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A Chance for Exploration in Oncological Treatment Rooms

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Citation (APA)
Sanz Segura, R., Romero-Piqueras, C., Manchado-Pérez, E., & Ozcan , E. (2019). Service Design and Sound: A Chance for Exploration in Oncological Treatment Rooms. In F. Cavas-Martínez, B. Eynard, F. J. Fernández Cañavate, D. G. Fernández-Pacheco, P. Morer, & V. Nigrelli (Eds.), *Advances on Mechanics, Design Engineering and Manufacturing II: Proceedings of the International Joint Conference on Mechanics, Design Engineering & Advanced Manufacturing (JCM 2018)* (pp. 639-648). (Lecture Notes in Mechanical Engineering). Springer. https://doi.org/10.1007/978-3-030-12346-8_62

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Service Design and Sound: A Chance for Exploration in Oncological Treatment Rooms

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Abstract. The value of sound design is increasing in the field of product development, and even more so in critical contexts such as healthcare. A well-designed sound can have an impact over job satisfaction, efficiency in work environment, user experience and well-being of healthcare staff and users as a whole. On the other hand, service design is a particular domain within design engineering focused on how the relationship between service providers and users can be improved. An emerging community highlights the utility of the tools and techniques to effectively include system stakeholders in the design and implementation of health technology and healthcare service design. Service design has been applied successfully in several projects to improve patient experience as well as in other areas of public sector. This paper states the potential contribution of service design to sound design, as another method-ological approach in order to improve audible alarm design for product development in healthcare environment. Likewise, the paper offers designers and engineers possibilities to implement together both the tools and methods of service design and product sound design deriving from the review of existing literature and empirical conclusions compiled from observation and analysis of oncological treatment rooms at different hospitals.

Keywords: Sound design · Service design · Design methods · Healthcare · Alarm fatigue

1 Introduction

The value of sound design is increasing in the field of product development, and even more so in sensitive sectors such as healthcare. A well-designed sound can have an impact over job satisfaction, efficiency in work environment, user experience and well-being of healthcare staff and users as a whole. From the perspective of nurses, inadequate audible alarms interfere with communication, create distractions, and affect cognitive ability and ease of concentration, which all together increase stress and

fatigue and therefore an overload in mental activities linked to their workflow. From the point of view of patients and their relatives, alarms have an adverse effect on comfort and recovery, interrupt sleep and disturbs daily routines, and reduce the overall perceived satisfaction of the patient, especially in critical care [1].

The need to adjust sound levels, reduce noise and environmental stress associated with it, is a recurrent aspect in the literature, and multiple authors and organizations have shown the need to reduce noise level and alarm fatigue [2–4] from the exorbitant number of false or non-actionable alarms, unnecessary, not standardized or without an efficient hierarchy [5]. However, there are studies that highlight the potential of sound as an essential element in transferring information from the product to the user, which on the other hand, significantly affects the experience that one offers to the other. This refers to the use of sound as an essential parameter to be taken into account throughout the design process. This way, through the characterization of a certain sound, the listener (nurse, patient or family members) can perceive in great complexity and full of nuances, the message conveyed through sound fulfilling the requirement of clinical critical contexts.

Therefore, the optimization of sounds allocation in the design of a digital interface offers enormous potential, especially in the case of interaction with complex products, such as clinical equipment or critical care settings. Thus, existing studies in the literature serve as a reference for the implementation of these approaches, however, they have their complications when applied to practice that concerns us, due to their own idiosyncrasies, requirements and limitations.

This paper states the potential contribution of service design to product sound design, as another methodological approach in order to improve audible alarms and alerts design in healthcare environment. The paper offers designers and engineers possibilities to implement together both the tools and methods of service design and product sound design deriving from the review of existing literature and empirical conclusions compiled from observation and analysis of oncological treatment rooms at different hospitals.

Service design is a specific domain within design engineering focused on how the relationship between service providers and users can be improved [6]. An emerging community highlights the utility of the tools and techniques to effectively include system stakeholders in the design and implementation of health technology and healthcare service design [7]. Service design has been applied successfully in several projects to improve patient experience [8, 9] as well as in other areas of public sector [10, 11]. Following the experience demonstrated in previous studies with service design techniques based on the in situ observation of the work environment and visualization methods and focus group interviews, a proposal for a first phase of study is stated.

2 Service Design and Patient Experience in Healthcare

In the field of research in design, there is an ever wider field for the application of working methods and capabilities of design professionals in non-industrial contexts, and which have not traditionally been addressed from a design perspective. Similarly,

the knowledge and good practices from the fields of Design Thinking and Service Design together can help improve services and even innovate new ones based on the analysis of people's experiences in certain contexts or situation [12].

There is also an emerging field of application in the area of healthcare linked to the development and analysis of services. Within the design for health services foreground, projects such as the mourning room for family members of The Vall d'Hebron University Hospital (VHUH), or the Philips Healthcare project that revolutionizes the body scanner experience for children through a playful process in which children learn to scan stuffed animals and understand the process that they will experience later [13]. Another relevant project is the set of services included in Sant Joan de Déu (SJD) Barcelona Hospital, such as the therapy with animals [14], the volunteer service to maintain the school year, or the spaces for internal consultations. All of them are results of projects in which the various design methodologies have been applied to the development of specific cases.

Patient Experience is a complex set of experiences, sensations, emotions, assessments and satisfaction in terms of health care services; it results of the phenomenon of interaction with people and touch points (spaces, equipment, information, among others) that make up this service. Offering experiences patient-centered is considered by various authors [15–17] as a synonym for quality in patient care, problem-solving and a holistic approach based on the set of human values. The American Medical Association proposes the assessment of patient experience as one of the best indicators of the quality of health care. Based on the statements of several authors [18], the working principles of Service Design in health care context could be summarized as follows:

1. People, patients, family members and workers are part of the development of new care solutions and at the center of the design process. Their needs are studied from a mainly qualitative approach through ethnographic techniques, interviews and participatory processes.
2. Projects are addressed in multidisciplinary working groups in which the different agents related to the services identify problems and co-create solutions.
3. Services are studied as a sequence of events, identifying moments of truth and points of improvement.
4. Solutions are prototyped and evaluated constantly during the design process in order to learn from mistakes and improve.
5. A holistic approach is considered that allows a global view of the service in its context and on a larger scale.

This is the conceptual framework of service design; a proposal to address and improve the patient experience.

2.1 Applying Service Design in the Area of Healthcare. Methodology

The service design approach exposed in this communication can be considered as a part of a larger focus oriented in previous experiences carried out in different hospitals that aimed to improve the experience of any oncological patient at different stages of the service, from its diagnosis to the subsequent treatment at the end of the disease. This

approach is developed from an action-research methodology already tested [19], in which the medical oncology service acts as a client that has a problem, being the research team through the best design of services who brings the solutions. This proposal is strictly focused on the treatment stage and the main objective is to map and represent the patients' experience in relation to the service. For this, it is necessary to know first-hand the different processes and experiences carried out by the different agents involved (patients, relatives, nurses, oncologists).

The action-research methodology is structured into two groups of actions:

- Actions oriented to know the different views of the stakeholders: in-depth interviews, context observation and focus group interviews. The use of these techniques allows obtaining a series of initial qualitative information for the next actions.
- The following action represents the patient's experience in the oncological treatment room using a customer journey. Customer journey is one of the essential tools in service design; a visualization of the path of a patient through the different touch points of the service [20]. For example, the main stages of a customer journey detected in existing literature related to healthcare services could be the following: consultation of first impact; analytical; request for consultation appointment; consultation of treatment; request of drug treatments; request for treatment appointment; and treatment.

Table 1. Action-research methodology

Action-research methodology		
Action	Stakeholders	Purpose
In-depth interview	Research team, patients and relatives	Patients and relatives insights
Context observations	Research team	Environment and products insights
Focus group interviews	Research team, nurses and medical team	Nurses and medical team insights
Customer journey	Research team	Patient's experience visualization

Within these stages, patients and staff perform different actions that affect the service experience. In addition to these actions, the patient has other interactions with products, spaces and diverse stimuli (sounds, images, etc.) that also have an impact on the perceived quality of care. In this paper, the stated focus is at some point of the treatment stage, and more specifically, on analyze how the sounds of the treatment equipment affect to the patient's experience in particular, and staff work processes in general. Table 1 shows the list of the actions carried out, the stakeholders involved in the action and its purpose:

3   Clinical Approaches to Audible Alarms

Alarm management has been investigated in complex nature environments such as aircrafts piloting, power plants monitoring or autonomous car driving where decision-making processes require very often time-critical responses. Studying these critical scenarios we can conclude several common aspects that are especially relevant to take into account: the differentiation of the alerts according to their urgency level; the criticality of the system events; and the influence in the response time to the stimuli to take the appropriate action (operator response) [21–23].

Clinical alarm management is a subject of study especially in those units that require special care services such as intensive care (ICU) or neonatal intensive care units (NICU), in which several cases of studies and evidences can be found that make it relevant and a real safety concern [24]. Alarms that do not require actions influence on hospital resources, contribute to the alarm fatigue and can affect the quality of patient care. Desensitization can even become a matter of life or death. Alarm fatigue was identified as the main technology hazard for health organizations, and is the focus of the National Patient Safety Goal (NPSG) about the alarm system management of the Joint Commission [25]. "*The Joint Commission now requires that its accredited hospitals to improve their alarm systems, aiming to alleviate the constant barrage of bells and whistles that are often the hallmark of a hospital stay for patients and that contribute to alarm fatigue of healthcare workers*" [26]. Since alarms ranked first in the Emergency Care Research Institute (ECRI) list of Top 10 Health Technology Hazards in 2014 [27], the issue of alarm management is an essential part of patient safety for healthcare organizations.

Usually, these studies are carried out from the perspective of clinicians and more specifically nurses as they are the main operators of clinical equipment, responsible for setting up and responding to device alarms. In this proposal, the patient has been placed at the center of the research, in application of the user-centered-design and service design principles. An unheard, silenced or unattended alarm can have unpleasant consequences for the patient. This situation justifies including a more detailed view of the patient, complementary to the previous ones; observing the perception of the patient, the space that surrounds him/her, the understanding of the monitoring equipment and also his/her concerns and expectations. Since a human centered approach is set as the starting point, service design tools and methods can be very helpful for the team to set up a first observation stage that would be scalable to other studies in the future.

3.1   Sound Experience by Oncological Treatment Rooms (OTR) Users

An oncological treatment room (OTR) is a complex environment with nurses (operators) monitoring different circumstances that can take place simultaneously from different beds (range of events). In the case considered, the treatment is provided by an infusion pump system analogue to the one showed in Fig. 1. The system monitor shows a series of visual indicators and sound warnings about the operation device. This kind of process is carried out based on standards as the Chemotherapy Administration Safety Standards [28].

Fig. 1. Infusion pump system

The observation of patients at the treatment rooms stated that there is a strong emotional implication to them and their relatives at the point of receiving a treatment expected to be very aggressive and full of secondary effects to treat a serious disease. Patients feel sometimes scared and insecure, and lack information about the functioning of a system that automatically delivers the treatment, and that seems extremely complex for them. Such clinical systems are normally provided with a set of audible or visual alarms to inform the nurses of a range of information and malfunctions that, nevertheless, can be observed by the patient, other patients, and their relatives (Fig. 2).
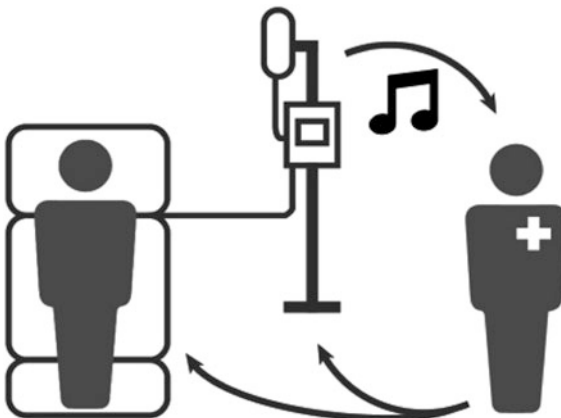

Fig. 2. Oncological treatment system

The set of alarms that surround the patient and operators are summarized in malfunctions and/or operational stage of the device such as the drug programming has been completed (volume to be infused completed or dose end); low battery; and occlusion due to different causes (movement of the patient, tube bent or plugged).

These alarms are medically actionable and represent events for which the nurse has to attend, in order of importance. The nurse needs to do not hear these alarms to understand and be sure that everything is working correctly and by this is getting an overall feedback of the patient's status, being the visual stimulus coming from the monitor insufficient, since she/he is not always in the bedside and is responsible of several patients at the same time, some of them very often located in different rooms with different layouts and occupations, reaching up to seven seats per room in some of the cases observed (Fig. 3).

Every nurse is responsible of several patients at the same time, being very often some of them located in different rooms with different layouts and level of occupation (reaching up to seven beds per room in some of the cases observed, Fig. 3). Since the nurse is not always in the bedside, the visual stimulus coming from the monitor is insufficient, and so these alarms are dedicated to provide an overall feedback of the patient's status, so if none alarm is perceived, the nurse understands that everything is running correctly.
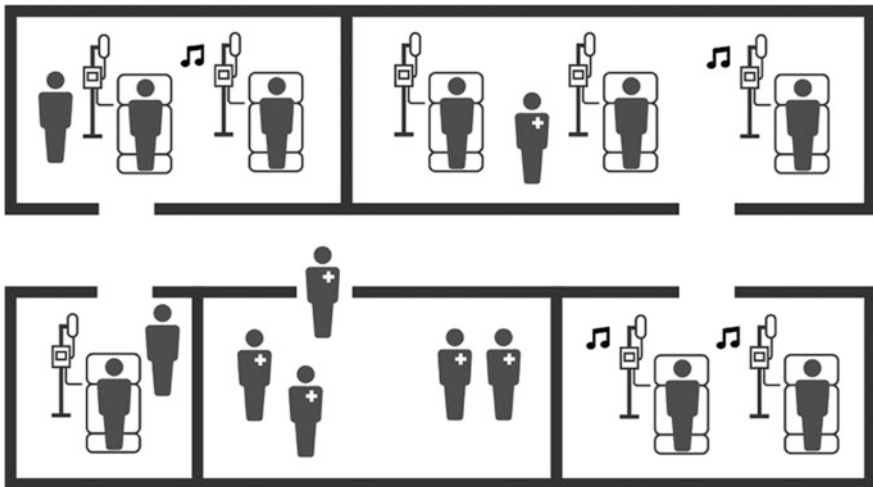

Fig. 3. Oncological treatment room layout

These alarms can refer to different events caused by system failures or monitor disconnection, due for example to the movement of the patient. However, auditory alarms are not hierarchical to communicate a series of system events (malfunction vs the drug is over), but a generic alarming sound is used for all messages, without any difference. That is, the alarm does not represent different circumstances that are really happening to the patient. Another problem is caused because all units, assigned to

different patients even on different rooms are identical, and so are their alarms, so the nurses need to identify the origin of the alarm just by ear. While the patients are receiving their treatment at certain rooms, the nurses are located normally at a different facilities, and the current systems do not count on any remote alarm or warning system, so nurses need to hear the alarm from a point located apart. Several patients are treated at the same time so several alarms can happen at any time, causing alarm fatigue on nurses, while anyway can expect some colleague to respond to any alarm, causing also at certain moments some lack of perceptual concentration.

As a result, patients and their relatives are the first to listen to the alarm informing that some unidentified problem occurs, but it can take a while until the alarm is attended by nurses. This causes an unnecessary stress on patients that can affect somehow to the success of the treatment and that has a negative influence on the experience of the service provided. Also affects to their relationship with nurses and can produce some conflicts such as relatives demanding attention to nurses that did not noticed that some event required their attention.

Thus, a systematic service design approach is proposed to identify potential improvements for the design of auditory information provided by this units, bearing in mind a closer approach to the context of OTRs, that requires it to be tailored to suit both the needs of the operators and users (health staff, patients and in some cases family) identified at the service design research and analysis stages. [29–31]. This proposed project to be developed can take into account more experiences and service design analysis at some other hospitals in order to make it universal, and/or take into consideration some analogue experiences coming from the field of service design and/or sound design at different areas. A promising example of this is the project CareTunes, a concept that challenges the clinical utilization of audible alarms (beeps) of monitoring devices found in Intensive Care Units (ICUs) and developed it as a musical streaming of patient vital signs in critical care [32].

4   Conclusions

From a first phase of observation at different hospitals, the potential of improvement in the design of the auditory signals provided by oncological treatment systems is detected. Existing literature evidences the high potential of these procedures in the improvement of critical context such as (but not only) healthcare units and at different stages. By means of service design tools application a qualitative study could be carried out to identify chances for reviewing alarms functioning, in order to improve the overall experience of the system by the patients.

In the proposal presented, the aim of service design is to provide specific insights, design specifications and recommendations for product sound designers and engineers. Qualitative observation sessions, focus group interviews and in-depth interviews seem to be especially useful to highlight insights about the routines and key activities of a nurse day work but also and more important, about the experience of patients during their 5 h treatment. The proposal exposed illustrates how some easy-to-carry service design tools can provide high valuable knowledge able to produce technical engineering and design specifications, obtaining high potential results at low project costs.

Because the work sequence proposed is based on the analysis of certain aspects common to other hospital services, the project to be developed in an oncology service is easily replicable and scalable to other areas, and further experiences can provide future lines of study and learning.

References

1. Joseph A, Ulrich R (2007) Sound control for improved outcomes in healthcare settings. Center for Health Design, Concord, CA
2. Excellence BP (2013) The Joint Commission announces 2014 national patient safety goal. Joint Commission Perspectives
3. ECRI Institute (2014) The alarm safety handbook: strategies, tools, and guidance. ISBN: 0981924174. https://www.ecri.org/components/Pages/Alarm_Safety_Handbook.aspx. Last accessed 10 Jan 2018
4. AAMI Horizons (2011) Alarms pose challenges to healthcare facilities. Horizons. https://s3.amazonaws.com/rdcms-aami/files/production/public/FileDownloads/Horizons/Alarms_Pose_Challenges_5.pdf. Last accessed 10 Jan 2018
5. Johnson KR, Hagadorn JI, Sink DW (2017) Alarm safety and alarm fatigue. Clin Perinatol 44(3):713–728
6. Griffioen I, Melles M, Stiggelbout A, Snelders D (2017) The potential of service design for improving the implementation of shared decision-making. Des Health 1(2):194–209
7. Williams I (2016) Travelling an unfamiliar road: implications for the entry of design practitioners into healthcare. Queensland University of Technology, Diss
8. Tsianakas V, Robert G, Maben J, Richardson A, Dale C, Wiseman T (2012) Implementing patient-centred cancer care: using experience-based co-design to improve patient experience in breast and lung cancer services. Support Care Cancer 20(11):2639–2647
9. Stacey PK, Tether BS (2015) Designing emotion-centred product service systems: the case of a cancer care facility. Des Stud 40:85–118
10. Service Design Impact Report (2016) Public sector. ISSN 1868–6052. https://www.service-design-network.org/uploads/sdn-impact-report_public-sector.pdf. Last accessed 10 Jan 2018
11. Service Design Impact Report (2018) Health sector. https://www.service-design-network.org/headlines/service-design-impact-report-health-sector. Last accessed 10 Jan 2018
12. Brown T (2009) Change by design
13. KittenScanner (2018) Involving kids in their own care. https://www.90yearsofdesign.philips.com/article/30. Last accessed 28 Jan 2018
14. SJD Barcelona Hospital (2018) Pet-assisted interventions. https://www.sjdhospitalbarcelona.org/en/pet-assisted-interventions. Last accessed 28 Jan 2018
15. Edvardsson D, Winblad B, Sandman PO (2008) Person-centred care of people with severe Alzheimer's disease: current status and ways forward. Lancet Neurol 7(4):362–367
16. McCormack B (2004) Person-centredness in gerontological nursing: an overview of the literature. J Clin Nurs 13(s1):31–38
17. Mead N, Bower P (2000) Patient-centredness: a conceptual framework and review of the empirical literature. Soc Sci Med 51(7):1087–1110
18. Stickdorn M, Schneider J, Andrews K, Lawrence A (2011) This is service design thinking: Basics, tools, cases (vol 1). Wiley, Hoboken
19. Coghlan D, Brannick T (2014) Doing action research in your own organization. Sage
20. Koivisto M (2009) Frameworks for structuring services and customer experiences. Designing services with innovative methods, pp 136–149

21. Sousa B, Donati A, Özcan E, van Egmond R, Jansen R, Edworthy J, Voumard Y (2017) Designing and deploying meaningful auditory alarms for control systems. In: Space operations: contributions from the global community (pp 255–270). Springer International Publishing
22. Kristensen M, Edworthy J, Özcan E (2017) Alarm fatigue in the ward
23. Baldwin CL, Lewis BA (2014) Perceived urgency mapping across modalities within a driving context. Appl Ergon 45(5):1270–1277
24. Freudenthal A, Van Stuijvenberg M, Van Goudoever JB (2013) A quiet NICU for improved infants' health, development and well-being: a systems approach to reducing noise and auditory alarms. Cogn Technol Work 15(3):329–345
25. Joint Comission (2017) National patient safety goals effective. Hospital Accreditation Program. https://www.jointcommission.org/assets/1/6/NPSG_Chapter_HAP_Jan2017.pdf. Last accessed 28 Jan 2018
26. Philips Healthcare (2018) Hospital alarm fatigue. Alarm management strategies to achieve national patient safety goal compliance. https://www.usa.philips.com/healthcare/articles/alarm-system-management/alarm-management-strategies. Last accessed 28 Jan 2018
27. ECRI (2014) ECRI institute top 10 health technology hazards report for 2014. http://www.ormanager.com/wp-content/uploads/2015/01/0215_ORM_15_ECRI-Institute-Perspectives.pdf. Last accessed 27 Jan 2018
28. Marcela DFE, Sylvia GNE, Carlos LCEJ, Aracely TME (2013) Enfermería oncológica: estándares de seguridad en el manejo del paciente oncológico. Revista Médica Clínica Las Condes 24(4):694–704
29. Sowan AK, Tarriela AF, Gomez TM, Reed CC, Rapp KM (2015) Nurses' perceptions and practices toward clinical alarms in a transplant cardiac intensive care unit: exploring key issues leading to alarm fatigue. JMIR Human Factors 2(1)
30. Kitzinger J (1995) The methodology of focus groups: The importance of interaction between research participants. Sociol Health Illn 16:103121
31. Kitzinger J (1995) Qualitative research: Introducing focus groups. BMJ: Br Med J 311:299302
32. Bogers K (2018) CareTunes: music as a nurses' monitoring tool. Master thesis. Delft University of Technology