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Guillain-Barre in the long-term acute care hospital setting: Ventilation does not prolong stay

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Abstract

Objective
Guillain-Barre Syndrome (GBS) is a rare acute inflammatory demyelinating polyneuropathy, resulting in loss of muscle function and potentially respiratory failure requiring prolonged mechanical ventilation. Data describing the demographics and outcomes of patients with severe GBS requiring prolonged ventilation in the long-term acute care hospital (LTACH) setting is limited. We hypothesized that patients with GBS requiring prolonged mechanical ventilation require longer lengths of stay in an LTACH and are discharged with poorer functional status than GBS patients who do not require mechanical ventilation.
Design, Setting, and Participants
We conducted a retrospective study of GBS patients admitted over a 9-year period at an independent, large LTACH and compared ventilated versus non-ventilated GBS patients' lengths of stay and functional ability at the time of admission and discharge.
Interventions
Not Applicable
Main Outcome Measures and Results
We found no significant difference in mean (standard error of means) lengths of stay between ventilated and non-ventilated GBS patients admitted to an LTACH (48.4 (± 8.0) vs. 38.8 (± 5.7) days, P 0.37). We also found that ventilated patients with GBS were discharged from an LTACH with similar functional ability than non-ventilated GBS patients (4.5 vs. 4.0, P 0.43 on 10 ft walk; 4.7 vs. 4.5 on P 0.70; 5.0 vs. 4.2, P 0.21 on 150 ft walk).
Conclusion
These findings suggest that GBS patients suffering from prolonged mechanical ventilation may expect similar lengths of stay in an LTACH as non-ventilated GBS patients and a similar or greater rate of functional improvement during their stay. These data support admission of chronically ventilated GBS patients to an LTACH for ongoing care after their acute care without the anticipation of greater length of stay or less rehabilitation outcomes with respect to non-ventilated GBS patients.

Keywords: Guillain-Barre Syndrome, Assisted Ventilation, Pulmonary Rehabilitation, LTACH, Critical Care

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Highlights:
• There are gaps in literature regarding long-term care and outcomes of GBS patients, especially in the LTACH setting.
• GBS patients suffering from prolonged mechanical ventilation may expect similar lengths of stay in an LTACH as non-ventilated GBS patients and a similar or greater rate of functional improvement during their stay.
• This new data may reassure LTACHs when screening GBS patients that whether they will need ventilation or not and other factors being equal, similar outcomes may be expected. Further, providing demographic data on this patient population can help medical facilities best prepare for their care, optimizing facility and patient costs and quality of life. Additionally, our study adds hope to both LTACHs and GBS patients amidst the paucity of literature on this subject.

Introduction

Guillain-Barre Syndrome (GBS) is a rare acute inflammatory demyelinating polyneuropathy. The incidence of GBS is estimated to be around 0.16-4 per 100,000 person-years depending on the specific location in the world. In the US alone, it is estimated to affect about 1,000 people annually. [1-4] GBS can result in the loss of muscle function and respiratory failure requiring prolonged mechanical ventilatory support. Prolonged ventilatory support is defined as requiring mechanical ventilation for 21 days or more without liberation. It is measured from the time of initial intubation, prior to or after admission, or whenever the admitting facility determines that the patient is “unable to wean from ventilator,” though a universal definition remains unclear. Studies have shown that patients who require prolonged ventilatory support will have a worse prognosis and take longer to be rehabilitated compared to patients who did not require prolonged ventilation or ventilatory support at all. [5]

GBS has the potential to significantly improve with proper supportive care and therapy. In many cases, a full recovery can be expected. [6] However, there are several gaps in the literature regarding the long-term care of GBS patients. First, most of the current data comes from acute care hospitals (i.e. intensive care units), which may not accurately reflect the experience and outcomes of patients in long term care settings. Second, many studies have shown variability in the treatment frequency and neuromuscular recovery timelines of the affected population that may not be accurate in other settings. Third, there is an expressed need to better understand the association between patient outcomes and patient age, duration of mechanical ventilation, and methods and frequency of treatments. [7-9] Despite these studies, there is a paucity of literature regarding the residual long-term effects of GBS, especially as it pertains to long-term acute care hospitals (LTACH). Studies have looked at the long-term effects that GBS can have on patients, however, there is a lack of clarity on how patients who need prolonged care and mechanical ventilation are affected after discharge. Since most of these studies are done after patients are cared for at large academic centers and/or acute care hospitals, it is of value to explore if staying at an LTACH has an influence on the long-term outcomes of these patients.

We hypothesized that GBS patients admitted to the LTACH requiring prolonged mechanical ventilation will have greater lengths of stay (LOS) and will require a longer rehabilitation to achieve similar functional abilities as non-ventilated patients. We performed a retrospective study in a rehabilitation focused LTACH to compare LOS and changes in functional ability of GBS patients who were admitted with prolonged mechanical ventilation and non-ventilated.

Materials and Methods

Ethical considerations
Prior to data collection and analysis, this study was approved by the Gaylord Hospital Institutional Review Board (IRB) to ensure ethical standards. All data were de-identified at the earliest possible moment to protect patient privacy.

Patient selection and Design
We performed a retrospective cohort study of patients admitted with GBS from January 1, 2013 to January 1, 2022 to determine risk factors for prolonged GBS associated with long-term acute care. All patients admitted within this timeframe with a diagnosis of GBS were included.

Data Collection Method
Data were collected using manual review of electronic medical records and standard reports from LTRAX, the institution’s outcome reporting system for Centers for Medicare and Medicaid Services (CMS) related metrics. Demographic and clinical data,

including gender, age, body mass index (BMI), LOS, number of readmissions to acute care, history of respiratory illness prior to GBS onset (including SARS-CoV-2 infection), and functional ability were compared for patients with GBS requiring mechanical ventilation and those who did not.

Functional ability was evaluated using the CMS required admission and discharge assistance scores for walking 10 feet, walking 50 feet with 2 turns, and walking 150 feet. A patient's ability to complete each task was scored based on the degree of support required to complete the functional task is scored on a scale from 1 to 6. A score of 1 indicates the patient was unable to perform the task whether due to functional inability or if it was deemed medically unsafe to perform the task at that time (e.g. over-sedated, inability to properly follow commands, etc.). A score of 6 indicates the patient was able to complete the assigned task independently. The change in score from admission to discharge is then reported.

Statistical analysis

Continuous variables were summarized as mean (standard error of means; SEM) and categorical variables as frequency (percentages). Value ranges for continuous variables were estimated within a 95% confidence interval (CI). Differences in continuous variables were tested using an unpaired student's t-test, and differences in categorical variables were tested using Fischer's Exact Test. Data were analyzed using OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version 3.01. Statistical significance was set as P ≤0.05.

Results

Total GBS population characteristics

Over the nine-year study period, 26 patients with a diagnosis of GBS were identified. When evaluated together regardless of the ventilation status, this LTACH treated GBS population had a mean (SEM) age of 54.9 (± 3.8) years, LOS of 41.4 (± 4.7) days, and BMI of 28.2 83 (± 1.5) kg/m^2.

The total population consisted of an equal proportion of males (13/26) and females (13/26). The population consisted of 96% (25/26) Caucasian and 4% (1/26) African American ethnicity. Of the comorbidities assessed, hypertension (12/26, 46%) and coronary artery disease (4/26, 15%) were the most abundant (Table 1).

Population characteristics by ventilation status

Of the 26 patients diagnosed with GBS, 7 required mechanical ventilation at admission and 19 did not (Figure 1). There were 6 males and 1 female in the ventilated group, and 7 males and 12 females in the non-ventilated group; demonstrating a significant difference in the proportion of genders between groups (P 0.04) (Table 2). Though not significantly different, the mean (SEM) age of the ventilated group was modestly greater than the non-ventilated group [65.6 (± 2.8) vs. 50.9 (± 4.8) years; P 0.08]. Similarly, mean (SEM) BMI [29.5 (± 2.0) vs. 27.7 (± 1.9) kg/m^2; P 0.60] and LOS [48.4 (± 8.0) vs. 38.8 (± 5.7) days; P 0.37] did not significantly differ between groups. In contrast, the ventilated groups demonstrated significantly greater mean (SEM) readmissions to acute care compared to the non-ventilated group [1.6 (± 0.4) vs. 0.2 (± 0.1) instances; P 0.01].

Patients in both groups presented with one or more comorbidities. Of the comorbidities evaluated, no significant differences in the proportion of conditions by group were observed, including: diabetes mellitus (P 0.63); hypertension (P 0.40); heart disease (P 0.29); COPD (P 0.06); emphysema (n/a); asthma (P 0.73); chronic kidney disease (P 0.73); cancer (P 0.47); stroke and seizure P 0.63); and depression and post-traumatic stress disorder (P 0.37).

There was no significant difference in the proportion of patients who received IVIG therapy [7/7 (100%) of the ventilated patients compared to 18/19 (95%) of non-ventilated patients, P 0.73]. No patients received IVIG during their LTACH admission. However, prior to LTACH admission, 96% (25/26) of patients had a history of polypharmacy (5 or more medications).

Medical history prior to GBS onset by ventilation status

Prior to GBS onset, ventilated patients were more likely to have experienced a respiratory illness than non-ventilated patients [43% (3/7) vs. 5% (1/19); P 0.047]. Although ventilated patients consistently demonstrated higher frequencies in vaccination, gastrointestinal illness, and COVID-19 prior to GBS onset than non-ventilated patients, these proportions were not significantly different overall (Table 3).

Pharmaceutical Use by Ventilation Status

Once admitted to the LTACH setting, pharmaceutical use was relatively similar between ventilated and non-ventilated patients. This included opioids [43%

(3/7) versus 47% (9/19); P 0.60], benzodiazepines [43% (3/7) vs. 32% (6/19); P 0.46], and mood stabilizers [57% 118 (4/7) vs. 37% (7/19); P 0.31] (Table 4).

Functional Ability

At the time of admission, patients who arrived on mechanical ventilation had worse functional ability than GBS patients who were not on mechanical ventilation (1.3 vs. 2.0, P 0.79 on 10 ft walk; 1.0 vs. 1.8, P 0.20 on 50 ft walk; 1.0 vs. 1.5, P 0.3 on 150 ft walk, respectively). At the time of discharge, patients who arrived on mechanical ventilation had similar functional ability as GBS patients who were not on mechanical ventilation when they were admitted (4.5 vs. 4.0, P 0.43 on 10 ft walk; 4.7 vs. 4.5, P 0.70 om 50 ft walk; 5.0 vs. 4.3, P 0.21 on 150 ft walk). Ventilated patients trended toward a greater positive change in functional ability during their LTACH admission (4 vs. 2, P 0.27 on 10 ft walk; 4 vs. 3 P 0.22 on 50 ft walk; 4 vs. 3, P 0.07 on 150 ft walk). Data are summarized in Figure 3.

Table 1. Demographics of overall GBS population

Age, mean (SEM), years	54.9 (± 3.8, 19-84)
Length of Stay mean (SEM), days	41.4 (± 4.7, 9-86)
BMI, mean (SEM), kg/m^2 [a]	28.2 (± 1.5, 17.2-47.9)
Gender, N (%) [b]	
Male	13 (50%)
Female	13 (50%)
Race/Ethnicity, N (%) [b]	
White	25 (96%)
African American	1 (4%)
Comorbidities, N (%) [b]	
Diabetes Mellitus	3 (12%)
Hypertension	12 (46%)
Coronary Artery Disease	4 (15%)
COPD	2 (8%)
Asthma	1 (4%)
Chronic Kidney Disease	1 (4%)
History of Cancer	2 (8%)

a: Continuous data presented as mean (± SEM, range).
b: Categorical variables are reported as frequency (%) of the total population; N=26

Table 2. Demographics and comorbidities of ventilated versus non-ventilated GBS populations

	Ventilated (N=7)	**Non-ventilated (N=19)**	**P-value**
Age (years) [a]	65.6 (± 2.8, 60.1-71.1)	50.9 (± 4.8, 41.6-60.2)	0.08
Male [b]	6 (86%)	7 (37%)	0.04
BMI (kg/m^2) [a]	29.5 (± 2.0, 25.7-33.4)	27.7 (± 1.9, 23.9-31.5)	0.60
Returns to Acute Care (times) [a]	1.6 (± 0.4, 0.8-2.4)	0.2 (± 0.1, 0.02-0.4)	0.01
Diabetes [b]	1 (14%)	2 (11%)	0.63
Hypertension [b]	4 (57%)	8 (42%)	0.40
Heart Disease [b]	2 (29%)	2 (11%)	0.29
COPD [b]	2 (29%)	0	0.06
Emphysema [b]	0	0	N/A
Asthma [b]	0	1 (5%)	0.73
Chronic Kidney Disease [b]	0	1 (5%)	0.73
History of Cancer [b]	1 (14%)	1 (5%)	0.47
Stroke/Seizure [b]	1 (14%)	2 (11%)	0.63
Depression/PTSD [b]	1 (14%)	6 (32%)	0.37

a: Continuous data presented as mean (± SEM, CI).
b: Categorical data presented as frequency (%).

Table 3. Pertinent medical history prior to GBS onset comparing ventilated and non-ventilated GBS population

	Ventilated, N (%)	Non-ventilated, N (%)	P-value
Vaccination	2/7 (29%)	1/19 (5%)	0.17
GI Illness	3/7 (43%)	3/19 (16%)	0.18
Respiratory Illness	3/7 (43%)	1/19 (5%)	0.047
COVID-19 Infection	2/7 (29%)	1/19 (5%)	0.17

Patients may have experienced one, more, or none of the indicated conditions and total observations may not equal the respective total populations (Ventilated N=7; Non-Ventilated N=19). Categorical data presented as frequency (%).

Table 4. Pharmaceutical use during LTACH stay comparing ventilated and non-ventilated GBS population

	Ventilated, n (%)	Non-ventilated, n (%)	P-value
Opioids	3/7 (43%)	9/19 (47%)	0.60
Benzodiazepines	3/7 (43%)	6/19 (32%)	0.46
Mood Stabilizers/Psychoactive	4/7 (57%)	7/19 (37%)	0.31

Patients may have been prescribed one, more, or none of the indicated medications and total usage may not equal the respective total populations (Ventilated N=7; Non-Ventilated N=19). Categorical data presented as frequency (%).

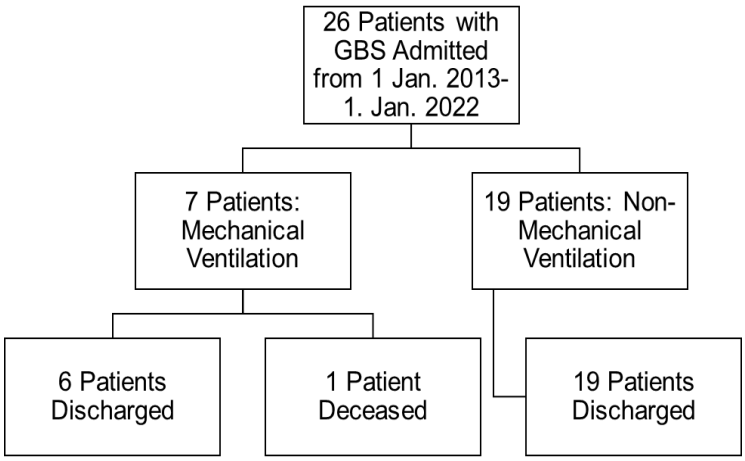


Figure 1. Consort diagram of GBS population. Representation of GBS study patient population from records of Gaylord Hospital within a 9-year timeframe.

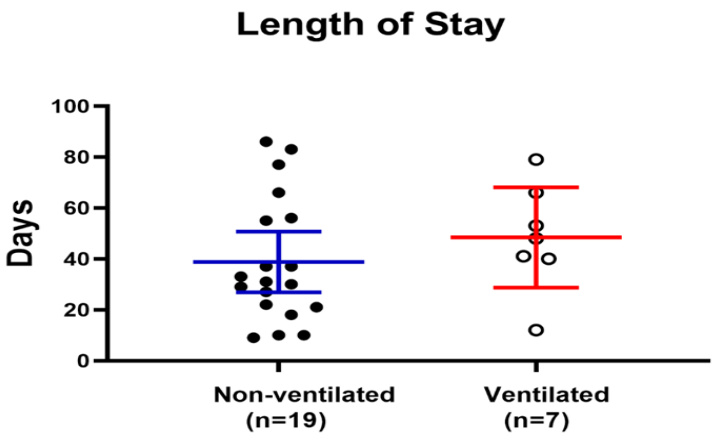
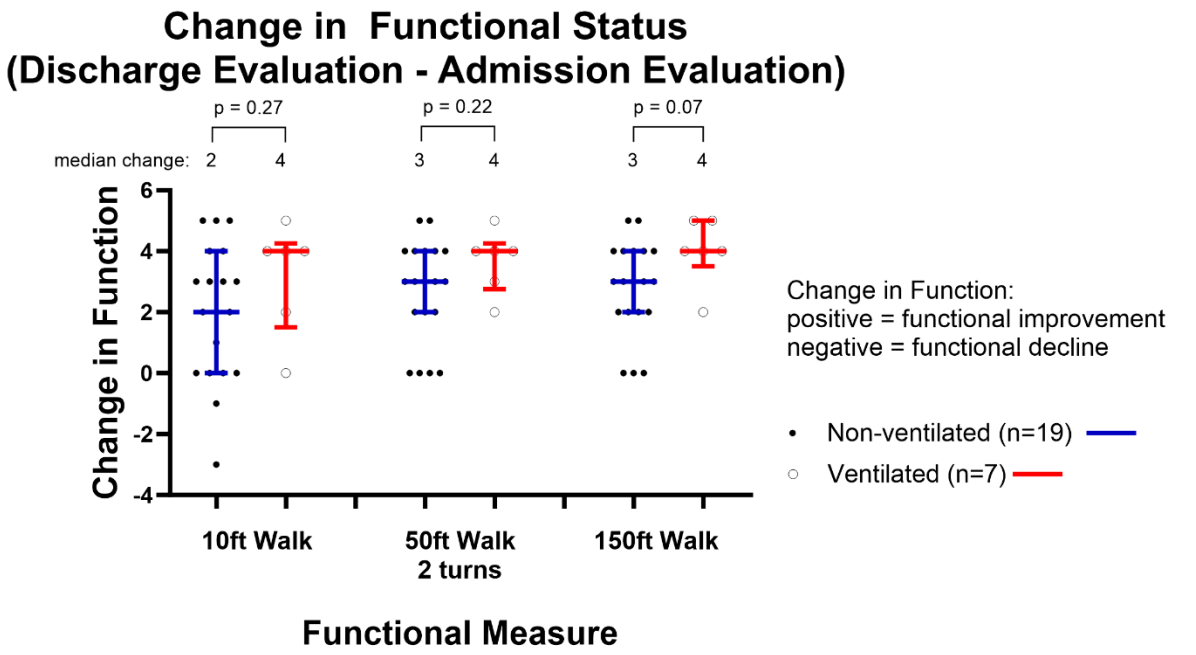


Figure 2: Non-ventilated and ventilated patients had similar mean lengths of stay (LOS). This is shown by the middle bar. The mean LOS (days) for ventilated patients was 48.4 (± 8.0), whereas non-ventilated patient mean LOS was 38.8 (± 5.7). Although ventilated patients did have a longer LOS, these values are comparable, and the difference was not found to be statistically significant (*P* 0.37).



Functional Scores		10 ft Walk	50 ft Walk	150 ft Walk
On Admission	Ventilated	1.3 (0.3, 0.7-1.9)	1	1
	Non-Ventilated	2.0 (0.4, 1.3-2.7)	1.8 (0.4, 1.1-2.5)	1.5 (0.3, 0.9-2.1)
	p-value	0.79	0.2	0.3
At Discharge	Ventilated	4.5 (0.5, 3.6-5.4)	4.7 (0.4, 4.0-5.4)	5.0 (0.4, 4.2-5.8)
	Non-Ventilated	4.0 (0.3, 3.3-4.7)	4.5 (0.3, 4.0-5.0)	4.3 (0.3, 3.8-4.8)
	p-value	0.43	0.7	0.21

Data presented as mean (± SEM, CI)

Functional Score Scale:
1 = unable to perform
2 = maximal assistance required to complete
3 = moderate assistance required complete
4 = verbal cue required to complete
5 = completed with dependence on device
6 = independently completed

Figure 3: Patients with GBS improve their functional ability during their LTACH stay; ventilated patients showed a trend of greater improvement than non-ventilated patients. The functional status of patients with GBS improved during their LTACH stay is measured by comparing their functional score at the time of discharge from their function score on admission, where a positive value suggests gains in function or functional improvement. Data are presented as scatter plots the median change in the respective CMS assistance scores for: walking 10 feet, walking 50 feet with 2 turns, and walking 150 feet. The whisker shows the interquartile range of each dataset.

Discussion

We hypothesized that GBS patients suffering from prolonged mechanical ventilation would require a greater LOS and rehabilitation to achieve similar functional abilities as non-ventilated GBS patients. Our data suggest that the opposite may be true. In our population, GBS patients requiring prolonged mechanical ventilation had similar lengths of stay and achieved a similar degree of functional outcomes as compared to other non-ventilated GBS patients treated in the same LTACH.

Our data promotes a better understanding of the LTACH needs of patients with GBS, specifically those who may need mechanical ventilatory support. This information will help patients and their families, medical professionals, and medical facilities, such as LTACHs, prepare for what to expect in terms of care and services.

Our study has shown that whether a patient was ventilated or non-ventilated at the time of their arrival at the LTACH, both groups left with significant functional improvement at discharge when cared for at the LTACH for similar periods of time. Our results differ from an earlier study that demonstrated significantly improved Functional Independence Measure (FIM), a method of measuring independence and self-care, [10] which found that ventilated GBS patients displayed greater levels of disability and longer LOS. [11] This earlier study

focused on acute inpatient admission and measured activities of daily living; whereas, we measured functional ability based solely on walking ability. The ability of detecting a single element of the FIM has not been reported; [12] therefore, it is difficult to directly compare the results of these two studies. The literature is clear that patients who have recovered from GBS should expect long-term effects including neuropathic pain accompanied by a degree of functional impairment, severe fatigue, and neurologic sequelae. [3,7-9] Our study and a previous report from our institution focused on the first step of rehabilitation in the long-term rehabilitation that GBS patients experience. [13]

The fact that ventilated patients showed similar CMS score improvements by discharge in this study support that proper rehabilitation may reduce overall costs of care for GBS patients, [14] though research remains scarce on methods of rehabilitation that best serve the GBS population. [15-17] Such studies are needed to help identify candidates who may have increased success at liberation from mechanical ventilation and neuromuscular recovery when screening individuals who may best benefit from care at a LTACH. This concurs with previous literature showing LTACH usage optimizes both facility and patient costs and quality of life. [18,19]

Based on our data, some generalizations can be made about the typical GBS patient population who may need inpatient stay at a LTACH. In our patient cohort, all ventilated patients arrived on mechanical ventilation from an acute care hospital. Compared to non-ventilated patients with GBS, ventilated patients with GBS were older; had a similar LOS and BMI; were more likely to return to an acute care hospital and then be readmitted back to the LTACH; have a significantly great instance of respiratory illness prior to GBS onset; and consisted of fewer female patients. Interestingly, and despite the difference in ventilation status, both groups showed similar functional improvements. Only one patient did not receive IVIG/plasmapheresis therapy, and they were a part of the non-ventilated group. At the end of the study timeframe, only one patient was deceased as a result of sepsis and respiratory failure. The deceased patient was a part of the mechanically ventilated group.

Study Limitations

It may seem that our sample size is small, however, it represents a large sample of this rare disease who require LTACH support. Given that incidence of GBS is as low as 1 per 100,000 and affects approximately 1,000 people in the US annually, [1-3] the population of GBS patients from this LTACH is larger than usual. Another possible limitation could be that our data comes entirely from an LTACH, and differences in data outcomes could possibly be present at a larger public or private hospital. Further, these data are limited to a single LTACH. Variations in practices and protocol between different institutions may limit the generalizability of our results. Finally, our data only included patients with GBS, and did not explore how outcomes could compare to a general population of admitted patients.

Conclusion

Our study has shown that ventilated GBS patients showed similar LOS and similar rate of functional improvement at discharge. There is limited data on this vulnerable population. These new data may reassure LTACHs when screening GBS patients that whether they will need ventilation or not and other factors being equal, similar outcomes may be expected. Finally, our study adds hope to both LTACHs and GBS patients amidst the paucity of literature on this subject.

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