



# Psychometric Properties of the Croatian Version of the Multiple Sclerosis International Quality of Life Questionnaire



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## ABSTRACT

**Aims** This study aimed to investigate the psychometric properties of the Multiple Sclerosis International Quality of Life (MusiQoL) questionnaire for Croatian-speaking MS patients.

**Instrument & Methods** This descriptive study was conducted in 2024 at Clinical Hospital Centre in Osijek, Croatia. Eighty-two patients with multiple sclerosis (MS) participated in the study (51 female and 31 male, mean age 42.6±11.9 years). The instrument used in this study was the MusiQoL questionnaire, which was translated into Croatian language using the forward-backward translation method. The data was descriptively analyzed. Cronbach's  $\alpha$  internal consistency coefficient and test-retest analyses were conducted for reliability. Pearson's correlation coefficient (r) was used to analyze the relationship between the MusiQoL index and dimensions. Exploratory factor analysis was conducted to test construct validity.

**Findings** The mean for the MusiQoL index was 64.18±17.13, while the dimension scores ranged from 54.73±28.12 to 84.05±18.85. High internal consistency was found for the MusiQoL index ( $\alpha$ : 0.93). All dimensions of the MusiQoL showed high internal consistency ( $\alpha$ : 0.75-0.95). The intra-class correlation coefficient of the MusiQoL dimensions and MusiQoL index were 0.949-0.971 and 0.911, respectively. There was a moderately strong relationship between the MusiQoL index and dimensions (r: 0.43-0.86). Bartlett's significance test of the correlation matrix is high and significant ( $\chi^2=2028.41$ ;  $p<0.001$ ). The Kaiser-Meyer-Olkin coefficient was calculated as 0.801. The extracted factors explained 66.10% of the variance, and the range of factor loading was 0.52-0.90.

**Conclusion** The Croatian version of the MusiQoL questionnaire is valid and reliable for measuring the quality of life among Croatian-speaking MS patients. It is especially useful for measuring health-related quality of life in clinical practice.

**Keywords** Multiple Sclerosis; Quality of Life; Patients; Croatia

## CITATION LINKS

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## Introduction

Multiple sclerosis (MS) is a chronic progressive inflammatory demyelinating disease of the central nervous system (CNS) [1]. It is also one of the most common diseases that affects the CNS. It has a lifetime risk of 1 in 400 cases [2], decreasing performance in about 75% of patients [3]. MS is usually diagnosed in people aged from 20 to 40 years, and it is more often diagnosed in females. In around 15 % of patients, disabilities often become severe in a short period of time. The most usual disabilities caused by MS are lower urinary tract symptoms (LUTS) and sexual disorders (SD) [1]. LUTS represent a group of symptoms that are caused by diseases and medical conditions of the bladder and urethra. The International Continence Society (ICS) separates LUTS into three groups: storage, voiding, and postmicturition symptoms. The prevalence of LUTS in the general population is high, measuring from 64.3% to 76.3%. Severe cases of LUTS, especially when reported among patients suffering from another primary chronic disease, are associated with a decrease in the quality of life (QoL), and that is the reason why proper management of LUTS is a must for maintaining the patient's QoL and wellbeing. It is estimated that around 90% of MS patients suffer from some types of LUTS. LUTS in MS patients range from urgency to urge urinary incontinence, incomplete bladder emptying, or hesitancy. Because of the multifocal and diffuse involvement of the CNS, LUTS in MS patients differ in intensity among different patients. In addition, LUTS are a serious risk to upper urinary tract safety. The most common LUTS in MS patients are urgency, frequency, and neurogenic detrusor overactivity (NDO) [3]. On the other hand, the North American Research Committee on MS (NARCOMS) estimated that around 65% of MS patients that report one or more LUTS, usually suffer from some type of SDs. The prevalence of SD among women with MS ranges from 34% to 85%, while in men, it varies between 50% and 90% [1]. Therefore, MS, which results in a wide range of clinical manifestations, greatly impacts patients' health-related quality of life (HRQoL) [2]. HRQoL is QoL aspect that mainly includes physical, emotional and social health and general well-being. In general, HRQoL studies the impact of diseases and treatments on everyday functions or disabilities, and it represents influence of health and well-being perception on ability to live satisfying life. HRQoL measurements became important instrument in patients' health assessment, treatment efficacy evaluation and care management. Results of HRQoL measure can also often improve the detection of unrecognized MS symptoms and stimulate communication between medical professionals and patients [4]. Health-related quality of life (HRQoL) indicators often appear on questionnaires that assess individuals' health status [4-7].

When measuring and assessing the HRQoL of MS patients, it is very important to ensure that the patient's perception is also accurately considered [8]. In 2004 and 2005, two papers reported 20 questionnaires designed for MS patients [9, 10], and today, the number of MS-orientated questionnaires is even larger.

Authors of the mentioned papers reported that none of those 20 questionnaires from that period specifically reflected the patients' point of view on the impact of MS on their everyday lives and that only a few included self-reported measures.

Because of earlier mentioned problems and lapses of questionnaires designed for MS patients, Simeoni *et al.* [11] collaborated with neurologists from 15 countries including Argentina, Canada, France, Germany, Greece, Israel, Italy, Lebanon, Norway, Russia, South Africa, Spain, Turkey, United Kingdom, and USA. They offered a new questionnaire for MS patients, the Multiple Sclerosis International Quality of Life (MusiQoL) questionnaire. MusiQoL is a specific questionnaire that includes the views of patients with MS about the impact of the disease on their daily lives and assesses various dimensions of their lives [12]. The MusiQoL questionnaire consists of 31 items that are divided into 9 different dimensions. Dimensions of questionnaire are: activity of daily living (ADL) with 8 items, psychological well-being (PWB) with 4 items, symptoms (SPT) with 3 items, relationships with friends (RFR) with 4 items, family relationships (RFa) with 3 items, satisfaction with health care system (RHCS) with 3 items, sentimental and sexual life (SSL) with 2 items, coping (COP) with 2 items and rejection dimension (REJ) with 2 items. The total questionnaire score ranges from 0 to 100 with lower score indicating worse HRQoL of MS patients [11].

Questionnaires designed for measuring HRQoL of MS patients that are currently available and most frequently used in clinical practice in Croatia are Functional Assessment of Multiple Sclerosis (FAMS) [13], Multiple Sclerosis Impact Scale 29 (MSIS-29) [14], and Multiple Sclerosis Quality of Life-54 Instrument (MSQOL-54) [15].

The reason why we chose to validate the Croatian version of the MusiQoL questionnaire to assess HRQoL of MS patients rather than use already translated and clinically used questionnaires in Croatia is mainly because of the MusiQoL questionnaire's specific design, which is easy to administer. It is easily understandable by participants and covers several life domains. Other advantages include the short time required to complete the questionnaire [11].

The MusiQoL questionnaire's advantages fill in the gaps that previous studies on MS quality of life (QoL) tools conducted in Croatia had. This study aimed to investigate the psychometric properties of the MusiQoL questionnaire for Croatian-speaking MS patients.

## Instrument and Methods

This descriptive study was conducted in 2024 at Clinical Hospital Centre in Osijek, Croatia. We received approval from the original author to translate the MusiQoL questionnaire [12] into Croatian (nine different dimensions: ADL-activity of daily living, PWB-psychological well-being, SPT-symptoms, RFr-relationships with friends, RFa-family relationships, RHCS-relationship with healthcare system, SSL-sentimental and sexual life, COP-coping and REJ-rejection). Forward-backward translation was used to translate the original version into Croatian. Two bilingual researchers translated the original tool into Croatian in the forward-translation stage. Then, in the back-translation stage, the third translator, who had not previously encountered the original tool, translated the Croatian version back into English. Guillemin *et al.* [16] and Beaton *et al.* [17] described the mentioned translation and adaptation procedures in detail.

Two main analyses were performed for reliability. Firstly, Cronbach's  $\alpha$  coefficient value was calculated for each dimension of the MusiQoL questionnaire and for the MusiQoL index to evaluate whether the items of MusiQoL were consistent [18]. Secondly, test-retest reliability was evaluated. For the reproducibility of the MusiQoL, the similarity between the two separate assessments was observed with the intra-class correlation coefficient (ICC, 95% CI) [19]. The normality of the distribution for variables was verified by the Shapiro-Wilk test. Pearson's correlation coefficient ( $r$ ) was used to analyze the relationship between the MusiQoL index and dimensions to evaluate convergent validity [20].

Construct validity was examined using exploratory factor analysis (EFA) under the principal components model with the varimax rotation. The sample size was determined as minimum of 80 individuals using a G\*Power set to Cohen's medium effect size of 0.5, a significant level of 0.05, and a statistical power of 0.8. using a G\*Power set to Cohen's medium effect size of 0.5, a significance level of 0.05, and a statistical power of 0.8. The sampling adequacy was deemed sufficient, with a Kaiser-Meyer-Olkin (KMO) value of 0.7-1.0. At the same time, Barlett's test of sphericity (BTS) showed significance at  $p < 0.001$ , indicating the usefulness of EFA for data analysis [21, 22]. Patients who underwent neurological care at Clinical Hospital Centre Osijek were randomly selected for this study. Before we started research, all patients were required to sign a statement of informed consent. We examined the scree plot, the percentage of the variance explained by the factorial model, and the patterns of the factor loadings.

## Findings

Eighty-two MS patients (51 female and 31 male), with a mean age of  $42.6 \pm 11.9$  years, participated in this study.

The mean score for the MusiQoL index score measured  $64.18 \pm 17.13$ . Cronbach's  $\alpha$  for MusiQoL index and dimensions ranged from 0.75 to 0.95, indicating good to excellent internal consistency. There was a strong relationship between the MusiQoL index with ADL, PWB, SPT, SSL, COP, and REJ ( $p < 0.05$ ). MusiQoL index was moderately related to RFr, RFa, and RHCS ( $p < 0.05$ ; Table 1).

**Table 1.** Descriptive statistics, internal consistency, and correlation of the MusiQoL dimensions and MusiQoL index

Parameter (n)	Score	Median (IQR)	Cronbach's $\alpha$	r
Activities of daily living (8)	54.73 $\pm$ 28.12	55 (40)	0.95	0.86*
Psychological well-being (4)	61.89 $\pm$ 24.17	63 (37)	0.86	0.75*
Symptoms (4)	62.65 $\pm$ 24.61	63 (44)	0.82	0.73*
Relationship with friends (3)	57.01 $\pm$ 28.46	58 (33)	0.86	0.43*
Relationship with family (3)	75.31 $\pm$ 25.31	83 (33)	0.84	0.46*
Relationship with healthcare system (3)	84.05 $\pm$ 18.85	92 (33)	0.81	0.48*
Sentimental and sexual life (2)	67.53 $\pm$ 28.72	75 (50)	0.92	0.53*
Coping (2)	60.67 $\pm$ 27.37	63 (50)	0.75	0.63*
Rejection (2)	74.09 $\pm$ 26.04	75 (50)	0.77	0.74*
Index (31)	64.18 $\pm$ 17.13	62 (26)	0.93	-

\* Statistically significant at  $p < 0.05$

**Table 2.** The test-retest reliability of the MusiQoL dimensions and MusiQoL index

Parameter (n)	Test score	Retest score	Intra-class correlation (95% Confidence interval)
Activities of daily living (8)	54.73 $\pm$ 28.12	58.91 $\pm$ 24.38	0.949 (0.92-0.96)
Psychological well-being (4)	61.89 $\pm$ 24.17	64.91 $\pm$ 21.19	0.949 (0.92-0.96)
Symptoms (4)	62.65 $\pm$ 24.61	64.79 $\pm$ 21.49	0.952 (0.93-0.97)
Relationship with friends (3)	57.01 $\pm$ 28.46	59.85 $\pm$ 23.56	0.955 (0.93-0.97)
Relationship with family (3)	75.31 $\pm$ 25.31	76.15 $\pm$ 21.28	0.962 (0.94-0.98)
Relationship with healthcare system (3)	84.05 $\pm$ 18.85	84.37 $\pm$ 16.44	0.960 (0.93-0.97)
Sentimental and sexual life (2)	67.53 $\pm$ 28.72	69.85 $\pm$ 24.70	0.968 (0.95-0.98)
Coping (2)	60.67 $\pm$ 27.37	63.26 $\pm$ 24.44	0.963 (0.94-0.97)
Rejection (2)	74.09 $\pm$ 26.04	75.76 $\pm$ 22.36	0.971 (0.96-0.98)
Index (31)	64.18 $\pm$ 17.13	68.65 $\pm$ 14.15	0.911 (0.87-0.94)

The test-retest reliability of all MusiQoL dimensions and the MusiQoL index was excellent. The ICC scores of the MusiQoL dimensions and the MusiQoL index were 0.949-0.971 and 0.911, respectively (Table 2). BTS of the correlation matrix is high and significant ( $\chi^2=2028.41$ ;  $p<0.001$ ). The KMO sampling adequacy index was 0.801, which shows that the correlation matrix of the measuring instrument variables is suitable for factorization.

The fact that the calculated values were statistically within the desired range showed that the sample size and structure of the study were suitable for EFA. The Gutman-Kaiser criterion obtained six factors with significant eigenvalues (11.00, 3.57, 2.85, 2.19, 1.54, and 1.28).

The extracted factors, which consist of 31 items and six dimensions, explained 66.10% of the variance (Table 3).

**Table 3.** Exploratory factor analysis of the MusiQoL questionnaire

Items	Factor loading
<b>Factor 1: Activities of daily living and rejection</b>	
Had difficulty walking or moving outside?	0.87
Had difficulty with outdoor activities: i.e. shopping, going out to a movie...?	0.85
Had difficulty walking or moving around at home?	0.90
Been troubled by your balance or walking problems?	0.70
Had difficulty with leisure activities at home: i.e. do-it-yourself, gardening...?	0.87
Had difficulty with your occupational activities: i.e. integration, interruption, limitation...?	0.82
Been quickly tired?	0.70
Been short of energy?	0.65
Been upset by the stares of other people?	0.57
Been embarrassed when in public?	0.56
<b>Factor 2: Psychological well-being and coping</b>	
Felt anxious?	0.63
Felt depressed or gloomy?	0.82
Felt like crying?	0.71
Felt nervous or irritated by a few things or situations?	0.68
Felt that your situation is unfair?	0.67
Felt bitter?	0.58
<b>Factor 3: Relationships with spouse/partner or family</b>	
Talked with your spouse/partner or your family?	0.57
Felt understood by your spouse/partner or your family?	0.67
Felt encouraged by your spouse/partner or your family?	0.66
Felt satisfied with your love life?	0.85
Felt satisfied with your sex life?	0.74
<b>Factor 4: Relationships with friends</b>	
Talked with your friends?	0.66
Felt understood by your friends?	0.85
Felt encouraged by your friends?	0.87
<b>Factor 5: Relationship with healthcare system</b>	
Been satisfied with the information on your disease or the treatment given by the doctors, nurses, psychologists ... taking care of your MS?	0.74
Felt understood by the doctors, nurses, psychologists ... taking care of your MS?	0.73
Been satisfied with your treatments?	0.72
<b>Factor 6: Symptoms</b>	
Been troubled by loss of memory?	0.72
Had difficulty concentrating: i.e. when reading, watching a film, following a discussion ...?	0.65
Been troubled by your vision: worsened or unpleasant?	0.61
Experienced unpleasant feelings: i.e. hot, cold ...?	0.52

## Discussion

Even though some papers in Croatia are written in QoL of MS patients, to the best of our knowledge, this is the first study in Croatia that investigates HRQoL for MS patients using the Croatian version of MusiQoL questionnaires. We found it necessary and important to investigate MS patients' HRQoL because of the mentioned and proven statement that as the disease progresses, about 75% of MS patients face a performance decrease in activities of daily living [3]. Therefore, MS, which results in a wide range of clinical manifestations, has a large impact on HRQoL, and to improve the HRQoL of MS patients, it is first necessary to make as complete and as high-quality an assessment of HRQoL as possible. MusiQoL was earlier translated, validated and reliability assessed

in many countries including Korea [4], Spain [7], Poland [12], Norway [23] and Greece [24]. The English version was also validated in the Asian regions, including the countries of Singapore, India, and Malaysia [25].

Our analyses demonstrated the construct validity, internal consistency, and reproducibility of the Croatian version of the MusiQoL. This study confirmed the process of validating the MusiQoL version translated into the Croatian language and underscores its potential utility as an outcome measure in the clinical trial setting. Our results for the construct validity, internal consistency, and reproducibility of the MusiQoL were similar to those of international patient samples. They also align with previous differential item functioning analyses that have yielded satisfactory results across countries [11].



The present findings, in combination with those of the initial validation report [11], thus indicate a major strength of the MusiQoL, that is, the simultaneous process of validation in different countries around the world.

Huh *et al.* validated the Korean version of MusiQoL questionnaires on patients with MS. As in our research, the internal consistency reliability was high for all MusiQoL dimensions (Cronbach's  $\alpha$  ranged from 0.77 to 0.96). The highest measured index MusiQoL score was  $49.88 \pm 12.86$ , which is noticeably lower than the index score in our sample [4]. The results in measuring the validity of HRQoL questionnaires are different from those reported by other authors in similar research [11, 23, 26].

Jamroz-Wisniewska *et al.* validated the Polish MusiQoL version. Cronbach's  $\alpha$  for dimensions ranged between 0.67 and 0.9, with SSL dimension lower than 0.70 and worse internal consistency than one reported in our study. The highest mean value was measured for the SPT dimension (67.1) and the lowest RFa dimension (19.0), which was, for example, the second-highest evaluated dimension in our sample with a mean value of 75.31. The results of the MusiQoL index in their sample measured  $42.50 \pm 12.80$ , which was again noticeably lower than the index score in our sample [12]. Similar results of validation in which it was confirmed that HRQoL was rather correlated with clinical manifestation of disease than with patients' socio-demographic characteristics were also found in earlier studies about MS [27, 28].

Beiske *et al.* also validated the MusiQoL questionnaire. Their validation was made on Norwegian patients with MS. Cronbach's  $\alpha$  ranged from 0.44 to 0.87. Contrary to our results, internal consistency in their research was not high for RHCS and REJ dimensions. The index MusiQoL score measured  $65.30 \pm 10.70$ , which is the closest to the index score of our sample, which measured  $64.18 \pm 17.13$  [23].

Triantafyllou *et al.* measured the validity and reliability of the Greek version of the MusiQoL questionnaire. Only the RHCS dimension of MusiQoL did not reach high internal consistency, with Cronbach's  $\alpha$  lower than 0.7 [24]. The RHCS dimension, which did not measure high internal consistency in research done by Triantafyllou *et al.* in our research, had Cronbach's  $\alpha$  coefficient of 0.81. It also measured the highest mean value out of all MusiQoL dimensions, with a value of 84.05.

Thumboo *et al.* adapted and validated the English version of MusiQoL on MS patients from three Asian countries, including patients from Singapore and Malaysia combined and separately from patients from India. As in our research, in a sample of MS patients from Singapore and Malaysia, all MusiQoL dimensions achieved high internal consistency. The lowest median score was reported for the ADL dimension (56.10), while the highest was measured

for the RFa dimension (80.00). Those results were the same as ours regarding the highest and lowest internal consistency and median score. On the other hand, in a sample of MS patients from India, the lowest median score was reported for COP (50.00), and the highest was reported for RFa dimension (100). Unlike our research, three MusiQoL dimensions did not reach high internal consistency. SPT, COP, and REJ dimensions had values lower than 0.7 [25]. This may be caused by the small size of some of the mentioned dimensions, consisting of only two items, as Cronbach's  $\alpha$  depends on the number of items in a dimension [29]. The results of the MusiQoL index score measured for the sample from Singapore and Malaysia was 67.7. The sample from India measured 69.3 [25], which is, in both cases, a slightly higher score than the one measured in our sample.

Fernández *et al.* [30] validated the Spanish version of MusiQoL on MS sample patients. Only the RFa and RHCS dimensions of MusiQoL did not reach high internal consistency, with Cronbach's  $\alpha$  lower than 0.70, which is a worse result than the one measured in our study. On the other hand, the reported index score measured  $70.32 \pm 13.71$ , which is higher than the  $64.18 \pm 17.13$  measured in our sample [7].

In recent years, studies using MusiQoL as an instrument have focused more directly on assessing the HRQoL of MS patients than on the procedure of MusiQoL validation [30-37]. Three out of eight earlier mentioned studies [32, 33, 36] that were focused on assessing HRQL of MS patients rather than validating the MusiQoL questionnaire reported lower MusiQoL index score and therefore lower HRQoL of patients with MS than  $64.18 \pm 17.13$  which was measured in our study. Natarajan *et al.* measured HRQoL of MS patients in Oman. The reported MusiQoL index score in their study was  $60.60 \pm 11.40$ . As in our research, the highest measured MusiQoL dimension was RHCS with a value of  $81.70 \pm 18.90$  [32], slightly lower than the RHCS measured in our study (84.05). Kołtuniuk *et al.* investigated sleep disturbance, degree of disability, and QoL of MS patients. They measured an index MusiQoL score of  $50.73 \pm 10.50$  [33], which is noticeably lower than one in our research ( $64.18 \pm 17.13$ ) and other studies from this category [30-32, 34-37]. In another study done by Kołtuniuk *et al.*, in which they investigated HRQoL, depressive symptoms, and physical disability of patients with MS, the index MusiQoL score was  $58.21 \pm 18.06$ , which is also lower than the one in our research. An interesting point is that the RHCS dimension was the highest dimension measured in our research ( $84.05 \pm 18.85$ ), and in the mentioned research, it was the lowest measured one with a value of  $49.45 \pm 28.28$  [36].

Five out of eight earlier mentioned studies [30, 31, 34, 35, 37] that were focused on assessing HRQL of MS patients rather than validating the MusiQoL questionnaire reported higher MusiQoL index scores and, therefore, lower HRQoL of patients with MS than

64.18±17.13 which was measured in our study. Fernández *et al.* made research on MS patients, their characteristics and QoL. Their results were very similar to ours in terms of index MusiQoL score, the lowest and the highest measured MusiQoL dimension. The Index MusiQoL score measured in their research was 65.80±14.80, the RHCS dimension with the value of 77.80±20.20 was also the highest measured dimension (our RHCS dimension measured 84.05±18.85), and the ADL dimension with the value of 54.2±27.1 was also the lowest measured dimension (our ADL dimension measured 54.73±28.12) [30]. Moore *et al.* measured the HRQoL of MS patients in Canada; the index MusiQoL score of their national sample was 71.90±14.80 [31], which is higher than in our research. A slightly higher index MusiQoL score than in our research when the HRQoL of MS patients was assessed was also reported by Achtnichts *et al.*, measuring 66.70±13.80 [34]. Another higher index of MusiQoL than the one we measured was reported in research by Dahham *et al.*, who assessed the HRQoL of patients with MS; its value was 71.33±15.48 [37]. Ismail *et al.* investigated QoL, access to treatment, and knowledge of MS patients in Lebanon. Regarding QoL, the index MusiQoL score was also higher than the one we measured (64.18±17.13) with a value of 69.20±11.50 [35]. Finally, most of the results of our study are largely consistent with the international validation study of the MusiQoL made by Simeoni *et al.* on patients with MS. Index MusiQoL score measured 65.82±14.75 which is again very close to one measured in our sample (64.18±17.13). As often reported in different studies, only the RHCS dimension of MusiQoL did not reach high internal consistency with Cronbach's  $\alpha$  lower than 0.70. All the data mentioned earlier and the similarities between our results and the original MusiQoL validation [11] lend further support to the validity of the Croatian adaptation of this questionnaire.

The following limitations of the present study need to be acknowledged:

1. A limitation of our study is the sampling method, and therefore, we recommend random sampling of larger samples for future studies.
2. The sample was relatively small and not predetermined. However, our analyses demonstrate the validity and reproducibility of the MusiQoL in this limited number of patients, underscoring this instrument's robustness.
3. Further research is required to test the strengths and weaknesses of the Croatian version of the MusiQoL in a prospective fashion using a larger and more balanced (in terms of clinical subtypes of MS) sample. Indeed, our group plans to perform a prospective, independent study involving additional academic centers from Croatia to evaluate the acceptability and compatibility of the Croatian version of the MusiQoL in the clinical practice setting. During that study, we also plan to implement the

MusiQoL in follow-up evaluations to explore and confirm its sensitivity to changes and evaluate its potential applicability as a prognostic tool.

## Conclusion

The Croatian MusiQoL version can be reliable, valid, and feasible for measuring HRQoL in Croatian-speaking MS patients. HRQoL of MS patients is estimated to have a moderate to good index. The internal consistency reliability is high for all MusiQoL dimensions.

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