

The Changing Face of Disability in the US Army: The Operation Enduring Freedom and Operation Iraqi Freedom Effect

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Abstract

Orthopaedic disorders account for significant disability among adults in the United States. Previous studies have demonstrated long-term disability in military personnel with musculoskeletal conditions. However, these studies focused primarily on battlefield-injured service members and did not evaluate the entire population. The goal of this study was to determine and compare the disabling conditions of the entire United States Army during peacetime and war. We identified the conditions leading to separation from military service before and during Operation Iraqi Freedom and Operation Enduring Freedom. During war, more soldiers are found to be unfit for duty, and they have more conditions per individual that make them unfit. Orthopaedic conditions account for the greatest number of soldiers separated from military service at both time points studied (ie, January through March 2001, January through March 2009). Back pain and osteoarthritis are the two most common causes of separation from military service; these conditions are responsible for the most disability during peacetime and war.

Musculoskeletal conditions cause significant disability and account for substantial healthcare costs in the civilian population in the United States.¹⁻⁴ The World Health Organization reports that musculoskeletal disorders account for the third greatest number of disability-adjusted life-years globally, that is, potential life years lost as the result of the mortality and morbidity of disease. Ischemic heart disease and cerebrovascular disease, respectively, account for the greatest and second greatest number of disability-adjusted life-years.⁵ In the United States, nearly 50% of adults aged ≥ 18 years report a musculoskeletal condition.⁶ Twenty-nine million adults in the United States re-

port difficulty performing routine activities of daily living without assistance due to a medical condition; more than half of these are due to musculoskeletal conditions.⁶ Musculoskeletal conditions account for most occupational injuries sustained in the United States.⁷ Such conditions are more severe and cause significantly more days of work lost due to injury than any other nonfatal work site injuries. Musculoskeletal injuries cause substantial disability within the entire population and detract from the productivity of the civilian work force.

The burden of musculoskeletal injury affects the military population as well, in the form of injury and dis-

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14. ABSTRACT Orthopaedic disorders account for significant disability among adults in the United States. Previous studies have demonstrated long-term disability in military personnel with musculoskeletal conditions. However, these studies focused primarily on battlefield injured service members and did not evaluate the entire population. The goal of this study was to determine and compare the disabling conditions of the entire United States Army during peacetime and war. We identified the conditions leading to separation from military service before and during Operation Iraqi Freedom and Operation Enduring Freedom. During war, more soldiers are found to be unfit for duty, and they have more conditions per individual that make them unfit. Orthopaedic conditions account for the greatest number of soldiers separated from military service at both time points studied (ie, January through March 2001, January through March 2009). Back pain and osteoarthritis are the two most common causes of separation from military service; these conditions are responsible for the most disability during peacetime and war.					
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ability. Recent studies performed at our institution indicate that musculoskeletal injuries account for most combat wounds, demand the greatest numbers of hospital resources, and represent the primary source of both separation from military service and long-term disability.⁸⁻¹⁰

Disability within the US Army is determined by the Army Physical Evaluation Board (PEB), an administrative body consisting of medical personnel and Army officers who determine whether an ill or injured soldier is able to perform his or her job. The PEB result includes whether the soldier is fit for duty. A soldier who is found to be unfit may be removed from active-duty service through medical retirement or separation based on the severity of the unfitting condition or conditions, or the soldier may petition to continue on active duty.

Unfitting conditions are grouped by region of the body or systems affected and are coded using the Veterans' Administration Schedule for Rating Disabilities code.¹¹ Each unfitting condition is also assigned a percent disability rating. This rating is a measure of the way in which the condition detracts from the soldier's ability to perform his or her job and determines eligibility for disability benefits.

The conditions that result in medical retirement or separation from the military represent the health concerns of the military population as a whole. During peacetime, these conditions likely represent the distribution of health problems seen in the active young civilian population. It is expected that, during a time of war, a greater number of unfitting conditions

will be related to combat injury, training injury, and non-battlefield injuries, while the health issues present during peacetime persist. The sum of PEB results collected during a time of war thereby encompasses the general health issues found in the military population as a whole, along with the conditions resulting from war wounds and training.

In this study, we describe the peacetime distribution of disabling disease in the US Army and attempt to determine how the Army's participation in Operation Enduring Freedom and Operation Iraqi Freedom has changed this distribution. We hypothesized that orthopaedic conditions account for the most common unfitting conditions during peacetime and war and that conditions such as traumatic brain injury (TBI), posttraumatic stress disorder (PTSD), and orthopaedic trauma account for the greatest number of unfitting conditions during war.

Methods

The PEB database was queried for all soldiers who were medically retired or separated in January through March 2001, before the wars began, and in January through March of 2009, when both conflicts were well established. (These data are included in the US Army PEB database and were studied through an Institutional Review Board-approved protocol at our institution and the Veterans' Administration. These data are not publicly available.) Only the list of unfitting conditions leading to separation or retirement was provided; demographic data and medical histories were not analyzed. Unfitting condi-

tions for each time period studied were grouped into categories consistent with Veterans' Administration Schedule for Rating Disabilities codes (Table 1). Unfitting conditions not related to the musculoskeletal system were analyzed based on the anatomic system affected. Orthopaedic unfitting conditions were further separated into anatomic regions for data analysis. The disability rating for each unfitting condition was determined, and the average disability rating associated with each category of conditions was calculated. The impact factor for each unfitting condition was calculated as the product of the frequency of the condition and the average percent disability.⁸

The percentage of soldiers with each unfitting condition and the average disability ratings between the two time points were compared. The Fisher exact test was used to determine whether the percentage of unfitting conditions changed, and unpaired Student *t* tests were used to determine whether the mean disability ratings changed between time points. Statistical significance was defined as $P < 0.05$.

Results

In the first quarter of 2009, 3,143 soldiers were medically retired or separated, compared with 1,673 in the first quarter of 2001. This difference represents an 88% increase during war, despite an increase of only 2.7% in total Army population in the same time period. The number of unfitting conditions per subject increased from approximately 1 to 1.7, yielding an additional 3,670 total unfitting conditions among soldiers

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Table 1**Definition of Categories of Unfitting Conditions in the US Army**

Category	Description
Nonorthopaedic unfitting conditions	
Blood	Any condition of the blood or hematopoietic system
Cancer	Any malignancy
Cardiovascular/peripheral vascular disease	Disorders resulting from illness or injury to the heart or peripheral vascular disease
Ear/hearing	Loss of hearing or other injury to the ear and/or vestibular organs
Endocrinology	Disease of the endocrine system resulting in an unfitting condition
Eye/vision	Loss of sight or other injury to the eye or ocular muscles
Female reproductive	Any pathology of the female reproductive tract resulting in an unfitting condition
Gastrointestinal	Disease of the gastrointestinal system resulting in an unfitting condition
Genitourinary	Disease of the genitourinary system resulting in an unfitting condition
Infection	Infection at any site in which the infection itself is the cause of an unfitting condition
Skin	Any dermatologic disease or injury to the skin, including burns
Neurologic	Any central or peripheral neurologic disorder, excluding injury to a peripheral nerve
Psychiatric	Diagnosis of any psychiatric condition
Posttraumatic stress disorder	Diagnosis of posttraumatic stress disorder
Respiratory	Disease of the respiratory system resulting in an unfitting condition
Rheumatologic	Disease due to a rheumatologic cause, resulting in an unfitting condition
Traumatic brain injury	Diagnosis of traumatic brain injury
Orthopaedic unfitting conditions	
Amputation	Any loss of limb or part of a limb, excluding isolated amputations of the fingers or toes
Back pain/vertebral condition	Back pain resulting from nondiscogenic causes and disorders of the vertebrae
Degenerative or herniated disk	Back pain resulting from discogenic causes, including nerve root symptoms
Foot and ankle	Any condition causing pain or loss of function of the foot and/or ankle, including osteoarthritis
Fibromyalgia	Diagnosis of fibromyalgia in which fibromyalgia itself is an unfitting condition
Knee	Any condition causing pain in or loss of function of the knee
Miscellaneous	All other disorders resulting in an unfitting condition not otherwise classified
Muscle	Any condition resulting in physical muscle loss or decrease in muscle function
Osteoarthritis	Arthritis of a joint resulting from degenerative or posttraumatic conditions and excluding inflammatory arthropathies
Other lower extremity	All other lower extremity disorders resulting in an unfitting condition not otherwise classified
Peripheral nerve	Injury to a peripheral nerve resulting in nerve pain or loss of function
Total joint arthroplasty	Any shoulder, hip, or knee replacement
Other upper extremity	All other upper extremity disorders resulting in an unfitting condition not otherwise classified

who appeared before the PEB in 2009. Orthopaedic diagnoses accounted for most conditions at both time points (75% in 2001, 64% in 2009) (Table 2).

The percentage of soldiers found to be unfit because of nonorthopaedic conditions did not change significantly between time points for most conditions. However, the percentage of psychiatric disorders, PTSD, and

TBI increased dramatically, whereas the percentage of unfitting conditions such as cancer, infection, and respiratory disorders decreased (Table 3). Significant increases were seen in the percentage of soldiers found to be unfit as the result of amputations and back pain, including vertebral conditions and degenerative/herniated disks, as well as disorders related to the foot and ankle, periph-

eral nerve, and lower and upper extremities (Table 4). A significant reduction was noted in the percentage of soldiers with knee disorders. Although the percentage of soldiers found to be unfit because of osteoarthritis (OA) decreased from 2001 to 2009, the absolute frequency of soldiers with OA increased, from 602 in 2001 to 987 in 2009.

At both time points, OA and back

Table 2
Characteristics of US Army Physical Evaluation Board Results^a

Parameter Evaluated	Jan–Mar 2001	Jan–Mar 2009	Increase (%)
Total US Army population	1,384,812	1,421,668	2.7
Soldiers medically retired or separated through the PEB	1,673	3,143	88
Unfitting conditions per soldier	1.01	1.69	67
Percentage of orthopaedic unfitting conditions	75%	64%	N/A

N/A = not applicable, PEB = Physical Evaluation Board

^a These data are included in the US Army Physical Evaluation Board database and were studied through an Institutional Review Board–approved protocol at our institution and the Veterans’ Administration. These data are not publicly available.

Table 3
Nonorthopaedic Unfitting Conditions^a

Unfitting Condition	Jan–Mar 2001		Jan–Mar 2009		P Value
	Frequency	% (n = 1,673)	Frequency	% (n = 3,143)	
Blood	3	0.18	4	0.13	NS
Cancer	15	0.9	16	0.51	<0.05
Cardiac/PVD	30	1.79	53	1.69	NS
Ear/hearing	11	0.66	50	1.59	<0.05
Endocrine	21	1.26	47	1.50	NS
Eye/vision	8	0.48	34	1.08	<0.05
Female reproductive	5	0.30	12	0.38	NS
Gastrointestinal	31	1.85	64	2.04	NS
Genitourinary	13	0.78	28	0.89	NS
Infection	10	0.60	7	0.22	<0.05
Skin	11	0.66	79	2.51	<0.0001
Neurologic	55	3.29	221	7.03	NS
Psychiatric	78	4.66	277	8.81	<0.0001
PTSD	5	0.30	627	19.95	<0.0001
Respiratory	106	6.34	116	3.69	<0.0001
Rheumatologic	10	0.60	28	0.89	NS
TBI	11	0.66	249	7.92	<0.0001

NS = not statistically significant, PTSD = posttraumatic stress disorder, PVD = peripheral vascular disease, TBI = traumatic brain injury

^a These data are included in the US Army Physical Evaluation Board database and were studied through an Institutional Review Board–approved protocol at our institution and the Veterans’ Administration. These data are not publicly available.

pain were the most common overall unfitting conditions, and orthopaedic conditions accounted for 5 of the top 10 conditions (Table 5). In 2009, OA and back pain were far more prevalent than PTSD; TBI; amputation; conditions of the foot, ankle, and lower extremity; and peripheral nerve disorders.

From the first quarter of 2001

through the first quarter of 2009, the average percent disability increased for PTSD and psychiatric disorders, but it did not change significantly for any other nonorthopaedic condition (Table 6). The average percent disability significantly increased for all orthopaedic conditions, with the exception of amputation, fibromyalgia, other lower extremity conditions,

and other upper extremity conditions (Table 7). At both time points, most of the conditions with the highest average percent disability were nonorthopaedic in nature (Table 8). Among orthopaedic conditions, only amputation and total joint arthroplasty were found in the top 10 at both time points. Cancer, infection, TBI, cardiac/peripheral vascular dis-

Table 4**Orthopaedic Unfitting Conditions^a**

Unfitting Condition	Jan–Mar 2001		Jan–Mar 2009		P Value
	Frequency	% (n = 1,673)	Frequency	% (n = 3,143)	
Amputation	1	0.06	33	1.05	<0.0001
Back pain ^b	376	22.47	1,348	42.89	<0.0001
Foot and ankle	54	3.23	324	10.31	<0.0001
Fibromyalgia	14	0.84	31	0.99	NS
Knee	62	3.71	32	1.02	<0.0001
Miscellaneous	25	1.49	74	2.35	NS
Muscle	43	2.57	110	3.50	NS
Osteoarthritis	602	35.98	987	31.40	<0.05
Other lower extremity	25	1.49	197	6.27	<0.0001
Peripheral nerve	30	1.79	134	4.26	<0.0001
Total joint arthroplasty	4	0.24	12	0.38	NS
Other upper extremity	27	1.61	83	2.64	<0.05

NS = not statistically significant

^a These data are included in the US Army Physical Evaluation Board database and were studied through an Institutional Review Board–approved protocol at our institution and the Veterans' Administration. These data are not publicly available.^b Back pain includes conditions of the vertebral column, herniated nucleus pulposus, and degenerative disk disease. It does not include disorders of the spinal cord.

ease, rheumatologic conditions, and genitourinary conditions were among the top 10 disability ratings at both time points. However, orthopaedic conditions were responsible for very high impact factors at both time points. Back pain and OA resulted in the first and second highest impact factors in 2001 and the second and third highest, respectively, in 2009 (Table 9).

Discussion and Conclusions

Our results confirm that orthopaedic disorders cause the majority of unfitting conditions in the US Army regardless of the presence or absence of combat operations. Despite a very small increase in the overall population, there was a large increase in the number of soldiers separated through the PEB. The number of unfitting conditions per soldier increased, as well. In one 3-month period alone, >3,600 additional unfitting conditions were reported to the

Table 5**Most Frequent Unfitting Conditions in the First Quarter of 2001 and the First Quarter of 2009^a**

Rank Order	2001	2009
1	Osteoarthritis	Back pain
2	Back pain	Osteoarthritis
3	Respiratory	PTSD
4	Foot and ankle/LE	Foot and ankle/LE
5	Psychiatric	Psychiatric
6	Knee	TBI
7	Neurologic	Neurologic
8	Muscle	Peripheral nerve
9	GI	Respiratory
10	Cardiac/PVD	Muscle

GI = gastrointestinal, LE = lower extremity, PTSD = posttraumatic stress disorder, PVD = peripheral vascular disease, TBI = traumatic brain injury

^a These data are included in the US Army Physical Evaluation Board database and were studied through an Institutional Review Board–approved protocol at our institution and the Veterans' Administration. These data are not publicly available.

PEB in 3,143 soldiers. Considered in the context of the entirety of both wars, these findings suggest that the total additional wartime burden of disease in the form of disabling conditions approaches or exceeds the tens of thousands. Five of the top 10

most common unfitting conditions at each time point were orthopaedic disorders. Back pain, OA, and conditions of the foot, ankle, and lower extremity were among the five most prevalent unfitting conditions during peacetime and war. As expected,

conditions that could reasonably be anticipated to be the result of war trauma (eg, PTSD, TBI, orthopaedic trauma) all increased from their pre-war frequencies, whereas other non-orthopaedic conditions remained mostly unchanged. Despite large increases in the occurrence of PTSD, TBI, and orthopaedic trauma, back pain and OA were far more common than these other three diagnoses at both time points.

The average percent disability associated with orthopaedic conditions increased for most impairments but has remained unchanged for the majority of nonorthopaedic conditions. However, the highest disability ratings are typically assigned to nonorthopaedic conditions. Only amputations and total joint arthroplasty were represented in the top 10 at either time point (ie, first quarter 2001, first quarter 2009). The large increase in the average percent disability for amputations is likely the result of the increased severity of injuries sustained in combat. However, because there was only one soldier with an amputation in the group from 2001, it is difficult to draw an adequate comparison. In general, the average percent disability was low for orthopaedic conditions. However, the combination of their disability rating and frequency led to very high impact factors for these conditions compared with the nonorthopaedic disorders. Back pain and OA account for the top two impact factors during peacetime and are second only to PTSD during war. Although back pain and OA are the most common disabilities, their disability ratings are relatively low (17% and 12%, respectively). The calculated PTSD impact factor is high because of the average 50% disability rating. Back pain and OA combined affect nearly four times more soldiers than does PTSD.

Previous results from our center re-

Table 6
Change in Average Percent Disability for Nonorthopaedic Unfitting Conditions From 2001 to 2009^a

Unfitting Condition	Jan–Mar 2001	Jan–Mar 2009	P Value
Blood	10	13	NS
Cancer	82	75	NS
Cardiac/PVD	36	44	NS
Ear/hearing	12	8	NS
Endocrine	19	14	NS
Eye/vision	21	35	NS
Female reproductive	12	23	NS
Gastrointestinal	38	27	NS
Genitourinary	32	43	NS
Infection	51	50	NS
Skin	24	21	NS
Neurologic	32	30	NS
Psychiatric	26	37	<0.0001
PTSD	26	50	<0.0001
Respiratory	27	30	NS
Rheumatologic	34	46	NS
TBI	49	39	NS

NS = not statistically significant, PTSD = posttraumatic stress disorder, PVD = peripheral vascular disease, TBI = traumatic brain injury

^a These data are included in the US Army Physical Evaluation Board database and were studied through an Institutional Review Board–approved protocol at our institution and the Veterans’ Administration. These data are not publicly available.

porting only service members evacuated from theater because of battle-field injury demonstrated that OA, nerve injuries, and back conditions are among the most frequent disabling conditions.⁸⁻¹⁰ Of soldiers evacuated with a primary diagnosis of penetrating chest or abdominal wounds with associated extremity injuries, the primary unfitting condition was orthopaedic in 76% of those who presented to the PEB.

Our results are consistent with those in the civilian literature. The large burden of musculoskeletal disease on the adult population of the United States has been demonstrated previously, including hundreds of billions of dollars in direct and indirect costs, difficulty with daily tasks, and substantial resource utilization.^{1,3,4}

In 2008, the United States Bone and Joint Decade published an anal-

ysis of the effect of musculoskeletal conditions on the US population.⁶ Based on the results of the 2005 National Health Interview Survey, the reviewers found that >107 million adults in the United States reported a musculoskeletal condition, representing nearly 50% of the population aged ≥18 years. In comparison, 28% reported circulatory conditions and 24% reported respiratory conditions. Three of the four most common medical conditions reported were musculoskeletal in nature, including low back pain, chronic joint pain, and arthritis. Low back pain was the most common musculoskeletal condition reported, found in 62 million adults (ie, 28% of the adult population). Young adults aged 18 to 44 years were found to be substantially affected by musculoskeletal conditions, with 38% reporting at

Table 7**Change in Average Percent Disability for Orthopaedic Unfitting Conditions From 2001 to 2009^a**

Unfitting Condition	Jan–Mar 2001	Jan–Mar 2009	P Value
Amputation	40	76	NS
Back pain ^b	13	17	<0.05
Foot and ankle	11	15	<0.0001
Fibromyalgia	24	27	NS
Knee	14	18	<0.05
Miscellaneous	2	13	<0.0001
Muscle	6	24	<0.0001
Osteoarthritis	6	12	<0.0001
Other lower extremity	14	15	NS
Peripheral nerve	10	17	<0.05
Total joint arthroplasty	30	81	<0.05
Other upper extremity	19	22	NS

NS = not statistically significant

^a These data are included in the US Army Physical Evaluation Board database and were studied through an Institutional Review Board–approved protocol at our institution and the Veterans' Administration. These data are not publicly available.^b Back pain includes conditions of the vertebral column, herniated nucleus pulposus, and degenerative disk disease. It does not include disorders of the spinal cord.**Table 8****Conditions With the Highest Average Percent Disability in 2001 and 2009^a**

Rank Order	Jan–Mar 2001	Jan–Mar 2009
1	Cancer	Total joint arthroplasty
2	Infection	Amputation
3	TBI	Cancer
4	Amputation	Infection
5	GI	PTSD
6	Cardiac/PVD	Rheumatologic
7	Rheumatologic	Cardiac/PVD
8	GU	GU
9	Neurologic	TBI
10	Total joint arthroplasty	Psychiatric

GI = gastrointestinal, GU = genitourinary, PTSD = posttraumatic stress disorder, PVD = peripheral vascular disease, TBI = traumatic brain injury

^a These data are included in the US Army Physical Evaluation Board database and were studied through an Institutional Review Board–approved protocol at our institution and the Veterans' Administration. These data are not publicly available.

least one. Of the young adults who reported a medical condition, >20% reported chronic joint pain or arthritis and nearly 28% reported back pain in the lumbar region, with nearly 15% reporting neck pain. These musculoskeletal conditions

were found to have a large impact on a patient's ability to perform activities of daily living and go to work. More than 29 million adults (ie, 13% of the population) reported difficulty performing activities of daily living due to a medical condition,

and more than half of these conditions were musculoskeletal. Musculoskeletal conditions also accounted for the greatest number of lost work days and bed days among American adults. Indirect costs, primarily in the form of lost wages resulting from musculoskeletal disorders, tallied \$340 billion from 2002 through 2004. Direct costs of medical care for these conditions was estimated to be \$510 billion.⁶

This study has several limitations. It is retrospective, and it was not possible to fully investigate the medical history of each soldier separated from active-duty service. Therefore, it is not possible to comment on the frequency of posttraumatic OA compared with degenerative OA or to provide a meaningful assessment of the severity of individual unfitting conditions. This topic warrants further study. Additionally, the study relies on the assumption that the 3-month periods chosen were representative of their respective time periods. Each individual soldier is referred to the PEB when he or she has reached the maximum medical benefit of treatment, and this timing is unique to each soldier. Furthermore, the pathway to the PEB is self-reported, and there may be bias relative to the assessment of disability. Overall, the period chosen likely is adequately representative of both the war and peacetime populations.

Summary

Review of nearly 5,000 PEB records clearly demonstrates that orthopaedic unfitting conditions account for the greatest number of soldiers separated from active-duty service and for the highest military-related disability costs during both peacetime and war. Although the time periods analyzed are short compared with the overall length of the wars, it is clear that more soldiers are found to

Table 9
Rank of Unfitting Conditions by Impact in 2001 and 2009^a

Rank Order	Jan–Mar 2001		Jan–Mar 2009	
	Unfitting Condition	Impact ^b	Unfitting Condition	Impact ^b
1	Back pain	4,888	PTSD	31,350
2	Osteoarthritis	3,612	Back pain	22,916
3	Respiratory	2,862	Osteoarthritis	11,844
4	Psychiatric	2,028	Psychiatric	10,249
5	Neurologic	1,760	TBI	9,711
6	Cancer	1,230	Foot/ankle/LE	7,815
7	GI	1,178	Neurologic	6,630
8	Cardiac/PVD	1,080	Respiratory	3,480
9	Foot/ankle/LE	948	Muscle	2,640
10	Knee	868	Amputation	2,508

GI = gastrointestinal, LE = lower extremity, PTSD = posttraumatic stress disorder, PVD = peripheral vascular disease, TBI = traumatic brain injury

^a These data are included in the US Army Physical Evaluation Board database and were studied through an Institutional Review Board–approved protocol at our institution and the Veterans’ Administration. These data are not publicly available.

^b Frequency × average percent disability

be unfit for duty during war than during peacetime and that the total burden of individual unfitting conditions increases substantially during war. Each unfitting condition is a source of morbidity and disability that may affect the wounded soldiers long after their military service has ended.

In contrast to our hypothesis, although conditions expected from combat operations did increase substantially, back pain and OA continue to be the largest force subtractors for the US Army during peacetime and war. The impact of these conditions is high, resulting in significant disability and resource utilization.

Musculoskeletal injuries must be recognized early by military health-care providers to allow optimum management and rehabilitation, with the goal of decreasing the long-term disability of each soldier. Further research efforts should be directed toward identification and mitigation of military-specific risk factors for development of back pain and OA.

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