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Research article

Packaging for the Medical Sector: A Systemic Design Perspective

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Abstract

Packaging for medical products demands careful consideration due to the numerous implications and interactions that occur throughout its lifecycle. It must ensure product protection and integrity, enhance safety and usability, and comply with regulatory and environmental requirements. In managing this complexity, Systemic Design offers a valuable framework for research and development. However, its application remains limited among designers and decision-makers in the medical sector. This study investigates the potential impact of integrating Systemic Design principles into medical packaging at the university training level. Specifically, it aims (i) to explore the relevance and benefits of adopting the systemic approach in this field, and (ii) to assess the knowledge, misconceptions, and systemic approach adoption of postgraduate design students. To achieve this, a dedicated workshop was conducted in which participants were asked to analyze and map systems around specific medical packaging case studies. Initial observations indicated that participants struggled to recognize the complexity involved in redesigning medical packaging, and often lacked comprehensive evaluation criteria despite their background in design. The workshop activities revealed a limited understanding of stakeholder networks and lifecycle phenomena, highlighting the need for a broader, systems-oriented perspective in the field.

Results show that Systemic Design approaches are not yet widely understood when applied in Packaging Design, so the introduction of dedicated tools and methods in educational settings can significantly enhance students' ability to approach complex systems. Finally, a follow-up study could be conducted to determine whether the participants will internalize and adopt systemic approaches in their future design practice

Keywords: Systemic Design; Industrial Design; Product Design; Design Education

Introduction

Medical Packaging has become an extremely relevant area within the sector of healthcare administration, since it serves a variety of functions like ensuring safety, efficacy, and compliance of medical products and supplies. This type of packaging should prevent degradation and safeguard the integrity of products that mostly require high sterility and optimal functional standards (Starr, 1986), contribute to the adequate conservation, and keep a medical product's planned properties throughout its life cycle. To address this inherent complexity, a systemic approach should be adopted, since many existing solutions in this field seem to fail to balance the needs of all stakeholders involved, particularly when facing the current environmental challenges.

Designers, often recognized as horizontal professionals, contribute to a systemic approach to Packaging research and development. However, challenges related to satisfying all stakeholders and balancing environmental considerations within the field of Medical Packaging persist, revealing areas of improvement when adopting a systemic approach when operating in this specialized sector.

This phenomenon was also observed in a set of medical packaging case studies, collected by postgraduate students, in which they seemed to have difficulties in introducing evaluation criteria or setting parameters related to analyzing them with a systemic perspective. This scenario might suggest that the systemic design approach may be underemphasized at the undergraduate level in design education

In order to better understand the gaps that foster those issues, this study aims (i) to explore the relevance and benefits of adopting the systemic approach in this field, and (ii) to assess the knowledge, misconceptions, and systemic approach adoption of postgraduate design students.

For the didactic purpose of a Product & Service Design international Master's, course in a second year design studio on the topic of Packaging Design for the Medical Sector, three main sectors of packaging were identified for their functions and peculiarities: packaging for sampling and transportation of biological materials, packaging for disposable medical tools and supplies, and packaging for pharmaceutical products. These mentioned fields share many similarities in the stages of their life cycle as well as in the manufacturin processes, exposing their main differences in the final use and disposal stages according to the degree of specialization of the product they contain. The literature considered for this paper will focus primarily on pharmaceutical packaging, since it is the field that offers a more comprehensive body of research from the design perspective.

Theoretical Background

In recent years, User-Centred Design (UCD) has become a dominant framework within the design field. While this approach has contributed to more accessible and user-friendly products, it has also reinforced development models more focused on economic growth, sometimes at the expense of environmental sustainability. Although minimal and resource-conscious strategies in many design domains offer a viable path toward greater environmental and social responsibility, in highly-regulated sectors, such approaches are much more constrained. Indeed, Medical Packaging is subject to rigorous standards, regulations, and performance requirements that prioritize safety, sterility, and efficacy, obliging designers to make compromises. Given the essential role these systems play in human well-being, the main challenges lie in maximizing functionality and usability, rethinking logistics and supply chains, maintaining the high standards and compliance imposed by the field, while minimizing environmental impact.

The sector of medical packaging should not only be aligned with compliance and users' needs, even among newer patient-centric trends in the healthcare sector. It should also be suitable for the current

productive, distribution, and quality control processes, since increased manufacturing and commercialization costs could result in a higher economic burden for public or private systems, and therefore have an impact on the health access for the population.

The Pharmaceutical Packaging Sector

Within the domain of Medical Packaging, the Pharmaceutical Packaging is particularly relevant since it favours the maintenance of drugs in right conditions and allows them to be administered in the intended ways (Lorenzini & Olsson, 2018); it accompanies them throughout their life cycle and the numerous interactions that take place in it and therefore, requires careful consideration (Lorenzini & Hellström, 2016). Generally, the packaging of medications is reported to be focused on well-structured processes and standardized packages with few opportunities for innovation, along with a lack of a user-centered design focus (Lorenzini & Olsson, 2018). Traditionally, it prioritizes protection over user-friendliness (Lorenzini et al., 2022).

This indicates the tendency of decision-makers to prioritize aspects such as normative compliance and product protection over the user experience or the treatment adherence, even if approaching the balance between packaging functionality and its user experience with a systemic approach is crucial for reducing medication errors across diverse healthcare environments, particularly in high-stress situations (Estock et al., 2018).

Pharmaceutical packaging is an essential but often overlooked component of the healthcare system (Salmenperä et al., 2022). Although the public and even healthcare professionals rarely recognize its importance, packaging is fundamental for ensuring that products are delivered safely, effectively, and efficiently. Without appropriate packaging, the distribution and administration of life-saving drugs, vaccines, and medical devices would be impossible.

Packaging is becoming a sophisticated field where science, engineering, design, and marketing converge, more so in recent years, where user experience has gained prominence. During this time, the Pharmaceutical Packaging Sector has encountered a growing number of complex challenges, including regulatory compliance, waste reduction, counterfeit prevention, and issues around sustainability. Its role is complicated by economic and productive demands, medical technologies, increasingly personalized therapies, and diverse global distribution systems; the field is only becoming more intricate with time, with new technological and socioeconomic variables (Hertig et al., 2019). This increase in complexity requires a systemic design approach to manage interconnected factors.

Given this scenario and the growing awareness of the importance of psychosocial conditions and human factors (physical and cognitive), designers need to meet not only functional and regulatory demands but also societal expectations and ethical responsibility. The dynamic nature of scientific advancements related to the holistic definition of health — and its direct impact on patient outcomes — requires continuous innovation, interdisciplinary collaboration, and heightened attention to the new project requirements. Keeping up with its evolution, also from the educational front of design, it is necessary to continue adding value in the industry to support patient care.

Systemic Design

According to the Design Council, Systemic Design can be defined as “the acknowledgement of complexity and interconnectedness throughout the design thinking and doing process, considered as a mindset and a methodology” (Design Council, 2021). It serves as a strategic approach to tackle emerging challenges faced by designers in understanding the complexity, offering possible solutions to interconnected problems (Smith & Kalantidou, 2023). Its value lies in its

capacity to shift perspectives, allowing designers to tackle complex challenges more broadly, detecting new opportunities for intervention. It has emerged as an approach that many authors consider useful to describe systems by integrating knowledge from different disciplines.

In present times of interconnectedness between disciplines, its purpose remains not merely as a hybrid field born from design, but as an evolving framework to attend complex, real-world challenges (Systemic Design Association). Its adoption is particularly relevant considering the stakeholders in the system, including doctors, pharmacists, nursing staff, the drug industry, and patients. Design interventions should aim to incorporate prescriptive aspects into the drug's form, packaging, and information system, extending from the prescription to the package leaflet. (Salmenperä et al., 2022).

Designers who choose to adopt this framework are invited to engage with it at three "levels of awareness": method, methodology, and mindset. These layers represent, respectively, the tactical tools, the strategic approach, and the cognitive stance necessary for systemic inquiry (Systemic Design Association), but they should continue to be flexible enough to explore and reframe problems, to evaluate and refine proposals from different perspectives.

Despite the mentioned potential, there remains a gap between the academic concept of Systemic Design and its industrial applications, particularly in highly specialized fields such as the medical one. This disparity represents a missed opportunity for the medical sector, where the human experience and the economic factor are as important as the technological development and its environmental impact.

Methodology

In order to assess the participants' prior knowledge on the matter and to understand the utility of the proposed tools, a four hour workshop was conducted considering the three mentioned fields of packaging for the medical sector, chosen for each one of the groups according to the ones that students themselves had proposed as case studies during previous sessions of the course.

Sample

The workshop involved 50 international post-graduate students from a Product & Service Design international Master's course on the topic of Packaging Design for the Medical Sector. Participants were divided into pairs and assigned a specific case study of the following domains: packaging for sampling and transportation of biological materials (8 groups), packaging for disposable medical tools and supplies (9 groups), and packaging for pharmaceutical products (8 groups).

Tools adopted

Three tools have been employed to conduct the activities of the workshop and gather insights:

Questionnaires: They allowed a comparative analysis on the participants' understanding and perception of Systemic Design between the Pre-Workshop and Post-Workshop phases, with a focus on common patterns and misconceptions.

System-Building Tool: Accompanied by the Case Study Profile, an A4 sheet describing the specific case study, it served the participants as a tool for defining the system around the packaging in its phases and other entities. Its usage allowed a qualitative analysis of the main difficulties in specific areas and topics of the system mapping exercise.

Fill-In-The-Blanks Form: a text with fillable spaces presented to explore the participants' understanding of system dynamics and highlights from the activity of mapping their case studies' systems through a text with fillable spaces.

These tools have been used to gather insights at different levels: the System-Building Tool and the Fill-In-The-Blanks Form were useful to get qualitative insights

on the current knowledge and perspectives of the participants regarding the systemic approach around Medical Packaging on the other hand, the questionnaires allowed the collection of feedback on the understanding and comprehension of Systemic Design in this specific field, allowing a comparison between their previous knowledge and the acquired one thanks to the activities of this study that saw the participants involved.

System-Building Tool

The System-Building Tool (Fig. 1 and 2) had the purpose of guiding the system-building process, highlighting main concepts that should have been considered while conceptualizing the system around a certain solution in the field by filling a matrix that connected the stakeholders and their interactions with the life cycle of the packaging. For building this matrix, the authors took as a base the Design Council's Stakeholders Ecosystem, presented in their Systemic Design Toolkit, combining it with the main stages of the life cycle of products, from the development to the end-of-life phases (Llorach-Massana et al., 2015).

These two models were chosen as they represent valuable inputs to create the custom tool for the workshop, since they might help designers to visually construct systems around any kind of project, considering environmental and socio-economic issues while identifying critical points and opportunities for improvement.

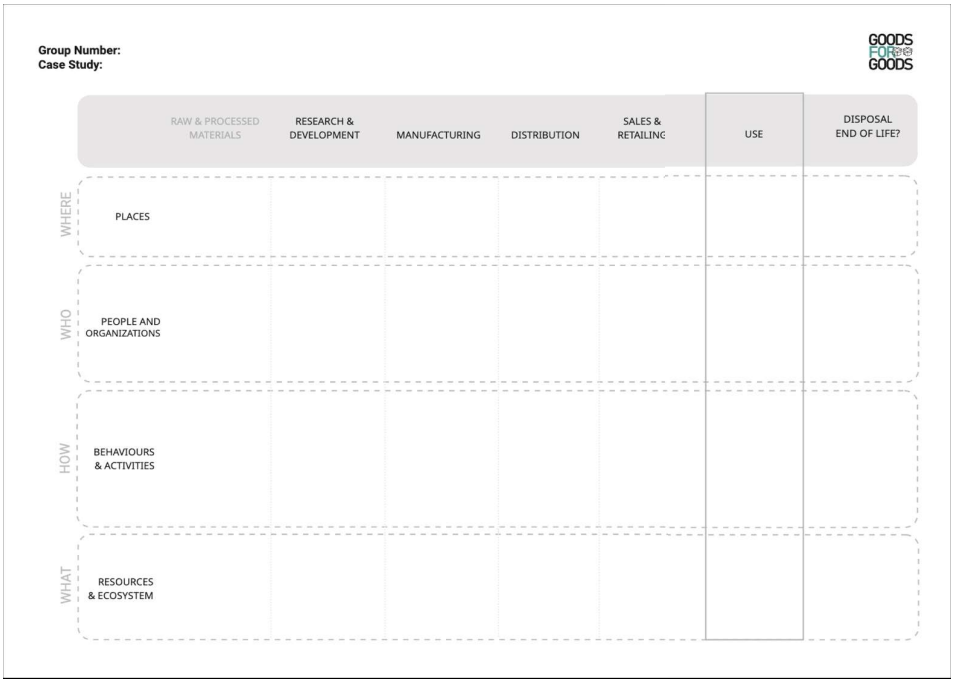


Figure 1. Fillable System-Building Tool, presented in an A3 format.

Questionnaires

To assess participants' knowledge and understanding of Systemic Design, two questionnaires were conducted: the Pre-Workshop Questionnaire and the Post-Workshop Questionnaire.

These questionnaires facilitated a comparative analysis of participants' understanding and perception of Systemic Design, enabling the identification of common patterns, misconceptions, and the extent of conceptual change between the pre-workshop and the post-workshop phase.

The answers to the questions in the questionnaires have been evaluated according to the following criteria:

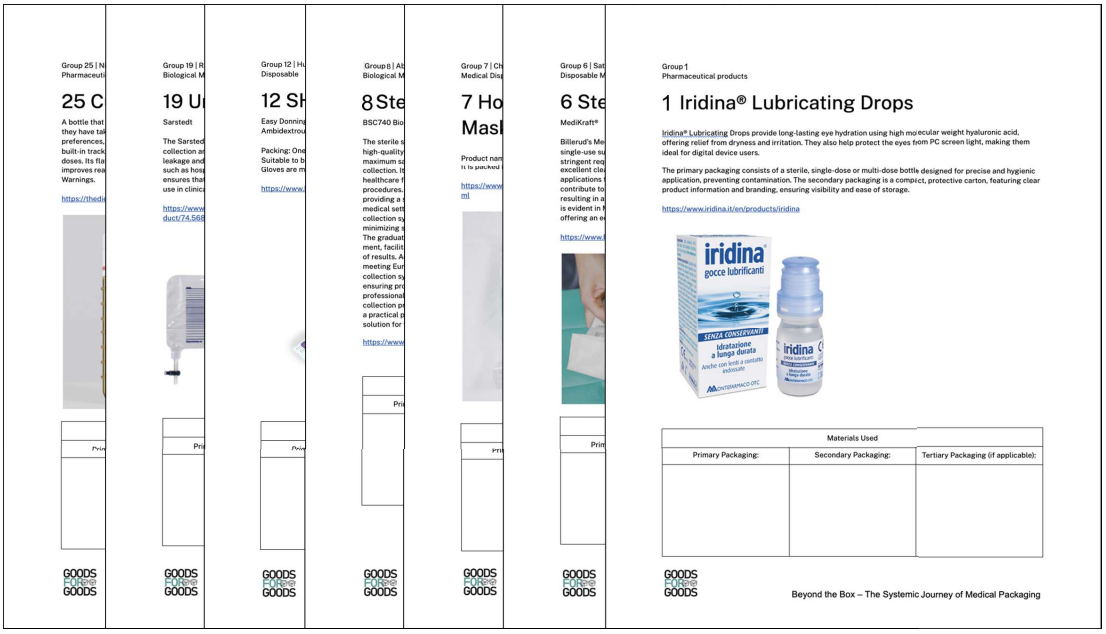


Figure 2. Case Study Profile examples, assigned to students after the introduction.

Accurate (correct or almost correct): If the response correctly describes systemic design as a holistic approach that involves systems thinking. It recognizes the importance of complexity, relationships, user interactions, sustainability, life cycles, and broader system dynamics.

Partially Correct (close, but some confusion): If the response shows good understanding of the main concepts but is either incomplete or overly focused on just one element, without fully capturing the holistic nature of systemic design.

Confused (confusing Systemic with other concepts): If the response is not entirely wrong, but the emphasis is misplaced. It might confuse systemic design with related concepts, such as sustainability, without addressing the full systems perspective.

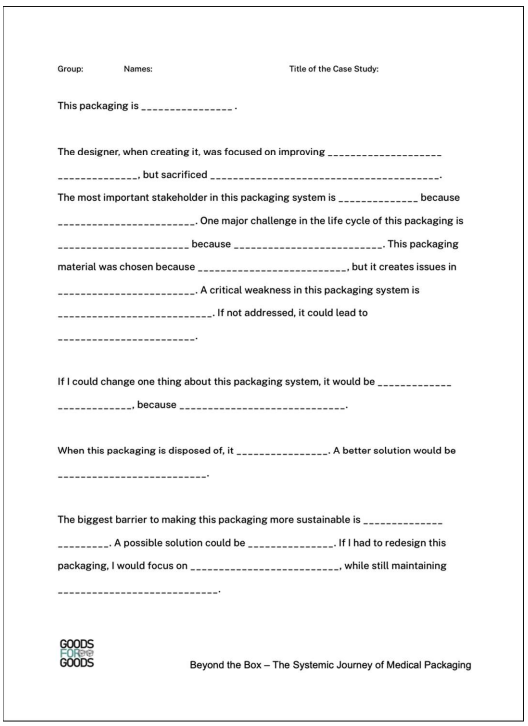
Incorrect, Incomplete, or out of scope: If the response does not describe systemic design, is too vague, or fundamentally misunderstands the concept.

Other (self-reported uncertainty and invalid answers): If the respondent admits to not knowing, expresses uncertainty, or leaves the answer blank. The questionnaires were presented to the participants digitally, through the Google Forms platform.

FIll-In-The-Blanks Form

The Form shown in Fig. 3 was developed as a complementary tool, specifically designed to facilitate the students' reflection on their work, carried out during the workshop. The form was structured to guide participants through a series of unfinished statements to help them articulate their understanding of systemic design principles and organize their takeaways. This tool aimed to encourage a critical and systemic analysis, nudging a deeper engagement with key concepts from the workshop.

In addition, the form served as a valuable instrument for assessing students' knowledge and conclusions following the workshop. It was provided on an A4 format paper sheet.


Group: Names: Title of the Case Study:

This packaging is _____ .

The designer, when creating it, was focused on improving _____ _____, but sacrificed _____.

The most important stakeholder in this packaging system is _____ because _____. One major challenge in the life cycle of this packaging is _____ because _____. This packaging material was chosen because _____, but it creates issues in _____. A critical weakness in this packaging system is _____. If not addressed, it could lead to _____.

If I could change one thing about this packaging system, it would be _____ _____, because _____.

When this packaging is disposed of, it _____. A better solution would be _____.

The biggest barrier to making this packaging more sustainable is _____ _____. A possible solution could be _____. If I had to redesign this packaging, I would focus on _____, while still maintaining _____.

Beyond the Box – The Systemic Journey of Medical Packaging

Figure 3. Fill-In-The-Blanks Form

Workshop articulation

The workshop presented in this study required each group to outline the life cycle of an assigned case study of medical packaging in the aforementioned fields with a systemic approach, identifying and describing in a schematic way the involvement of stakeholders, places, activities, and resources along the process. Based on the completion of this task, insights have been gathered on the approaches and comprehension of systemic design-related concepts and practices by this target. Before the beginning of the workshop, the participants were told that these activities, along with their outcomes, did not impact the final evaluation of the course.

The workshop began with an assessment of the participants' prior knowledge of Systemic Design through a five-question initial questionnaire, built using Google Forms. The questions aimed to gather the following information: the participants' specific bachelor's area, their prior knowledge about the concept of systems and Systemic Design, and the features they valued as most relevant to evaluate the quality of a medical packaging solution.

Then, the participants have been provided with the rudiments of Systemic Design through a dedicated lesson, to make sure that all of them possessed the fundamental notions required to take part in this workshop. The topics covered in this briefing comprised an overview of Systemic Design, taking as a reference the educational resources made available by The Design Council, and the general definition of the key concepts in the System-Building Tool.

In the hour that followed, the groups explored their case study through the Case Study Profile and filled in the System-Building Tool to outline the entities that characterize the system of the packaging they have been assigned, i.e. stakeholders, places, activities, and resources, throughout the entire packaging life cycle. The participants were then provided with the Fill-In-The-Blanks Form, which functioned as a supportive tool to summarize the main takeaways and other key information on the case studies and their systems. This phase was followed by the recollection of the material. Right after, the participants were asked to fill in a second questionnaire, built using Google Forms, the aim of which was to explore the shifts in perspective after the previous phases. To do so, some of the initial questions were presented again, e.g. the one regarding what a system means and how they would describe Systemic Design, to allow a comparison with the answers of the previous questionnaire. The completion of this phase marked the end of the workshop. After the workshop, the authors of this study analyzed the material to uncover common patterns and unique characteristics in the participants' approaches and biases on Systemic Design in the field of Medical Packaging

In addition, the form served as a valuable instrument for assessing students' knowledge and conclusions following the workshop. It was provided on an A4 format paper sheet.

Results

Insights from the System-Building Tool and the Fill-In-The-Blanks Form

In this section, a comprehensive analysis of the main patterns, misconceptions, and critical insights that emerged from the use of the System-Building Tools and the Fill-In-The-Blanks Form is presented.

The analysis of the participants' work highlighted several recurring patterns and critical gaps in their understanding of the systemic approach around Medical Packaging Design. The first aspect worth discussing concerns the raw materials and end-of-life being the most problematic phases of the life cycle to address, i.e. the initial and the final phases of the life cycle. For instance, many considered the final user "throwing the packaging in the bin" as the end of the life cycle, ignoring crucial steps connected to the packaging disposal. Additional overlookings of necessary

resources and activities have also been frequent in other steps, such as distribution and retail, often leading to incomplete life cycle mapping.Moreover, the packaging journey was often linearly and sequentially mapped, instead of posing the attention on systemic or circular interactions. Moreover, the work of many participants often lacked internal coherence: within a given phase, they introduced elements (e.g., the pharmacist in the "Who" section) without mentioning connected instances (e.g., the pharmacy in the "Where" section). Their understanding of stakeholders was also limited: although patients and manufacturers were properly mentioned across all groups, other key actors such as regulators, healthcare institutions, and waste managers were not mentioned. Connected to this, it is worth mentioning that many groups tended to refer to stakeholders as organizations and groups of people, rather than individuals. When the participants were asked to provide suggestions for improvement of their case study packaging, the participants mostly prioritized material features to improve sustainability, mentioning solutions like adopting recyclable, biodegradable, or mono-material options (even if some of them had slight confusion between recyclable and recycled materials). However, these proposals largely focused on material improvements, ignoring major factors like increased emissions, resource use, or non-compliance with regulatory means. Indeed, only a few participants demonstrated awareness regarding medical packaging design choices being dependent on stringent pharmaceutical regulations (e.g., sterility, contamination prevention, and quality standards). Other valid strategies throughout the life cycle, such as reducing packaging dimensions, reuse possibilities, system redesigns, user behaviors, or policy interventions (such as take-back programs), were rarely proposed. Although challenges connected to the disposal of packaging (dispersion in landfills, incineration, and non-recyclability) were mentioned, only a few groups considered how other systemic factors (like user behavior, infrastructure, and regulation) can also impact the environmental dimension after disposal.

Insights from the Questionnaires

The following section summarizes the insights gathered from the questionnaires before and after the workshop, which focused on investigating the participants' knowledge shift regarding the systemic approach.

Table 1. Pre-Workshop questionnaire results (50 answers)

CATEGORY	TYPE OF ANSWERS	EXAMPLES	NUMBER OF ANSWERS
Accurate	Holistic, complex systems, connections, users, environment	"Combines systems thinking and design"	11
Partially Correct	Good ideas, but incomplete/specific focus	"Comprehensive design process"	14
Confused	Misplaced focus	"Better service feeling for customers"	10
Incorrect, Incomplete, or out of scope	Wrong ideas, misunderstandings	"Design with some rules"	13
Other (self-reported uncertainty and invalid answers)	Admitted uncertainty	"Turns out I didn't know"	2

Table 2. Post-Workshop questionnaire results (50 answers)

CATEGORY	TYPE OF ANSWERS	EXAMPLES	NUMBER OF ANSWERS
Accurate	Holistic, complex systems, connections, users, environment	"A broader approach to product design, including its entire life cycle for example."	20
Partially Correct	Good ideas, but incomplete/specific focus	"It means system thinking and design methodology together focused on human-center solutions."	15
Confused	Misplaced focus	"Organizing all components and processing to achieve the final goal"	5
Incorrect, Incomplete, or out of scope	Wrong ideas, misunderstandings	"Design from 0 to 100"	7
Other (self-reported uncertainty and invalid answers)	Admitted uncertainty	"Still don't know"	3

In the pre-workshop phase, many participants demonstrated limited or unclear understanding of Systemic Design. Based on inferred responses, common misconceptions and design assumptions arose. Participants predominantly approached design from a linear perspective, often conceptualizing it in terms of "product–user" without acknowledging the broader system involved. The focus was primarily on functionality and aesthetics, with little consideration for the life cycle of products or the interconnectedness of design elements across various stages. Additionally, many participants confused "systemic" with "systematic", using that word to refer to step-by-step processes rather than a holistic and interconnected approach. There was also a limited recognition of stakeholder mapping or life cycle thinking, which are core principles of Systemic Design.

The Post-Workshop Questionnaire revealed a notable shift in participants' understanding of Systemic Design. The majority of the responses now referenced concepts such as networks, life cycle, stakeholders, and connections. This shift in vocabulary signified a higher awareness that Systemic Design is not merely about the object or product, but rather about the broader context and relationships in which that object exists. One participant described it as "a way of thinking in a holistic approach for optimizing processes and services from their beginning to the end of the life cycle", while another noted it as a "design that considers the broader context, relationships, and long-term effects".

This notable shift can be noticed in Fig. 4. The participants' responses indicate a deeper understanding of the importance of life cycle thinking, interconnectedness, and environmental and stakeholder-related factors in the design process. However, despite these improvements, there were still instances of uncertainty, with few participants answering "Still don't know" or offering vague descriptions such as "assemble" or "design with rules". These patterns suggest that while awareness has increased, full internalization of systemic thinking requires more effort.

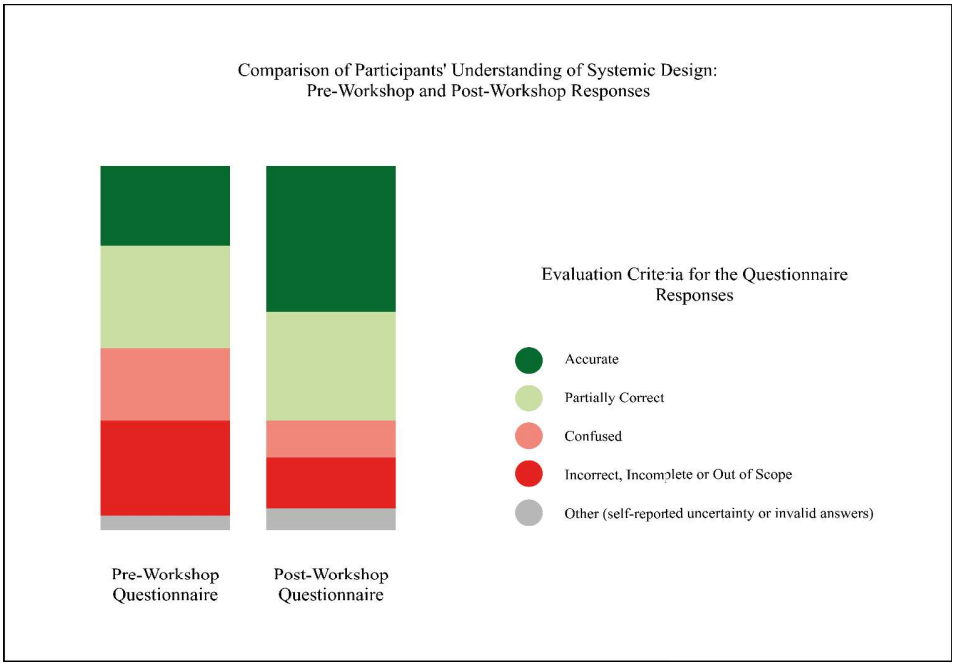


Figure 4. These bar charts illustrate the evaluation of responses to the questionnaires. A noticeable positive shift in participants' understanding of Systemic Design is evident between the Pre-Workshop and Post-Workshop Questionnaire results

A major difficulty that emerged in this study is that participants lacked knowledge on specific topics that are usually not addressed in design courses, still relevant to the adoption of systemic thinking for Pharmaceutical Packaging. For instance, many participants neglected the issue of energy and resources connected to the phases of transportation and disposal. Dominici (2017) highlights that the most important aims of a systemic paradigm are the education of ecoliterate people and the awareness development, which is focused on the network between systems and subsystems. In this regard, multiple strategies, such as project-based learning and holistic analysis and evaluation, could be adopted to overcome this challenge in design education. In particular, Peer-to-Peer learning was reported as a valid method to achieve this objective, which is the case of the workshop carried out in this study. A more profound comprehension of systemic design could ultimately bring future benefits in industrial settings, once students integrate this knowledge into their professional practice.

Observation of Systemic Analysis on Pharmaceutical Packaging Projects

Systemic analysis provided participants with a more holistic framework for reimagining medical packaging design, not simply as a physical product, but as an active component that interacts with and influences the surrounding ecosystem. In this project, for example, the team considered multiple interconnected factors, including manufacturing processes, logistics, environmental sustainability, and patient usability. Through this lens, the designers identified several inefficiencies in both the primary and secondary packaging, particularly concerning the accurate dispensing of doses for children and the environmental risks posed by the disposal of unused antibiotics.

The project was developed within the context of the aforementioned Master's course and promoted in collaboration with a local pharmaceutical packaging manufacturer. The example focused on amoxicillin, a commonly prescribed antibiotic for children, typically available in powder form in a bottle (Figure 5) that

must be turned into a liquid solution before use. Preparing the solution requires adding a precise amount of clean water to the powder to create a liquid suspension, which must be shaken thoroughly before each dose is administered.

Figure 5. The typical amoxicillin packaging that this project aims to innovate.

Figure 6. The prototype developed by participants after implementing a Systemic Design approach.

During their investigation, the participants identified a critical issue in the usage stage related to dosing precision. While this was a primary concern, through systemic analysis the designers could unveil additional issues that needed to be tackled. One major issue concerned the standard practice of preparing the full suspension at once, which must then be consumed within 14 days. Often, the prescribed volume exceeds what is actually needed, leading to significant waste as unused portions expire.

Dosing errors were another common problem, as caregivers frequently used spoons rather than calibrated tools like syringes or dosing cups, resulting in inaccurate administration. Another important aspect regards the fact that shaking the bottle before each use is often an overlooked action, useful to provide consistent dosing uniformity. Storage also presents challenges, as the need to preserve the solution in a refrigerated environment is sometimes overlooked, especially when instructions are unclear or refrigeration is unavailable. Finally, Contamination constitutes an additional risk if the bottle or dosing instruments are not kept clean. If the medication is not consumed within the specified period, it may degrade, and improper disposal of unused antibiotics poses an environmental hazard.

To address all these challenges, the team proposed a solution involving single-dose

powder sachets (Figure 6), designed to be mixed with water at home just before use. This approach could improve accuracy in pediatric dosing and maintain the stability of the medication, as the components would not degrade over time. Additionally, the design would allow for more compact secondary packaging and more precise distribution, reducing waste and environmental impact while utilizing similar material resources. Unveiling and tackling many of the described issues could be possible mostly because the systemic approach was adopted along the phases of the project.

Conclusions

As the healthcare sector continues to evolve through new social dynamics, emerging technologies, and shifting methodologies, designers must be equipped to respond to complex and rapidly changing challenges with a systemic approach to problem-solving. This evolving landscape requires expanding the focus beyond users to include multiple perspectives, accounting not only for human and societal needs, but also for non-human and non-present stakeholders, such as the environment and future generations. The Systemic Design approach for Medical Packaging helps to embrace a more inclusive mindset that acknowledges interdependencies, ethical responsibilities, and the broader impact of design decisions across time and different stakeholders and contexts. A lack of attention from companies and decision-makers could have repercussions for the sustainability of the entire health sector. professional development of students, and thus on the future of the industry. As well as, the approach of educators in the packaging sector only focused on product innovation could have repercussions for the professional opportunities of young designers.

Many gaps and misconceptions were observed during the workshop activities presented in this study, and a meaningful shift in perspective emerged after the use of the tested tools. Participants increasingly internalized concepts such as networks, life cycle stages, connections, and stakeholder relationships. These changes in vocabulary and framing capability suggest an increased adoption of systemic thinking. Participants' responses indicate a growing awareness that Systemic Design is not limited to the service level but must account for its embeddedness in complex, multi-actor systems. Subsequent feedback suggested that while awareness has increased, full internalization of systemic thinking still requires a deeper study of the Medical Packaging Sector according to the approach of Systemic Design.

Future research could contribute to a more comprehensive understanding of how systemic thinking is adopted and applied within the Medical Packaging Sector. To deepen this perspective, similar studies could involve a broader range of stakeholders, including pharmacists, regulators, experienced designers, healthcare professionals, and waste management experts, whose insights are essential for acquiring a more complete and integrated view of the system as a whole. Additionally, a follow-up study could be conducted to assess whether the participants of this workshop eventually internalize and implement systemic approaches in their future design practice.

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