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# DIABETES LITERACY AMONG HIGHER EDUCATION STUDENTS

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## ABSTRACT

Literacy in diabetes appears to be one of the key tools to combat the increasing prevalence of this chronic disease that has grown exponentially over the years and globally at national level. This study aimed to evaluate the level of literacy in diabetes among students and provide guidelines for proposing an intervention project among this community. The specific objectives were: validate the Diabetes Knowledge Questionnaire (DKQ); and relate the levels of knowledge about diabetes with the socio-demographic and clinical variables. The sample comprises 432 higher education students who replied to the questionnaire in the period between February 15 and March 18, 2016. It was found that the DKQ (Sousa, 2003) that evaluates the knowledge of people about diabetes and its treatment seems to be acceptable for the general population and the two-dimensional model obtained from the confirmatory factor analysis revealed good levels of adjustment (CMIN/DF=1.645, CFI=0.983, NFI=0.959, TLI=0.979, PCFI=0.803, RMSEA=0.039). The results showed a low level of literacy about diabetes and that there is a need for investment in community education projects to increase literacy about diabetes.

Keywords: Diabetes, Health Literacy, Knowledge, Intervention.

JEL Classification: C93, Y90

## 1. INTRODUCTION

The aging of the world population has brought with it an increase in the incidence of chronic diseases, associated to an increase in demands and costs in health. Among these diseases diabetes mellitus (DM) has been highlighted for its exponential increase over the years.

In 2008, according to the World Health Organization (WHO), 58 million deaths worldwide were due to non-communicable diseases, with DM being responsible for 3.5% of these deaths, with the associated behavioural risks of four metabolic and psychological changes: increased blood pressure, obesity, hyperglycaemia and hyperlipaemia (WHO, 2012).

According to Nurse, Dorey, Yao, Sigfrid and Yfantopolous (2014), one of the most cost-effective human-based interventions is the preventive diabetes lifestyle program, which promotes Literacy in DM as an engine for adopting healthier lifestyles and concomitantly, preventing their onset.

Thus, given the current challenge of a society in a continuous process of demographic aging, with the increase of chronic non-communicable diseases closely related to the lifestyle adopted, the theme related to the level of health literacy and DM, as a relevant factor for the control and prevention of diabetes highlights the pertinence of the present study.

Diabetes is a metabolic disease that affects a large number of people both globally and nationally, conferring it pandemic characteristics (Correia, 2010). This notion is reinforced by Whiting, Guariguat, Weil and Shaw (2011), who consider diabetes as one of the chronic diseases whose incidence and prevalence has increased exponentially over the years.

According to Beaglehole and Lefèbvre (2004,) “the world is facing an increasing epidemic of diabetes with potentially devastating proportions. Its impact will be felt more severely in developing countries.”

Unwin and Marlin (2004) point out that “awareness among policymakers at international and national level about the importance of diabetes at the clinical and public health levels remains low.”

The International Diabetes Federation (2013) points out that diabetes is currently a major cause of chronic morbidity and loss of quality of life and is responsible for a high frequency of consultations and urgent care, having in 2013 been responsible for 5, 1 million deaths. According to Feudtner (2011) type 2 diabetes can be considered a “disease of civilisation”, a “product of modern technology”.

## 2. LITERACY IN HEALTH AND PREVENTION

Health literacy is defined by DeWalt, Berkman, Sheridan, Lohr, and Pignone (2004) as the “degree to which individuals can obtain, process, and understand the basic health information and services they need to make appropriate health decisions,

which includes adequate interpretation of documents, reading and writing quantitative information, and the ability to listen effectively in a health care setting". For Nutbeam (2008) the relationship between illiteracy and health status is currently well recognized and understood. According to this author, the interest in this relationship contributed to the emergence of the concept of health literacy, with two different roots - public care and public health. This concept is simultaneously a challenge, leading to the development of new intervention strategies in clinical practice and consequently to a change in health organizations as well as an based on educational research for literacy, concepts of adult education and health promotion, with a view to develop skills and abilities aimed at the acquisition by the patient / client of the health service of greater control over their Health and the factors that influence it, being this notion corroborated by Freedman *et al.* (2009).

According to Heide, Heijmans, Shuit and Rademakers (2015) initiatives should be developed to strengthen and improve the role of patients in health care, focusing attention on patients ("specifically functional and interactive health literacy"). These authors developed a study to examine the extent to which functional, interactive and critical health literacy is associated with the control of patients' perceptions of health care and the frequency of visits to primary health care institutions. The study of control of care was associated with the perceived ability to organise care, interact with suppliers, and to perform self-care through multiple linear regression analysis and logistic regression analysis and identified relations between health literacy and perceived control over care and, subsequently, visits to primary health care. The results suggest that some patients may be less able to exercise control over their care because of poor health literacy. Functional, interactive and critical health literacy varies according to the patients' ability to exercise control. For Chinn and McCarthy (2013) health literacy is a complex and evolving construction. The authors carried out research to develop a tool to measure health literacy in primary health care, encompassing functional, communicative and critical health literacy, after consulting 146 health professionals and health care users. The results of the study indicated that the Health Literacy Scale provides health professionals with relevant information on health literacy needs as well as on the capacity of understanding by health service users.

Merkur, Sassi and McDaid (2013) report that controlled observational studies highlight evidence on the effectiveness of health promotion and disease prevention interventions to reduce risk factors by intervening in health determinants such as: risk of tobacco and alcohol consumption, increased physical activity, adoption of a healthy diet, psychological protection and emotional well-being, reduction of environmental damage, and increased environmental safety. According to the authors, this effectiveness culminates in increased cost-benefit whenever interventions in different health determinants are streamlined simultaneously as already outlined by Rosales, Coe, Stroupe, Hackman and Zapien (2010), when they stated that public and social health services, in order to solve complex health and social issues, such as diabetes, increasingly use collaborative and community-based approaches. Merkur *et al.* (2013) warn of the need for caution on the part of policymakers as to the assumptions made about the persistence of the effect of health promotion interventions on long-term behavioural changes. They also add that interventions aimed at children are more likely to be more effective and profitable.

### 3. DIABETES LITERACY AND PREVENTION

Success in addressing diabetes requires competencies to increase adherence and compliance that supersede the person's prior positions of blame in a "what-should-do" system, based on an educational biomedical model (Beaser & Brown, 2013, p. 399).

In partnership with the American institutions of health and higher education, Vojta, Koehler, Longjohn, Lever and Caputo (2013) implemented a National Diabetes Prevention Program in the United States of America, whose intervention lasted from July 2010 to December of 2011, whose data were analysed in February 2012. They designed a model of group intervention, consisting of 16 sessions with monthly follow-up, conducted by educators in lifestyle training. The results were evaluated in the following items: infrastructure (communities involved and trained personnel), involvement (evaluation and involvement of people with pre-diabetes), program results (attendance and weight loss) and cost of intervention. The program was implemented in less than two years in 46 communities in 23 states, with more than 500 lifestyle coaches trained.

Shue, O'Hara, Marini, McKenzie, and Schreiner (2010) reported that patients with diabetes, with poor health literacy, often struggle with poor health management. They proposed to develop a video with a multidisciplinary group to help these patients better understand their disease (increase in diabetes literacy) and improve the communicational process with health professionals. The results indicated that the patients evaluated the intervention as useful and informative, leading them to consider a behavioural change, also indicating an improvement in the communication process with the attending physician.

Diabetes Mellitus is a health condition that is complex in the long term (Stiles, 2011). To achieve better results, diabetic people should have a good understanding of their condition, as well as adopt a vigilant self-care approach (Stiles, 2011). However, according to the author, this may be difficult for patients with low health literacy, because they may have difficulties in obtaining, understanding and applying health information (Stiles, 2011). Health literacy encompasses factors such as culture, empowerment, motivation and the quality of individual exchanges with the health system. Nurses' understanding of health literacy (as a concept) is critical to helping patients achieve self-management of their long-term condition (Stiles, 2011). Health literacy strategies should focus on providing information in a variety of formats, as well as trying to improve patient access to health services (Stiles, 2011).

Based on the premise that cognitive impairment is common in older adults with diabetes, the authors developed a study of 537 African-American, Indian-American, and Caucasian individuals, including men and women aged over 60 years, hypothesizing the association of health literacy with cognitive function, indicating that it is independent of education. In the study, the measures of cognitive function included the Mini-Mental State Exam (MMSE), Verbal Fluency, brief attention and Digit Span tests were applied. Health literacy was assessed using S-TOFHLA. The results indicated that cognitive functions were associated with health literacy, regardless of other factors of education. Each unit increase in MMSE, Digits

Backward, Verbal Fluency or Brief Attention has been associated with an increased assumption of adequate health literacy, respectively. The authors add that deficient cognitive function may undermine health literacy and increased literacy is a factor in maintaining cognitive function.

#### 4. METHOD

We established three specific objectives for this study: (a) identify the levels of knowledge that higher education students have about diabetes; (b) relate the levels of knowledge about diabetes with socio-demographic and clinical variables; and (c) validate the Diabetes Knowledge (DKQ) questionnaire for a general public of higher education students.

##### 4.1 Participants

Our sample consisted of 432 students, of a total of approximately 700, of the School of Communication, Administration and Tourism of Mirandela (unit belonging to the Polytechnic Institute of Bragança).

##### 4.2 Material

A questionnaire was given out, composed of a first part with socio-demographic and clinical information of the respondents and a second part composed of the 35-item Diabetes Knowledge Questionnaire – DKQ (Sousa, 2003). The original DKQ is divided into 7 dimensions: Identity, Causes, Duration, Treatment, Limitations, Control and Complications.

##### 4.3 Procedures

After formulating the formal request to the Direction of the Polytechnic Institute of Bragança (IPB) and the respective authorisation, the questionnaires were applied to the 432 students of our sample, between February 15, 2016 and March 18, 2016. Students were asked for legal consent. A cross-sectional observational study, using quantitative methods, was performed.

Statistical operations were performed using SPSS v23 for OSX and the modelling of structural equations was done using AMOS v.22.

#### 5. RESULTS

Table 1 shows that the distribution by gender is almost uniform (51.2% of males), that the majority is moved from outside the District of Bragança (53.9%) to study, the majority attend the first year of an undergraduate course (44.7%) and most have relatives with diabetes (52.3%). None of the respondents have diabetes themselves.

Table 1 - Socio-demographic data

		N	%
Gender	Female	211	48,8%
	Male	221	51,2%
	Total	432	100,0%
Residence	Moved from outside the district	229	53,9%
	Moved from inside the district	45	10,6%
	From the municipality	151	35,5%
Study year	First undergraduate	193	44,7%
	Second undergraduate	136	31,5%
	Third undergraduate	76	17,6%
	Fourth undergraduate	0	0,0%
	Masters	27	6,3%
Relatives with diabetes	Yes	226	52,3%
	No	128	29,6%
	Don't know	78	18,1%

Source: Research team (2016)

In terms of knowledge about diabetes, Table 2 shows that the mean number of correct answers is 11.27 out of a possible 35 and that none of the respondents scored on more than 29 questions. In terms of gender, female respondents achieve an average of just over 1 point higher.

**Table 2 - Mean scores by gender**

Gender	Mean	N	SD	Min.	Max.
Female	11,8863	211	5,56403	,00	29,00
Male	10,6833	221	5,58400	,00	29,00
Total	11,2708	432	5,60024	,00	29,00

Source: Research team (2016)

This information led us to conclude that the average knowledge about diabetes is low and far under the 50% of correct answers. As such, the first objective outlined in our study was achieved.

To find answers for the second objective, i.e. if there is a relationship between socio-demographic and clinical data and knowledge about diabetes, Mann-Whitney and Kruskal-Wallis tests were performed, as our data had a non-normal distribution according to the Shapiro-Wilk tests performed ( $p < 0.001$ ).

From the tests carried out, it was concluded that only for the independent variable “Course” a statistically significant relation existed ( $p < 0.001$ ), being that, as can be observed through Tables 3 and 4, course “14” (undergraduate course in Marketing) has the highest mean rank.

**Table 3 - Kruskal-Wallis test results – Mean rank of correct answers per course**

Course	N	Mean Rank
1	1	16.00
3	10	227.70
4	13	246.69
5	14	184.50
6	13	120.04
7	74	202.35
8	46	206.60
9	98	190.21
10	49	209.07
11	24	224.46
12	10	262.90
13	29	179.84
14	25	419.86
15	12	266.54
16	14	256.82
Total	432	

Source: Research team (2016)

**Table 4 - Kruskal-Wallis test statistics - Correct answers per Course**

	Total correct answers
Chi-Square	93.742
df	14
Asymp. Sig.	.000
a. Kruskal Wallis Test	
b. Grouping Variable: Course	

Source: research team (2016)

Performing pairwise comparisons, including the Bonferonni correction, only the pairs that included course 14 (undergraduate course in Marketing), showed statistical significant differences ( $p$ , as can be observed in Table 5. The remaining pairs did not show any statistical difference ( $p=1$ ).

**Table 5 - Dunn-Bonferroni pairwise comparisons and Bonferroni correction (Adj. Sig.)**

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
1-14	-403.860	125.827	-3.210	.001	.140
6-14	-299.822	42.190	-7.106	.000	.000
13-14	-240.015	33.673	-7.128	.000	.000
5-14	-235.360	41.187	-5.714	.000	.000
9-14	-229.651	27.646	-8.307	.000	.000
7-14	-217.509	28.542	-7.621	.000	.000
8-14	-213.262	30.658	-6.956	.000	.000
10-14	-210.789	30.325	-6.951	.000	.000
11-14	-195.402	35.260	-5.542	.000	.000
3-14	-192.160	46.166	-4.162	.000	.003
4-14	-173.168	42.190	-4.104	.000	.004
16-14	163.039	41.187	3.959	.000	.008
12-14	-156.960	46.166	-3.400	.001	.071
15-14	153.318	43.331	3.538	.000	.042
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .05.					

Source: Research team (2016)

As such, from the socio-demographic comparisons, only attending or not the undergraduate course in Marketing makes a statistical significant difference when it comes to knowledge about literacy with a clear superior knowledge by the population from this course, when compared to all other groups. With this step we concluded the research for our second objective.

To achieve our third objective, validate the Diabetes Knowledge Questionnaire for a general public of higher education students, we submitted our data to a Principal Component Analysis to analyse the validity of the theoretical construct for the studied population. The first results, after extracting components with an eigenvalue equal or above 1, resulted in 7 factors, not presenting, however, theoretical coherence. Sousa, McIntyre, Martins and Silva (2015) initially obtained 13 components, but as verified in their study it was necessary to reduce to 3 components and items from 35 to 20. With our sample the same type of reductions were necessary. However, the grouping of the items per component in our sample did not follow the same distribution as with the study of Sousa *et al.* (2015), nor did the elimination of certain items coincide with the ones eliminated in that study. We did however follow the same methodology of eliminating items with loading factors under 0.40 and/or items that didn't have theoretical consistency with the remaining items of the same component. This led to the results shown in Table 6, with a 19 items questionnaire loading to three components.

**Table 6 – Principal Component Analysis – Rotated Component Matrix**

	Component		
	1	2	3
Incl_Q4aRC	,900		
Incl_Q6bRC	,897		
Incl_Q6dRC	,861		
Incl_Q7cRC	,818		
Incl_Q4cRC	,807		
Incl_Q7dRC	,757		
Incl_Q2eRC	,699		
Incl_Q2cRC	,689		
Incl_Q6cRC	,637		
Incl_Q6aRC	,630		
Incl_Q1aRC	,567		
Incl_Q4dRC	,556		

Incl_Q7bRC	,537		
Incl_Q3bRC		,829	
Incl_Q3aRC		,818	
Incl_Q3eRC		,749	
Incl_Q5bRC		,467	,405
Incl_Q4eRC			,747
Incl_Q5dRC			,662
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 5 iterations.			

Source: Research team (2016)

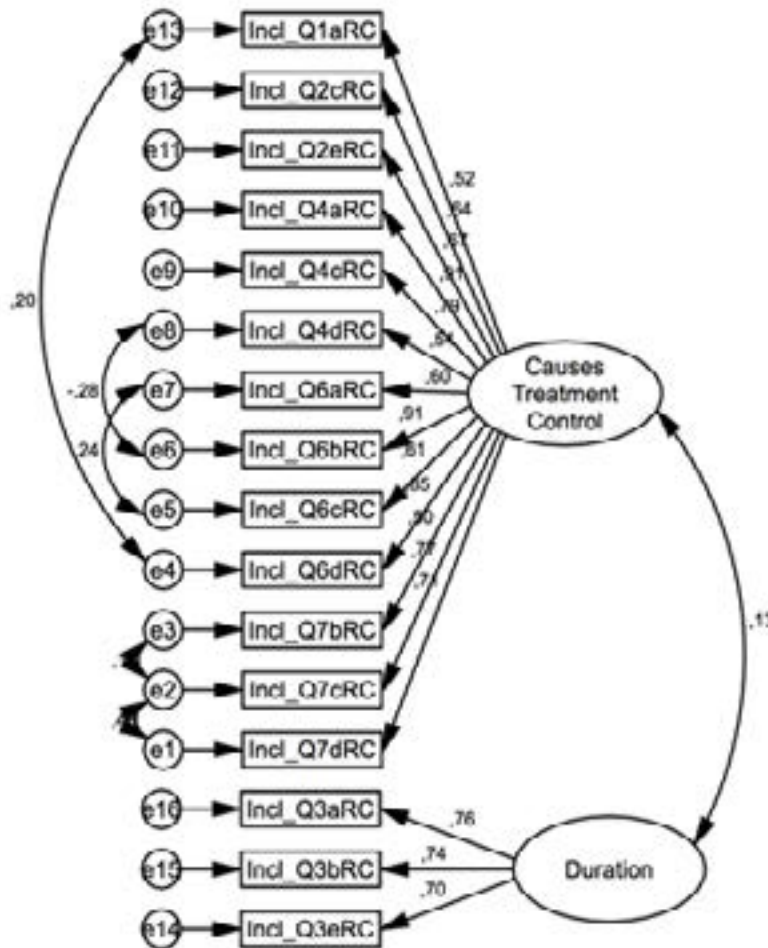
Notwithstanding ending with 3 components as in the study of Sousa *et al.* (2015), our 19 items loaded to 3 components that could be best described as measuring knowledge about diabetes in the areas of: Causes, Treatment and Control of Diabetes, explaining 37.40% of the total variance; Duration of Diabetes, explaining 13.84% of the total variance; and Limitations Originated by Diabetes, explaining 6.04% of the total variance.

Although the item Incl\_Q5bRC loaded to two factors we considered it belonging to component 3, given relation and consistency of the question with the remaining two questions of the same component.

Notwithstanding the differences of measured knowledge between our results and the ones from Sousa *et al.* (2015), we have to bear in mind that our sample was composed out of individuals not carrying diabetes, contrary to the other study, and therefore differences in interpretation were expected.

Finally, to validate the questionnaire, we performed Structural Equation Modelling, resulting initially in a non-acceptable result. A further analysis to the fit indices and data, led us to eliminate the third component, as the statistics showed contradictory results and low reliability of the data. As a result, we ended with a two-dimensional model measuring knowledge about: Causes, Treatment and Control of Diabetes; and knowledge about Duration of Diabetes, as depicted in Figure 1.

Figure 1 - AFC generated bifactorial model - standardised factorial weights



Source: Research team (2016)

After eliminating the third group, the results indicated a good quality of adjustment of the model supporting the factorial validity of the questionnaire, with: CMIN/DF=1.645; CFI=0.983; TLI=0.979; PCFI=0.803; RMSEA=0.039. According to the literature, the aforementioned indices are recommended for acceptance when: CMIN/DF < 2 (Ullman, 2001), CFI ≥ 0.95, TLI ≥ 0.95 and RMSEA < 0.6 (Hu and Bentler, 1999), being it that all our indices are within the consensual area of “good fit”.

From the result of the confirmatory factor analysis, we can conclude that the questionnaire is validated for the studied population, measuring in a statistically significant way the knowledge about the causes, treatment, control and duration of diabetes, for a public of higher education students not carrying diabetes.

## 6. DISCUSSION OF RESULTS

The diabetes knowledge questionnaire (Sousa, 2003), which evaluates people’s knowledge about diabetes and its treatment, was applied by the authors on a population of people with diabetes (239 participants). In our study we intended to validate the scale for a population of public higher education, so the original version (Sousa, 2003) was applied to higher education students (432 participants).

From the statistical treatment performed and the Confirmatory Factor Analysis with good results, we can conclude that the objectives we set ourselves were reached, and can even affirm that validation for a non-diabetic population of higher education students was achieved.

Sousa *et al.* (2015) performed a CFA on a sample of people carrying diabetes, reducing the initial questionnaire (Sousa, 2003), from 35 to 20 items, obtaining results consistent with a “good fit”. Our analysis, on a population of higher education students, showed also consistent results and even higher than the ones obtained by Sousa *et al.* (2015), as depicted in Table 7.

**Table 7 - Comparison between studies**

Study	CFI	PCFI	TLI	RMSEA
Sousa <i>et al.</i> (2015)	0.908	0.774	0.892	0.052
Our	0.983	0.803	0.979	0.039

Source: Our: Research team (2016); Sousa *et al.* (2015)

This leads us to consider that the results obtained statistically are valid both in statistical terms and in terms of their theoretical construct, concluding our third objective.

Our participants responded correctly to 21,61% of the answers, showing a low knowledge about diabetes, being it that these results are in line with other studies like the one performed by Okoh and Jaja (2014), whose results made the authors conclude that the awareness and knowledge shown by adolescents was extremely reduced and possibly representative of the general knowledge of the Nigerian population. Also the results of the research carried out by Al-Sarayra and Khalidi (2012) led the authors to the conclusion that there is a low level of consciousness and knowledge among university students. The same type of conclusions were obtained in the research carried out by Shin and Schlenker (2012), concluding the level of knowledge among American students was low, just as the research from Khan, Gomathi, Shechnaz and Muttappallymyalil (2012), evidencing an inadequate knowledge about diabetes among university students from the United Arab Emirates, notwithstanding being exposed to information from several sources.

The results obtained in our research reinforce the results of the European study about health literacy performed in several countries like Portugal, Poland, The Netherlands, Ireland, Spain, Greece, and Germany, amongst others, where Portugal appeared as the second country with the most inadequate knowledge about health and also as the second highest in health (Escobal, 2016).

The results of our analysis lead us to conclude that the level of literacy on diabetes in the population is very low, and this fact is worrying when we consider that diabetes is a disease with great incidence in Portugal. These results are even more worrying when we consider that 52.3% of the sample has relatives with diabetes, leading us to suppose that at least this group had a higher level of knowledge.

Low levels of literacy have confirmed that reduced awareness of common and serious diseases, such as diabetes, is worrying, leading to questions about what measures should be implemented in terms of information dissemination and public awareness of the risks of these same diseases.

Finally, we can't fail to mention the surprising result of the undergraduate students in marketing who scored, on average, almost twice as much as the second highest average course. Although it was first suspected that there might have been some kind of concerted action in the production of the answers in the classroom, this possibility was discarded since the high average occurs among the students of the several years of this degree, but it was not possible to identify the reason for this discrepancy with the remaining sample.

## 7. CONCLUSIONS

Health literacy is a field of research whose objectives are to explore the existing disparities in this area. Some economists estimate that a low level of health literacy could cost the US health care system more than \$73 billion a year and the Swiss

system \$1.5 billion a year, with no estimates for the Portuguese reality. Assessing health literacy to introduce measures to promote it is therefore crucial to strengthening resilience in the face of adversity (Saboga-Nunes *et al.*, 2014).

To achieve an adequate level of health knowledge, it becomes necessary to identify and satisfy basic needs in order to adopt behavioural changes, practices and attitudes that aim at the maintenance of health promoting lifestyles (Silva, Pereira, Lima, Machado de Matos & Martins, 2014).

It is highlighted that there is a high level of illiteracy in diabetes, and that their ignorance is associated with myths and false concepts rather than uncertainty. This fact becomes relevant because it may influence the general public in the search decision, and even avoids the search for more knowledge about the pathology, since there seems to be an awareness of knowledge based on false conceptualisations.

We conclude, therefore, that the initiatives that currently exist with regard to the dissemination of information must be re-equated in order to achieve a greater degree of literacy.

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