The Usage of Stress Management Interventions?

Researching the habits and perception of stress and stress management

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ABSTRACT

Stress management is important for long-term cardiovascular health, as well as prevention of many other negative side effects. This is especially true for people with chronic or very high levels of stress. Effective measures for stress exist, just as effective ways of stress management. However, stress is still a present problem within our society. Therefore this study looks into the awareness of stress levels, as well as the usage of stress management interventions. It was found that the interventions, of which the main goal was stress reduction, were barely used. Furthermore this intervention usage could not be effectively stimulated through the presentation of stress measurement data or the usage of a persuasive design, as it was ineffective. However, awareness of stress levels is generally present and can be effectively increase through letting the participants measure their stress. Lastly on of the main reasons for not engaging in stress management was that participants felt either too busy or too stressed. This presents an interesting starting point for future research.

INTRODUCTION

Nearly everyone experiences stress from time to time. This is useful, as the short-term stress response, also known as the fight or flight response, can help to deal with threats, challenges and opportunities [17]. When crossing the street and a car comes flying around the corner a spike of acute stress will increase cardiovascular function and cause a release of adrenal catecholamines, including adrenaline, to allow you to jump out of the way in time [26]. However, stress is often considered a negative phenomenon, both in society and within literature. This is for good reason though, as can have detrimental effects on health [16]. Heightened cardiovascular reactivity and delayed recovery to acute stressors are prospectively associated with increased cardiovascular disease risk [6,12,45]. People that experience chronic stress also have an increased risk of chronic illness, mortality and accelerated biological ageing [19,25,36]. Moreover, greater exposure to stressful life events, experiencing a greater amount of traumatic events and a greater emotional response to daily stressors are shown to increase development and progression of Cardio Vascular Disease [11,14,44], is associated with worse health and mortality [20,27,29,38] and is linked to worse mental and physical health [3,9,10,41], respectively. Even though stress has its benefits and cannot be prevented, it is important to manage stress levels to prevent negative effects on health. This is especially true for people who have had a cardiovascular incident, to reduce the risks at further incidents.

The Maxima Medical center or MMC, is currently setting up a study that, over the course of a year, monitors different lifestyle parameters of patients that had a cardiac incident. The goal is to provide the patients with insight into these parameters and their habits that impact the chances of having another cardiac incident. Based on these insights interventions can be provided to change behavior in order to reduce the risk of further incidents. However, how the data of these lifestyle parameters is presented and if this would lead to intervention usage for stress management remains the question. It is assumed however that presentation of data on lifestyle parameters, such as stress levels, will help to change behavior. An interview with an internal heart rehabilitation psychologist further underlined that recognition of harmful behavior and stress levels that are too high is one if not the most important step in effective stress management [52].

This also presents a gap in current knowledge; much is known on the possible effects of stress on mental and physical health as well as ways to evaluate and measure stress, both objectively and subjectively. Methods and interventions that aid in stress management exist and range from psychological therapy to biofeedback devices. However, the question remains if the gathering and provision of data on stress levels actually have the potential to increase intervention usage and, in long term, increase health.

RELATED WORKS

Stress measures

Objective

As stated before chronic stress and increased reactivity on acute stress can negatively affect mental and physical health. Being able to measure this stress is the first step into gaining insight and managing stress. Both objective and subjective measure for stress exist, but in order to gain a reliable image, both should be used [16]. Some of the physical measures that can be used to evaluate stress levels, in increasing correlation strength, include brain activity, measured through an electroencephalogram (EEG), Skin conductivity, measured through Galvanic Skin Response (GSR) and lastly heart activity, measured through Heartrate Variability (HRV) [40]. HRV has also been widely supported as a measure for stress [28].

Subjective

Subjective measures exist to evaluate both stressor and perceived stress levels. Measures of stressor exposure include for example the Life Events and Difficulties Schedule (LEDS) [7], which uses a structured interview format, and the Stress and Adversity Inventory (STRAIN) [42], which is a computer-assisted methodology for online assessment of stress exposure. Furthermore, the Daily Inventory of Stressful Events (DISE) [4] or the Daily Stress Inventory (DSI) [5] can be used to measure daily stressors. However, for this particular research measuring perceived levels of stress is more suited, which can easily be done through self-reporting. The Perceived Stress Scale (PSS) [13] measures perceived stress levels related to the past month and focuses on general stress as opposed to specific. 14-Item, 10-item and 4-items versions exist, with the 10-item version having superior psychometric properties, however, all are valid for assessing stress [31]. While the PSS evaluates the perceived stress over a period of time, it is also important for this study to evaluate stress levels at a single moment in time. This can be done through the State-Trait Anxiety Index (STAI) [43] or more specifically through the use of a 6-item version, which is based on the state measure of the STAI [33], thus creating a State Anxiety Scale. This is more applicable due to the state focus as well as its briefer nature, while still having a high correlation with the 20-item scale [46].

Stress management

A key aspect to effectively managing stress is the awareness of harmful, such as chronic, stress. Managing stress often requires active engagement with interventions or stress reduction techniques and methods. Behavioral theories, such as the Integrated Behavioral Model [22], pose that behavior, such as engaging with interventions, is largely based on intention. However, this intention will not arise if there is no awareness of the problem. Creating awareness will also help to move patients through the first stages of change, as presented by the Trans-theoretical model [22]. However, the question remains if this will enough to stimulate intervention usage. In a study on stress in nurses and physicians, it was shown that there was an interest in one's stress data, however, existing coping strategies turned out to be a barrier to the adoption of new tools [35]. This could mean a limited usage of stress management interventions and techniques. It was also recommended that persuasive applications should be incorporated, that focus on integrating existing coping strategies.

While the amount of usage remains the question, there is a broad body of knowledge on stress management techniques and interventions. Examples include biofeedback devices, coping strategies, relaxation exercises, and many others. Research on biofeedback devices has been on the rise since the last decennium, first showing its promise and effectiveness [21] and later showing its possibilities as well as areas to further develop [50]. Examples of biofeedback devices already exist, which are often based on music [49] or light [51]. Other relaxation techniques that have scientific support for their effectiveness include for example progressive muscle relaxation [18], and autogenic training [32], albeit it affects only perceived stress and not HRV. Relaxation techniques in general have support for their effectiveness in anxiety reduction [48] and relaxation with pain reduction as a result [47], by making use of muscle relaxation, breathing techniques as well as music. Music therapy in particular also can reduce stress [30], as well as (yogic) breathing exercises [39]. Psychological treatments are also used to reduce stress, such as mindfulness, which has been shown to be an effective treatment to a wide range of psychological disorders [24] and stress in particular [15]. Other treatments include Cognitive behavioral therapy, which has been shown to treat many disorders

as well as managing stress [8,23]. Acceptance and Commitment therapy is also used to treat multiple problems, including stress [37]. Psycho-Educational Prevention modules are often used in hospitals, however this is no standardized method, even though research is being done on this subject [1]. Many existing applications make use of a wide range of principles and methods to help with stress management, which are often inspired by, or make use of, other principles of stress management. These applications use a number of different persuasive principles to stimulate stress management, with common strategies including personalization, self-monitoring, simulation and tailoring [2].

Research questions

With the rise of knowledge on both reliably measuring stress and interventions for stress management, an opportunity presents itself. If the stress measurement data can be used to increase intervention usage, harmful stress levels could be reduced and thus decrease its negative effect on health. The scope of the research is visualized in figure 1.
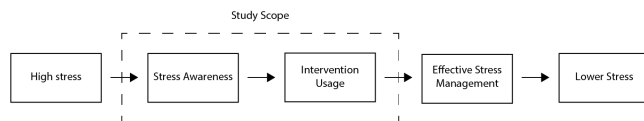

Figure 1: Study scope visualization

Based on this knowledge and the studies conducted by the MMC the following research questions are posed:

- *Does presenting graphed data from stress measurements increase awareness of stress levels?*

- *Does presenting graphed data from stress measurements increase stress management intervention usage?*

However, Michie, Stralen and West [34] pose that multiple elements are needed for behavior to be performed. In order to design for behavioral change they have created a theoretical framework, which links interventions to stimulate behavior change to an analysis of current behavior. This is presented as the COM-B model: Capabilities, Opportunities and Motivation that need to be sufficient for Behavior to occur. This model forms the hub of the 'Behavior Change Wheel' (figure 1). The BCW is a model that presents the COM-B components and links them to intervention functions; methods that stimulate and change the COM-B

components so that behavior can be performed. It furthermore includes policies that could enable those interventions to occur.
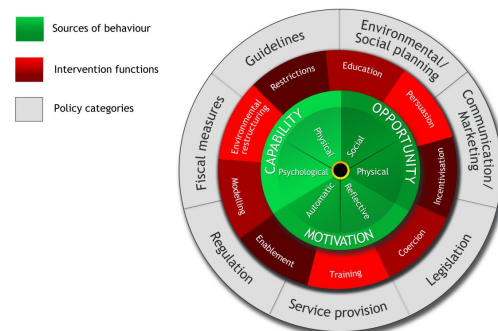

Figure 2: Behavior Change Wheel [34]**.**

This model can help in designing for stress management intervention usage. By creating a persuasive design that targets the COM-B components using the intervention functions it can try to increase stress management intervention usage. Thus the following research question is posed:

- *Does a persuasive design that targets COM-B components increase stress management intervention usage?*

It is also interesting to see if a persuasive design is more effective at increasing intervention usage than solely the presentation of stress measurement data and as such the following research question is also posed:

- *Does the usage of a persuasive design cause a higher increase in stress management invention usage than the presentation of stress management data?*

METHOD

The study had a 2x2 design, where two groups were monitored over the course of two weeks. The study was conducted with a total number of 37 participants, of which 2 had to be excluded from the study due to invalid or missing data. After recruiting the participants were extensively briefed about what was expected from them as daily interaction with the study was needed for reliable results. They were also asked to sign an informed consent form and provided with the link to the website used for the study. The participants were divided into two groups based on their participant number.

Group 1

Both groups were asked to only record their daily intervention usage during the first week. During the second week the separate conditions got introduced. Group 1, the stress measurement group, was asked to measure their stress levels each day during the second week. This was done using the PSS-4 [ref] as well as the STAI-6 [33]. These measures were selected as they provide insight both into the general stress levels over a longer period of time, a month, as well as their anxiety levels, which give insight into their stress levels at that moment. For both of these measures shortened versions were selected, to reduce completion time and because the slightly decreased reliability presents no problem as the results of these questions are not included in this study. However, the results were graphed and presented to the participant as feedback, in order to see if this would increase awareness and intervention usage. The averages of the questionnaires were plotted on a five point scale as bar charts, with the STAI-6 being translated to fit the range. The participants also continued to report their intervention usage on a daily basis.

Group 2

Group 2, the persuasive design group was asked to read persuasive messages that targeted specific COM-B components each day during the second week. In order to create these messages a COM-B analysis [34] was conducted based literature knowledge, the setup of the study and four exploratory interviews on stress and stress management [ref]. The analysis of the behavioral components and their anticipated need for change is summarized in table 1.

Table 1. COM-B Analysis

COM-B Components	What needs to happen for the target behavior to occur?	Is there a need for change?
Physical capability	Have the physical skills to take part in stress management	No, only people who can do this are included in the research.
Psychological capability	Know how to manage stress	Yes, as many people
	Know when it is important to manage stress / when stress levels are high	might not know when and how to manage their stress levels.
Physical opportunity	Have and be aware of the tools to manage stress	No, as these are provided with the research.
Social opportunity	Be in a context where stress management is an option	No, as it is not prevented or really applicable.
Reflective motivation	Believe that engaging with stress managing is important and effective.	Yes, as many people are not aware of the effects of harmful stress.
Automatic motivation	Be able to make stress management a routine/habit	Yes, as it is often experienced as difficult

This analysis is partially a hypothesis and thus needed to be further validated. To do this all components were posed as statements, e.g. "I have the physical skills to take part in stress management" and the participants were asked how much they identified with the statements. This was done using a 5-point Likert scale, ranging from "Fully disagree" to "Fully agree". This was also done after the second week of the study in order to see if the persuasive messages were effective. It also gives insight into the problems with stress management for future research.

Michie et al. [34] further provide a range of intervention functions, which are linked to COM-B components, which are possible to be used to improve the separate components. Based on the COM-B analysis a range of suitable interventions functions was selected. Consecutively, the mapping of intervention functions to specific Behavior Change techniques [34] was used to select appropriate BC techniques. Lastly these

techniques were translated to specific messages that the participants of the second group read each day. The goal of these persuasive messages was to increase the COM-B components and in turn stimulate intervention usage. The participants were also asked to record their intervention usage during the second week.

Final evaluation

After the completion of the two week study, the participants were asked to complete a questionnaire. This questionnaire inquired into their perceived awareness of their stress levels during both weeks, their general desire to reduce their stress levels over the entire course of the study and their reasons to engage and not to engage in stress management. After the completion of the two week study it was discovered that an error occurred in the data collection of the daily intervention usage. As a result, no data was collected on this. However, to compensate for this, questions were added to the questionnaire, inquiring into their intervention usage during the first and second week.

DESIGN

For the study it was important that both the collection of data and the engagement with the conditions was made as easy as possible for the participants. To facilitate this need, an online environment was set up, in the form of a website. This website was built using HTML, CSS & JavaScript. This fulfilled four functions for the participants. First, it allowed the participants to report the number of times that they had used a stress management intervention that day (daily intervention usage). Second, it allowed them to measure their stress, which was turned into a graph and presented back to the participants. Third, it provided the participants with persuasive messages and fourth, it allowed them complete the questionnaire on the COM-B components.

As seen in figure 3, the site immediately prompts the participants with the choice between reporting intervention usage and completing a stress measurement or receiving the persuasive message. When reporting intervention usage the participants are redirected to a form, which was hosted on a secure server provided by the ID department, DataFoundry. This allowed the participants to report their usage without risk. When the participants wanted to engage with their condition during the second week they are

filtered based upon their participants, to ensure equal distribution between the groups.

The participants in group 1, the measurement group, are then presented with a two forms, containing the PSS-4 [31] and the STAI-6 [46]. After completing the form, the individual results of both questionnaires were averaged and the result of the STAI-6 was scaled to match the 5 point scale of the PSS-4. Both were then plotted using the Chart.JS library and shown to the user. The advantage of this, compared to an online form services, is that the results were instantly plotted. More important however, is that the sensitive data on stress levels is only stored locally in the cache of the website, rather than permanently in a cloud. This made data leaks virtually impossible.

The participants in group 2, the persuasive messages group, were presented with a different item each day, which was based on the date. During the first day the participants were redirected to a form, which worked the same way as reporting the intervention usage, but instead it evaluated the COM-B components. Afterwards, they were directed back to the site and presented with the persuasive message of that day. The following days they were presented with a different message and the last day the COM-B components were evaluated again after the last message.
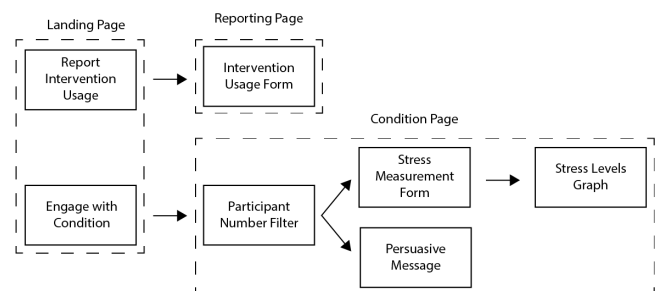

Figure 3: Website flowchart

Due to the voluntary participation in the research and the intensity of the study, namely two-times daily interaction for two weeks, it was necessary to increase ease of use of the website as much as possible. This was done in several ways. First of all everything was in one place because of the website. This also has the benefit over for example a physical diary that people are nearly always able to access it. To further improve the usage the site was made accessible through both computer and smartphone. Additionally, the number of steps required

to complete each action was brought down to a minimum.

Within this study the website functioned as the design artifact, albeit it being digital due to the limitations of the study. The design functioned as an experimental component, as describe by Wensveen and Matthews [49]. This is because a strict relation between variables was researched, namely the intervention usage, awareness and the presence or absence of the different designed conditions. Due to the statistical nature of the study and the respective results, the design of the experiment was equally important. Therefore, special attention has been paid to the definition of stress management, the measured variables as well as the briefing of the participants. As a result the research contribution is also largely empirical, however the results are further supported by the qualitative data.

RESULTS

The results that were gathered from the final questionnaire include quantitative and qualitative data. The qualitative data included the usage of interventions, the participants' awareness of their stress levels, their desire to reduce their stress and lastly their perceived effectiveness of the interventions. All these variables were measured using a 5-point Likert scale, ranging from "Not at all" to "Very much". These results can be found in table 2 and 3 for group 1 and 2 respectively. The

qualitative data included reasons why to engage or not to engage with stress management.

Quantitative results

Group 1

From the results presented in table 2 it can be seen that for the first group the intervention usage did not increase after the introduction of the condition. However, the stress awareness level did increase after the condition was introduced. A one-tailed T-test was performed, which showed that there was a significant increase in awareness. This matched the perception of the participants, because the question whether the measurements helped to create awareness scored an average of 3,235, which was slightly above "A little".

Group 2

In table 3 a very slight increase in intervention usage can be seen within group 2, however, this increase is not significant. There was no increase in awareness in the second group. When asked whether the participants found that the persuasive messages helped to engage in stress management, an average response of 2,556 was give, which was in-between "Barely" and "A little", showing a discrepancy between their perception and the intervention usage. Furthermore, to evaluate whether the persuasive messages were effective the different COM-B components were analyzed using a 5-point Likert scale.

Table 2. Measurement group results

Group 1 (stress measurements)	Week 1	Week 2	P(T<=t) one-tail	Significant increase
Intervention usage	2,235	2,118	0,350	No
Awareness	3,353	4,000	0,015	Yes
Desire for stress reduction	2,824		-	-

Table 3. Persuasive design group results

Group 2 (Persuasive messages)	Week 1	Week 2	P(T<=t) one-tail	Significant increase
Intervention usage	2,111	2,222	0,360	No
Awareness	3,389	3,389	0,500	No
Desire for stress reduction	2,833		-	-

	C-Ph	C-Ps	O-Ph	O-So	M-Re	M-Au
Week 1	3,778	3,444	4,333	3,444	3,444	2,556
Week 2	4,600	3,600	4,533	3,600	3,933	2,067
P(T<=t) one-tail	0,089	0,332	0,181	0,369	0,087	0,157
Significant increase	No	No	No	No	No	No

Table 4. Evaluation of COM-B Components

The results in table 4 show that the persuasive messages did not significantly increase the COM-B components, which could explain why no increase in intervention usage was found. However, only half of the participants received the persuasive messages, of which only 9 completed the first evaluation and 15 the second. This effect of this small sample size on the significance can also be seen.

It can also be seen that during the second week the physical capability and the physical opportunity score between "Agree" and "Fully agree", as was expected within the analysis. The social opportunity score between "Neither agree or disagree" and "Agree" highlighting that this might play a large role than expected. The psychological capability scored in this same range, as did the reflective motivation, albeit it being closer to "Agree". Lastly we can see that automatic motivation score very close to "Disagree", showing that automatic motivation is barely present. These results also suggest that psychological capability, social opportunity, reflective motivation and especially automatic motivation need to be improved in order for the behavior to occur.

General

Furthermore, it was investigated if a Pearson correlation existed between intervention usage and desire to reduce stress. No significant correlation was found between the intervention usage and desire the reduce stress during the first week. However, a significant correlation of 0,388 was found during the second week, with a P-value of 0,021.

Desire to reduce stress and Stress awareness was also compared to see if a correlation was present. During the

first week a correlation of 0,327 was found, however this correlation was not significant, as the P-value was 0,056. However, during the second week a significant correlation of 0,549 was found, with a P-value of 0,0006. Lastly, no significant correlation was found between stress awareness and intervention usage during either week.

Insight can also be gained from the separate averages. The total average of intervention usage scores 2,171 for both weeks, which is slightly above "Barely" used, indicating that engaging in stress management is not common. Furthermore, the total average awareness scored 3,371 and 3,686 for the first and second week respectively. These values fall in-between "A little" and "Fairly" aware, showing that stress awareness is at least present to some extent.

Qualitative results

The qualitative results were analyzed using a thematic analysis.

Reasons to engage in stress management

A large range of themes was found as reasons to engage in stress management. Their mere goal of being and feeling less stressed was brought up by 12 out of 35 participants. The reduction of physical effects, such as health and sleep quality, was mentioned by 7 participants. 4 participants stated that they engaged in stress management to gather insight and gain awareness of stress levels and another 4 stated that had learning goals or were curious. 2 participants used stress management to increase efficiency and lastly 8 participants stated that they did not or did not have reasons to engage in stress management.

Reasons not to engage in stress management

Several themes were found during the analysis. 10 out of 35 participants mention that they had little to no stress and didn't find it necessary to engage in stress management. More interesting however, is that 18 participants mentioned that they had too little time or were too busy or stressed to engage in stress management. Furthermore, 6 participants stated that they had other methods to deal with stress or they found that the methods provided by the research were ineffective. 5 participants mentioned that stress management was difficult or high effort, 2 mentioned that they would rather work on the task that caused stress than to engage in stress management and a single

participant stated that stress was beneficial for their concentration. The two largest themes are very clear. Firstly, there can be a low need for stress management, which is to be expected, as people are not always stressed and not all stress is negative. Secondly, that in a lot of cases participants who arguably would benefit the most from stress management, did not engage in stress management due to being busy and stressed.

CONCLUSION

A number of insights can be gained from the gathered data. First of all we can see that within this study stress management interventions are barely used. Awareness of stress levels is present to some extend and can effectively be increased with the usage of stress measurements and the presentation of this data. However, the awareness of stress is not enough to stimulate intervention usage. Furthermore, it proves difficult to create an effective persuasive design that increases COM-B components and intervention usage, although there might be potential.

The COM-B analysis proved to be decently accurate. As long as users have access to stress management tools, physical capability and opportunity should not present a problem. However, the other components still have the possibility of being improved, especially automatic motivation. Furthermore, the psychological capability should be adapted to also include that the participants have time and are not too stressed to engage in stress management.

An interesting finding was that even though the intervention usage did not increase, a significant correlation between desire to reduce stress and intervention usage was found during the second week, which was not present during the first week. This is likely due to individual differences of the participants and the large amount intervention usage scores that were the same in the first and second week. However, it is possible that the participants with a high desire to reduce stress were more influenced, causing this difference.

Lastly, the thematic analysis show that not all participants needed stress management, but this was to be expected. Interestingly, a fair amount of participants had the reduction of stress as an end goal, while other wanted to reduce negative side effects. This does show that stress is regularly considered as negative by itself. A

prominent reason why participants did not engage in stress management was that they felt "Too busy" or "Too stressed". This paradoxical effect is clearly present and might be large determinant for effective intervention usage. Further research into this phenomenon would aid in stimulating stress management when most needed. Additionally, further reducing the barriers to stress management, providing additional support and supporting a wider range of stress management techniques can also aid in this process.

DISCUSSION

Multiple important points of discussion arise after the completion of this study. First of all the definition of stress management used in this study is likely to have a large impact on the results. Stress management and intervention usage was defined as any activity which was undertaken with the main goal of reducing stress. This was done to stay close to the stress management techniques as presented earlier. As a result, meditation was classified as a stress management activity, whereas exercising was not if the main goal was to stay fit and relaxing was a side effect. This could partially explain the low amount of intervention usage, while in reality stress management might have been done more often through other activities. It should be noted however, that only 6 participants explicitly mentioned that they used other methods.

Another limiting factor of this study is the target group, which was very general. This worked well to gain a first general insight, however as shown in the qualitative results there were also a number of participants who did not deem it necessary to engage in stress management. However, for risk groups, such as cardiovascular patients stress management can be far more important. This might also affect behavior, intervention usage and motivation, so future research would do well to further look into these specific target groups. To further nuance the research it would also be good to include the data on the stress levels, to see if this has an effect on the intervention usage.

As stated in the related works section, not all stress is bad. In the future, further nuance should be made within similar studies between different types of stress and level of danger that stress can present. This would aid in effectively combatting harmful stress, but could also help to lift the negative stigma that exists around stress. While

stress reduction is one option, changing the perception of stress and using it ones advantage might also present opportunities.

Furthermore, future research would do well to conduct qualitative studies to gain more insight into the behavior around the usage of stress management interventions. This study has shown that stress management is often not used, even when it would be beneficial, however the knowledge of the exact processes is still limited. Additionally, further research into methods and their applicability to different target groups could provide further insight on the topic, as well as the difference between 'active', as a main goal, or 'passive', as a side goal, stress management. Lastly looking further into the design of the interventions themselves would provide a needed addition to this study and would guide designers to take the next step toward effective stress management.

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