A Proposed Roadmap for Inpatient Neurology Quality Indicators

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Abstract

Background/Purpose: In recent years, there has been increasing pressure to measure and report quality in health care. However, there has been little focus on quality measurement in the field of neurology for conditions other than stroke and transient ischemic attack. As the number of evidence-based treatments for neurological conditions grows, so will the demand to measure the quality of care delivered. The purpose of this study was to review essential components of hospital performance measures for neurological disease and propose potential quality indicators for commonly encountered inpatient neurological diagnoses. **Methods:** We determined the most common inpatient neurological diagnoses at a major tertiary care medical center by reviewing the billing database. We then searched PubMed and the National Guidelines Clearinghouse to identify treatment guidelines for these conditions. Guideline recommendations with class I/level A evidence were evaluated as possible quality indicators. **Results:** We found 94 guidelines for 14 inpatient neurological conditions other than stroke and transient ischemic attack. Of these, 36 guidelines contained at least 1 recommendation with class I evidence. Based on these, potential quality indicators for intracerebral hemorrhage, subarachnoid hemorrhage, pneumococcal meningitis, coma following cardiac arrest, encephalitis, Guillain-Barre syndrome, multiple sclerosis, and benign paroxysmal positional vertigo are proposed. **Conclusions:** There are several inpatient neurological conditions with treatments or diagnostic test routines supported by high levels of evidence that could be used in the future as quality indicators.

Keywords

central nervous system diseases, cerebrovascular disorders, hypoxia-ischemia, brain, intracranial hemorrhages, stroke delirium, outcomes, epidemiology

Physicians, hospitals, and health plans are feeling increased pressure to measure and report the quality of care they provide. On a fundamental level, the purpose of measuring quality in clinical practice is to learn and improve, and thereby positively affect individual patient outcomes. However, there is also a demand by insurers, accreditors, regulators, and consumers for more transparency and accountability in health care delivery. This stems in part from research that suggests that many Americans do not receive recommended preventive, acute, and chronic care of a variety of conditions.^{1,2} Some policymakers even argue that physician pay should be linked to performance with respect to specific quality indicators.

Compared with internal medicine, there has been little focus on quality measurement in neurology. This may be for a variety of reasons. Internists treat many common diseases with clear, evidence-based therapies, such as pneumonia, acute myocardial infarction, and congestive heart failure, whereas neurologists deal with less common diseases, and until recently, evidence from randomized controlled trials was not available to guide management for many of these. As the

body of evidence supporting treatments of many neurological diseases grows, however, there will be an increasing demand to show that patients have access to, and are receiving, appropriate treatments. Neurologists, and particularly neurohospitalists where inpatient neurology is concerned, should take a leadership role in defining quality indicators for our own field. If we do not, it is likely that regulatory agencies will develop such measures, possibly without major input from practicing neurologists.

In this article, we will review the definition of quality and the process of choosing clinical performance measures, and describe the steps that need to be taken to develop and validate quality indicators for inpatients with neurological disease.

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We then propose potential quality indicators by identifying the most common inpatient neurological diagnoses at our institution and reviewing treatment recommendations for each with the highest level of evidence in existing guidelines.

What is Quality and How Should it be Measured?

Measurement of health care quality generally spans the following 3 components: structure, process, and outcomes.^{3,4} Structure involves the setting in which health care is delivered and includes such factors as equipment and training, and availability of the personnel. The presence or absence of an acute stroke team is an example of a health care structure. A process example is the prescription of an antiplatelet medication for ischemic stroke, while the associated outcome would be prevention of recurrent stroke. Although outcomes represent the ultimate goals of health care and provide a purpose for the structure and the process, their use as quality indicators is fraught with problems. They are often more difficult and costly to measure and their occurrence may be too infrequent or delayed to create a meaningful feedback loop. Outcomes are also affected by many factors, such as disease severity or medication adherence, that providers have little control over. Thus, their ultimate meaning as an indicator of quality care, even when adjusted for known confounders, is debatable. For example, if a provider prescribes an antiplatelet agent to every ischemic stroke patient with the proper indication and routinely educates patients regarding their use, most would consider this high quality care. However, if a large number of that provider's patients cannot afford to pay for the medication and do not use it, measuring the outcome of recurrent stroke may not truly reflect the quality of care being delivered.

It is thus often easier, cheaper, and more meaningful to measure structures and processes of care in assessing health care quality. If a structure or process is clearly associated with an outcome, usually demonstrated through a rigorous clinical study such as a randomized controlled trial or a meta-analysis of multiple trials and often synthesized by a panel of experts into a clinical practice guideline, then it can be measured as a proxy for outcome.

When choosing an area in which to measure clinical performance, consideration must also be given to the cost and benefits of measurement. Generally, diseases that are common and have a high public health burden or economic impact are good areas on which to focus, especially if there is data suggesting effective treatments are being underutilized.⁵⁻⁷ Finally, providers must have some control over the structure or process if the measure is to achieve its purpose of promoting change at the point of care.

Among 20 national priority areas for quality assessment and improvement identified by the Institute of Medicine in their 2003 report calling for concerted action to address health care quality, stroke was the only neurological condition.⁸ It meets the above criteria, indicating that it is a common illness with a high public health and economic burden, and

that there are treatments proven to reduce stroke recurrence and evidence to suggest they are underutilized.² Therefore, a focus on quality measurement and improvement in ischemic stroke is justified. Because ischemic stroke and transient ischemic attack are already the focus of quality measurement and outcomes research, we will not discuss them specifically here. Whether we should also be expending resources on quality measurement for other neurological diseases in addition to stroke, however, has received little attention nationally and in the medical literature.

Methods

To gauge which inpatient neurological conditions are most common, we examined the frequency of diagnoses on the neurology and neurovascular services, both primary and consultative, at the University of California, San Francisco (UCSF), Medical Center. We identified all patients discharged from the neurology service, neurovascular service, or seen by the consult service between October 2006 and July 2008 from the hospital billing database. The primary diagnosis for each encounter was derived from ICD-9 codes.

We then searched the National Guidelines Clearinghouse and PubMed using the limit search option for "Practice Guideline" articles to find English-language clinical practice guidelines related to the most common adult inpatient neurological diseases treated at UCSF. Our search terms included the diagnosis in question (eg, "Guillain-Barre syndrome" or "status epilepticus"). Although this approach was not a systematic review, it was expected to find the most relevant guidelines. For guidelines with more than 1 edition, only the most recent update was included. We then reviewed these guidelines for class I or level A recommendations for structures or processes of care that were associated with clinically meaningful outcomes and were germane to the inpatient setting. Because there is variability in the level of evidence required for a class I or level A recommendations among different guidelines, only those recommendations based on evidence derived from meta-analyses or from at least one high-quality large randomized controlled trial were included. Based on these recommendations, potential quality indicators were proposed.

Results

A total of 3180 patients were seen by the neurology services at UCSF between October 2006 and July 2008 (Table 1). The most common diagnoses were ischemic stroke, seizure, encephalopathy, intracerebral hemorrhage, subarachnoid hemorrhage, meningitis, anoxic brain injury, transient ischemic attack (TIA), and status epilepticus.

Each of the most common inpatient neurological diagnoses, with the exception of ischemic stroke and TIA, yielded 2 to 17 guidelines (Table 2). Only 40% of these contained level A recommendations. There were level A recommendations

Table 1. Most Common Inpatient Diagnoses on an Academic Neurology Service

Diagnosis	Number	Frequency (%)
Cerebrovascular disease		
Ischemic stroke	593	18.65
Intracerebral hemorrhage	201	6.32
Subarachnoid hemorrhage	182	5.73
Transient ischemic attack	113	3.55
Other	15	0.46
Seizure disorders		
Seizure (without status)	316	9.94
Status epilepticus	100	3.14
Encephalopathy and delirium ^a	310	9.75
Infectious disease		
Meningitis	125	3.93
Encephalitis	57	1.79
Anoxic brain injury	116	3.65
Myelopathy/myelitis	108	3.40
Headache	89	2.80
Neuromuscular disease		
Neuropathies ^b	197	6.19
Myasthenia gravis	66	2.08
GBS	45	1.42
Myopathy	31	0.97
Motor neuron disease	9	0.28
Brain tumors ^c	52	1.64
Demyelinating disease of the CNS		
Multiple sclerosis	39	1.23
Neuromyelitis optica	16	0.50
Other	34	1.07
Syncope	39	1.23
Dizziness and vertigo	22	0.69
Movement disorders		
Parkinson disease	21	0.66
Secondary parkinsonism	21	0.66
Other	41	1.29
Other (no diagnosis over 1%)	222	6.98

GBS = Guillain-Barre syndrome; CNS = central nervous system.

^a Includes any cause not otherwise listed in this table.

^b Includes cranial neuropathies, radiculopathies, plexopathies, mononeuropathies, and polyneuropathies, not otherwise specified.

^c This is an underestimate, because most patients with brain tumors are cared for by the neurosurgical service at the University of California, San Francisco (UCSF).

for every diagnosis with the exception of myelopathy. Several recommendations could be translated into feasible, measurable quality indicators (Table 3).

Seizure. For patients hospitalized with unprovoked seizures, long-term therapy with an antiepileptic medication has often begun. There are guidelines from multiple agencies concerning the initial approach to seizure monotherapy. Level A recommendations support the use of carbamazepine, phenytoin, valproic acid, lamotrigine, gabapentin, oxcarbazepine, or topiramate for adults with newly diagnosed epilepsy with partial onset seizures.^{9,10} One guideline makes a specific recommendation for lamotrigine or gabapentin in the elderly with

Table 2. Existing Guidelines for Inpatient Neurological Conditions

Diagnosis (In Order of Frequency)	Number of Recent Guidelines	Number With Class I/Level A Recommendations
Seizure (without status)	17	4
Encephalopathy and delirium	5	1
Intracerebral hemorrhage	3	2
Subarachnoid hemorrhage	4	1
Meningitis	6	3
Anoxic brain injury	3	2
Myelopathy/myelitis (nontraumatic)	2	0
Status epilepticus	5	2
Headache	16	6
Myasthenia gravis	6	2
Encephalitis	4	2
GBS	4	3
Multiple sclerosis	17	6
Dizziness and vertigo	2	2

GBS = Guillain-Barre syndrome.

partial onset seizures.¹⁰ For adults with primary or secondary generalized epilepsy, no level A recommendations with regard to initial monotherapy are made. These guidelines were released prior to the publication of the important Standard and New Antiepileptic Drugs (SANAD) studies that provide more information to guide treatment of generalized epilepsy in adults.^{11,12}

With regard to refractory partial epilepsy, oxcarbazepine and topiramate are recommended as monotherapy options, and gabapentin, lamotrigine, tiagabine, topiramate, oxcarbazepine, levetiracetam, and zonisamide are recommended as add-on therapies. Topiramate is recommended as an option in the treatment of refractory generalized seizures.¹³

Despite these recommendations, it may be problematic to base a quality measure on antiepileptic choice for newly diagnosed epilepsy. The decision of which medication to start is highly individualized with consideration given to comorbidities as well as a discussion of side effects with the patient. Requiring strict adherence to guidelines in this specific instance may introduce too much rigidity into this highly complex decision-making process.

Delirium. There are no level A recommendations for delirium except for those dealing with the treatment of alcohol withdrawal. In such cases, benzodiazepines should be used and neuroleptics should be avoided as first line agents.¹⁴ Existing guidelines do not address recent data that a multi-component intervention can reduce the incidence of delirium in elderly inpatients, which might be considered as a quality indicator if further research confirms this finding.¹⁵

Intracerebral hemorrhage (ICH). There were 2 level A recommendations associated with outcomes in the guidelines for intracerebral hemorrhage (ICH). First, routine early

Table 3. Proposed Quality Indicators

Diagnosis	Quality Indicator
Intracerebral hemorrhage	Prescription of an antihypertensive at discharge
Subarachnoid hemorrhage	Use of nimodipine during hospitalization
Pneumococcal meningitis	Use of dexamethasone prior to or with first dose of antibiotics
V-fib or pulseless V-tach arrest	Therapeutic hypothermia
Encephalitis	Performance of herpes simplex virus-1 and virus-2 polymerase chain reaction on CSF
GBS	Use of IVIg or plasma exchange if unable to walk without aid or progressive symptoms within first 2 weeks of illness
Multiple Sclerosis	Brain MRI during hospitalization or scheduled on discharge for first demyelinating episode
BPPV	Canalith repositioning maneuver performed

CSF = cerebrospinal fluid; GBS = Guillain-Barre syndrome; BPPV = benign paroxysmal positional vertigo; MRI = magnetic resonance imaging.

hematoma evacuation in supratentorial ICH with standard craniotomy should not be performed because there is strong evidence that this does not improve outcomes. A possible exception occurs when the clot is within 1 cm from the surface, in which case craniotomy and hematoma evacuation could be considered. Second, hypertension should be treated with an angiotensin-converting enzyme inhibitor and/or thiazide diuretic in the nonacute setting to reduce the risk of recurrent ICH.^{16,17} Thus, an indicator of quality for the treatment of ICH might be the prescription of an antihypertensive at discharge, if the comorbid diagnosis of hypertension is made during the hospitalization.

Subarachnoid hemorrhage (SAH). There is a level A recommendation for oral nimodipine to prevent adverse outcomes associated with vasospasm after subarachnoid hemorrhage (SAH).¹⁸ However, at the time of this writing, there had been no comprehensive guideline with respect to SAH published since 1994. Since then, there have been studies suggesting improved outcomes for SAH treated at high-volume centers, and improved outcomes for treatment of ruptured aneurysms with intravascular coiling versus surgical clipping.^{19,20} However, these issues should be subjected to the formal guideline development process before becoming the subject of quality measures. A feasible quality indicator based on current guidelines would be the use of nimodipine during the hospitalization for patients with aneurysmal SAH.

Meningitis. In the workup of suspected bacterial meningitis, it is recommended that a lumbar puncture be postponed if there is imaging evidence of an intracranial mass lesion, obstructive hydrocephalus, or midline shift. Both the

European Federation of Neurological Societies (EFNS) and the Infectious Disease Society of America (IDSA) recommend the use of dexamethasone 0.15 mg/kg every 6 hours for 2 to 4 days if given either shortly before, or concomitant with, the first dose of antibiotics for adults with suspected or proven pneumococcal meningitis. Dexamethasone should be discontinued if the etiology of meningitis is found to be a pathogen other than pneumococcus.^{21,22} For patients with cryptococcal meningitis, regardless of HIV status, induction therapy should include amphotericin B and flucytosine.²³ Of these recommendations, tracking the use of dexamethasone for pneumococcal meningitis might be the most meaningful and feasible quality indicator.

Anoxic brain injury. There is a level A recommendation for induced hypothermia to 32 to 34°C in patients who remain unresponsive after resuscitation from a nonperfusing ventricular tachycardia or ventricular fibrillation.²⁴ For patients suffering from anoxic brain injury, the determination of prognosis for recovery often falls on the shoulders of the neurologist. Only the absence of pupillary or corneal reflexes, or absent or extensor motor response at 72 hours postarrest, is predictive of a poor outcome based on the highest level of evidence. However, this has not been validated in patients treated with hypothermia.²⁵ A potential quality indicator might be how frequently therapeutic hypothermia is used for patients with an in-hospital or out-of-hospital cardiac arrest because of ventricular fibrillation or a nonperfusing ventricular tachycardia.

Status epilepticus. For the initial management of generalized convulsive status epilepticus (GCSE), current guidelines recommend the use of intravenous lorazepam or diazepam followed, if necessary, by phenytoin or equivalent fosphenytoin.^{26,27} There is no level A recommendation for GCSE that is refractory to these measures. For patients presenting in status epilepticus related to alcohol withdrawal, intravenous lorazepam or diazepam are still the drugs of choice. Both are recommended for primary and secondary prevention of alcohol withdrawal seizures as well.²⁸ However, designing a quality measure for GCSE would be challenging because it would be hard to identify cases appropriately. It may be difficult on chart a review to differentiate between convulsive and nonconvulsive status epilepticus, for example, and the treatment algorithm for nonconvulsive status is not as well established.

Headache. Headache is a common complaint among inpatients and a common reason for neurological consultation. Level A recommendations in published guidelines support the use of the following: triptans; dihydroergotamine nasal spray; antiemetics including metoclopramide, chlorpromazine, and prochlorperazine; and nonsteroidal anti-inflammatory drugs alone or with caffeine, for abortive therapy for migraines in patients without contraindications. Amitriptyline, beta blockers, calcium channel blockers, divalproex sodium, and

topiramate are recommended as preventive therapy.²⁹⁻³² The best available evidence supports the use of 100% oxygen, sumatriptan, or zolmitriptan for the treatment of cluster headaches.³³ For the prevention of a postlumbar puncture headache in diagnostic lumbar puncture, current guidelines recommend the use of an atraumatic spinal needle, using the technique of replacing the stylet before the needle is withdrawn.³⁴

Because headache treatment is so individualized and there are many reasonable therapeutic options, developing a measure of quality in this arena would be complicated. Much like the choice of an antiepileptic in seizure patients, strict adherence to guidelines may be too restrictive in many cases.

Guillain-Barre syndrome (GBS). For Guillain-Barre syndrome (GBS), level A recommendations include treatment with either plasma exchange or IVIg (2 g/kg over 2-5 days) within 2 to 4 weeks of onset for patients who require aid to walk. Treatment with corticosteroids and combination therapy with plasma exchange followed by IVIg is not recommended.³⁵⁻³⁷ A feasible quality measure might be the use of IVIg or plasma exchange for patients diagnosed with GBS who require an aid to walk or who have documented progression, either by history or exam, within the first 2 weeks of their illness. It may not be reasonable to use treatment between 2 and 4 weeks as a quality indicator because treatment during this time frame is not as strongly supported by the available evidence.

Myasthenia gravis. IVIg or plasma exchange is also recommended for acute myasthenic exacerbations and short-term treatment of severe myasthenia.^{35,36} Because the decision of when to use these treatments in myasthenia depends on clinical factors that would be difficult to measure, the use of these treatments as a quality indicator may not be feasible.

Encephalitis. In the diagnostic evaluation of patients with suspected encephalitis, a lumbar puncture and polymerase chain reaction studies on cerebrospinal fluid, for specific, treatable viral pathogens, are recommended. Magnetic resonance imaging (MRI) is the most sensitive and useful imaging modality. The only treatment recommendation, based on high quality evidence, is acyclovir for encephalitis because of the herpes simplex virus (HSV).^{38,39} A possible indicator of quality in patients given a clinical diagnosis of encephalitis might be the routine use of HSV PCR testing in all such cases. A corollary quality measure would be the use of acyclovir in PCR-confirmed cases.

Multiple sclerosis. Patients with a first demyelinating episode involving the central nervous system should undergo brain imaging with MRI, because the presence of 3 or more white matter lesions on a T2-weighted sequence is highly predictive of the development of MS in the next 7 to 10 years. A follow-up MRI should be obtained after 3 to 6 months to establish dissemination in time.^{40,41} For patients with an acute MS attack, glucocorticoids should be considered.^{42,43} The use of IVIg as

monotherapy or as add-on therapy with glucocorticoids is not recommended.

There are level A recommendations for the consideration of interferon beta, glatiramer acetate, and natalizumab in relapsing remitting MS, but because these are usually prescribed and administered in the outpatient setting they are not discussed further here.^{42,44} There is disagreement in various guidelines with respect to the utility of testing for neutralizing antibodies to interferon beta.⁴⁵

The use of brain MRI, either during or within a defined short period of time after discharge in patients hospitalized with a first demyelinating episode, could be proposed as a quality indicator. While there is no direct evidence that such imaging affects patient outcomes, it could be justified because there is evidence that the use of interferon beta delays the onset of MS in patients with a clinically isolated syndrome and 2 or more brain lesions on MRI, and because a second MRI documenting dissemination in time would confirm the diagnosis of MS and might lead to the earlier initiation of therapy.

Vertigo. The only guidelines addressing dizziness and vertigo deal specifically with benign paroxysmal positional vertigo (BPPV). The American Academy of Otolaryngology-Head and Neck Surgery Foundation recommended that the diagnosis of BPPV be made when a patient presents with paroxysmal vertigo and there is a characteristic response to Dix-Hallpike testing.⁴⁶ In a recent guideline, the American Academy of Neurology recommended the canalith repositioning procedure for BPPV.⁴⁷ Thus, for patients with BPPV, the documentation that a canalith repositioning procedure was performed would be a reasonable and feasible quality indicator.

Discussion

We identified the most common inpatient neurological diagnoses at our academic medical center. We then reviewed the literature to determine the level A recommendations for treatments relevant to the inpatient setting for each of these diagnoses. Based on these recommendations, we proposed several possible indicators of high quality inpatient neurological care.

There are several steps that must be taken before implementing these measures on a wider scale. The ideal quality measure should improve the way care is delivered. Thus, if every eligible patient already receives the appropriate treatment, there is little purpose in spending precious resources to measure the indicator. Furthermore, to accurately assess the cost and potential benefit of measuring quality for a specific disease, the degree of potential improvement in care should be known. However, for the conditions listed in this review, it is not known how frequently patients are treated appropriately, and additional research is needed in this area to determine which inpatient neurological conditions are most often undertreated. Such research should include the community hospital setting, because the relative frequencies of the conditions reported here are likely influenced by referral bias.

While we have proposed several possible quality indicators based on our review of the literature, these measures should be evaluated by a panel of experts in hospital-based neurology prior to broad implementation. Guidelines are useful only so far as they are free from bias and adhere to recommended methodology, but some authors have found that many guidelines do not meet these criteria.⁴⁸ There have been recent attempts to modify the guideline development process to more objectively select expert panelists and minimize the possibility that dominant personalities skew the final recommendations.^{49,50} Therefore, while quality indicators for a single institution, such as those suggested in this article, may be developed by a team of specialists' review of the literature and expert opinion, more broadly applied quality indicators should be vetted by the same process through which the most rigorous, bias-free guidelines are developed. This is important too because both guidelines and quality metrics have the potential to be used to define the standard of care in legal settings.

Once inpatient neurology quality indicators have been chosen, their parameters must be specified and a measurement strategy defined. For example, if the use of IVIg or plasma exchange is to be measured as an indicator of quality in the care of GBS, there are many details that must be delineated. How will GBS be defined and how will cases be identified? How severe must the illness be and how will severity be measured? When in the disease course should treatment be given? What dose of IVIg or plasma exchange will be acceptable? Will adherence to the quality indicator be determined by retrospective chart review or will it be documented at the point of care? All of these questions must be answered and the specifications accepted as reasonable by practitioners on the ground level for the measure to be successful. Finally, the measure should be validated and appropriate target rates of adherence to the measure determined by testing its use in a consortium of hospitals with a high volume of inpatient neurological disease.

While choosing quality indicators based on evidence that they are linked to outcomes is reasonable, there are some important processes of care that will never be tested with a randomized controlled trial because of ethical and financial realities. To eschew these potential quality indicators may be to miss important opportunities to improve care. For example, there is a preponderance of data that smoking leads to accelerated atherosclerosis, stroke, and heart disease, but there is no randomized trial proving that smoking cessation counseling—an important part of stroke care—leads to decreased rates of recurrent stroke. Similarly, the benefit of early dysphagia screening for both ischemic and hemorrhagic stroke patients is unlikely to be proven with a randomized trial. Counseling patients regarding local driving regulations after a single seizure, the use of emergent EEG in patients with status epilepticus treated with pharmacologic coma or without a rapidly improving neurologic exam, and the measurement of forced vital capacity and negative inspiratory force within 24 hours of admission for patients with GBS and myasthenia

gravis, are other processes that are not based on level A guideline recommendations but might indicate high quality care.

Conclusions

There is increasing demand for accountability and reporting of quality in the delivery of health care. While this pressure comes from various sources, it is ultimately our responsibility as physicians to monitor and continually improve the quality of care we provide. While large-scale quality initiatives are justifiably focused on common diseases with a high economic burden and known deficiencies in care delivery, this is an ideal time to start thinking more broadly about how to measure quality in a wider array of neurological conditions. Neurohospitalists are in a good position to be leaders in the inpatient arena. Indeed, there are numerous diseases common to inpatient neurology for which there are evidence-based diagnostic tests and treatments and that are amenable to measurement as quality indicators. Prior to implementing any widespread policy regarding quality measurement for inpatient neurology, however, more research is needed to determine the degree to which recommended tests and treatments are being used appropriately at the current time. In addition, unbiased expert consensus is required to choose the most scientifically rigorous quality measures, and more experience on the local level is needed to evaluate the reliability and validity of such measures. Ultimately, it is our hope that these steps will help improve outcomes for inpatients with neurological disease.

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