Feasibility and acceptance of a virtual multidisciplinary care programme for patients with type 2 diabetes during the COVID-19 pandemic

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Abstract

Background and aims: Type 2 diabetes mellitus is one of the major public health concerns. The current lifestyle and advances in technology resulted in the development of a virtual mode of professional healthcare, which is an effective alternative method of management of patients. This study aimed to assess the feasibility of implementation of a virtual comprehensive care programme during the COVID-19 pandemic, patients' acceptance and the changes in self-care behaviours, metabolic parameters and emotional factors.

Methods: The programme employed in this study included nine health interventions in 1 day. Due to the COVID-19 pandemic, the mode of interventions, including questionnaires, patient evaluations and a satisfaction survey, was modified to the virtual form in 2020. This study assessed the changes in self-care behaviours, metabolic parameters and emotional factors and compared the data pertaining to patients who received virtual healthcare in 2020 with those who received face-to-face modality of medical care in 2019.

Results: During June to November 2020, 130 patients received healthcare by means of the virtual modality. The change in modality of healthcare was feasible and 75% of the patients displayed good acceptance of the same. The evaluation of self-care behaviours included self-monitoring blood glucose (SMBG) levels, foot care and regular exercise. The duration of exercise decreased from 120 to 0 min/week ($p < 0.001$). However, there was no change in metabolic parameters. Regarding the mental health parameters, we observed an increase in the proportion of patients with anxiety (21.5% *versus* 11.1%), depressive symptoms (10.8% *versus* 4.3%), diabetes distress (18.5% *versus* 11.1%) and prescription of psychotropic drugs (32.8% *versus* 18.2%) ($p < 0.05$) in virtual *versus* face-to-face, respectively.

Conclusion: The virtual comprehensive care programme for the management of patients with diabetes is a feasible approach that allows healthcare professionals to provide an adequate care during the COVID-19 pandemic.

Keywords: e-Health, pandemics, quality of life, type 2 diabetes, virtual assessment, virtual evaluation

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Introduction

Type 2 diabetes mellitus (T2D) is considered to be one of the major global public health problems and is associated with disabling complications, high morbidity and mortality.[1–3] The chronic care model emphasises the deployment of multidisciplinary healthcare teams to achieve diabetes control among patients.[4] The COVID-19 pandemic gave rise to scenarios that warranted the development and improvement of modalities of diabetes

management, which resulted in the application of advanced technology in professional healthcare, to provide the patients with virtual forms of medical care.[3] The aforementioned strategy addresses health problems and reduces the risk of COVID-19 transmission.[5–7] Moreover, the virtual mode of healthcare has been proven to be successful under certain circumstances, such as situations involving healthcare crises or natural disasters, and the delivery of medical care in remote areas.[8,9] However, the implementation of virtual medical care is a challenging endeavour. The challenges include lack of access to technology, lack of knowledge regarding the use of digital communication platforms via Internet and problems associated with Internet connectivity.[10] This study aimed to assess the feasibility of implementation of a virtual comprehensive care programme during the COVID-19 pandemic, patients' acceptance of the same and changes in self-care behaviours, metabolic parameters and emotional factors.

Methods

This descriptive study employed a model that has been described in previous literature.[1,11] In brief, the comprehensive care programme consisted of two phases. The first phase comprised a primary visit and four 6-h visits 1 month apart. The second phase consisted of annual evaluations. During each visit, the patients were examined by nine different healthcare professionals, namely, endocrinologists, diabetes educators, nutritionists, physical activity instructors, psychologists, liaison psychiatrists, ophthalmologists/optometrists, nurses and dentists. These interventions can be divided into four categories as follows: medical, mental health, lifestyle and diabetes education. Each intervention followed the guidelines specified in a procedure manual and involved 30- to 60-min sessions. The blood tests and somatometric measurements were performed prior to the commencement of sessions, to modify the interventions and treatments on the basis of the results. The appointments were prespecified in accordance with the number of patients who visited the centre. This scheduling facilitated the logistics of implementation of simultaneous interventions. All visits were held at the centre in 2019. The primary visit comprised a complete evaluation of the patient by all the specialists, which provided basic information to initiate the necessary changes. The second visit involved an evaluation of problem-oriented

situations, to offer individualised recommendations. The third visit involved identification of potential barriers that could hinder the achievement of respective metabolic goals. The fourth visit involved the reinforcement of acquired knowledge and evaluation of the results of interventions. The annual visit involved a review of barriers and proposal of solutions by healthcare professionals. The treatment protocol was modified on the basis of new barriers that were encountered after a time period of 1 year. Moreover, this study applied a structured pattern of evaluation to assess the competencies acquired by each patient, which involved activities related to self-care (self-examination of feet, glucose monitoring and management of hypoglycaemia). The patients were examined by respective general physicians during the time period between the fourth visit and annual visit.

The mental health evaluations were conducted by a liaison psychiatrist and psychologist who were fully trained in diabetes management. During each visit, specific questionnaires were administered to all the patients, to complete the evaluation. The aforementioned questionnaires included the Mini-International Neuropsychiatric Interview (MINI),[12] Diabetes Empowerment Scale-Short Form (DES-SF),[13] Hospital Anxiety and Depression Scale (HADS),[14,15] Diabetes Quality of Life (DQoL) Questionnaire,[16,17] Problem Areas in Diabetes (PAID) Scale,[18] International Physical Activity Questionnaire (IPAQ)[19] and a 3-day food record to document the daily calorie intake.[20]

This study was approved by the Institutional Ethics and Research Committees of the National Institute of Medical Sciences and Nutrition Salvador Zubirán (INCMNSZ, i.e. an acronym for the Spanish name) (Ref 1198) and registered at the website, ClinicalTrials.gov (NCT02836808). Written informed consent was obtained from all the patients involved in this study.

Procedures

As a result of the COVID-19 pandemic, the mode of interventions of the programme was modified to the virtual form since June 2020 and video communication platforms and telephonic communication were utilised for the same. Each patient was provided with the information regarding virtual evaluations prior to the scheduled consultation via e-mail, which included instructions

concerning the maintenance of confidentiality and requisitions for blood tests that could be performed in any laboratory, as per the patient's convenience (in view of the fact that patients could not visit the centre). All the questionnaires were converted into the virtual format and the links were included in the e-mail, so that the questionnaires could be answered by the patients before consultation. Data pertaining to the respective laboratory test results, weight (measured on a personal scale), blood pressure (measured using a portable sphygmomanometer), photographs of feet and shoes that are used regularly and the results of questionnaires were obtained a few days prior to the consultation, to acquire all the information required for complete analysis of each patient. Subsequently, a second e-mail was sent to the patients to confirm the appointment, resolve doubts regarding the process and to provide the links to be used for consultation, including links for each specific intervention. The same appointment schedule was used in both the modalities of care, that is, virtual and face-to-face modes. Hence, the simultaneous implementation of different interventions was possible. The only difference was that the evaluations were performed remotely.

The interventions had a duration of 30 min and commenced in the morning. All specialists had respective digital links that were provided to the patients to implement the virtual session (similar to changing offices). In the case of interventions that involved challenges concerning remote assessment, like ophthalmologic, dental and foot care interventions, semistructured interviews were used to evaluate acute complications and review treatment plans that were proposed after the previous annual assessment.

All healthcare professionals prepared a cross-reference report and the metabolic parameters and treatment protocols were documented using a follow-up card, which was forwarded through e-mail, along with the strategies to resolve new barriers or challenges identified through the interventions. Moreover, the abovementioned e-mail included a link for a satisfaction survey to be answered by the patients, to obtain data regarding the virtues and difficulties of this new modality. The survey comprised a questionnaire with eight items on a Likert-type scale and explored the quality of attention received, privacy, comfort in relation to the interventions and time spent online

during the course of the day. The items were developed to evaluate the patients' perception of virtual medical care. All authors unanimously agreed to consider the aspects that could be affected by the change in modality, which could impact the quality of the interventions.

Participants
This study included nonsmoking adult patients with T2D without any disabling chronic complications.[11] The present analysis compared the data pertaining to all the patients who underwent the first annual face-to-face consultation in the year 2019 with the patients who underwent the first annual virtual consultation in the year 2020 (during the pandemic).

Statistical analysis
In this study, categorical variables were analysed using frequencies and percentages. Statistical significance was determined using the chi-square test or chi-square test for trends. The groups were compared by means of the Mann–Whitney U test. The year of visit (2019, 2020) was considered as the independent variable and metabolic and somatometric outcomes were considered as dependent variables.

In the year 2020, 267 patients were contacted to receive the respective annual evaluations, among which, merely 47% participated in this study ($n = 130$). The main difficulties encountered were lack of access to Internet, computer malfunctions or other related issues and refusal to undergo blood tests at a laboratory, owing to the fear of COVID-19 contagion. The satisfaction survey was completed by 125 patients (96%) and the results revealed that 97.6% of the patients found that the instructions provided in the e-mail were adequate to schedule the respective appointments. Moreover, more than 90% of the patients completely agreed that the questionnaires were easy to answer, the communication with healthcare professionals was clear, the duration of each intervention was adequate, they felt comfortable with virtual consultations and that the expected attention was received. The results of the survey are presented in Figure 1.

The assessment of metabolic parameters, self-care behaviours and emotional factors involved the data pertaining to 305 patients who attended the centre in 2019 and 130 patients who received
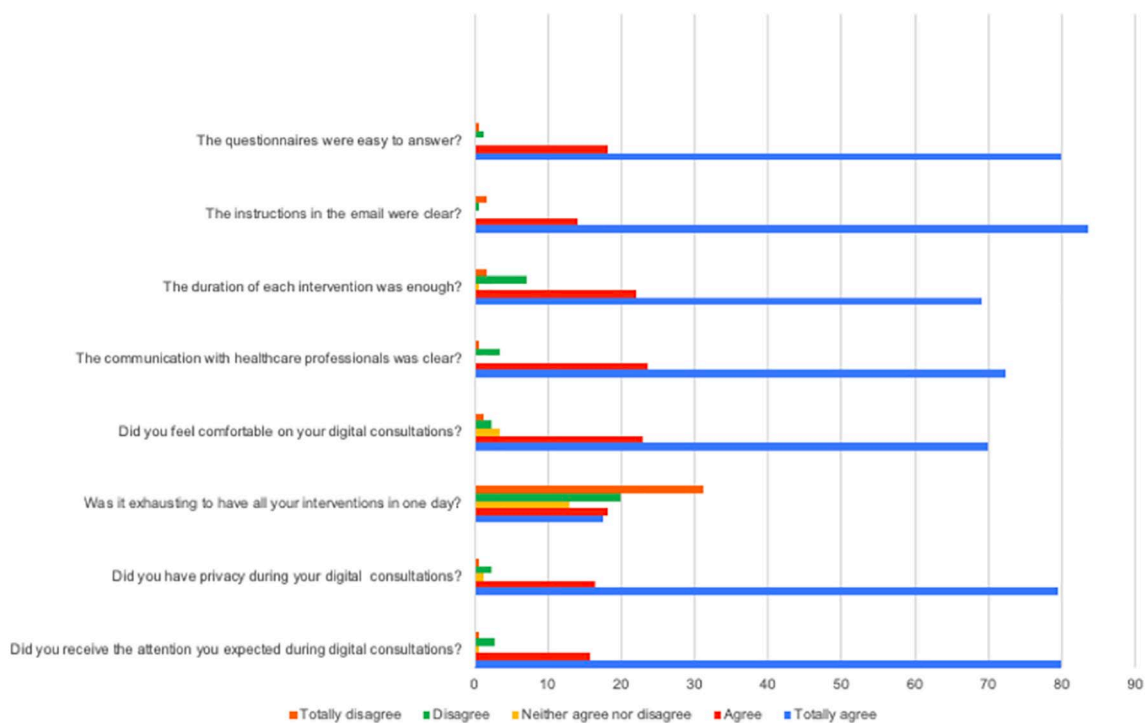
Figure 1. Results pertaining to the satisfaction survey of patients who underwent the respective annual evaluations through virtual modes of healthcare.

virtual healthcare in 2020. The mean age of the patients was 55 ± 9.4 years, 55.2% were female patients and the mean HbA1c level was 6.97 ± 1.6%. The data regarding formal education level of the patients are stated as follows: elementary school: 9.6%; junior high school: 12.8%; high school: 26.2%; university: 43.3%; and postgraduate degree (master's degree or PhD): 6.9%. Merely 0.2% of the patients did not have any formal education. Hence, they were aided by educated relatives. Regarding the marital status, 69.4% of the patients were married or living with common-law partners, while 25.7% were single or divorced.

A comparative analysis revealed that the group of patients who received virtual healthcare in 2020 showed an increased proportion of patients who were diagnosed with T2D within the previous 1 year, compared with the group of patients who attended the centre in 2019, which included a greater proportion of patients who were diagnosed with diabetes more than 3 years prior to the study. This study did not observe any difference between the two groups in regard to the demographics, metabolic parameters, calorie consumption and body mass index (Table 1).

The data regarding self-care behaviours during the course of the preceding year were obtained by means of interviews conducted by diabetes educators. This study did not observe any difference between the two groups with regard to the self-monitoring blood glucose (SMBG) or foot care behaviours and the results pertaining to both the parameters were adequate. The number of days and minutes of exercise per week was observed to be significantly higher in the group of patients who attended the centre in 2019, compared with the group of patients who received virtual healthcare in 2020 (120 min/week in 2019 and 0 min/week in 2020; $p < 0.001$) (Table 2).

The mental health analysis revealed a higher proportion of patients with anxiety syndrome (MINI Interview) in the group of patients who received virtual healthcare in 2020 (21.5%), compared with the group of patients who attended the centre in 2019 (11.1%) ($p = 0.032$). This study did not observe any difference between the two groups with regard to the proportion of patients with affective syndrome or eating disorders. Furthermore, the group of patients who received virtual healthcare in 2020 exhibited a higher prevalence of patients with prescription of

Table 1. Comparison of the demographic, anthropometric and metabolic parameters pertaining to the patients.

Variable	Goal	2019 (1 year) n = 305	2020 (1 year) n = 130	p value
Sex				
Female (%)	–	172 (56.4%)	68 (52.3%)	0.555
Male (%)	–	133 (43.6%)	62 (47.7%)	
Age (years)	–	56 (49–63)	56 (50–62)	0.580
Years since diagnosis				
0–1	–	0 (0%)	19 (14.6%)	<0.001*
2–3	–	137 (44.9%)	55 (42.3%)	0.346
>3	–	168 (55.1%)	56 (43.1%)	0.014*
Glucose (mg/dl)	<130	112 (96–135)	117 (103–137)	0.170
HbA1c (%)	<6.5	6.4 (6–7.3)	6.5 (6–7.3)	0.812
Triglycerides (mg/dl)	<150	148 (108–199)	145 (113–199)	0.761
Total cholesterol (mg/dl)	<180	167 (147–196)	165 (147–192)	0.761
LDL cholesterol (mg/dl)	<100	101 (84–126)	100 (81–119)	0.974
Non-HDL cholesterol (mg/dl)	<130	122 (102–152)	123 (104–145)	0.909
Uric acid (mg/dl)	<6.3	5.5 (4.5–6.3)	5.5 (4.7–6.3)	0.300
Calories consumed (kcal/day)	–	1384 (1204–1591)	1438 (1226–1652)	0.096
BMI (kg/m²)	–	29.0 (26.4–32.4)	29.4 (26–33) (n = 93)	0.496

BMI, body mass index; HbA1c, glycated haemoglobin; HDL-c, high-density lipoprotein cholesterol; LDL-c, low-density lipoprotein cholesterol.
n (%), median (interquartile range: 25–75).
*$p < 0.05$ (Mann–Whitney U test).

psychotropic drugs (selective serotonin reuptake inhibitors: 81%; serotonin, noradrenaline reuptake inhibitors: 4.8%; and sleep inducers: 23.8%), compared with group of patients who attended the centre in 2019 ($p = 0.016$). Regarding depressive symptoms, this study observed that the group of patients who received virtual healthcare in 2020 displayed a higher proportion of patients with severe symptoms, compared with the group of patients who attended the centre in 2019. This study did not observe any difference between the two groups with reference to the proportion of individuals with symptoms of anxiety, as there was no significant difference in regard to any category of the HADS test.

Furthermore, the group of patients who received virtual healthcare in 2020 exhibited higher levels of diabetes-related distress (PAID scale), compared with the patients who were assessed in 2019 (18.5% *versus* 11.1%), and the difference was observed to be statistically significant. This study observed lower levels of empowerment (DES-SF) in the group that received virtual healthcare (73%), compared with the group that received the face-to-face modality of the same (81%). However, the difference was not observed to be statistically significant. The proportion of individuals with improvement in quality of life during the course of the pandemic (2019–2020) in the two groups were observed to be 5% and 7%, in

Table 2. Comparison of the results pertaining to self-care behaviour.

Variable	2019 (1 year) *n* = 305	2020 (1 year) *n* = 130	*p* value
SMBG			
No	32 (10.5%)	13 (10%)	0.317
Once a week	118 (38.7%)	41 (31.5%)	
Twice a week	155 (50.8%)	76 (58.5%)	
Foot care behavior			
No	41 (13.4%)	18 (13.8%)	0.910
Yes	264 (86.6%)	112 (86.2%)	
Regular exercise			
Days/week	3 (0–5)	0 (0–4)	<0.001*
Minute/week	120 (0–240)	0 (0–152)	<0.001*

SMBG, self-monitoring blood glucose.
Median (interquartile range: 25–75) for regular exercise.
*$p < 0.05$ (Mann–Whitney *U* test).

the virtual and face-to-face groups, respectively. The main results of this study are presented in Table 3.

Discussion

This observational study assessed the feasibility of implementation of a virtual comprehensive care programme during the COVID-19 pandemic, patients' acceptance of the same and changes in self-care behaviours, metabolic parameters and emotional factors. In view of the unusual circumstances created by the COVID-19 pandemic, interventions for the management of patients with T2D were modified to achieve and maintain a good quality of care. Multidisciplinary programmes have been proven to provide a framework to achieve positive outcomes in patients with various diseases.[21] The challenging times associated with the pandemic have forced other multidisciplinary programmes to adapt to the situation and incorporate advanced technology and innovative techniques into the process of treatment with feasibility and good acceptance from patients.[21,22]

This study modified the therapeutic modality to virtual medical consultation by way of scheduled video conference meetings and telephone calls, in view of the patients' necessities and technological infrastructure. Regardless of certain technical hurdles, such as problems with Internet connectivity, the virtual modality was observed to be highly effective in the administration of personalised care and follow-up of patients. In addition, this study conducted a satisfaction survey to identify the potential barriers, accessibility and perception of quality regarding telemedicine consultation in the programme.

Several previous studies have evaluated the application of telemedicine in the treatment and follow-up of patients with diabetes with good metabolic control, compared with the conventional mode of treatment.[6,23–25] Furthermore, previous studies have assessed the patients' satisfaction and preference regarding the application of telemedicine for the management of their condition. The studies have reported that most of the patients in both urban and rural settings were satisfied with the treatment. These studies identified several factors that resulted in greater patient satisfaction, which include time-saving modes of consultation, easier access to physicians and sharing of resources. However, some problems were also reported, including the lack of continuity of care provided through telemedicine, variation in the quality of care and poor communication among team members.[26] This study demonstrated the feasibility of a virtual multidisciplinary programme and patients' satisfaction and acceptance of the same.

This study did not observe any difference between the group of patients who received virtual healthcare in 2020 and the group of patients who attended the centre in 2019 with regard to the metabolic parameters, SMBG and foot care behaviours. Conversely, this study observed that mental health parameters worsened in the year 2020, which might be related to the current pandemic.

Literature reports state that the observed data imply a significant decrease in the global physical activity levels during the period of lockdown to contain the spread of COVID-19, which resulted in the deterioration of cardiovascular health,[27,28] especially among the patients with T2D. Similarly, this study observed a significant reduction in physical activity and the patients reported that the major barriers for regular exercise were the fear of contracting COVID-19 during outdoor activities,

lack of knowledge regarding indoor exercises that can be performed at home and lack of time. Consequently, the authors are trying to develop several indoor exercise programmes that can be performed at home, to improve the adherence to exercise programmes.

This study identified a significant increase in the number of patients with anxiety syndrome, depressive symptoms and prescription of psychotropic drugs. Moreover, this study observed higher levels of diabetes-related distress (PAID scale). The patients with diabetes involved in this study understood that uncontrolled diabetes is associated with an increased risk of worse outcomes. In addition, the patients were worried about not being able to manage diabetes in case of infection, high mortality rates associated with the infection and uncertainty regarding the future. The aforementioned concerns are concurrent with previous reports of studies involving patients with diabetes.[24,25] A previous study has reported that the pandemic has caused great distress in society that has resulted in increased rates of depression, anxiety and other psychiatric disorders.[29] This is concurrent with the current results obtained during the year 2020. These findings offer an opportunity to commence or modify treatment strategies and provide careful follow-up and support to the patients who require the same.

Previous research involving telemedicine compared the patient satisfaction regarding virtual and face-to-face modes of consultation. This study assessed patient satisfaction using the Diabetes Treatment Satisfaction Questionnaire (DTSQ) and did not observe any difference between the two groups. The proportion of patients who were 'very satisfied' with the consultation was greater in the group that received virtual consultation.[30] Evaluation of the patient satisfaction regarding virtual healthcare indicated that telemedicine is a good option to administer medical care. This evaluation proved that the virtual mode is comfortable, adjustable, easy to administer and a good method of solving medical problems.

The strength of the model employed in this study is that the evaluation of acute renal, ophthalmological, dental and foot care complications can be ensured in all patients with diabetes. This allows for the establishment of appropriate treatment and referral strategies. Moreover, the virtual model does not require patients to spend time in

Table 3. Comparison of the results of mental health evaluation of the patients.

Variable	2019 (1 year) *n* = 305	2020 (1 year) *n* = 130	*p* value
Psychiatry consultations			
Anxiety syndrome	34 (11.1%)	28 (21.5%)	0.032*
Affective syndrome	47 (15.45%)	18 (13.8%)	0.675
Eating disorder	24 (7.9%)	14 (10.8%)	0.327
Psychotropic drug	55 (18.2%)	42 (32.8%)	0.016*
HADS depression			
Mild (0–6)	231 (75.7%)	91 (70%)	0.036*
Moderate (7–10)	61 (20%)	25 (19.2%)	
Severe(11–21)	13 (4.3%)	14 (10.8%)	
HADS anxiety			
Mild (0–7)	237 (77.7%)	90 (69.2%)	0.138
Moderate (8–10)	40 (13.15%)	26 (20%)	
Severe (11–21)	28 (9.2%)	14 (10.8%)	
PAID			
Without distress (0–39)	271 (88.9%)	106 (81.5%)	0.040*
Distress (≥40)	34 (11.1%)	24 (18.5%)	
DES-SF			
Lack of empowerment (0–74)	58 (19%)	34 (26.2%)	0.095
Empowerment (≥75)	81 (81%)	96 (73.8%)	
DQoL			
Good (35–75)	182 (59.7%)	71 (54.5%)	0.329

DES-SF, Diabetes Empowerment Scale-Short Form; DQoL, Diabetes Quality of Life; HADS, Hospital Anxiety and Depression Scale; PAID, Problem Areas in Diabetes.
n (%).
*$p < 0.05$ (chi-square test).

transportation and waiting rooms. This study has certain limitations. First, the sample size of the group that received virtual healthcare was significantly smaller (130 patients), compared with the group that received face-to-face consultations (435 patients), on account of the fact that some patients faced technical difficulties and others refused to undergo blood tests at a laboratory, owing to fear of contracting COVID-19.

Another limitation can be attributed to fact that it is impossible to control variables such as previous usage of applications, digital competencies and digital health literacy. A completely virtual mode of intervention was not used prior to the COVID-19 pandemic. Hence, this study did not have appropriate tools for the evaluation. Nevertheless, the satisfaction survey sought to identify the potential difficulties that patients might encounter during virtual consultations, regardless of their skills and previous digital experience. The results did not reveal any aspects that might affect the development of interventions.

It is important to continue the virtual mode of evaluation of metabolic control in patients who utilised the same, in contrast to those who persisted with face-to-face consultation. Hence, the scenario warrants further follow-up studies, to demonstrate the efficacy of virtual multidisciplinary programmes in achieving good metabolic outcomes.

Conclusion

In accordance with the proposed model to consider Diabetes Centre of Excellence,[31] the programme has the infrastructure and competency of a multidisciplinary and comprehensive care model, which is feasible and virtual mode of the same displays good acceptance. The virtual mode can be employed to improve outcomes, educate patients and prevent acute or chronic complications in patients with T2D.

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