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REVIEW

The effect of nature exposure on the mental health of patients: a systematic review

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Abstract

Background The effect of nature-based interventions on self-reported mental well-being in patients with physical disease is gaining increasing attention. However, there is a lack of randomized controlled trials investigating this area. Due to the massive costs in health care systems, there is a need for new strategies to address these issues and an urgent need for attention to this field. Nature-based interventions are low cost, easy to implement, and should get attention within the health care field. Therefore, the objective was to find the impact of nature interventions on mental well-being in humans with a physical disease.

Methods In four major databases (PubMed, Cinahl, PsycINFO, and Cochrane Library), a systematic review of quantitative studies of nature's impact on self-reported mental health in patients with physical disease was performed. A total of 1909 articles were retrieved but only five met the inclusion criteria and were summarized.

Results All five studies were quantitative, with a control group and a nature-based intervention. A source of heterogeneity was identified: the patients in one of the five studies were psychosomatic. In the four studies with somatic patients, significant benefit of nature on self-reported mental health outcomes was found; the only study that failed to show a significant benefit was the one with psychosomatic patients.

Conclusion A significant effect of nature on mental well-being of patients with somatic disease was found. The result in patients with psychosomatic disease is inconclusive, and more studies in this category are needed. Further research on the effect of nature on mental health is merited, with special attention to standardizing intervention type and dose as well as outcome measures within each medical discipline.

Keywords Systematic review · Patients · Nature · Nature-based interventions · Mental well-being

Introduction

The rationale for the present review was that nature's impact on human health has become a growing field of research since Kaplan introduced some breaking research in the 1980s, pointing to the fact that being in nature can restore attention in individuals [1, 2]. Evidence supports that contact with nature is beneficial for health and well-being even though humans today spend little time in nature [3, 4]. Postmodern urbanization limits access to outdoor recreation [5, 6].

Other reviews have searched for impact of nature interventions, especially within the mental health field regarding patients with a psychiatric diagnosis [7–9]. Mental health issues are increasing and it is suggested that in 2020, 15% of the health care global burden is related to mental health [4].

Mental health is defined by WHO as "a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community" [10].

Mental health issues in patients diagnosed with physical diseases pose a substantial challenge for the health care

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system, affecting millions of patients, worldwide [11]. The development of new strategies to take advantage of nature therapy is not only relevant in the psychiatric field but may have major clinical implications for practice in broad terms. Ulrich and colleagues were some of the first to describe a positive impact on rehabilitation of patients in a surgical ward, by viewing nature through a window. The patients not only achieved shorter postoperative hospitalization periods, but also a reduced need for moderate and strong analgesics as well as fewer postsurgical complications [12].

Green care is a broad term including social rehabilitation or health promotion [7]. In this review, we use the term nature-based intervention to describe any nature-based intervention that has an impact on the patient's mental well-being. These interventions are also known as eco therapy, adventure therapy, outdoor adventure intervention, eco-psychosocial intervention, lifestyle therapy, or green prescription [13].

We know little of how these nature-based interventions impact human health during or in the wake of physical disease. There is a paucity of randomized, controlled clinical trials to evaluate this important field. Furthermore, in reviews regarding clinical nature-based interventions, there are great varieties in outcome. To obtain comparable data, we focused on outcomes based on self-reported psychological functioning and well-being, excluding for instance physiological outcomes. The objective of this review was to substantiate the impact of nature interventions to improve mental well-being in humans with a physical disease. The research question was: What evidence is there to show the impact of nature-based interventions on the mental well-being of patients who have been diagnosed with a physical disease?

Methods

Literature search

The PRISMA 27-items template [14, 15] was followed. However, the protocol was not pre-registered.

The eligibility criteria were that there were no restrictions applied regarding the year of publication but that the search was limited to English articles. A systematic search for quantitative studies in four major databases was performed. The information sources were PubMed, Cinahl, PsycINFO, and Cochrane Library.

The search terms were qualified by researchers working with nature research, health professionals, and two research librarians. MeSH indexing was used. If the overall MeSH-term could be further refined by selecting a descendent subheading, this approach was used. In cases where further refinement was not possible, because there were no relevant descendant MeSH-terms, we used the overall term (e.g., psychology). We used the PICO strategy for literature search [16], and divided our search terms into blocks using the Boolean operator OR between keywords inside the specific block, and the Boolean operator AND between the blocks. Due to the relatively few hits and to not unnecessary limit the search result—and thereby missing relevant hits—the C-block was omitted.

Thus, the PICO search was as follows: (inpatient* OR outpatient* OR * OR patient*) AND ("Nature-based" OR "Open space*" OR Garden* OR Horticultur* OR Wilderness OR Countryside OR Outdoor* OR landscape* OR botanic* OR nature*) AND ("Psychosocial" OR Rehabilitation* OR Restorati* OR Recovery OR "Well-being" OR Wellbeing OR "Well being" OR Psychology* OR "Quality of Life" OR "Life Satisfaction" OR Recreati* OR Self* OR "personal development" OR "personal growth" OR grief OR crisis OR Happiness OR Anxiety OR Depression OR "psychological stress" OR "mental stress" OR Suffering OR Illness OR Spirit* OR Hope* OR Meaning* OR Resilience OR "Burn-out" OR Cope OR Coping* OR "mental health" OR mindful* OR emotion*).

The search protocol is summarized in Fig. 1.

Selecting the studies, the inclusion criteria were controlled trials and quasi-experimental studies (non-randomized allocation) with adult patients diagnosed with a physical disease, participating in nature-based interventions. Outcome was self-reported mental well-being, broadly defined as a set of key constructs related to psychological functioning. We placed no restrictions on time from diagnosis to intervention participation and no limitations regarding the duration of the intervention.

Exclusion criteria were other types of studies, e.g., observational and qualitative. Studies with patients under the age of 18 and studies targeting patients with a psychiatric diagnosis were excluded as well. Studies using 'artificial' nature for intervention (e.g., pictures of natural scenery or recordings of nature sounds) were also not included.

Titles and abstracts were screened by four separate reviewers, based on specific inclusion and exclusion criteria. We included only clinical trials and quasi-experimental studies. Only studies on adult patients were included. We excluded studies aiming at health promotion and studies focusing on artificial nature such as auditory or visual stimuli simulating nature. Full-text articles were retrieved and reviewed by the same four reviewers for additional screening. The remaining studies were read thoroughly to identify whether they met the inclusion criteria or not. To identify gray literature, and to include the newest literature, a literature search by hand was completed.

Two reviewers performed eligibility assessment independently in an un-blinded standardized manner. Disagreements between reviewers were resolved by consensus.

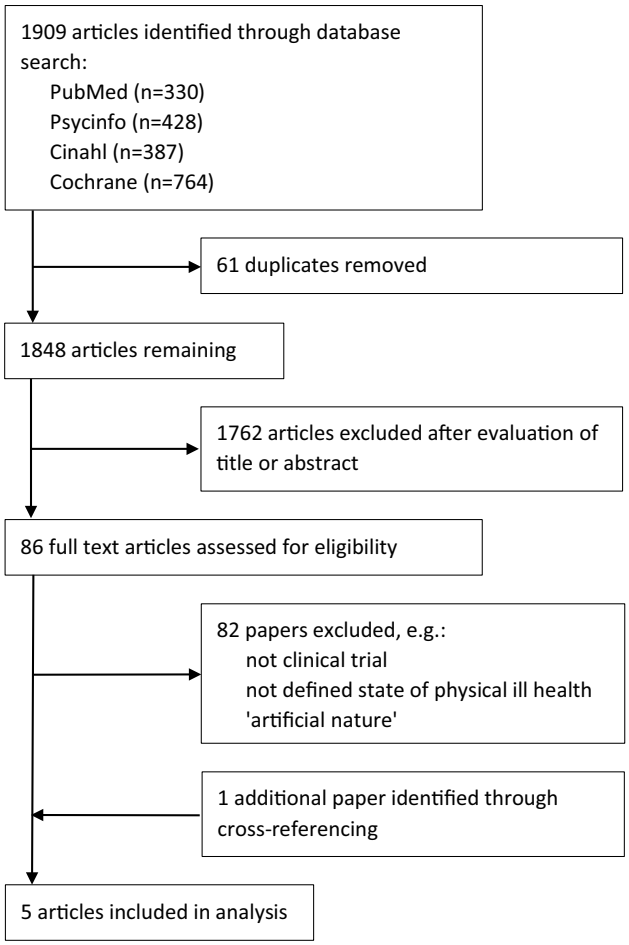

Fig. 1 Flow chart for the literature search

To assess the risk of bias and the overall quality of the studies, we used two different guidelines: the Consort checklist [17] for RCTs and the Joanna Briggs Institute [18] checklist for quasi-experimental studies. This was chosen because the included studies were either RCTs or other types of controlled trials, e.g., quasi-experiments. Three authors independently scored the included studies according to both guidelines and discussed the overall findings in plenum.

Due to heterogeneity, the studies were synthesized in a narrative way. It was not possible to perform a meta-analysis, and no additional analyses were retrieved.

Results

Study selection

The overall search yielded a total of 1909 articles in the following databases: 330 in PubMed, 428 in PsycINFO, 387 in Cinahl and 764 in Cochrane. Among these, 61 were duplicates, which were removed after identification in a MySQL database (see Flowchart Fig. 1).

All the 1848 research articles were screened by title and abstract, which yielded 86 articles for full-text reading. Of these, 82 articles were excluded due to the exclusion criteria. Most studies were excluded due to absence of somatic disease. Some studies did not assess mental well-being and a few did not rely on nature-based interventions.

Further, one paper was retrieved by hand searching.

Study characteristics

In total, five articles met the inclusion criteria. Of these, there were two RCT studies [19, 20], two quasi-experimental studies [21, 22], and one evaluation study [23]. To assess the risk of bias, checklists were used. The appraisal with Joanna Briggs' checklist was positive for all studies. Yet not all studies fulfilled all categories in the Consort checklist: for instance, none of the articles provided information on where to obtain a full protocol, nor did any of the studies assess possible harms or side effects. Thus, the studies varied with respect to scientific rigor, especially regarding the type of randomization and transparence of the protocol or data analysis.

Outcome

While all the studies used reliable and validated tools for the assessment of outcomes, there was no overlap on the chosen scales. Each study was designed to measure a specific self-reported outcome related to mental well-being outcome. The studies also showed a great variety concerning sample characteristics, diagnosis, type, and duration (dose) of the intervention. Three out of five studies incorporated physical activities as a part of the outdoor intervention. In one study, the participants were obliged to choose a restorative outdoor activity. In two studies, the participants were diagnosed with cancer. All studies included patients that had been hospitalized, which indicates that the rehabilitative aim was a priority. For all studies, the majority of participants were female.

Cimprich and Ronis reported a significant increase in total attention score in 157 women newly diagnosed with breast cancer and a mean age of 43.6 years. The intervention consisted of 120 min of self-chosen outdoor restorative activity for a period of 5 weeks [19]. The outcome was computed as an aggregate score across several cognitive attention scales (see Table 1). Using multiple regression, the study obtained a beta coefficient of 0.158 (i.e., a 'small' effect) for the intervention as a predictor for the outcome variable, when controlling for extent of surgery, education, and other variables.

In the other RCT study, including 138 patients, Watzek and colleagues did not find any significant improvement in

Table 1 Studies included in the review

Study	Sample	Intervention	Methods/design	Outcome measures[a]	Results	Limitations
Cimprich and Ronis [19]	Women with newly diagnosed breast cancer (n = 157) intervention: (n = 83), control: (n = 74). Mean age: 53.8. USA	Self-chosen restorative outdoor activities (e.g., visiting a scenic spot, tending gardens, watching a beautiful sunset) 120 min a week for 5 weeks. Controls: treatment-as-usual	RCT. Time between measurements: 5 weeks	Constructs: Symptom distress, Attentional fatigue and 'Cognitive Capacity to Direct attention' (CDA), i.e., ability to focus and concentrate Instruments: Symptom Distress Scale (SDS) Digit span forward (DSF) and backward (DSB) Trail making A and B (TMA and TMB) Necker cube pattern control (NCPC) 'Total Attention Score' (TAS): compound score of DSF/DSB, TMA/TMB, NCPC	Intervention group scored significantly better on symptom distress and cognitive measures (P ranging from 0.04 to < 0.001), except for NCPC (non-significant improvement)	Larger drop out for lower educated Non-blinded No power calculation reported
Hiltzig et al. [21]	Persons with spinal cord injury (n=21). Intervention: (n = 14; Mean Age: 42.3, 11 males), Controls: (n = 7; Mean age: 46.7, 5 males). Canada	4-day program in the countryside, living in a cottage and participating in outdoor recreational activities (e.g., fishing, canoeing)	Quasi-experiment (pretest–posttest, non-randomized design)	Constructs: Self-esteem, positive/negative affect, self-efficacy, and personal goal attainment Instruments: Rosenberg Self-Esteem Scale (RSE) Positive Affect and Negative Affect Schedule (PANAS) Moorong Self-Efficacy Scale (MSES) SCRP Cottage Program evaluation Questionnaire[b]	Significant ($P = 0.03$) increase in self-efficacy and positive affect. Differences in negative affect and self-esteem were non-significant	Small sample size Non-randomized allocation Allocation procedure not well described Non-blinded No power calculation reported

Table 1 (continued)

Study	Sample	Intervention	Methods/design	Outcome measures[a]	Results	Limitations
Raanaas et al. [22]	278 cardiac and pulmonary in-patients undergoing a 4-week rehabilitation program. Mean age: 62–64. 65.2% males. Norway	Private bedroom with a panoramic view to natural surroundings. Controls: private bedroom with view to partially or entirely blocked building	Quasi-experimental longitudinal study with blind quasi-random allocation (alphabetic by surname) to intervention or control condition. Total time span (T1-T3): 6 weeks	Constructs: Self-perceived physical and mental health, subjective well-being Instruments: The 12-item Short form Health Survey (SF-12) Circumplex model: AUP (activated-unpleasant affects) UAP (unactivated-pleasant affects) Satisfaction and time spent in room[b]	Significant increase in self-reported mental health (SF-12 MENTAL), especially in men and pulmonary patients ($P < 0.01$). No significant differences in subjective well-being (AUP/UAP)	The last measurement (T4, 2 week follow-up) did not include SF-12 or AUP/UAP No power calculation reported
Rosenberg et al. [23]	199 young adult cancer survivors (ages 18–39, mean ages: 29.3–31.3, mean years since cancer diagnosis: 3.9–4.5. 17.1% males. USA	6-day outdoor adventure program including instruction and supervision by program staff Experimental arms: P1 (n= 87; their first outdoor program); P2 (n=41; second program) WT (n=71, wait-list control group)	Quasi-experimental evaluation study (pretest–posttest, non-randomized design, wait-list control group). Timespan pre- and post-test: 5–7 weeks (2–3 weeks before and after intervention)	Constructs: Body image, self-compassion and psychosocial function (self-esteem, depression, alienation) and quality of life Instruments: Body Image Scale (BIS) Self-Compassion Scale-Short Form Psychological Screening Inventory-2 (PSI-2)	Significant ($P < 0.001$) improvement in body image, self-compassion, depression. Significant ($P < 0.01$) improvement in self-esteem, alienation, fatigue, and concentration. Effects were moderated by patients experiencing quality of life impacted by cancer treatment (greater effect if impacted). Differences in alienation, aggression, or isolation were non-significant No significant differences between P1 (first program) and P2 (second program)	Non-randomized and non-blinded. Allocation procedure not elaborated No power calculation reported

Table 1 (continued)

Study	Sample	Intervention	Methods/design	Outcome measures[a]	Results	Limitations
Watzek et al. [20]	Psychosomatic in-patients with medical diagnosis participating in a 4-week rehabilitation program (n=138; n = 69 controls, n = 69 intervention group). 84.1% were diagnosed with chronic pain. Mean age: 43.6 years 49.3% male. Switzerland	Therapeutic Nordic Walking, 45 mins, on avg. 2 times per week, for 4 weeks, in supplement to the standard intervention of the hospital (e.g., medication, nursing care, occupational, psycho- and physiotherapy). Control group only received the standard intervention	'Pragmatic RCT.' Single-blinded. Time span btw baseline and posttest: 4 week	Constructs: Pain self-efficacy, Chronic pain management, Capability for daily activities, Attitudes towards Therapeutic Nordic Walking Instruments: Pain Self-Efficacy Questionnaire (PSEQ) The Freiburg Questionnaire—Stages of Chronic Pain Management (FQ-STAPM), ratings by both therapist and patient Spinal Function Sort (SFS)—physical capabilities Questionnaire about Therapeutic Nordic Walking	No significant ($P > 0.05$) differences in any outcomes	Patients had psychosomatic symptoms, 55% had 2 comorbidities Limited control over how much standalone exercise was done by the control group

[a]Outcome measures: all studies provided information on the validity and reliability of the instruments used as primary outcome measures

[b]Secondary ad hoc questionnaires developed specifically for the study

self-efficacy in patients with psychosomatic disorders that were subjected to therapeutic nordic walking in nature [20]. The effect size was reported as cohen's $d=0.19$, which is non-significant, given the sample size.

In the study from 2012, Raanaas and colleagues assessed the effect of emotional well-being from bedroom view to natural surroundings. Unobstructed views improved self-reported mental health in 278 patients primarily admitted to a heart and lung department (187 men and 91 women, mean age 62.7 years) [22]. Using ANOVA to assess the overall effect on the outcome, the authors obtained a partial eta squared of 0.03 (a 'small' effect by most conventions).

Significant increase in self-efficacy and positive effect was found in the study by Hitzig, Alton, Leong, and Gatt [21]. 21 patients with spinal cord injury (16 men and 5 women, mean age 44.5 years) were enrolled in a therapeutic cottage program lasting 4 days. In this intervention, patients engaged in a variety of outdoor activities on land and in water. Seven patients were recruited as a control group, which did not participate in the program. The authors did not report standardized effect sizes, but based on the details of the authors Kruskal–Wallis test, we calculated epsilon squares of 0.24 and 0.23 for the two statistical significant outcomes. According to conventions, this may be considered a 'relative strong' effect.

In the evaluation study by Rosenberg and colleagues, 199 patients with a mean age of 30.6 years were included. In this study, three groups were evaluated. One group assigned to a waiting list consisted of controls (14 males/57 females), another group followed a primary program (11/76), and a third group followed a second program (9/32). This study found significant improvements in body image, self-compassion, and self-esteem and reduced depression in the group of patients enrolled in the first intervention (P1) consisting of a 6-day outdoor adventure program, compared to the controls. In the group participating in an additional intervention, no further gain in outcome was observed [23]. Based on the reported data, we calculated the effect sizes to be in the 'medium' to 'upper-medium' range, spanning from $d=0.47$ (self-esteem) to $d=0.64$ (body image).

Summarizing the results with regard to statistical significance and effect size, four out of five studies reported a significant ($\alpha=0.05$) effect on a mental health outcome as a result of a nature-based intervention and the effects sizes ranged from 'small' to 'medium' according to conventional labeling (this does not take study specifics like clinical significance and chosen outcomes into account).

Discussion

This systematic review points out the nature's impact on mental well-being in patients with physical disease. Due to the heterogeneity in outcome variables, target groups, and study design, we did not perform a meta-analysis. A total of 20 different outcome measures were described and used in these studies.

Several reviews provide a beneficial impact of nature interventions on mental health in subjects with a psychiatric illness. Few studies have evaluated the effect of nature interventions on subjects with somatic disease, a condition that inevitably causes psychological distress. The connection between mental and physical health is interesting and deserves further attention. Most illnesses are influenced by a combination of biological, psychological, and social factors [10, 24]. Nature has unused resources that are ready to be applied in a health care system lacking resources [13]. Thus, nature as a framework for healing can challenge the way in which the health care system perceives people suffering from disease. In other words, nature can promote a more holistic approach to people afflicted by disease. However, the impact of time spent in nature on mental well-being is a relatively unexplored field.

The limitations of the review are connected to the preliminary aim to include quantitative studies exclusively. This purpose was set in orders to ensure a high level of evidence. However, due to the small number of articles and variable outcomes in the studies, it is impossible to demonstrate a high evidence in the field of nature interventions aimed at improving the mental well-being of patients, during or after treatment. As the studies included here are relatively new, we see a need to include the study of nature interventions as a treatment option for somatic patients, as a growing field of research within health care research.

Two of the studies included patients with cancer diagnoses. The nature of the disease should be taken into consideration. When asked, cancer patients point out nature as the most important coping strategy [25]. Nature is pointed out as an important additional psychosocial care that supports cancer patients coping, dealing with their disease, and reconstructing their everyday life [26]. This is interesting, since two of the included studies proved a significant effect in the well-being of cancer patients. There was also a significant effect in heart and lung patients and spinal cord patients, but not in patients with chronic pain and psychosomatic comorbidity. In this study, the impact of nature itself on the mental well-being of patients was not discussed. Furthermore, there was no control in the clinical routine showing how much standalone exercise the control group did. The lack of significance could possibly be explained by a dose that is too small to be effective. In a study by Shanahan, it is stated that health outcome is dependent on both dose and duration of nature visits. Patients with depression and high blood pressure achieved health benefits from being in nature for at least 30 min. This amount of time reduces illness prevalence by 7% and 9%, respectively [27]. In another study, the importance of

duration, intensity, location, gender, age, and health status is stressed [28].

When evaluating the outcome of nature-based interventions, the distribution of gender must be taken into consideration. Most of the included patients were women, except for the study by Raanaas and colleagues [22]. In a cohort study, a variation in rehabilitation needs was observed. There were differences in the level of activity participation, and unmet needs in relation to sex, age, and cancer type were observed. Female cancer patients were more likely to express their needs and participate in rehabilitation interventions [29]. In the study by Raanaas, there was majority of male participation, but the intervention did not include physical activity.

Four of the studies included physical exercise in the intervention. Thus, it is essential to define whether the intervention relies on viewing nature, spending time in nature, or being physically active in nature. The added beneficial impact of exercising in nature has to be taken into consideration.

Furthermore, the social benefits from participating in nature-based interventions need to be explored.

Conclusions and implications for further research

This study provides support for determining the relevance of nature-based interventions aimed at patients with a physical disease. However, randomized, controlled trials and other quantitative studies could further substantiate the role relevance of nature interventions in relation to the self-reported mental health of these patients. Furthermore, there is a need for more reliable outcome measurement of nature-based interventions aimed at improving the mental well-being of patients [30]. To illuminates the importance of different feature, e.g., physical activity, social learning, it is very important to discriminate the components in nature-based interventions. Long-term follow-up on studies may also contribute to the strengthening of evidence related to nature-based interventions.

There is an urgent need to reorganize the rehabilitative practice of the health care system. Traditional support is limited to an institutional way of defining human life. Addressing the mental well-being of patients, for example by nature-based intervention, is highly needed. This review highlights that nature holds potential to increase mental well-being in patients with physical disease.

Nature-based interventions are low cost and non-invasive and no or few adverse effects have been observed. Nature-based interventions hold essential contributions to a modern health care system designed to improve human health, healing, and rehabilitation.

As stated in the article by Rosenberg et al. [23] who addressed the impact of nature on cancers survivors, the mental health of patients with a physical disease needs to be addressed, not only during active treatment but also throughout the continuum of survivorship care [31, 32].

Limitations of this review

Only few studies were included in this review. This implies a lack of robustness in the final conclusions. In addition, all studies were conducted in western industrialized countries. Thus, we cannot claim that the findings are universally applicable across different health care contexts and cultural settings. Only one study did not find any significant effects, but due to the small number of studies we cannot rule out the possibility of publication bias, i.e., negative findings not being published. Furthermore, the one study that did not find a significant effect was the only study which reported a proper power calculation as basis for determining sample size. Overall, the heterogeneity of the study designs and the diversity of the interventions and outcome measures make it hard to derive a definitive conclusion about the clinical effectiveness of nature-based interventions in general.

One study in this review included patients with a combination of somatic and psychiatric comorbidity diagnoses [20]. This challenges the review's initial aim to include somatic patients. However, we decided to include the study due to the researchers' definition of diagnoses in the chosen target group. They consider psychosomatic disease as a complex condition involving both physical and psychological components. This is a clinical issue as well, since the majorities of patients present a variety of symptoms.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors. The study is a literature review.

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