
<thead>
<tr>
<th>Packaging</th>
<th>Product weight</th>
<th>Pack weight</th>
<th>Pack-product ratio</th>
<th>Materials</th>
<th>Easiness of disassembly</th>
<th>Fastening type</th>
<th>Glues</th>
<th>Adhesive labels</th>
<th>Labeling</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>500 g</td>
<td>32 g</td>
<td>55%</td>
<td>medical paper PVC</td>
<td>heat sealing</td>
<td>NO</td>
<td>NO</td>
<td></td>
<td>STERILE</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PACKAGING</th>
<th>PRODUCT WEIGHT</th>
<th>PACK WEIGHT % on total weight</th>
<th>PACK-PRODUCT VOLUME RATIO</th>
<th>MATERIALS</th>
<th>EASINESS OF DISASSEMBLY</th>
<th>FASTENING TYPE</th>
<th>GLUES</th>
<th>ADHESIVE LABELS</th>
<th>LABELING</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>THERAPEUTIC OPTION 1</td>
<td>variable</td>
<td>28 g n.a.</td>
<td>80%</td>
<td>PP</td>
<td>heat sealing</td>
<td>NO</td>
<td>YES</td>
<td>none</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>500 g</td>
<td>32 g</td>
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</table>
## Qualitative Analysis: results

### Functional Issues
- Difficulties in storage
- Difficulties in handling secondary packaging
- Difficulties in the disposal of bulky hazardous waste

### Sustainability Issues
- Oversized packaging
- Problems in emptying packaging
- Difficulty of disassembly
- Use of pre-assembled kit
- Lack of information about disposal
## Funcionality guidelines

<table>
<thead>
<tr>
<th>Functionality Guidelines</th>
<th>Pack/Dispos.</th>
<th>Machine</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Improve movement and handling of secondary packaging</strong></td>
<td>Pack for Transport</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Design secondary pack providing gripping points and facilitating the opening even when stacked.</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Facilitate the set up phase both for HHD and IHD treatments</strong></td>
<td>Pack for Treat Disposables</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Avoid the use of pre-assembled kit, designing new systems easy to use even by non-medical staff for HHD treatments.</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Facilitate the end of dialysis phase and the sorting of hazardous waste</strong></td>
<td>Pack for Treat Disposables</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Improve the disposal operations of bulky hazardous waste (bloodlines/dialyzer/infusion line).</em></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
**Sustainability guidelines**

<table>
<thead>
<tr>
<th>Sustainability Guidelines</th>
<th>Pack/Dispos.</th>
<th>Machine</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design the composition of AVF connection kits</td>
<td></td>
<td>Pack for Distr. Disposables</td>
<td></td>
</tr>
<tr>
<td>Avoid the waste of not used products and/or allow the personalization of the kit according to the specific treatment method.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimize packaging dimensions</td>
<td>Pack for Transport</td>
<td>Pack for Transport</td>
<td></td>
</tr>
<tr>
<td>Avoid unnecessary oversizing, especially in secondary packaging.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extend the lifecycle of secondary packaging</td>
<td>Pack for Transport</td>
<td>Pack for Transport</td>
<td></td>
</tr>
<tr>
<td>Evaluate the use of reusable secondary pack or provide added functions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allow the emptying of residual materials</td>
<td>Pack for Treat</td>
<td>Pack for Treat</td>
<td></td>
</tr>
<tr>
<td>In particular the bicarbonate contained in the bicarbonated cartridge and the solution residuals in flexible bags.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allow the sorting of different materials</td>
<td>Pack for Treat</td>
<td>Pack for Distr.</td>
<td></td>
</tr>
<tr>
<td>Avoid permanent joints and, if possible, the use of composite materials and composite polymers.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
FUTURE STEPS
EcoDialysis Project

1. **Analysis of Packaging and Disposables**
   - **Method**: Quali-quantitative disassembly analysis
   - **Outcome**: Ecoguidelines

2. **Analysis of Dialysis Equipment**
   - **Method**: Design by components
   - **Outcome**: Ecoguidelines

3. **Analysis of Interaction**
   - **Method**: Systemic design / interaction design
   - **Outcome**: Ecoguidelines

4. **Design Phase**
   - Prototypes for new eco-sustainable treatments

5. **Verification**
   - Verification of environmental, economical and social sustainability

Amina Pereno | Design for sustainable healthcare
**JOURNAL ARTICLE**


**CONFERENCE PROCEEDINGS**


**POSTERS**

THANK YOU FOR YOUR ATTENTION!

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