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CHARACTERIZING THE SOUNDSCAPE OF ONCOLOGY HOSPITAL SPACES AT UNIVERSITY HOSPITAL "MOTHER TERESA" (UHCT): ASSESSMENT OF PATIENTS AND STAFF

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ABSTRACT*

The increasing number of users in oncology units globally, including in Albania, underscores the critical importance of assessing the acoustic environments of such spaces. Despite the significance of acoustic exposure in clinical settings, studies focusing on soundscape evaluations remain scarce, particularly in the Albanian context, where no soundscape-based research has been conducted to date. This study extends the Albanian adaptation of perceived affective qualities derived from the SATP project to explore the experiences of two user profiles in oncology hospitals. A total of 97 participants completed surveys, administered both online and on paper, across various spaces in oncology hospitals during daytime hours, including ambulatory chemotherapy rooms, staff rooms, patient rooms, operatory rooms, waiting areas, and reception areas. Simultaneously, objective sound pressure level metrics and audio recordings were conducted at each location to characterize the acoustic environment. The findings of this study in Albania will offer valuable insights into how users perceive the soundscape of oncology hospitals. These results aim to inform the design of more inclusive and user-centered healthcare environments, addressing the needs and experiences of most stakeholders in those critical yet utilitarian environments.

Keywords: *ISO 12193, healthcare soundscape, Oncology soundscape, Albanian affective attributes, soundscape inclusiveness*

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1. INTRODUCTION

Hospitals and healthcare facilities are highly sensitive environments that deserve special attention, as noise pollution can negatively affect patients' health and recovery and impair staff well-being. The World Health Organization (WHO) suggested a daytime guideline value of 30 dB L_{Aeq} (averaging time 16h), together with a 40 dB L_{Amax} during the night for the wards in the hospitals [1]. The actual sound environment in the hospital continues to be noisy [2] and noise issues has been often complained about [3]. Noise in hospitals has been considered to disturb rest, delay recovery for patients, lead to anxiety, and impair working efficiency for staff [2]. In 2022, there were an estimated 19.9 million cases of cancer around the world, circa 10.3 million among men and 9.6 million among women. In 2012, this estimate was 14.1 million cases, with an estimated increase to 24 million by 2035 [4]. The

increasing number of users in oncology units globally, including in Albania, underscores the critical importance of assessing the acoustic environments of such spaces

Despite the significance of noise exposure in clinical settings, studies focusing on soundscape evaluations remain scarce, particularly in the Albanian context, where no soundscape-based research has been conducted to date. This study extends the Albanian adaptation of Perceived Affective Qualities (PAQs) derived from the SATP project [5] to explore the experiences of two user profiles in oncology hospitals.

Assessment using subjective evaluations as a perceptual construct of the acoustic environment based on affective attributes is a well-established approach, that provides a holistic assessment of the acoustic environment. Within the soundscape research, Talebzadeh [6] claimed the need to integrate an inclusive approach. While there is evidence that demographic, personal, and other non-acoustic factors influence perception [7] in any ordinary environment, user profiles in hospital environments also would provide distinctive evaluations [3]. An inclusive soundscape approach would help in providing further insights. In hospital soundscape design, for example, authors [8] designed sound environments through the fundamental needs of ICU patients. Another example of inclusive soundscape is the PECS project led by Torresin and colleagues [9]. PECS considers individuals' sensitivities, expectations, and needs. The project started with thermal comfort and air quality and aims to continue in the acoustic domain. Similarly, Talebzadeh [10] and coauthors proposed a sound selection methodology to augment the sound in nursing homes and be adjusted by users themselves.

1.1 Hospital Soundscape Assessment

For many years, most of the studies have focused on particularly noisy areas such as intensive care units and hospitals (ICUs) [11-12], and also in specific areas such as hospital wards [13] and less investigation exists in Oncology hospitals [14].

Sound environments in a hospital are different from those of other workplaces or educational facilities since they include not only building operations (i.e., HVAC) and building occupants (i.e., communication) but also other activity noise (i.e., alarms) [2]. The role of these sounds in hospitals is quite essential and subjective assessments (i.e., affective qualities) in employing a soundscape approach are in their early stages [3], [13].

Moreover, previous studies have focused on evaluating SPLs and/or reverberation time inside hospital facilities [15]. By focusing on determining the most dominant sound sources in hospital settings, authors [16] identified the most disruptive noises for patients, including snoring, crying, staff conversations, door slamming, objects banging, and so forth. In employing a laboratory study based on a 50h long audio data, Dawson and colleagues [17] identified 16784 sound episodes from which auditory communication (i.e., staff communication, loud voices, clinical rounds, or visiting) was reported as the most frequented episode, with 34 % followed by clinical tasks with 20%, alarms (i.e, ventilator, monitor, intravenous pumps, humidifier) with 18% and so forth.

1.2 Albanian PAQs development

Fasllija et al. [5] developed the Albanian soundscape attributes within the SATP project [18]. The study was conducted in a 3-phase assessment including both qualitative and quantitative evaluation where the corresponding Albanian equivalents for the soundscape Perceived Affective Qualities emerged as Eventful (AL:*Gjallërues*), Vibrant (AL:*Dinamik*), Pleasant (AL: *I Këndshëm*), Calm(AL: *I Qetë*), Uneventful (AL: *I Shkretë*), Monotonous(AL: *Monoton*), Annoying(*AL: I Bezdisshëm*), Chaotic (AL: *Kaotik*) [5].

Albania has already implemented specific legislative measures to address noise pollution. Noise pollution is also a concern in the hospital environment, which has recently been treated in Decision No. 114, dated March 6, 2024, on the Approval of Design Standards for Hospitals and Healthcare Clinics [19]. The focus of the government's approval of design standards for hospitals is mainly on acoustic comfort, providing patients with quiet and health-promoting environments. There is no study, however, on the perceptual aspect of the acoustic environment.

2. METHODOLOGY

2.1 Study areas

The research focuses on six hospital units, with the corresponding participation represented in percentages as follows: waiting room (%), chemotherapy room (23.4%),

consultation room (12.8 %), patient room (30.9%), operatory room (9.6%), corridor (9.6%), and reception (waiting area) (13.8%). The units are part of the Oncology Hospital, University Hospital Mother Theresa, UHCT, located in Tirana, Albania. The UHCT is Albania's largest national university hospital, offering tertiary care to 150,000 outpatients and 75,000 inpatients [20].

Figure 1. Images of Oncology Hospital areas where the data are collected

2.2. Data collection

The data were collected within one week after the ethical approval from the ethical office at the General Directorate of the University Hospital. The data consists of participants' subjective responses and audio environment recordings. Images, without identifiable information, were taken to visualize each unit of the oncology waiting area. The subjective response data for this study were collected using online and paper-based surveys in Google Forms. The audio recordings were collected using an installed SoundMeter X, Version 12.6 developed by Faber Acoustical in 2008 smartphone. Studies investigating the effectiveness of using smartphones (i.e., IOS and Android) and various applications (e.g., SPLnFFT, NoiSee) have found that Soundmeter X is the app best suited for occupational and general-purpose noise measurements [21].

2.2.1 Questionnaire

The language for this study questionnaire was Albanian following the development of the Albanian PAQs [5]. The questionnaire consists of four parts. The first part consists of the location of the participants when filling out the survey, then demographic questions such as age, gender, education and user profile. The second part consists of sound dominance which were developed based on observation done in a tertiary hospital by a previous study [3] then the soundscape quality administering the Albanian PAQs [5] then the survey continued with annoyance from sound sources and lastly questions regarding the overall quality and soundscape appropriateness as outlined in ISO/TS 12913-2:2018.

2.2.2 Recordings

The recordings for this study were collected using a smartphone with the SoundMeter X by Faber Acoustical installed. The app has A/C/SPL weighting, L_{eq}, Int/Ext mic, and Calibration features. Before recording the device was calibrated. During the measurements, the smartphone was located on a stable tripod at a sitting level of 1.2 m.

Table 1. The sound pressure level parameters (L_{Aeq},L_{10},L_{90}) characteristics of Oncology hospital areas

Hospital Areas	SPL		
	$L_{Aeq\ (dB)}$	$L_{10\ (dB)}$	$L_{90(dB)}$
Chemotherapy	61.88	64.30	52.70
Corridor Area	58.28	61.70	49.00
Waiting Room	70.09	72.50	63.80
Consultation	61.64	63.40	47.10
Patient Room	60.29	63.30	45.90
Operatory	63.65	67.50	55.30

2.2.3 Participants

In total, 97 participants took part in this study, and 94 surveys were valid, out of which 74 females (78.7 %) and 16 males (17%), 4 preferred not to say (4.3 %). Users were equally distributed among patients and staff, with 47 (50 %) each, respectively. Among the participants, 33 % (n=31) were above 56 years old, 25.5 % (n=24) ranged between 46-55, 11.7 % (n=11) ranged between 36-45, 23.4 % (n=22) ranged between 26-35 and 5.3 % (n=5) were below 25.

2.3 Data analysis strategy

The collected data for this study were analyzed using SPSS 2025 and Python programs. The package *soundscapy* [22] was administered to analyze the soundscape distribution of each investigated unit. The analysis consists mainly of

descriptive statistical results, as the main aim of this study was to characterize hospital environments in an understudied context. Non-parametric Mann-Whitney *U* tests were conducted to check for the differences between groups (Patient-Staff) as the data lacked normality according to the Shapiro-Wilk test ($p<0.001$). Mann Whitney *U* test was employed for the whole dataset and separately for Chemotherapy and Patient rooms since they had a higher percentage of collected data.

3. RESULTS AND DISCUSSION

The results of this study are organized as follows: First, an overall assessment of the soundscape qualities by all participants was analyzed and shown in Figure 2, in density plots. As seen from the plots, the distribution is limited, mostly due to the low sample size in each unit, and is mainly central to the eventfulness axis. When focusing on the Chemotherapy unit is perceived as mainly a chaotic environment, while the Corridor leans towards the annoying PAQ. As these environments both trigger unfavorable experiences for the patients (and maybe for the healthcare providers), they are somewhat expected to be associated with negative attributes. The Waiting Room, the Consultation Room, the Patient Room, and the Operating room were more concentrated, primarily in the neutral pleasantness and eventfulness axis, subtly questioning the appropriateness of using the ISO/TS 12913-2: 2018 PAQs indoors, and the equivalence of the Albanian PAQs [5]. On an overall scale, while also trying to understand the existence of any difference between the soundscape perceptions of user profiles, their assessments are indicated in Figure 3. While the Staff might have a more concentrated neutral assessment as they might be more habituated to the sounds of the hospital environments, patients have a wider spread, especially along the pleasant-annoying axis. Mann-Whitney U tests indicate a significant difference between users for Vibrant ($p=0.034$, $p<0.05$) and Calm ($p=0.030, p<0.05$) attributes. The results indicate a calmer, sound environment for patients ($\mu=2.87$, $SD=1.50$) and a more vibrant for staff ($\mu=3.15$, $SD=1.20$). When focusing on the two units with the highest response rates from both user profiles (i.e., the Chemotherapy and Patient Room), it is observed from Figures 4-5 that the soundscape assessment varies between Staff and Patients in terms of distribution.

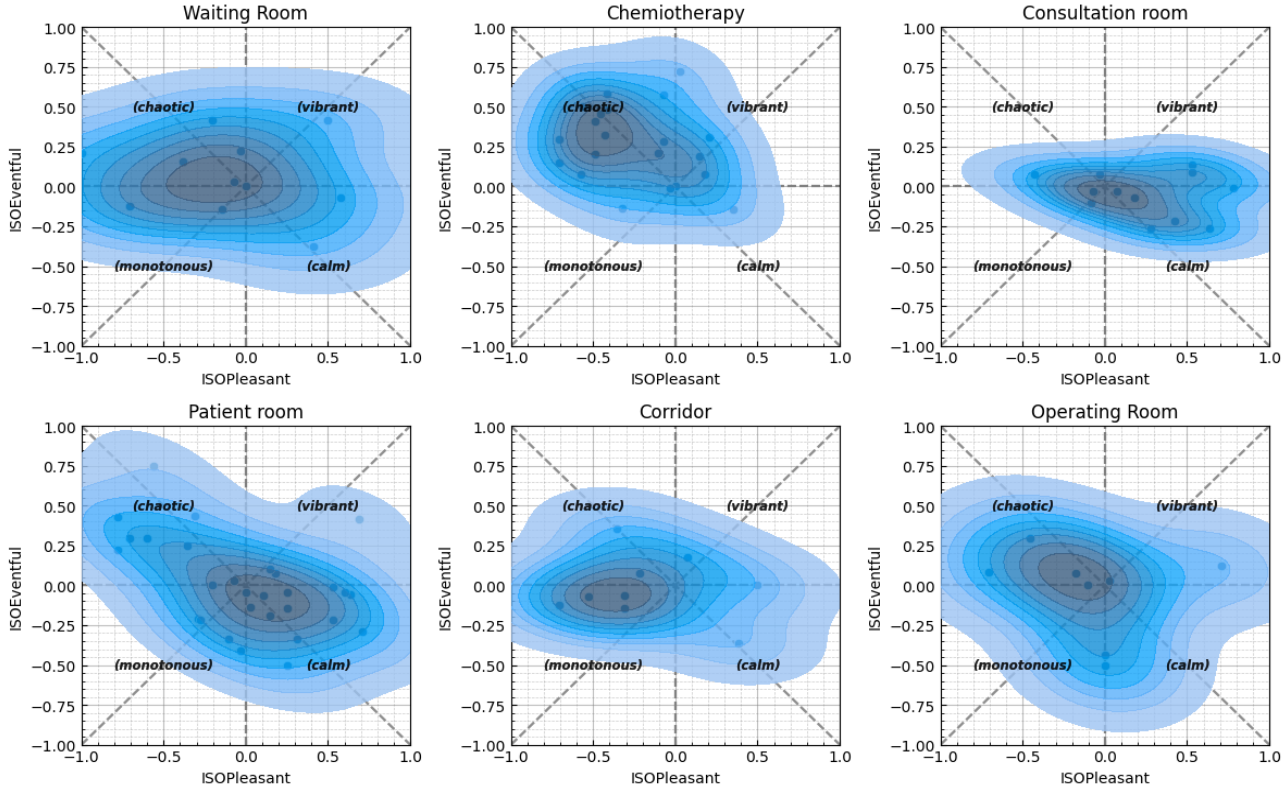

Figure 2. Soundscape density plots of the studied units

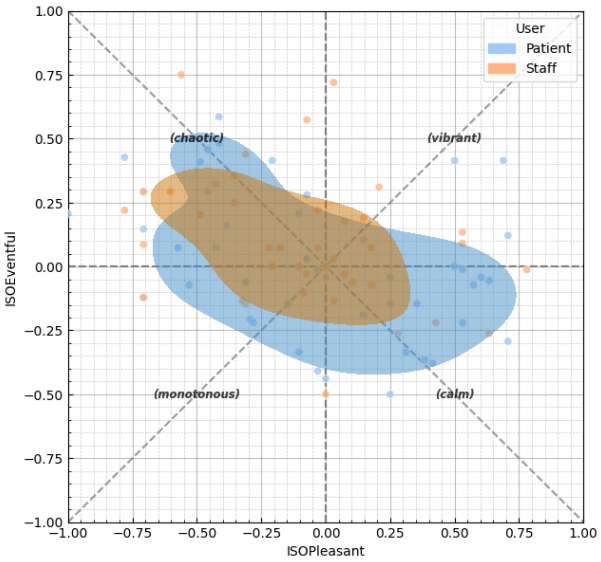

Figure 3. Overall soundscape assessment between user profiles

Table 2. Comparison of Patients and Staff on Soundscape descriptors (Overall)

Variable	M (Patient)	M (Staff)	*p*-value
Vibrant	2.60 (1.47)	3.15 (1.20)	.034*
Pleasant	2.45 (1.46)	2.32 (1.27)	.814
Calm	2.87 (1.50)	2.21 (1.28)	.030*
Uneventful	1.81 (1.25)	2.06 (1.11)	.104
Monotonous	2.85 (1.46)	2.81 (1.17)	.951
Annoying	2.87 (1.68)	2.94 (1.37)	.742
Chaotic	2.55 (1.67)	3.11 (1.46)	.078
Eventful	2.60 (1.47)	3.15 (1.20)	.220

While no significant difference is found between profiles for the Chemotherapy Room, the analysis revealed differences in the auditory experiences in the Patient Room, clearly illustrated in Figure 5. In this unit, the staff tends to view the environment as predominantly chaotic, yet they maintain a neutral assessment, particularly regarding the eventfulness range. In contrast, patients perceive the environment differently, with a broader distribution within the pleasant and uneventful quadrant, though not significantly extending into the calm PAQ.

This discrepancy may arise because the auditory area for patients is likely smaller and more restricted compared to that of the staff, who are responsible for caring for multiple patients (up to four) within the same environment.

Table. 3 Comparison of Patients and Staff on Soundscape descriptors (Chemotherapy)

Variable	M (Patient)	M (Staff)	*p*-value
Vibrant	3.25 (1.36)	3.80 (1.03)	.34
Pleasant	1.92 (1.17)	2.20 (1.40)	.63
Calm	2.00 (1.21)	1.90 (1.37)	.71
Uneventful	1.83 (1.34)	2.30 (1.57)	.43
Monotonous	2.50 (1.31)	2.50 (1.65)	.83
Annoying	3.92 (1.38)	3.40 (1.51)	.42
Chaotic	3.67 (1.16)	4.40 (0.84)	.12
Eventful	2.58 (1.08)	2.20 (1.48)	.40

Based on nonparametric test results, there is a significant difference between user profiles regarding Vibrant ($p=0.02$, $p<0.05$), Pleasant ($p=0.04$, $p<0.05$), Calm (p=0.001), and Chaotic ($p=0.005$, $p<0.05$). The patient finds the patient's wards more pleasant ($M=2.82, SD=1.41$), notably calmer $M=3.61$, $SD=1.24$) whereas the staff finds the patients ward more vibrant ($M=3.27$, $SD=1.10$), and notably chaotic ($M=3.27$, $SD=0.42$) as presented in Table 4.

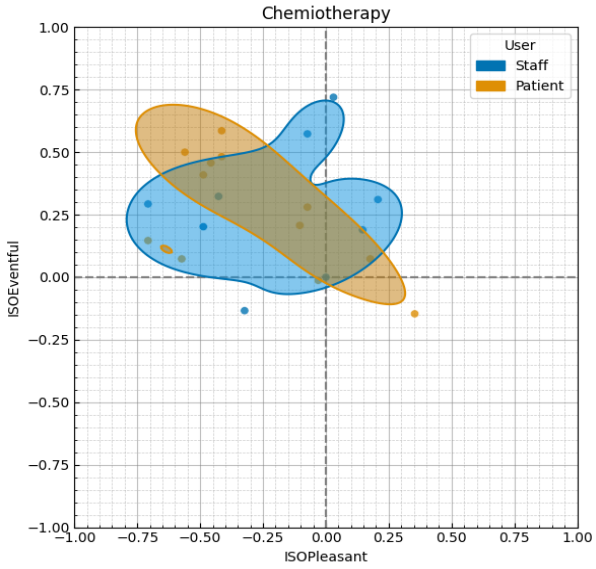

Figure 4. Soundscape assessment between user profiles in the Chemiotherapy Room

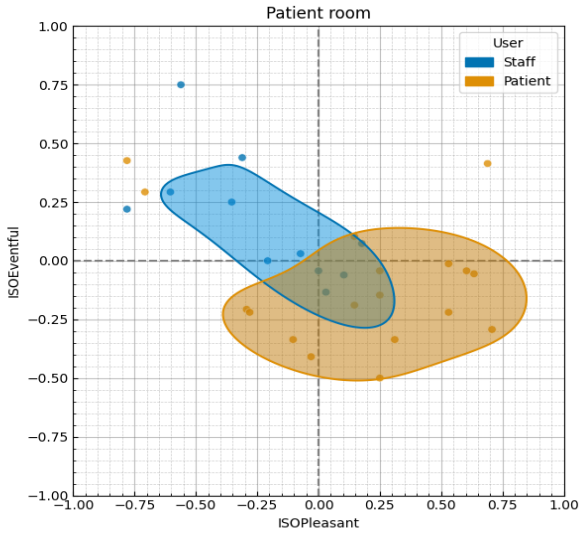

Figure 5. Soundscape perception between user profiles in the Patient Room

The sound dominance analysis included only the two specific areas, as presented in Fig.6. The results indicate that in chemotherapy, patients (42%) and staff (40%) report Human Vocal sounds completely dominated the acoustic environment, followed by operational sound, with 33 % as completely dominant as reported by patients and 50 % as moderately dominant by staff. Mechanical sounds dominate 30 % completely, as reported by staff in contrast to patients who report mechanical sound to be 75 %, which is a little.

Table 4. Comparison of Patients and Staff on Soundscape descriptors (Patient)

Variable	M (Patient)	M (Staff)	*p*-value
Vibrant	2.17 (1.33)	3.27 (1.10)	.02*
Pleasant	2.89 (1.41)	1.82 (0.84)	.04*
Calm	3.61 (1.24)	1.64 (0.67)	.001**
Uneventful	1.61 (0.97)	1.64 (0.80)	.71
Monotonous	2.78 (1.47)	2.91 (1.13)	.76
Annoying	2.22 (1.55)	3.18 (1.40)	.06
Chaotic	1.78 (1.51)	3.27 (0.42)	.005*
Eventful	2.39 (1.14)	1.82 (1.24)	.11

This might indicate staff insensitivity to the acoustic environment [3]. The distribution indicates that staff perceives a variety of sounds in Chemotherapy compared to patients due to their familiarity with the activities and equipment's presence. In the patient room, patients found environmental sounds dominating completely (33%), followed by human sounds (17%), whereas other sounds were almost absent. Patient in general complained about the traffic noise. Similarly, staff, reported that the acoustic environment of the patient room is completely dominated by environmental sounds (45%), followed by mechanical (45%) and human vocal (45%) sounds. Based on these results, staff generally perceived more sound variety and intensity than patients.

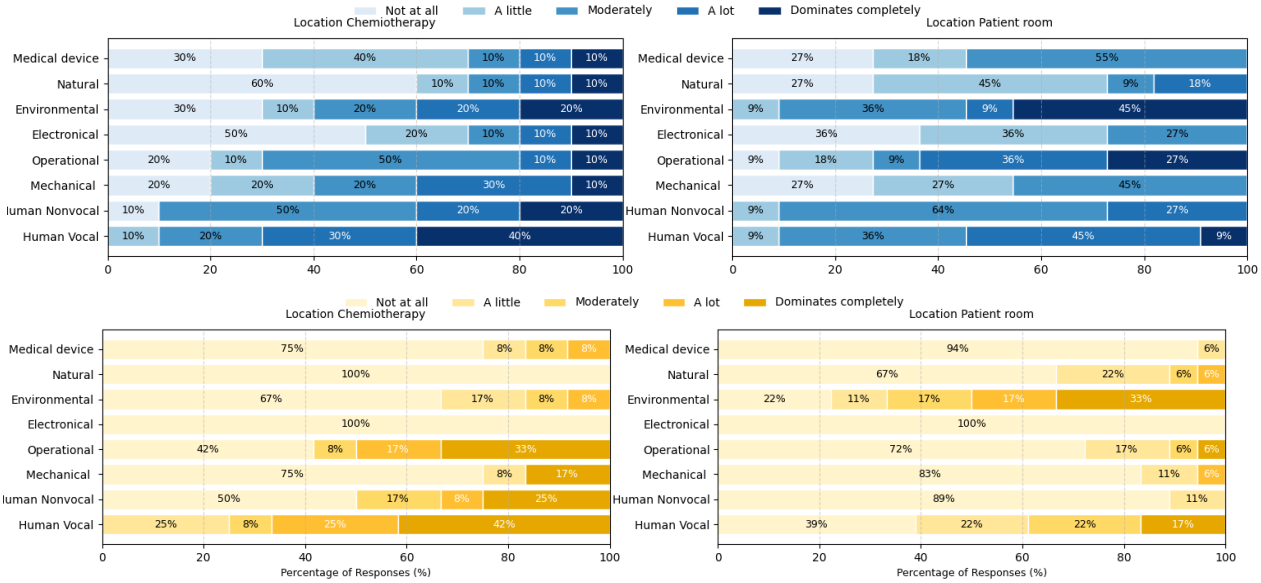

Figure 6. Sound Source Dominance in Chemotherapy and Patient Room of Oncology Hospital

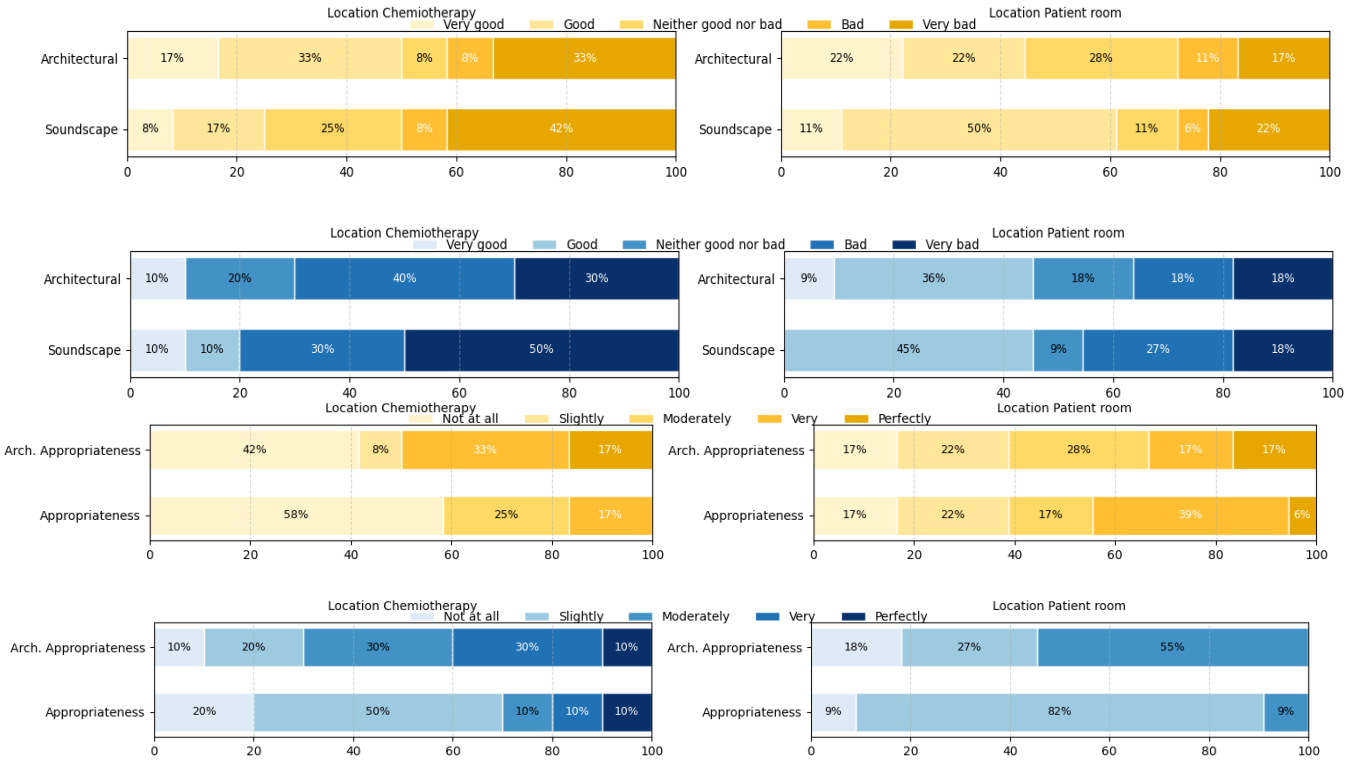

Figure 7. Architectural and Sound Appropriateness and Overall Quality in Chemotherapy and Patient Room

Regarding sound and architectural overall quality, both staff and patients report it as very bad, with a similar distribution in chemotherapy. A lower percentage is reported as very bad in the patient rooms. Whereas, architectural and sound appropriateness, both staff and patients find the chemotherapy room inappropriate, with patients reporting it higher. The sound environment of the patient room is reported as 39 % very appropriate by the patients, thus supporting the PAQs distribution. Meanwhile, staff considers 82% slightly appropriate, supporting the PAQs distribution.

4. CONCLUSION

The Oncology hospital in Tirana has been presented, providing an overview of the hospital soundscape. The Albanian PAQs previously developed and under validation have been administered in this study, which is part of a survey that includes dominance of sound sources, soundscape appropriateness, and overall quality. Results show that the soundscape distribution in this area is mostly neutral, questioning the use of soundscape protocols and their translation in this context. Further studies, however, are planned to proceed.

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