Development and evaluation of a web system for the design of digital games with therapeutic potential by end users

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Abstract. *Additional therapy support for the treatment of Substance Use Disorders (SUDs) can be provided through digital games. However, we still face challenges in including people in SUDs rehabilitation in the digital game design process. This work seeks to minimize these challenges by investigating how to build a web system that guides end users in recovery from SUDs in digital game design activities with therapeutic potential. We used the Design Science Research method. To evaluate the system, we conducted a usability test with health professionals. The results suggest that healthcare professionals would use the system as an alternative therapy with their patients in SUDs rehabilitation because they saw therapeutic potential in the proposed solution.*

1. Introduction

Demands related to mental disorders are large all over the world, but current resources are still insufficient. Mental disorders, such as Substance Use Disorders (SUDs), bring individual and societal challenges that are considered complex because there is no single solution. In the quest to alleviate these challenges, solutions using digital interventions tend to demonstrate effectiveness and can be engaging, less stigmatizing, and more accessible [Monarque et al. 2023]. However, for the development of digital solutions in this context, there must be the active participation of a multidisciplinary team. The expectation is that this team includes computer professionals, health professionals who are specialists in the pathology to be addressed, patients, and caregivers [Schmitt and Yarosh 2018, Souza et al. 2019].

Therapeutic digital games, for example, have the potential to be well employed in the SUDs context. Game design can also contribute to the recovery process, complementing traditional treatments, enabling users to express their opinions in the first person, and building computational systems to help them better adhere to the prescribed treatment. It can also improve their self-esteem [Garcia et al. 2019]. By allowing them to actively participate in design and development, design decisions are expected to be more

aligned with their specific needs. In addition, personalized content dedicated to supporting your recovery facilitates the rehabilitation process. Nevertheless, several design considerations are necessary to take into account their specific conditions and reduce any risks [de Beurs et al. 2017]. Thus, involving people in recovery from SUDs in the design process can be complex and it is not fully investigated.

The first stage of this research was carried out to investigate the involvement of people in recovery from SUDs in the design of digital games with therapeutic potential. Design activities based on the SemTh approach [Souza et al. 2019] were applied with patients at a psychosocial care center. The activities carried out were brainstorming, the definition of interested parties, enrichment of personas, the definition of therapeutic objectives and requirements, modeling of interactions, implementation, and evaluation of games. The previous implementation was carried out in a game editor software called Lepi [Garcia et al. 2019]. We intended to study how those people would go through a design process, identify facilities and difficulties they would have, and list specific demands to build a solution that supports game design by this population.

In that first approach to people in SUDs rehabilitation, it was possible to identify that they were engaged in the proposed activities. With the support of the health professional who accompanied the activities, the participants were able to discuss harmful and protective actions associated with SUDs. In addition to the reflections that emerged, another important therapeutic aspect was related to self-esteem. Participants were proud of what they had created, which is known to be beneficial in the context of SUDs recovery. However, some challenges were also observed. The participants needed support at all times from the computing professionals who were involved in the activities. Some activities had to be adapted, as the participants had difficulty understanding parts of the process, especially parts that involved greater abstraction. Another challenge was the need to explain, exemplify and remember what had been done in previous activities and what needed to be done next. The rotation of the participants was also a challenge and the lack of knowledge in the use of the computer.

Considering the challenges encountered, this research presents the construction of a web system that supports the design of digital games with therapeutic potential by people in recovery from SUDs. The emerging results of this research contributed to the research of a doctoral project [Souza 2024] that promoted a way for end users recovering from SUDs to design digital games with therapeutic potential, in a scalable and autonomous way. The objective of this paper was to design a web system that guides end users recovering from SUDs in carrying out digital game design activities with therapeutic potential.

The research method used was Design Science Research (DSR) [Peffers et al. 2007], detailed in the section 3. For evaluation, the system was made available to four health professionals from the Psychosocial Care Center - Alcohol and Drugs (CAPS-AD) in Passos City, state of Minas Gerais, Brazil. The professionals participated in a usability test. The results suggest that the system is apt to be used by patients recovering from SUDs and professionals are willing to use it to support therapy with their patients. The results of the implementation and evaluation, as well as a discussion of the results, are detailed in the section 4.

2. Background

2.1. Recovery from Substance Use Disorders and Support by Computing

The abusive consumption of psychoactive substances, such as alcohol and drugs, can lead a person to individual vulnerability, social and community. The growth of abusive consumption of these substances has demanded public policies to minimize the aggravated consequences to the health of individuals. The recovery of people with SUDs is related to inclusion initiatives through social, cooperative, productive, and income-generating activities. Social inclusion is also important in the context, aiming at exercising citizenship and developing autonomy. The concepts of psychosocial rehabilitation and social reinsertion are also used in the literature on SUDs. All terms used are related to the creation of conditions for people in recovery from SUDs to be able to maintain their social, family, and community relationships, participate in society, and have their rights guaranteed with the maximum possible autonomy [Sanches and Vecchia 2018].

Research is being carried out on the experience of SUDs users in the use and design of technologies to support therapy. However, previous work on the experience of end-users with an SUDs background has been limited due to several factors. Not only is it complex to reach and recruit such individuals, but they may also be hesitant to share their perspectives, feeling uncomfortable being actively involved in research and design activities due to past negative experiences involving judgment, stigma, trauma, among others [Woelfer 2014]. Furthermore, traditional Human-Computer Interaction (HCI) approaches to user-centered design have not been validated with vulnerable groups, thus we argue that a range of adjustments is needed to ensure that data collection truly reflects the views of end users.

Given the challenges mentioned above, previous works involving end-users with a history of SUDs have primarily focused on predictive analytical to support recovery from substance addiction, mobile apps to assist patients in recovery, virtual agents for motivational interviewing and pairs support for online communities. Methods employed include questionnaires, interviews, model development, participatory design, and experiments [Olafsson et al. 2020, Rubya and Yarosh 2017, Fischman 2018, Schmitt and Yarosh 2018]. As far as we know, the active participation of people with SUDs in the design and development of therapeutic solutions involving technology has not yet been properly investigated, being considered an innovative and challenging field of research.

2.2. Design and Development of Digital Games with Therapeutic Potential

The application of knowledge in computing to support other areas of knowledge is a reality on the world stage. In the health area, technological development has changed several practices, including activities such as clarifying pathologies, education, management, diagnosis, and therapy [Nunes et al. 2011]. It has been developed from application programs that support health professionals in their offices (e.g. spreadsheets, software for financial and patient control, etc.), hospital care systems, diagnostic support systems (e.g. medical image processing), therapy support systems, and also digital games created to directly assist in the treatment of patients.

Digital games have increasingly become part of people's daily lives. Therapeutic games are a subset of serious digital games designed to complement rehabilitation ther-

apies. Therapeutic digital games are digital games that produce a direct, expected and intended therapeutic effect on the patients who play them. This therapeutic effect can alleviate, improve, or cure the specific condition of the patients. Game design is the process by which a game designer creates a game. The design of therapeutic digital games differs from the others due to the need for the participation of specialists in the field of therapy to be attended. The creation of therapeutic digital games should be considered the participation of computer professionals, health professionals, and patients themselves [Mader et al. 2016, Souza et al. 2019].

SemTh is an approach to therapeutic digital game design that supports the participation of multidisciplinary teams throughout the design process. The approach consists of four steps, namely: 1) Clarification of the Design Problem; 2) Interaction Modeling; 3) Materializing Design; and 4) Evaluation [Souza et al. 2019].

3. Method

The research method used in this study was DSR. The DSR process includes six steps, being them: i) problem identification and motivation; ii) definition of the objectives for a solution; iii) design and development; iv) demonstration; v) evaluation; and vi) communication [Peffers et al. 2007].

The identification of the problem and motivation, as well as the objectives and requirements for this study, emerged from a doctoral project [Souza 2024] and are detailed in subsection 4.1. The project investigated the design and development of digital games by end users recovering from SUDs. One of the products of the doctoral research is a system to support the investigation process. The study presented in this paper consisted of the development and initial evaluation of the proposed system. The design, development, and demonstration of the system are detailed in subsection 4.2. The valuation method applied is detailed in subsection 3.1 and the results of the evaluation are detailed in subsection 4.3. Finalizing the DSR process, in section 5, the authors present a discussion of the results and their implications for future research.

3.1. Evaluation Method

For the evaluation carried out in this study, we applied a usability test with four health professionals from the CAPS-AD. The system was made available to health professionals, and after using the system, they answered two questionnaires. The purpose of the first questionnaire was to identify perceived ease of use. Questionnaire questions were based on the Technology Acceptance Questionnaire (TAQ), a research instrument that measures user acceptance of a given technology. The TAQ is composed of two main dimensions: Perception of Usefulness and Perception of Ease of Use [Davis 1989]. This study considered the Perception of Ease of Use.

In addition, another questionnaire was applied to collect the profile of the health professionals and obtain feedback with qualitative data on which specific points of the system could be improved. We also sought to identify the health professionals' perception of demands to make the system available to their patients. For data collection, in addition to the questionnaires, we used direct observation and a field diary. For the analysis of the qualitative data collected, the thematic analysis method was used. The basic steps of thematic analysis are: 1) Data preparation; 2) Identification of themes; 3) Categorization of theme; 4) Pattern analysis; 5) Validation of results; and 6) Report of results

[Bernard et al. 2016]. For the analysis carried out in this study, we used the ATLAS.ti [1]. The evaluation results are described in subsection 4.3.

4. Results

In this section, we present the results of this research following the steps of the DSR. In Subsections 4.1 to 4.3 the results of five DSR steps are presented. In Section 5 we finish with the sixth step of the DSR, through a discussion of the results and their implications for future design research in the SUDs domain.

4.1. Problem identification, motivation, and definition of the objectives for a solution

The problem and motivation of this research are related to a doctoral project [Souza 2024] that investigated ways to support the design and development of digital games with therapeutic potential by people in recovery from SUDs. Our motivation is to make these people more autonomous, feel empowered in the creation of therapeutic digital games, and be able to express themselves through the design and stories created for the games.

Seeking to investigate this population in a real-life scenario, design and development activities for therapeutic digital games were carried out in a specialized institution. With this first step, it became possible to identify some demands that supported the definition of the proposed objectives and requirements for the system presented in this paper. The activities provided discussions on harmful and protective actions in SUDs, providing an opportunity for patients to express themselves. However, cognitive limitations and those related to low literacy demanded adaptation to the activities. With this, it was considered that alternative forms of interaction would be necessary for the system.

Already in this first step, it was also noticed the difficulty of patients in activities that demanded greater abstraction. Therefore, for the construction of scenes and modeling of interactions, for example, we provide the system images of scenarios and real contexts. Collaboration between patients during activities was also observed, which is why we seek to support, encourage, and take advantage of this collaboration for the outcome of the games. Another identified demand is related to the exemplification of the proposed activities and the return to the train of thought. In activities that require sequence, like in a design process, it is necessary to support patients in resuming their train of thought. The design process as a whole should also be guided by reminding patients about the activities that have already been done and the goals of the next activities. Finally, it was observed that the patients needed support at all times from the computing professionals who were involved in the activities. Patient turnover and lack of knowledge of computer use were also a challenge.

Considering the observed demands, the authors of this paper listed the requirements for the system. The main listed requirements and the design decisions that were taken to meet the listed requirements are presented in Table 1. In addition to the requirements presented, it was defined that the system should support patients throughout the creation process, from planning to implementation of the game. For this, the interface must offer tutorials and support resources and allow collaboration between patients and

[1] https://atlasti.com

the health professionals who accompany them. In addition to the design decisions presented, a design decision that encompassed all activities and requirements was to simplify the technical terms. For example, when talking about personas, the participants in the first stage of the study understood that they were the characters in the game. At the time, it was difficult for them to understand that personas were player profiles. That's why we don't use the term personas in the system, but players. The same occurred with the terms "stakeholders" and "interaction modeling".

Table 1. Main requirements listed for the system and design decisions.

Requirement description	Design decision
The system should guide the user with explanations and examples of the activities.	We implemented a CA in the system that explains and guides patients during all activities.
The system should allow interaction using text, voice, audio, and click.	The CA's interaction with the user is by text, audio, and/or videos. And the user's interaction with the CA is by click.
The system must have an activity to identify potential stakeholders.	In the first activity of the system, we implemented the definition of interested parties, so that users can identify players, community, and sources of information.
The system should have a player characterization activity for users to characterize the players.	We implemented that in the second activity users must think about the name, image, clinical symptoms, form of treatment, and description of the player.
The system should have the activity to draw the scenes and characters of the game.	In the third activity, we implemented that the user must build the game scenes through images with scenarios and characters that refer to the real world.

4.2. Design, development, and demonstration

Once the requirements had been defined, prototypes (wireframes) were built, which were soon implemented by the development team. The main task to be carried out in the system, named SemTh Web [2], is the design of a digital game with therapeutic potential. The system user will be instructed to carry out design activities for the creation of a storytelling game, building scenarios, and characters, and creating stories with reflections on everyday life.

The SemTh Web can be used by two user profiles, health professionals and patients. Health professionals can register, log in to the system, and manage projects. Patients use the system without the need to register, and there is no need to save data from these users. When entering the system, the health professional will be able to create new projects. The system generates an automatic and unique code for that project. As soon as the patient enters the system with the code informed by the health professional, the system will start the activities and present the patient with a CA explaining the activities. The patient will be able to perform all activities guided by the CA. The CA shows the patient a step-by-step explanation and example of each activity. The CA interacts via text, audio,

[2]https://semth-web-self.vercel.app/

click, and explanatory videos if the patient has difficulties understanding the activities to be performed. If the patient wants, he also has the option of closing the CA and carrying out the activities. In this case, the CA is "waiting" and if the patient needs it, s/he can request the CA's help again.

The SemTh Web supports four design activities: i) definition of interested parties; ii) enrichment of personas; iii) modeling of interactions; and iv) implementation. Each activity was adapted according to the demands identified for the SUDs rehabilitation population. We seek to reduce the need for technical knowledge and abstraction in understanding and carrying out activities. In activities i and ii there is a board with predefined suggestions to help patients think of examples and complete the activities.

The definition of interested parties was called in the system of *"possíveis interessados no jogo"* (see Figure 1a). In this activity, patients are instructed to identify potential players for the game and think about sources of information and institutions in the community in general that could contribute and/or be impacted by the therapeutic game they will build. Enrichment of personas was called in the system of *"caracterização dos jogadores"* (see Figure 1b). The term *"jogadores"* (players) makes it easier for patients to understand. In this activity, patients were instructed to think about who the game they are going to build will be for, and think about who will play the game. Patients then define a name, an image, clinical symptoms, treatment that can be addressed in the game to help the player improve their clinical symptoms, and a description for the player. The modeling was presented in the system through the construction of scenes (see Figure 1c), using images close to reality, reducing the need for abstraction. In this activity, the patient is instructed to think about the story of the game, choosing the scenes and characters in the story. Later, the constructed scenes can be downloaded from the web system and imported into the Lepi game editor. For the implementation activity, the system shows instructions in the format of four videos. The videos cover explanations on how to use the Lepi game editor software, how to download created scenes, and how to import them into Lepi.

Figure 1. a) Screen with all the steps of Activity 1. b) Screen with all the steps of Activity 2. c) Screen with all the steps of Activity 3.

4.3. Evaluation

To carry out the system evaluation, we contacted the CAPS-AD. CAPS-AD is an institution designed to provide open healthcare and support services for the local community and specializes in disorders caused by alcohol and drugs. We invited all the institution's professionals, 4 of whom were interested in evaluating the system and subsequently applying it to their patients. We held three meetings with professionals. Each meeting lasted approximately one hour. At the first meeting, we presented the project and invited health

professionals, henceforth called P1, P2, P3, and P4. In the second meeting, they were able to use the system to design a digital game with therapeutic potential. They carried out the design activities proposed in the system, identified potential stakeholders in the game, characterized the players, and designed the scenes. Finally, in the third meeting, they answered the questionnaires to evaluate the system.

The health professionals were two psychologists, a social worker, and an arts monitor. On a 5-point scale related to experience with technology, P1 considered having 2 experience points, P2 considered having 3 experience points, P3 and P4 considered having 4 experience points. None of the health professionals had previously participated in digital game design activities. And none had previously used digital systems to support the therapy of their patients. The first questionnaire answered by the health professionals was based on the TAQ. The objective was to identify the perception of ease of use of the system. Nine items were presented to the health professionals who could respond on a scale of 1 to 7, where 1 was strongly disagree and 7 strongly agreed. Table 2 shows the items covered in the questionnaire and the average of the health professionals' answers. All items had an average score above 4.5 points, indicating good results in the perception of ease of use of the system.

Table 2. Result of the questionnaire for perception of ease of use of the system.

Item	Mean
I learned to use this technology quickly.	5.75
It is easy to use this technology.	6
It is easy to learn how to use this technology.	5.5
Using this technology requires little mental effort.	4.75
It is easy to remember how to use this technology.	6
Interact with this technology is clear and understandable.	5.75
This technology is easy to use without outside help.	5.5
I feel confident in using this technology.	6
I feel comfortable using this technology.	6.25

The second questionnaire contained questions about the health professionals' profiles and closed and open questions about their general perspectives when using the system. The closed questions of the second questionnaire were answered on a 5-point Likert scale. In general, the health professionals reported feeling interest, autonomy, and satisfaction when using the system, with an average of 4 points or more for these questions. Health professionals also showed interest in using the system as an alternative therapy with their patients. The only question that had an average score lower than 4 was related to the health professionals' perception of the patients finding the system easy to use. The health professionals were not sure how easy the patients would find it to use the system since each patient has their specific conditions. However, although the health professionals are not sure about ease of use, they found that patients would be interested in using the system.

For the analysis of the qualitative part of the second questionnaire, it was used the thematic analysis method. First, the data preparation step was performed, and the questionnaire with responses from the health professionals was transcribed for ATLAS.ti. By reading the responses, we identified themes and included them in the ATLAS.ti coding.

The identified themes were categorized into themes about the system, health professionals (therapists), patients, and about the therapist-patient relationship. The answers were analyzed and coded according to the themes. Figure 2 shows a diagram generated in ATLAS.ti with a list of themes and how many times they were identified in the health professionals' responses.

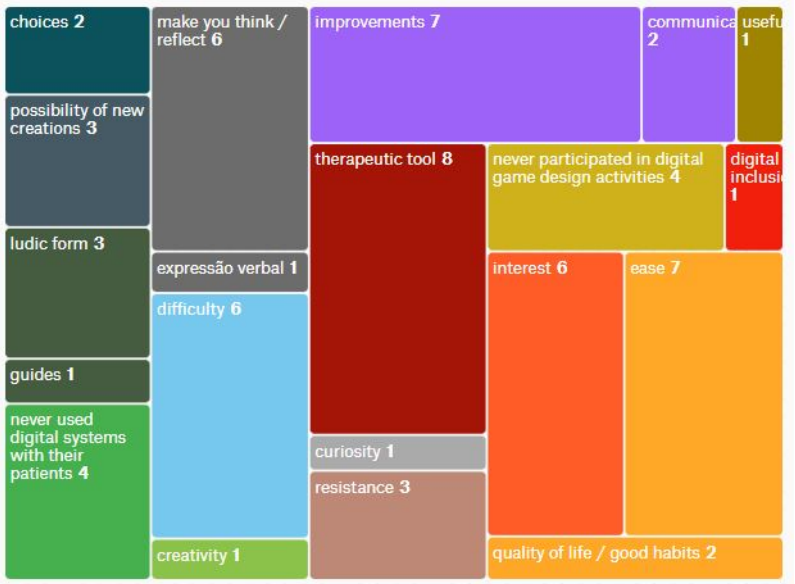

Figure 2. Result of the questionnaire about the general perspective of the health professionals when using the system. Qualitative part.

The theme that stood out the most (8 occurrences) was the potential of the system to be used as a therapeutic tool. All health professionals reported believing that the system can help in the therapy of their patients. P3 reported that the system is "a good therapeutic tool, facilitating communication between therapist and patient". P4 reported that by raising relevant themes in the creation of game design, it is possible that the system can help as one of the therapeutic tools.

In second place (7 occurrences), the themes that appeared the most were about the ease of using the system and about improvements to be made. The health professionals reported that there was not much difficulty in using the system. Although in the closed questionnaire the lowest score was about ease, in the open questionnaire they reported that they did not see many difficulties for patients. P2 reported that "the system is easy to work with because it guides you on what to do". About improvements, P4 reported the need to have an "experience of playing before creating the games" and an "illustrative video of a game created by the tool". They also indicated more specific improvements. P4 reported on the possibility of more image options for creating scenes, allowing you to include more than 3 characters in the scene and having the possibility of enriching scenes with more objects. P1 spoke about the need to facilitate the explanation for the next step. P3 reported on the need for audio description but later observed that the system already had this functionality.

In third place (6 occurrences), the themes that appeared the most were about the potential of the activities in the system to make patients think and reflect on real-life decisions, interests, and some points identified as difficulties. P3 reported that "at first, there

may be resistance from some patients, as they are not familiar with digital, but I believe that later it will awaken interest". P4 reported that the creation of the games "promotes the player's identification with the situations and characters", "can facilitate the representation of everyday choices", and "represent real situations of choices". The difficulties encountered are related to the use of the system itself. P1 reported that the "difficulty was understanding that it is necessary to click on continue". P3 found it difficult to return to the previous stages and to confirm to proceed. P4 reported as difficulty "familiarizing yourself with dialog boxes", and "understanding what they ask for in defining the steps", however, he also reported that he believes "that was a difficulty from the first contact". P3 reported that "the most playful way can arouse interest". P4 also reported that "the tool is a playful way of representing real situations of choice, promoting good habits for a better quality of life".

5. Discussion

Based on these results, our discussion seeks to bring new insights to the scientific community to inspire design research involving populations in recovery from SUDs. To do this, we discuss our findings on 5 aspects, described below.

Approximation of the population. Design professionals and HCI already know the need to get closer to end users to ensure technology solutions are adapted to the context. However, this need is even greater when it comes to vulnerable populations and little studied by the computing literature. We observed that by inserting ourselves into a real scenario of SUDs rehabilitation, we had the opportunity to identify the specific demands of that population. For example, low literacy, lack of knowledge in basic computer use, difficulty with abstraction, difficulty following a line of thought, and difficulty remembering previous activities. We also observed that this population is interested in digital games, they can think of stories and create games with the support of computing and health professionals.

Data collection methods. The number of healthcare systems that publish their usability assessment results remains just a small fraction. Quantitative questionnaires are the most prevalent evaluation method, which provides an overall measure of usability but does not identify issues that need to be resolved. The observation and qualitative data can add richness to assessments in the context of SUDs. We identified that the demands for observing the population in a real scenario and the qualitative responses of health professionals who evaluated the system brought more useful information to identify difficulties and improvements for the system.

Design implications. When designing digital solutions in the context of SUDs, it is necessary to guide the activities that the patient will perform, guiding what should be done. In activities and processes that require sequentially, it is necessary to support them in resuming the train of thought. It was also observed the importance of more visual activities and interaction based on clicking, dragging, and dropping. Other alternative forms of interaction should also be considered in an SUDs context, such as text, audio, and video interaction. Technical terms should be avoided, and the need for abstraction should be minimized. The use of the ludic was also pointed out by health professionals as a good way to arouse the interest of patients.

Interest of health professionals. The use of computer systems in the context

of SUDs rehabilitation did not seem to us to be very common. However, we observed that health professionals were very interested in using technology as an alternative form of therapy with their patients. They reported that the evaluated system can help in collaboration between patients and therapist-patient communication. We believe that this engagement of professionals is fundamental for the success of therapeutic systems and that they are willing to collaborate with computing in the construction of these systems.

Therapeutic instrument. Both in the first approximation of the population and in the evaluation of the system with health professionals, it was possible to observe that game design activities tend to have a therapeutic effect on patients. In the first step of the research, we observed an improvement in self-esteem; the feeling of being inserted and learning something different; they felt proud of themselves; were able to express themselves through the stories created for the games; and discussed ways of protection and harm reduction. In evaluating the system, health professionals considered that the system has the potential to be used as a therapeutic tool and showed interest in using the system as an alternative form of therapy with their patients.

6. Final Remarks

This research presents the design, development, and evaluation of a web system for the creation of digital games with therapeutic potential by end users. We used the DSR method and presented the results according to the steps proposed by the method. The objective of this paper was therefore to design a web system that guides end users in SUDs recovery in carrying out digital game design activities with therapeutic potential.

In the first contact with the studied population, we identified demands for the construction of the system. The system was developed and an evaluation was carried out with four health professionals the CAPS-AD. The results suggest that the system can be applied to patients in an alternative SUDs therapy context. The professionals who evaluated it showed interest in using the system with their patients.

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