Oral Health Management through Plaque Control in Gingivitis with Autism Spectrum Disorder (ASD): A Rapid Review

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Abstract

Gingivitis is a reversible inflammatory condition of the gingival tissue that is most usually caused by microbial plaque deposits in or near the gingival sulcus. Individuals with autism spectrum disorders are predisposed to gingivitis, the prevalence of which is increasing by around 15% every year in Indonesia. Prevention of gingival problems through plaque control is the most effective alternative for the promotion and maintenance of good oral health, as well as to reduce general healthcare costs and improve patient quality of life. Therefore, this study aims to determine the best approach in performing plaque control in gingivitis patients with autism spectrum disorders (ASD). This systematic literature review is conducted using the Rapid Review method that refers to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines. Electronic searches are conducted from 6 electronic databases of the National Library of Medicine (MEDLINE/PubMED), Google Scholar, The Cochrane Library, EbscoHOST, Wiley's Library, and SAGE Journal. There are a total of six Randomized Control Trials (RCT) – interventional studies publications that have been selected based on the inclusion and exclusion criteria, and will be examined qualitatively later. The results obtained for a period of 3 weeks to 6 months showed that the approach taken is in the form of visual reinforcement as well as modification of instrument and manual plaque control methods. According to the six publications examined, oral health management combined with manual plaque control through a visual approach is the simplest and most successful method for reducing plaque in individuals with autism spectrum disorders at severity level 1, 2, or 3. Meanwhile, effectiveness can be increased by modifying the instrument and the brushing method.

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Introduction

Periodontal disease is one of the most prevalent oral and dental conditions that is generally grouped into gingivitis and periodontitis. Gingivitis is a reversible periodontal disease that manifests as gingival inflammation without loss of periodontal ligament attachment. It is caused by a buildup of plaque in the gingiva that triggers an inflammatory response.[1] Furthermore, it can develop into chronic periodontitis in susceptible individuals, such as patients with autism spectrum disorders.[2]

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The term ASD came into use in 2013 by The Diagnostic and Statistical Manual of Mental Disorders (DSM-5), covering diagnoses such as autism disorder, Asperger's disorder, childhood disintegrative disorder, and unspecified pervasive neurodevelopmental disorder.[3] The prevalence of ASD has increased significantly over the last few decades, with the male-female ratio remaining between 3 and 4:1.

Data from The Centers for Disease Control and Prevention (CDC) and the 2009-2010 National Health Interview Survey (NHIS) estimate the prevalence based on parental reports for children aged 3-17 years at 1.1%. Therefore, about 1–1.5 million Americans are living with ASD. In Indonesia, ASD prevalence was predicted to be 1 per 500, 1 per 300, and 1 per 250 children in 2000, 2010, and 2015, respectively. The Ministry of Health reported that in 2009, there were around 475,000 Indonesian

children born with autism (0.67%). Furthermore, the Ministry of Education also estimates that the prevalence is increasing by about 15% annually.[4] A study conducted by Sikarwar et al. showed that children with autism had poor oral hygiene and gingival health with a higher incidence of periodontal disease than normal children. Individuals with ASD have higher plaque and gingival index scores with an increased need for periodontal treatments such as scaling and root planing.[2]

The common gingivitis seen in individuals with autism is associated with several reasons such as irregular brushing habits, lack of manual skills, poor hand coordination, poor dental health awareness, lack of education on teeth as well as side effects of certain medications used to treat multiple manifestations of autism.[5] Additionally they were more susceptible of having fear of dental treatment due to their condition which is highly sensitive to kinds of stressful stimulus received by the sensory organs (ears, eyes, or skin).[6] Mandasari et al. found that the application of special care dentistry (SCD) in Indonesia, especially in Jakarta, is still lacking. This is due to various obstacles such as lack of operator experience, inadequate treatment facilities, inadequate staff to meet the special needs of patients, difficulties in managing patient behavior problems, time longer required, and lack of interest in treating patients with ASD.[7] The availability of professional health care workers knowledgeable of the ASD's are also still lacking. The priority given on the topic of oral health was low, thus there is a necessity to educate them on oral health in order to reach children at an early age regardless whether they have ASD or not.[8] Gingivitis was more prevalent in individuals with mixed and permanent dentition. This is consistent with other studies, where the incidence was significantly higher in older individuals with autism.[9,10]

In conclusion, the prevention of gingivitis through plaque control can be the most effective alternative to improve and maintain oral health, especially gingival health for people with ASD at all severity levels, to reduce general health costs and improve quality of life. Moreover, studies on dental and oral health care through plaque control in gingivitis sufferers with ASD determine the most effective approach.

Materials and methods

This study was conducted using a rapid review method. Specific questions were designed based on the concept of the PICO framework, as follows: Population: Gingivitis patients with ASD; Intervention: Plaque control treatment with a specific approach; Comparison: Individuals without receiving plaque control treatment with a specific approach; Outcome: Changes in plaque or gingival index in gingivitis patients with ASD. Furthermore, the search and selection of articles to be analyzed were carried out according to the Preferred Reporting of Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[11] The article search strategy was conducted on six electronic search engines, namely: National Library of Medicine (MEDLINE/PubMED), Google Scholar, The Cochrane Library, EbscoHOST, Wiley's Library, and SAGE Journal. In this stage, several keywords were used combined with boolean operators as follows: (Gingivitis) AND (Plaque Control) AND ((Autism) OR (Autism Spectrum Disorder)). Medical Subject Headings (MeSH) were utilized to focus the search and identify more relevant references in the MEDLINE/PubMED and The Cochrane Library databases, and free text was used in other electronic databases. Additional resources were gathered by reviewing reference lists from relevant studies through handpicking and snowballing methods. Figure 1 shows the flow chart of PRISMA as the article selection process. Following the selection of several articles and the availability of full-text versions, all articles were read in their entirety and analyzed using the inclusion and exclusion criteria summarized in Table 1. Qualitative analysis was used to select and examine the results and findings.

Inclusion Criteria	Exclusion Criteria
1) Articles published in the last 10 years 2) Articles in English 3) Articles consisting of full text 4) Articles with Randomized Control Trials (RCTs) designs or intervention/experimental study that meets the requirements below: (1) The articles aim to assess the efficacy of plaque control in patients with ASD disorders through a specific approach. (2) The subjects are children or adults with gingivitis with ASD (3) The test group received oral health management in the form of plaque control as a comparison before and after treatment.	1) Experimental study on non-humans or animals 2) Articles with a systematic review, meta-analyses, and other designs with a level of validity under interventional study based on an evidence-based pyramid. 3) Inaccessible article.

Table 1. Inclusion and Exclusion Criteria.

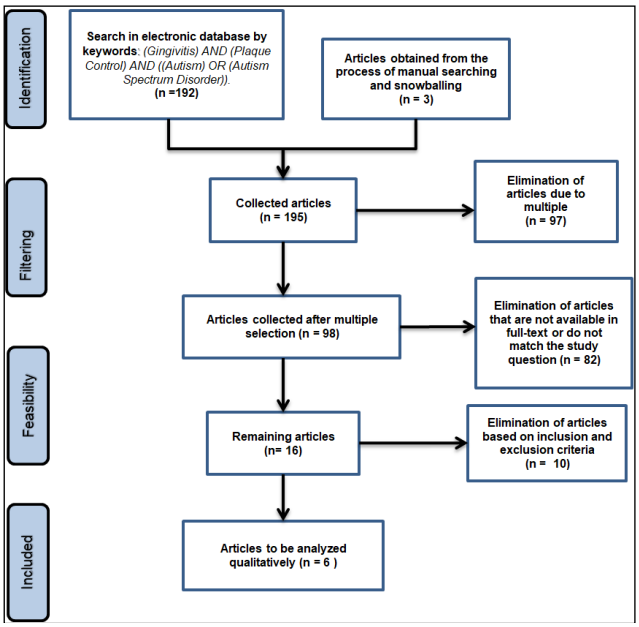

Figure 1. PRISMA chart.

Results

After conducting a search utilizing six electronic search engines and picking articles from an initial pool of 195, six articles met the inclusion requirements. Then, the results of data extraction from the six articles are summarized in Table 2.

Severity Level	Communication and Social Interaction	Limitations, Repetitive Behavior
Level 1 (*Low-level*)	Little need for support, deficits in social communication causing marked impairment, difficulty initiating social interactions and responding to atypical or failed social offers, and lack of interest in social interactions.	Inflexible behavior, causing significant impairment in the functioning of one or more word/context relationships, difficulty in changing activities, and having problems in organizing and planning that hinder independence.
Level 2 (*Mid-level*)	A significant deficit in verbal and nonverbal social communication skills; marked social impairment even with adequate support; initiates limited social interaction; and less/abnormal responses to social offers from others.	Inflexible behavior; difficulty adapting to change, or other restrictive or repetitive behavior that occurs frequently and can be noticed by someone who is seeing it for the first time; and difficulty changing focus or action.
Level 3 (*High-level*)	Severe deficits in verbal and nonverbal social communication skills lead to severe impairment of functioning, very limited initiating social interactions, and minimal response to social offers of others.	Inflexible behavior; severe difficulty adapting to change, or other restrictive and repetitive behaviors that significantly impair the functioning of any aspect of life; and high difficulty changing focus or action.

Table 3. Severity of ASD[21,22]

Discussion

Dental and oral health care is a component of maintaining oral hygiene in order to avert the formation and progression of gingival disorders in the future.[12] Gingivitis often occurs in children and adolescents with a prevalence of more than 60%.[13] Poor oral hygiene neglect during childhood and adolescence can have a number of harmful consequences, including a negative influence on the quality of life among ASD sufferers.[14] The levels in the severity of ASD sufferers are summarized in Table 3. Gingivitis rarely evolves to periodontitis in children, although it is a determining factor in the likelihood of alveolar bone deterioration in adulthood when left untreated.[15]

Several attempts have been undertaken to discover the optimum way to plaque management treatment in ASD patients of various severity levels. Six publications were retrieved, and the findings were analyzed, beginning with Yanlin Du et al. (2020) and Popple ben et al. (2016), both of which conducted studies with a visual approach via posters and films. The consistent decrease in plaque scores in the experimental group, coupled with parental reports of changes in their child's behavior, showed that the TBVP (Toothbrushing Visual Pedagogy) approach is an effective way of future intervention efforts.[16] The use of TBVP in dentistry is effective for preventive measures and it offers an alternative approach to healthcare professionals when teaching tooth brushing to their patients diagnosed with ASD, particularly in children with poorer basic oral hygiene and higher rates of gingivitis.[13] Significant improvements in oral health were observed when compared to oral health conditions previously, which tended to show a decrease in plaque and gingivitis rates after TBVP intervention after 3 and 6 months. Furthermore, sociodemographic factors and child development profiles did not significantly influence the likelihood of plaque index improvement.

According to Popple ben et al. (2016), the likelihood of an increase in overall oral hygiene was attributable to the twice-daily reminder e-mails that were sent to the participants' parents to remind them to view the assigned video and wash their teeth. The frequency of these reminders has promoted good oral hygiene practices regardless of video content, making it a higher priority in daily routine.[16]

Vajat et al. (2015) and Silva et al. (2020) compared the manual plaque control instrument used, between manual and electric or powered toothbrushes. Electric toothbrushes, first

introduced in the 1960s, are used as an alternative to manual toothbrushes, which are recognized to benefit people with special needs. The two studies showed slightly different results where Vajat et al. (2015) reported a significant reduction in clinical parameters in the use of electric toothbrushes compared to manual in individuals with special needs.[17] Decreased plaque and gingival scores in participants can also be associated with constant reinforcement of OHI (Oral Health Instructions) given to the subject and supervision by parents.[17]

The study by Vajawat et al. (2015) has been equipped with the detection of red complex organisms (*Porphyromonas gingivalis, Tannerella forsythia,* and *Treponema denticola*) using PCR (Polymerase Chain Reaction). As a result, no statistically significant reduction in red complex organisms was seen in the subjects. This was achievable since the study did not scale the participants ahead of time, therefore no substantial reduction in bacteria was obtained. The PCR technique detects the presence of red complex organisms hence the slightest number will show a positive result. In contrast, the technique used does not provide a quantitative assessment of the number of bacteria such as the real-time PCR technique since the magnitude of the decrease in the number of red complex organisms is unknown.[17]

Silva et al. (2020) stated that the use of electric and manual toothbrushes has almost the same efficiency in reducing plaque, but electric brushes give better cleaning. Brushing teeth is deemed effective when it results in a plaque reduction of more than or equal to 60%, with reduction obtained by combined manual and electric methods above 70%.[14] The duration and movement of brushing teeth are the main factors for good oral hygiene; hence electric toothbrushes are more effective at removing plaque. The fascination with technology can operate as motivation, increasing brushing duration and compensating for the low physical dexterity found while using a manual toothbrush, which restricts the effectiveness of plaque removal.[18]

The research of Sadashiva et al. (2018) is also about instruments more easily used by people with autism or individuals with special needs. The capacity of children to operate the toothbrush in the oral cavity varies depending on their dexterity at various stages of physical and neurological development. Children with special needs and neurodevelopmental disorders such as autism, cerebral palsy, and epilepsy find it more difficult to maintain oral hygiene.[12] Furthermore, Sadashiva et al. used the Novel Pediatric Oral Hygiene Need Station (Modified Oral Irrigation Device) and the instruments include brushing, flossing (with water), and rinsing in a single device for better oral hygiene. The water jet from the brush head is useful for cleaning between teeth as well as within gingival crevices and it reaches areas that are difficult to access thereby washing away plaque. The finding showed that the NPN (Novel Pediatric Needs) Station, which is a modified oral irrigation device, was more effective at removing plaque than manual brushing. This method combined the effects of brushing, flossing (with water), and rinsing simultaneously, thereby requiring no special motor skills.[12]

Min Oh et al. (2016) used a toothbrush toothpick method to remove plaque in the gingival sulcus and proximal area and to increase the effect of gingival massage in patients with early-stage gingivitis. This modified technique is based on the necessity of plaque control in the proximal and gingival sulcus for people with special requirements.[19] The toothpick method is conducted by pushing the toothbrush while moving in a short zigzag vibration, either from the labial or buccal to the lingual direction or vice versa. The bristle tip of the toothbrush is placed at an angle of 30o to the tooth's long axis anteriorly and about 70^{o} posteriorly.[19] The results showed that brushing teeth using the toothpick method in persons with disabilities or individuals with special needs is effective to improve gingival health. It is indicated by a significant decrease in the gingival bleeding index, PMA index, PHP index, CPI, and bad breath after a 6-month study. Therefore, this method is recommended to treat gingival health for people with disabilities and special needs as one of the dental and oral health programs.[19]

Oral conditions like periodontal diseases may impair the individual's health and quality of life. Findings shown that much more severe disease such as periodontitis may give preponderant effect on the patients OHRQoL (Oral Health Related Quality of Life) compared to those who only have gingivitis regardless whether they had ASD or not, thus demands attention from the health authorities.[20] All of the

above plaque control procedures can be applied to all individuals with ASD at all severity levels, but the duration and level of difficulty in introducing the method or instrument increases with the severity. The limitation on dental and oral health care through plaque control in gingivitis sufferers with autism spectrum disorders is that these studies focused only on the effectiveness of mechanical plaque control and there has been no such test in gingivitis patients with ASD. Another limitation is the relatively small number of participants and some studies stated that participants withdrew during the study period due to uncooperativeness. This is undeniable because the subjects are individuals with ASD or with special needs. Efforts should be made to preserve the constancy of the number of research participants from beginning to end. As a result, data analysis may be carried out with a larger number of samples, obtaining a more representative validity of the study.

Conclusions

Based on the analysis of all articles collected, dental and oral health care through manual plaque control with a visual approach is considered the easiest and most effective method in reducing the amount of plaque in gingivitis patients with ASD for all levels of severity. The manual plaque control technique can be made more effective by using unique methods and devices designed to treat the condition of people with ASD. Further study is suggested to conduct a review of experimental and observational research with longer control periods and a larger number of participants to obtained more representative results.

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Declaration of Interest

The authors report no conflict of interest.

No	Author (Year)	Study Design	Study Time	Participant	Plaque Control Intervention	Result	Conclusion
1.	Vajawat *et al.*[17] (2015)	RCT	February – May 2021 (4 Months)	40 patients were divided into 2 groups: 1. Experimental Group: 20 patients 2. Control Group: 20 patients	All groups were instructed to brush their teeth 2 times a day for 3 minutes every day 1. Experimental Group: Using a powered toothbrush 2. Control Group: Using a manual toothbrush	1. There was a higher decrease in Plaque for the experimental group from 1.03 ± 0.37 to 0.71 ± 0.3, compared to the control group from 1.03 ± 0.26 to 0.93 ± 0.29 2. There was a higher decrease in the gingival index in the experimental group from 0.75 ± 0.29 to 0.49 ± 0.25, compared to the control from 0.81 ± 0.23 to 0.65 ± 0.20 3. For the bacterial load (*P. gingivalis, T. forsythia, and T. denticola*), both the experimental and control groups decreased but not significantly.	In patients with ASD, powered (electric) toothbrushes resulted in significant improvements in plaque control and gingival health, when constant reinforcement OHI was administered. However, there was no difference in the detection rate of complex organisms between the groups.
2.	Yanlin *et al.*[13] (2020)	Interventional/ experimental study	3 – 6 Months	122 preschool children with ASD and their parents in Hong Kong between 2.5 and 7 years old.	1. All participants received TBVP (Toothbrushing Visual Pedagogy). A flip chart containing 13 photographs was used as TBVP, which sequentially showed a boy describing the steps for brushing teeth. A training DVD was also provided along with a flip chart for parents and staff at the training center 2. After 3 months from the initial intervention, a clinic appointment was made. Oral hygiene instructions were reinforced using each method with the new toothbrush and toothpaste provided.	1. There was no significant difference in the sociodemographic profile of children in terms of gender, level of formal education of parents/PCG, level of family income, and developmental profile between participants who graduated and did not. 2. There was a significant change in the score and the mean plaque index (PI) from 1.00 to 0.65. Similarly, there was a significant reduction of the 'percentage of area with plaque' at 3 and 6 months compared to baseline from 84% to 61.5%. 3. There was a significant change in the gingival index (GI) score over time from 0.91 to 0.59. Similarly, the average 'percentage of area with gingivitis' also decreased significantly over time, at 3 and 6 months from 83% to 57.5%.	Findings suggest TBVP was effective in improving oral hygiene maintenance and periodontal conditions among individuals diagnosed with ASD.
3.	MinOh *et al.*[19] (2016)	Interventional/ experimental study	6 Months	35 adults with disabilities who have been hospitalized at a facility in Jeju province. Participants aged 10 - 30 years and classified by type of disability such as intellectual disability, physical ability, encephalopathy, autism, and visual impairment.	1. The toothpick method was given to all experimental groups at 2-week intervals for 6 months (a total of 11 times) after scaling both the experimental and control groups. 2. While educational instructions were provided with only a rolling method to the control group.	The downward trend was found in all items such as the gingival index, PMA index, PHP index, Malodor, and the CPI (Critical Periodontal Index) index, and was statistically significantly different ($p<0.01$), before and 6 months later in the experimental group. - GI: from 3.57 to 2.24 - PMA: from 22.4 to 12.77 - PHP: from 9.49 to 8.03 - Oral Malodor: from 3.63 to 2.29 - CPI: from 3.29 to 1.54	In conclusion, oral health as measured by items such as GBI, PMA, PHP, CPI, and VSC (Volatile Sulfuric Compound) greatly improved after 6 months of oral care with the toothpick method, hence it was recommended to treat using this method for people who have mental or other limitations to support dental health program.

4.	Sadashiva *et al.* [12] (2018)	RCT – Pilot Study	No information	12 children aged 5.5 – 6.5 years. Divided into 2 groups: - Experimental Group 6 people Control Group 6 people	- Control Group: instructed to brush teeth with a commercially available ordinary pediatric toothbrush and fluoridated toothpaste - Experimental Group: instructed to brush teeth with a novel pediatric oral hygiene need (NPN) with a commercially available fluoride toothpaste.	1. The comparison of the mean intragroup plaque scores in group 1 (manual brushing) before and after brushing teeth was 0.51600 ± 0.1039 and 0.28183 ± 0.0838, respectively. 2. The comparison of the mean intragroup plaque scores on the modified oral irrigator (NPN) was 0.56833 ± 0.0652 and 0.14500 ± 0.04593. The difference was very statistically significant	Children under 6-7 years are still developing fine motor skills. It was found that the NPN Station – as a modified oral irrigation device was proven to be more effective than the use of a manual toothbrush because it combined the effects of brushing, flossing (water floss), and rinsing on children's teeth simultaneously and at the same time not demanding special motor skills.
5.	Popple *et al.*[16] (2016)	RCT – Pilot Study	3 weeks	18 Children aged 5-14 years with a ratio of 10:8 for boys and girls, all of whom were Yale-New Haven Hospital Pediatric Dentistry clinic patients. Divided equally into 9 experimental groups and 9 control groups	1. Participants were randomly assigned to receive a control video or an intervention video during the study. These videos are 1 minute and 6 seconds long. They were emailed at 5:30 am and 4:30 pm daily for 3 weeks starting the morning after the first clinical visit. 2. Intervention videos model proper brushing techniques with closed narration and captions, allowing multiple ways to understand the message and enhance its effect.	1. Parents reported that the control video had helped the brushing process. Regular practice and focus on videos give their children time to prepare for brushing hence the sessions are completed more successfully. 2. Many patients' behavior in the clinic improves during the clinical visit. Most of the participants became more comfortable in the clinic at each visit. 3. The plaque index of the test group dropped drastically from 1.78 to 0.38 while the control group only dropped slightly from 1.75 to 1.20.	The results showed that oral hygiene improved slightly in the intervention and control groups. Although it was not statistically significant, possibly due to the small sample size, the findings are promising. Consistent decrease in plaque scores in the experimental group during the intervention, coupled with parental reports about the success of the intervention. This article shows that many children with ASD can brush their teeth effectively with proper support. Furthermore, video modeling paired with email reminders can be a good means of providing information and resources to members of the autism community.
6.	Silva *et al.* [14] (2020)	RCT	3 weeks	Participants totaled 29 patients with 11 males and 18 females. They were diagnosed with Down syndrome or were patients with special needs with an average age of 9.03 years.	1. The participants were given a toothbrush that matched the experimental group to which they were assigned along with the toothpaste. No guidance was given on tooth brushing technique 2. In the first evaluation period. 16 participants used a conventional toothbrush, and the rest used an electric rotational oscillatory toothbrush. 3. In the second evaluation period, the type of toothbrush used by each group was exchanged. 4. No oral hygiene procedures were performed 23 to 25 hours before each evaluation, for accumulation purposes intentional biofilm. 5. During the evaluation, participants were asked to brush with the same technique. Then, used toothbrushes were collected and participants underwent a seven-day washout period, during which they returned to their usual brushing practices (before joining the study).	1. Plaque changes were seen using The Quigley Hein Index. Then the percentage was calculated using the formula: % biofilm reduction = (BTbt-BTat)/BTbt X 100, where BTbt = biofilm disclosed before toothbrushing; BTat = Biofilm disclosed after toothbrushing. 2. Based on the type of toothbrush used, it was found that there was no significant difference in the changes in the biofilm, where before (ET: 2.39 ± 0.62; MT: 2.25 ± 0.58; p = 0.390) and after (ET: 0.73 ± 0.36; MT: 0.73 ± 0.34; p = 0.985). However, the use of ET showed a decrease in biofilms greater than 70% in most of the participants. (ET = Electric Toothbrush MT = Manual Toothbrush) 3. Behavioral assessment was carried out using the Frankl Behavior Scale with two types of toothbrushes while clinical evaluation was carried out for biofilm measurement. 4. The attitude of the participants regarding the use of an electric toothbrush was 86.2% cooperative while for a manual toothbrush 82.8% was cooperative. Overall, there was no significant difference in tooth brushing behavior with both types of toothbrushes (p = 1,000).	This study showed that electric and manual toothbrushes were equally effective at removing biofilm. Children and adolescents with Down syndrome or with special needs are classified as cooperative with both types of mechanical plaque control.

Table 1. Results of Data Extraction.

*PMA: Pappilary-Marginal Attachment Index; GBI: Gingival Bleeding Index; PHP: Personal Hygiene Performance.

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