diid

disegno industriale
industrial design

theorìa
pòiesis
praxis

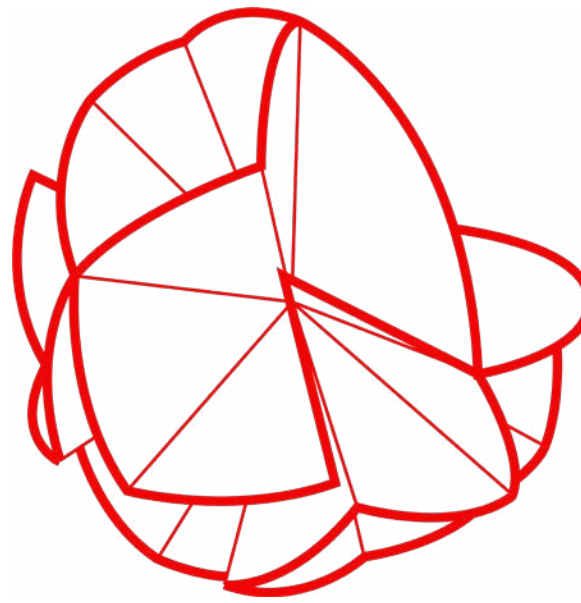
diid.it

DIGITAL
SPECIAL
ISSUE
1

Disrupting Geographies in the Design World

Proceedings of the 8th International Forum of Design as a Process

Alma Mater Studiorum — Università di Bologna



Editors
(Eds.)
Erik Ciravegna
Elena Formia
Valentina Gianfrate
Andreas Sicklinger
Michele Zannoni

Colophon

diid
disegno industriale
industrial design
Digital Special Issue 1
— DSI 1

Year
XXI

diid is an open access
peer-reviewed scientific
design journal

diid is published
three times a year

Registration at Tribunale
di Roma 86/2002
(March 6, 2002)

www.diid.it

Print subscription
(3 issues)
Euro 60,00
Subscription office
ordini@buponline.it

Editor-in-chief
Flaviano Celaschi
Alma Mater Studiorum
— Università di Bologna

Deputy Editor-in-chief
and Managing Editor
Elena Formia
Alma Mater Studiorum
— Università di Bologna

Editors
Erik Ciravegna
Elena Formia
Valentina Gianfrate
Andreas Sicklinger
Michele Zannoni
Alma Mater Studiorum
— Università di Bologna

Founded by
Tonino Paris

Associate Editors
Viktor Malakuczi
Sapienza — Università
di Roma

Lorela Mehmeti
Alma Mater Studiorum
— Università di Bologna

Elena Vai
Alma Mater Studiorum
— Università di Bologna

Art Director
Davide Giorgetta

Editing Assistant
Olga Barmine

Publisher
Fondazione
Bologna University Press
Via Saragozza 10
40123 Bologna
Tel. (+39) 051 232 882
Fax (+39) 051 221 019
www.buponline.com
info@buponline.com

ISSN
1594-8528

ISSN Online
2785-2245

DOI
10.30682/diiddsi23

ISBN Online
979-12-5477-329-1

Main partners

Latin Design Process

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI ARCHITETTURA

Advanced Design Unit

DISEÑO | UC

MA DA Magister en Diseño Avanzado UC

Tecnológico de Monterrey
Escuela de Arquitectura, Arte y Diseño

diid

Related activities and projects

Winter School
Design for Responsible Innovation

BIOGRAFILM FESTIVAL
INTERNATIONAL CELEBRATION OF LIVES

Endorsers

Centro di Ricerca sulle Industrie Culturali e Creative
— Università di Bologna

Cumulus Association

New European Bauhaus

SID Società Italiana di Design

In collaboration with

DAMSLAB

Reviewers

The Proceedings of the 8th International Forum of Design as a Process have undergone a rigorous peer-review process to ensure the scholarly quality of the contributions contained herein.

The Editors extend their sincere appreciation to the following Scholars who served as Reviewers for this Digital Special Issue.

Tarek Abdellatif
Cosimo Accoto
Elena Alfaro
Giulia Allegrini
Margherita Ascari
Margarida Azevedo
Laura Badalucco
Silvia Barbero
Luca Barbieri
Esra Bici Nasır
Alessandra Bosco
Saveria Olga Murielle Boulanger
Sabrina Bresciani
Elena Brigi
Francesca Calabrese
Alberto Calleo
Alfredo Calosci
Serena Cangiano
Stefano Capolongo
Lina María Cárdenas
Paolo Cardini
John Cardozo
Giorgio Casoni
Andrea Cattabriga
Manuela Celi
Gabriel Cereceda
Simona Colitti
Pietro Costa
Doriana Dal Palù
Giorgio Dall'Osso
Dolly Daou
Antonio De Feo
Vanessa De Luca
Barbara Del Curto
Özgen Osman Demırbaş
Carmelo Di Bartolo
Loredana Di Lucchio
Amir Djalali
Alice Donferri Mitelli
Sergio Donoso
Seyedarshia Eghbali
Paola Fabbri
Daniele Fanzini
Anne Farren
Valentina Frosini
Rossana Gaddi
Vanessa Galvin
Silvia Gasparotto
Pamela Gatica
Gionata Gatto
Angela Giambattista
Valentina Gianfrate
Clara Giardina
Carlo Giardinetti
Debora Giorgi
Michael Gray
Pablo Hermansen
Oscar Huerta
Çiğdem Kaya
Elif Kocabıyık
Christopher Kueh
Kristina Lamour Sansone
Jennifer Lane
Carla Langella
Lorna Lares López
Beatriz Leal Ramos
Margo Lengua
Ruth Maribel León-Morán
Beatrice Lerma
Ami Licaj
Lígia Lopes
Anna Lottersberger
Stefano Luca
Patricia Mann
John Martin
Martina Massari
Mauricio Mejía
Paula Melo Signerez
Riccardo Mercuri
Leonel Merino
Giuseppe Mincolelli
Katharine Mollenhauer
Pierluigi Molteni
Carlos Montaña
Roberto Montanari
Edgardo Moraga
Alfonso Morone
Erica Isa Mosca
Federica Natalia Rosati
João Nunes Sampaio
Boon Ong
Giulio Palmitessa
Anty Pansera
Veronica Pasini
Amina Pereno
Merav Perez
Pier Paolo Peruccio
Bárbara Pino Ahumada
Davide Pletto
Gregory Polletta
Alessandro Pollini
Shalini Prasad
Diego Pucci
Nathalie Rodríguez Estrada
Valentina Rognoli
Maximiliano Romero
Ludovica Rosato
Ilaria Ruggeri
Francesca Sabatini
Mariana Salgado
Jorge Sanabria
David Sánchez Ruano
Romina Santi
Andreas Sicklinger
Leila Signorelli
Ricardo Sosa
Frank Spencer
Chiara Sponza
Laura Succini
Ermanno Tasca
Martin Tìroni
Umberto Tolino
Florencia Toro Silva
Beatrice Turillazzi
Elena Vai
Virginia Vignali
Paula Wuth
Burcu Yahız
Nélida Yanet Ramírez Triana
Michele Zannoni
Carola Zurob

Contents

Track 1

There's No Plan(et) B: Sustainable Transitions to Systemic Planet-Centric Design

Track 2

Intersectional Design for an Accessible and Empowering World

Track 3

Design and Responsive Technologies for Human Wellbeing

Track 4

Design Values Out of the Mainstream: New Geographies of Influence

Track 5

New Education Pathways for Future Designers in a Changing World

Reducing Waste in Healthcare: A Systemic Design Approach for Sustainable Disposables Manufacturers

Gabriele Maria Cito
Sapienza University of Rome
gabrielemaria.cito@uniroma1.it
ORCID 0000-0001-7009-192X

Angela Giambattista
Sapienza University of Rome
angela.giambattista@uniroma1.it
ORCID 0000-0002-8301-5966

Abstract
Efficient waste management is crucial in the healthcare system due to the complex composition and associated risks to workers, patients, and the environment. While there is growing awareness of the need to change the system, there is still an urgent need for a sustainable healthcare system. Sustainability concepts can guide designers in taking action, from considering waste reduction in the choice of materials to optimizing management systems through information and staff training. Systemic design methods can help involve business teams in the development of sustainable practices and strategies for production, use, and disposal. Research aimed to identify the types of disposables produced according to their polymers and weight, and to detect associated problems. The quantification of results led to the development of strategies aimed at reducing the number of polymer types used in product manufacturing with A case study on the Neonatal Nasal Mask, a consumable device was conducted to apply sustainable design strategies.

Keywords
Healthcare LCA
Disposables
Neonatology
Circular product design
Circular economy

Introduction

Over the past decade, the global problem related to environmental pollution emerged as one of the most debated issues in multiple sectors and on what strategies might be necessary for a redirection of the globe toward a future that seems compromised. In 2017, global healthcare expenditure was estimated at $7.8 trillion worldwide and is about 10% of the world's gross domestic product (GDP) (WHO, 2019). In healthcare facilities, waste management plays a primary role because of the complex and diverse composition of the waste produced, the potential risks their handling poses to health, the safety of healthcare operators, patients, environment, and the costs of their disposal. For this reason, the study explored the lifecycle of medical consumables for Neonatology departments in a purely corporate context, in which to observe, project, and test new sustainable solutions in the entire product lifecycle, not until they are delivered to the healthcare facility, but to their separation and proper disposal in the hospital area. Specifically, the following research questions that guided the study:

- Which raw materials are used in the production of the company's single-use medical devices, and which of these could be replaced with sustainable alternatives?
- Which of these products are composed of two or more types of polymers?
- Which of them can be redesigned by reducing the typology of multi-material products and the assembly parts of them?
- Which items have the highest and lowest overall weight among the product range, and what percentage does packaging affect the overall weight of the company's disposables?

Background and Problem Identification

From an overall perspective, pollution is a major cause of morbidity and mortality in the world and was associated with about 9 million premature deaths globally in 2015, accounting for 16% of all deaths (Landrigan, 2018). Environmental pollution produced by the Global Health system has been a serious problem to be focused on since as far back as 1995. On that date, the U.S. Environmental Protection Agency identified medical waste incineration as the main source of dioxin production, one of the most potent naturally occurring toxic and carcinogenic chemical compounds. (Thornton et al., 1996). Studies in the United Kingdom showed that 80 percent of the National Health Service (NHS) generates 22.8 million tons of carbon dioxide emissions annually, with 60 percent consisting of equipment and consumables (Centre for Sustainable Healthcare, 2017).

During the pandemic period, growing concern about the risk of infection contributed to increasing amounts of disposable items and their packaging disposed of as clinical waste. Almost all this waste was incinerated, even though some of it could potentially have been recycled. (Silva et al, 2020). A study led by Benson et al., shows that 1.6 million tons of plastic waste generated daily worldwide, also estimating the disposal of about 3.4 billion disposable face masks or

diid DSI No.1 — 2023
Doi: 10.30682/diiddsi23t1d

face shields being discarded daily. (Benson, 2021). By placing attention on the types of polymeric medical products, the European Commission recognized plastics as a key priority for a paradigm shift, in which consumers should be "aware of the need to avoid waste and make the right choices" (Foschi & Bonoli, 2019, p.18). Numerous challenges are currently being pursued by hospitals and nongovernmental organizations aimed at making the healthcare sector sustainable, but these fail to counterbalance the incompatibility generated in the massive daily use of medical disposables and packaging with the strict environmental need to reduce and minimize the impact these products have on the environment from their production to their disposal.

Literature Review

One of the terms that the research pathway focuses on, closely related to the principles of sustainable design, is the concept of circular economy, one of the most recognized definitions of which is offered by the Ellen MacArthur Foundation, which a circular economy is one that is reparative and regenerative by design and aims to maintain products, components, and materials at their maximum utility and value at all times, distinguishing between technical and biological cycles (Ellen MacArthur Foundation, 2015). Another significant definition that meets the research aims refers to the EU Action Plan for the Circular Economy: "In a circular economy, the value of products and materials is maintained as long as possible; waste and resource use are minimized and resources are kept within the economy when a product has reached the end of its life, to be used again and again to create further value" (European Commission, 2015). Over the past two decades, many communities around the world begun to recognize the need of a transformation in healthcare, but despite the growing attention to the urgent need for a sustainable health care system, there still appears to be little sustainable research and actions that can be implemented in Neonatology areas, an area where the use of single-use products has a major impact on costs and the environment (Newman, 2011; Nichols 2014). The reasons behind the problem can be found in the pilot study by Verma et al., in which they state that "neonatal care is an acute case specialty, and causally due to the high rate of admissions with neonatal sepsis and other forms of infections, to maintain sterility the current practice, it is standard to discard or in sterilizing all unused items present at the bedside of infants who have tested positive or suspected of having an infection", generating an additional cost to patient care. In addition, excess supplies are assumed to be infected if infant tests positive for infection, and all unused supplies are discarded, when infant is discharged or dies (Verma et al., 2019). Studies conducted by the Royal College Nursing (2011) provided some clues about the high cost and differences between the costs of "clinical" or "infectious" waste and household waste, seeing that per ton, the management of "infectious" clinical waste costs about three times that of household waste (RCN, 2011). A proper waste separation, as stated by Nichols (2014), lead to the compromise of neonatal wards and can reduce the ability of staff to effectively separate waste at the point

of generation. The goal of properly separating waste at the point of generation prevents non-infectious waste from being disposed of through the more costly clinical waste stream, thereby increasing costs that can be up to three times higher than ne-needed (Nichols et al., 2016). In conclusion, literature suggests that healthcare organizations have not yet adopted the concepts of sustainable development and circular economy such as, for example, systems for tracking, monitoring, and assuming sustainable waste management practices aimed at waste reduction, reuse, and recycling. In this regard, research pushes for the implementation, in the manufacturing context, of methodologies and design concepts inclined to a multi-directional sustainability found both in the production area and in use and disposal.

The Sustainable Design Value

To understand in what different ways they connect with and affect design, it is necessary to make a distinction between the definitions of Green, Sustainable and Regenerative, when they are referred to the sphere of circular design, seemingly similar in their meaning but different in their design operation. Regarding Green Design, as stated by Raymond J. Cole, it aims to reduce the negative and harmful impacts on both the environment and humans resulting from the development of the latter in the process of humanity's evolutionary growth (Cole, 2012). The variance of regenerative design from concepts of sustainability is emerged in the purpose to reconnect humans with nature through a renewal of a set of ecological and social systems. Unlike its precursors, the regenerative approach stimulates continuous feedback at each stage of its process by generating results that are adaptable and dynamic to the operational context. Only in past few years there has been a shift toward a circular approach to resource consumption, increasing interest in circular actions that can be implemented even in health care settings, finding in such circumstances, in the figure of the designer, the expertise useful for the implementation of the concepts previously outlined in a specific context, a potential actor for a transformation to a circular economy. The designer capabilities within the English health system, as Freire and Sangiorgi (2010) state, in their analysis of the evolution of the sector from care to cure has been directly shifting from a mere design of products to a role as a facilitator of connections between stakeholders and simultaneously as a provider of tools, methodologies, and strategies to assess and solve the current problems of the complex health system (Freire and Sangiorgi, 2010).

Limits of Research Field

The research aims to reconcile the health needs of citizens with environmental health compromised by consumables in the healthcare sector. The scientific problem involves different healthcare departments, but focusing holistically on the problem would result in large structural and organizational complexity. Therefore, the survey focuses on the Neonatology department, which is likely to

use disposable items daily for care, considering important evidence demonstrated by international research, which show a high use of disposable devices to minimize the risk of infection on patients (Settimo & Viviano, 2013). This ultra-specialization of pediatrics deals with the medical treatment of newborns, and in Italy, the care is provided in three levels based on the number of annual deliveries and neonatology ward characteristics. The choice of investigating this department is due to its high use of disposable devices to minimize the risk of infection on patients and collaboration with GINEVRI, a company engaged in producing medical equipment and disposable products for neonatology wards.

The reasons related to the choice of investigating this type of ward are summarized in two main reasons.

- The collaboration in the research path with the company GINEVRI, which has been engaged in the design and production of medical equipment and disposable medical products for neonatology wards, with which it is possible to have a field screening of the types of disposable items produced in order to map their product life cycle from their CAD design, to packaging and labeling for consecutive sale to public hospitals as well as private facilities.
- Evidence obtained from the scientific literature, which affirms a lack of focus on the quantities of waste produced in this department on procurement costs and the high cost of management of waste produced in the Neonatology area.

Methodology and Research Phases

The research adopted the Systemic Design method, combined with principles of Sustainable and Anthropocentric Design, to involve the business team in practices and strategies for the production, use, and disposal of disposable polymer products. Participatory design tools allowed co-design with stakeholders involved in the life cycle of plastic products within specialized companies and Neonatology wards in Lazio. The research stages Fig. 1 carried out to achieve the subsequent results followed the following breakdown:

Desk Research

- Acquisition of paper and digital material of technical data and user manuals of consumable goods produced by the company GINEVRI, for a preliminary enquiry of the production processes and raw materials adopted for each product.

Field research

- Acquisition of data from administrative staff, through the company's management program, of the quantities and types of periodic purchases made by the regional operators regarding the purchase of consumable goods for Neonatology
- Observation of medical dispositive assembly practices and their packaging in single or kit mode
- Production of photographic documentation and numerical quantification of data related to the company's consumable goods and the types of primary and secondary packaging adopted for transportation.

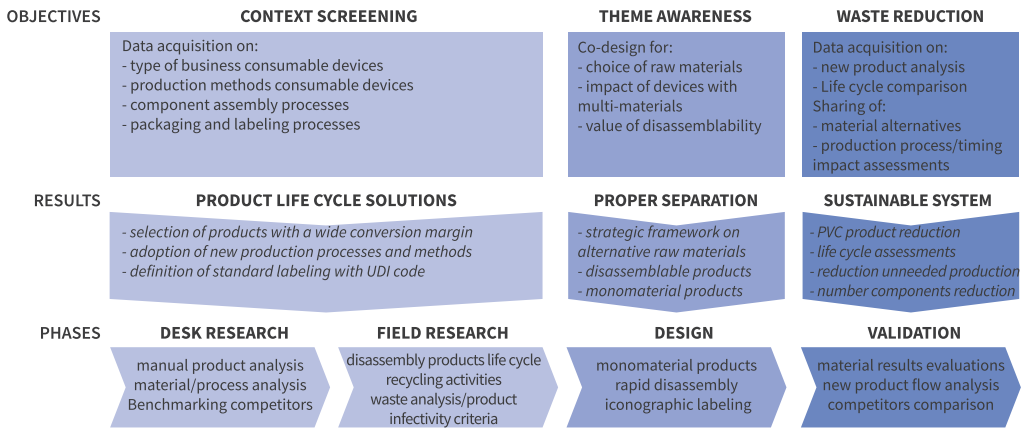


Fig. 1
Research methodology and stages (Gabriele Maria Cito, 2022).

Results

The results from the two types of research analysis allowed for the gaining of data collection that was crucial for the construction of the design phase. Among the data collected in the desk phase of the research were:

- Types of consumable devices produced by company
- Production process of disposable medical devices
- Assembly processes of product components
- Primary and secondary packaging processes
- Design methods of labeling disposable devices

Pilot desk research carried out in the company area made it possible to return a mapping of the items in the company to keep track of the quantities of material entering and leaving the company, as well as the type of packaging of each consumable device.

The field research, on the other hand, carried out a photographic documentation activity of the consumable goods produced in the company and the types of primary and secondary packaging for transport, through a selection and photographic documentation of the single-use items produced and assembled in the company in order to get an overview of the macro-areas of use and the choice of packaging adopted for each consumable device. Fig. 2

The following parameters were considered in the field analysis:

- Name, material, available in multiples, weight of the consumable item
- Material, weight of packaging items
- Percentage of weight packaging based on total weight.

Among the data acquired in the field phase of the research, the following can be found instead:

- The two-way disposable circuit is a heavy item composed of multiple polymer components that do not come into direct contact with the patient and can potentially be recycled according to specific polymer streams.
- 35.7% of the range of disposable items considered in the survey are composed of multi-material.
- 42.8% of the products analyzed are composed of PVC, which is one of the most polluting polymers for production pro-

cesses as well as recycling activities.

- The packaging for disposable items is mostly composed of LDPE, which is among the least polluting materials for both production and recycling.

This pathway enabled an expansion and sharing of knowledge about the disposables produced in the company, generating the following results:

- analytical assessment of primary and secondary packaging processes and a tracking of the types and quantities of materials produced by the company
- identification of critical issues related to packaging weight for certain items
- general assessment of the major types of products purchased by sanitary facilities regarding neonatal care.

Fig. 2
Photographic documentation on polymer material typology and packaging manufacturing methods by Ginevri Srl. (Angela Giambattista, 2022).

Conclusions and Future Developments

In this research, an analysis of the company's production processes regarding consumables for Neonatology departments was carried out. This research stemmed from the need to have an overview of the types of materials produced according to their polymer composition, their specific weight, and the best assembly and labeling processes for disposable items.

The activities carried out for the survey were:

- the observation of the company's user manuals of each company's medical device from which resulted in the identification of the types of raw materials used
- photographic documentation that allowed the cataloging of weights for corporate products and packaging, and finally an analysis of the packaging processes and
- amount of information in labeling that led to the definition of an adaptability of both the size of the packaging used and the size and information illustrated on the labels

The methodology used to carry out the survey of such desk products, through the acquisition of company information material acquired and reprocessed in the form of an Excel sheet showing an overview of what is the current state of the company's disposable products and what are the peculiar critical issues that can be acted upon. Tab. I Then, field research was conducted to quantify in person, through observation and weighing of products and packaging useful for understanding the major polymers used in the range of corporate disposable devices.

Product Name	Weight item	Weight pack	Weight overall	% pack per product	Material Item	Material pack
Smart Flow Kit Niv Multisize	67	16	100	16,0%	MIX	LDPE
Smart Flow Kit Niv Extra Small "Rosso"	69	12	107	11,2%	MIX	LDPE
Smart Flow Kit Niv Small "Verde"	70	12	109	11,0%	MIX	LDPE
Smart Flow Kit Niv Medium "Bianco"	70	12	110	10,9%	MIX	LDPE
Smart Flow Kit Niv Large "Blu"	70	12	111	10,8%	MIX	LDPE
Circuito Paz. T-piece C/valvola Peep	41	10	51	19,6%	PVC	LDPE
Tubo Doppio con trappole PNT	53	10	68	14,70%	ND	LDPE
Mascherina Facciale Size1	12	3	15	20%	PVC	LDPE
Mascherina Facciale Size2	16	3	19	15,78%	PVC	LDPE
Sync Flow Cannula - XXS	71	6	77	7,79%	PVC	LDPE
Sync Flow Cannula - XS	72	6	78	7,69%	PVC	LDPE
Sync Flow Cannula - S	73	6	79	7,59%	PVC	LDPE
Sync Flow Cannula - M	73	6	79	7,59%	PVC	LDPE
Filtro Aria Inc. Polytrend	19	11	41	26,82%	ND / TEX	LDPE

Product Name	Weight item	Weight pack	Weight	% pack per product	Material Item	Material pack
Flow Cannula - XXS	16	8	24	33,33%	PVC	LDPE
Flow Cannula - XS	16	8	24	33,33%	PVC	LDPE
Flow Cannula - S	16	8	24	33,33%	PVC	LDPE
Flow Cannula - M	17	8	25	32%	PVC	LDPE
Flow Cannula - L	17	8	25	32%	PVC	LDPE
Cover di Protezione Materassini	15	12	27	44.44%	PP	LDPE
Nasal Cannula Ø2-L8 Mm	2	2	4	50%	TPU	LDPE
Nasal Cannula Ø2-L10 Mm	2	2	4	50%	TPU	LDPE
Nasal Cannula Ø3-L12 Mm	3	2	5	40%	TPU	LDPE
Nasal Cannula Ø3-L14 Mm	4	2	6	33,33%	TPU	LDPE
Circ.Disp.Risc. 2 Vie + Camera Umid	343	53	381	13,91%	MIX	LDPE
Test Lung Ventilazione Non Invasiva	33	3	36	8,33%	VMQ	LDPE
Adattatori per circ. Wetty	7	1	8	12,50%	ND	LDPE
Filtro antibatterico per circuito paziente Giulia	22	3	25	12%	ND	LDPE

Tab. I
Multipolymers & PVC recycling difficulties, LDPE packaging for all the items and the percentage between packaging and overall pack weight showed critical issues such as products weighing just twice as much as the packaging containing them (Gabriele Maria Cito, 2022).

The manufacturing company can gain greater knowledge about disposable products by analyzing data on their material composition and assembly. By identifying the percentage of multi-material types and PVC items, specific actions can be taken to address these issues. This research can also lead to the formulation of mono-material products with less impactful polymers, both in their production and recycling. New prototypes of disposable products that reduce environmental impact through circular design have been developed based on field research. Communication with users through new manuals and labeling will inform them about the types of polymers used, increasing potential for proper recycling.

The following are the strategies that the company has begun to implement following the conducted analysis, with which it can redesign the life cycle of consumables and their environmental impact in the production process. In sustainable design, the choice of materials is crucial to reduce the environmental impact of products. In this context, we have analyzed the differences between two materials commonly used in neonatal nasal masks: TPU and PVC.

diid DSI No.1 — 2023
Doi: 10.30682/diiddsi23t1d

In the following table, we summarize the characteristics of these two materials, including the origin of raw materials, biodegradability, recyclability, and the environmental costs of production, recycling, and disposal. Tab. II

SYSTEMIC IMPACT ASSESSMENT

POSITIVE VALUE

NEGATIVE VALUE

CharacteristicsT	PU	PVC
Flexibility8	5S hore A7	0S hore A
Breakr esistance5	0M Pa	40 MPa
Compatibility with humanb odyA	pproved form edical useA	pproved form edical use
Biodegradability	Non-biodegradable	Non-biodegradable
Emissionso ft oxic substances	LowV OC emissions	High VOCe missions
Recyclability	Recyclable with lowc osts	Difficult to recycle
Origin of rawm aterials	Derived from petroleum products	Derived from petroleum products
Environmentalc osto fr aw material origin	High	High
Productionc ostM	edium-lowM	edium-high
Recyclingc ostL	ow	Medium-high
Disposal cost	LowM	edium-high
Availability of rawm aterials	Widea vailabilityL	imited availability
Environmentali mpactd uringp roductionL	ow	High
Environmentali mpactd uringd isposal	LowH	igh

Tab. II
Main differences between TPU and PVC materials used in the lifecycle process of neonatal nasal masks. (Gabriele Maria Cito, 2022).

The project resulting from the life cycle analysis carried out in the company in correlation with the company's operational needs was the design and prototyping of a nasal mask for the Oxygen Therapy procedure performed with equipment for neonatal ventilation. The following are the strategies and applications in the company's area for the specific case study:

Adoption of monomaterials
and less environmentally impacting materials

This approach is manifested in the design of a Nasal Mask that meets the need to be adaptable, through a modular joint, to various configurations of support for neonatal breathing. Regarding the material choice, the company directed itself towards producing the designed component in Silicone TPU instead of PVC, as it offers greater flexibility and softness compared to PVC, making it more comfortable to wear and reducing the risk of skin irritation. Additionally, Silicone TPU is less prone to cracking and breaking than PVC, which means it can last longer and require fewer replacements.

Design of devices with easy disassembly of components

Through a redesign of the Nasal Mask product, in relation to the disposable articles with which it is used in operational settings, the number of components necessary for mask adaptability has been reduced from n° 3 to 2. This simplifies the disposal process by making it easier to disassemble and not using multiple materials for the components for healthcare workers.

Use of circular design integrated into the product design phase

The mask design includes the adoption of a modular joint that allows the mask to be adapted to various configurations of support for neonatal breathing. This circular design approach creates a versatile product that can be used for different needs and in different contexts, reducing the need to produce and dispose of specific devices for each individual use. Additionally, the circular design of the mask reduces the number of components necessary for adaptability, simplifying the disposal process and reducing the use of multiple materials for the components.

Selection of products with potential for sustainable conversion

Considering disposal impacts, both PVC and Silicone TPU are materials that can be recycled, but with different difficulties and costs. PVC is known to be difficult to recycle and often requires the use of special disposal processes. Silicone TPU, on the other hand, is a relatively new material and is still developing efficient recycling techniques. However, Silicone TPU offers greater chemical resistance than PVC, which means it can be disposed of more safely without releasing toxic substances into the environment.

Adoption of new production processes and methods

In the previously mentioned project, alternative production methods to PVC for some disposable articles for neonatology allow for a reduction in production impacts because:

- Silicone TPU is less prone to thermal deformations than PVC, which means it can be processed at higher temperatures without damage.
- Silicone TPU is less likely to adhere to working surfaces than PVC, which means it can be processed with fewer release agents and solvents.

Labeling with instructions for correct disposal

The labeling of the mask includes information on the material used for production and instructions for the correct disposal of the product. In this way, healthcare workers can correctly dispose of the mask and reduce the negative environmental impact associated with

the production and disposal of disposable medical devices. Proper labeling can also help ensure that the mask's materials are correctly separated for recycling or appropriate disposal.

While sustainable production can be challenging due to increased costs and difficulty sourcing sustainable materials, companies can benefit from increased efficiency, better resource management, and improved customer loyalty. GINEVRI has implemented strategies such as using less impactful materials, designing disassemblable devices, and adopting circular design to reduce the environmental impact of its products and promote a circular economy. These practices could lead to increased efficiency and cost reduction while improving the company's reputation in sustainability.

Gabriele Maria Cito
Industrial PhD student, Department of Planning, Design, and Technology of Architecture, Sapienza University of Rome.

Angela Giambattista
Research Fellow, Department of Planning, Design, and Technology of Architecture, Sapienza University of Rome.

References

Benson N, et al. (2021). *COVID pollution: impact of COVID-19 pandemic on global plastic waste footprint.* Heliyon. 7(2):e06343.

Centre for Sustainable Healthcare. (2017). We Work in Healthcare – Of Course We Care about Carbon.

Cole, R. J. (2012). Transitioning from green to regenerative design. *Building Research & Information*, 40(1), 39–53.

Ellen MacArthur Foundation. (2015). Schools of thought – industrial ecology.

European Commission. (2015). Circular economy package: Questions & answers: MEMO/15/6204.

Freire, K. & Sangiorgi, D. (2010). Service Design & healthcare innovation: from consumption to co-production and co-creation. *Nordic Service Design Conference.*

Foschi, E. & Bonoli, A. (2019). The Commitment of Packaging Industry in the Framework of the European Strategy for Plastics in a Circular Economy. *Administrative Sciences*, 9(1), 18.

Geisendorf, S. & Pietrulla, F. (2017). The circular economy and circular economic concepts-a literature analy-sis and redefinition. *Thunderbird International Business Review*, 60(5), 771–782.

Landrigan, P., et al. (2017). The Lancet Commission on pollution and health. *Lancet*. 391(10119):462-512.

Manzi, S., et al. (2014). A non-participant observational study of health and social care waste disposal behaviour in the South West of England. *J Health Serv Res Policy.* 19, (4) 231-235.

McDonough, W., & Braungart, M. (2002). Cradle to cradle: remaking the way we make things. *North Point Press*.

Newman, C., (2011). *How to reduce medicines waste*. Clinical Pharmacist.

Nichols, A., (2014). The impact of the clinical environment on family centred care in the neonatal unit: A qualitative investigation. *J Neonatal Nurse.* 20, (5) 230–235.

Nichols, A., et al. (2016). Achieving cost and carbon savings in neonatal practice: A review of the literature on sustainable waste management. *Journal of Neonatal Nursing*. 22(2), 81–87. https://doi.org/10.1016/j.jnn.2016.01.002

Silva, A. L., et al. (2020). Rethinking and optimising plastic waste management under COVID-19 pandemic: Policy solutions based on redesign and reduction of single-use plastics and personal protective equipment. *Science of The Total Environment*. 742, 140565.

Royal College of Nursing. (2011). Freedom of Information report on waste management. *Royal College of Nursing.*

Thornton, J., et al. (1996) Hospitals and plastics. Dioxin prevention and medical waste in-cinerators. *Public Health Rep.* 111(4):298-313.

Verma, V., et al. (2019) Minimizing Waste in Neonatal Intensive Care Units by Effective bedside Supply Management: Application of Lean Six Sigma in Neonatal Intensive Care Unit. *Neonat Pediatr Med 5*: 175.

World Health Organization. (2019). Global Spending on Health: A World in Transition.

diid DSI No.1 — 2023
Doi: 10.30682/diiddsi23t1d

DIGITAL SPECIAL ISSUE 1

The 8th International Forum of Design as a Process, themed "Disrupting Geographies in the Design World" was held in Bologna from 20 to 22 June 2022. The event was organised by the Advanced Design Unit of the Alma Mater Studiorum – Università di Bologna, Department of Architecture, in collaboration with two partner universities: Tecnológico de Monterrey (TEC) and Pontificia Universidad Católica de Chile.

The Forum engaged speakers from the Global Design community, expanding the original vocation of the Latin Network for the Development of Design as a Process to include researchers and designers of the Mediterranean Area, Middle East, IOR (Indian Ocean Region), and Global South regions. The goal was to share new perspectives on imagining design futures in a responsible and just perspective, at the forefront of change, while building strategic partnerships and creating accessible knowledge.

Structured around three pillars — seminars, workshops, and exhibitions — the Forum hosted meetings, reflection opportunities, networking activities. It involved designers, scholars, young researchers, design entrepreneurs, in an experimental format.

Speakers' contributions not only inspired the practices of the designers' community, but also resonated with students and the broad audiences. The presentations explored intersections of materiality and culture, post-coloniality, decoloniality, gender studies, and other areas of human thought and action which seek to analyse, question and challenge the disruptive geographies in the world, today.

The papers submitted to the five tracks proposed are published in the Digital Special Issue 1 of *diid. disegno industriale – industrial design*, celebrating during those days its 20th anniversary and serving as the fourth partner of the event.

The Editors
Erik Ciravegna, Elena Formia, Valentina Gianfrate, Andreas Sicklinger, Michele Zannoni

DSI No. 1 — 2023
Year XXI
ISSN 1594-8528
ISSN Online 2785-2245
ISBN Online 979-12-5477-329-1

Bologna University Press