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Original Article

Comparing psychological burden of orthopaedic diseases against medical conditions: Investigation on hospital course of hip, knee, and spine surgery patients

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ABSTRACT

Retrospective review of National Inpatient Sample (2000–2012) revealed that 31.28% of musculoskeletal (MSK) patients were found to have in-hospital psychological burdens (PBs). Adult spinal deformity (ASD), degenerative disc disease (DDD) and lung cancer patients had highest PB-prevalence. MSK patients with PB were more often young, white females with increased Deyo index compared to no-PB patients. Patients who underwent spinal revision procedures had higher PB rates than with primary procedures; a converse trend was observed for total hip/knee arthroplasty. Psychological disorders were identified as significant predictors of increased total-hospital charges. Augmenting counseling with psychological screening/support is recommended to complement MSK management.

1. Introduction

Due to pain and decreased functionality, living with musculoskeletal (MSK) disorders can detrimentally effect a patient's quality of life.[1–4]While these effects are certainly physical, the association between pain, disability and poor mental health is well established in the literature.[5] The National Mental Health Survey in Australia showed that 29% of people with disabilities reported an anxiety disorder within the previous year, compared to 12% in the general population.[6] Carroll et al.[7] reported that spinal pain is one of the most important predictors of early-onset depression in the general population. Shamji et al.[8] reported that among 150 patients with neuropathic pain diagnoses, 63% screened positive for depressive symptoms, while 23% screened positive for anxiety symptoms. Patients' depression scores were also correlated with pain intensity. Katon et al.[9] reported that in a cohort of 37 patients with chronic pain, 32.4% were concurrently diagnosed with major depressive disorder (MDD), 43.2% had a previous episode of MDD, and 40.5% had alcohol abuse.

Tending to patients requires employing a comprehensive approach to care, identifying and treating all aspects of the burden of their disease. The overlap between pain/disability and poor mental health makes delineating these conditions of utmost importance within the context of treating patients with musculoskeletal pathologies or injuries. However, little is known about the psychological burden associated with orthopaedic conditions, especially when compared to other the established understanding of psychological burdens associated with chronic medical conditions. The objective of this study was to investigate the psychological burden (PB) in patients with orthopaedic conditions via a retrospective review of data of inpatient admissions for common orthopaedic procedures related to the hip, knee, and spine.

2. Materials and methods

2.1. Data source

A retrospective review of the National (Nationwide) Inpatient Sample (NIS) dataset from 2000 to 2012 was performed. The Health Care Cost and Utilization Project (HCUP) provides support for the NIS.

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Further support comes from federal, state, and industry partnerships. The NIS database is the most robust available all-payer data for inpatient care in the United States. NIS obtains data for eight million hospital stays from 1000 hospitals each year. Data is collected and coded in the inpatient setting for any diagnosis assigned to a patient during their hospital stay. This data is comprised of a 20% stratified random sample of all community hospitals in the country. This study was exempted by our Institution Review Board (IRB) due to the de-identified nature of the data.

2.2. Patient population

The International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes were utilized to identify adult patients (> 18 years old) who were admitted for the following principal diagnoses and underwent the subsequent procedures:

- Patients with primary osteoarthritis of the knee (715.15) underwent total hip replacement (THA: primary, 81.51; or revision, 00.70, 00.71, 00.72, 81.53).
- Patients with primary osteoarthritis of the knee (715.16) underwent total knee replacement (TKA: primary, 81.41, 81.54; or revision, 81.55).
- Patients with adult spinal deformity (ASD), defined as idiopathic scoliosis (737.30, 737.32), or degenerative disc disease (737.10, 737.20, 722.52, 722.51, 724.02, 721.3, 738.4, 722.10, 756.12, 722.73, 721.42, 724.01, 721.2, 722.72, 721.41, 722.11, 724.03, 756.11) who underwent ≥4-level spinal fusion (81.63, 81.64).
- Patients with degenerative disc disease (DDD) who underwent 2–3-level spinal fusion (81.62).

Patients were excluded if they had osteomyelitis, traumatic fracture, pathologic fracture, or any type of cancer. Patients admitted for cardiac diseases (Cardiac), diabetes mellitus (DM), and lung cancers (LC) were used as controls. Patients' groups were isolated from each other in order to avoid confounding effects of overlapping comorbidities. Psychological burden (PB) of the disease was defined as the percentage of patients who were coded for at least one psychological disorder during their hospital stay. ICD-9-CM codes reported in the Diagnostic and Statistical Manual of Mental Disorders: 5th Edition (DSM-V) were used to identify patients with the following psychological disorders: depression (296.99, 296.20, 296.21, 296.22, 296.23, 296.24, 296.25, 296.26, 296.30, 296.31, 296.32, 296.33, 296.34, 296.35, 296.36, 300.4, 293.93, 311), anxiety (300.29, 300.23, 300.01, 300.22, 300.02, 293.84, 300.09, 300.00), obsessive-compulsive (300.3), stress (313.89, 309.0, 309.24, 309.28, 309.3, 307.4, 309.81, 308.3, 309.89, 309.9), somatic symptom (300.81, 300.82), sexual dysfunction (302.72, 302.9, 607.84), substance-related and addictive (303.0, 303.9, 305.0, 305.9, 304.00, 305.5, 304.10, 305.40, 304.20, 305.60, 304.30, 305.20, 304.50, 305.30, 305.90, 304.50, 304.80, 304.90, 305.10, 305.70, 304.40, 304.60), delirium (293.0, 293.1, 780.09), and personality (301.0, 301.10, 301.11, 301.12, 301.20, 301.22, 301.3, 301.4, 301.50, 301.59, 301.6, 301.7, 301.81, 301.82, 301.83, 301.89, 301.9) disorders.

2.3. Data collection

The demographics studied were age, gender, race, type of insurance (Medicare, Medicaid, Private Insurance, Self-Pay, No Charge, Other), and Deyo Index (Deyo Index, also known as the Deyo/Charlson-Comorbidity Index, which is a modified version of the Charlson-Comorbidity Index that is used to categorize comorbidities of patients based on ICD diagnosis codes).[10] Length of stay, total hospital charges, and mortality rates were also collected.

2.4. Statistical analysis

2.4.1. General analysis

Seven patient groups were identified (ASD, DDD, THA, TKA, Cardiac, DM, and LC). Demographics were compared between the groups using ANOVA for age, Deyo Index, total charges, and length of stay. Chi-Square analysis was used to characterize the variation in race, gender, and primary payer for the varying patient groups. Chi-Square analysis with Bonferroni correction was also used to determine the difference in relative frequency of psychological burden incidence across the groups.

2.4.2. Musculoskeletal diseases analysis

Demographic analysis was conducted using univariate independent-sample *t*-tests to compare those that were coded with concomitant PB versus those who were not coded with concomitant PB within the ASD, DDD, THA, and TKA groups. Additionally, variation in psychological illness between patients that received primary or revision surgeries for ASD, DDD, THA, and TKA conditions was analyzed using Chi-Square analysis. Lastly, a logistic regression model controlling for age, gender, and Deyo Index was employed in order to identify any independent predictors of increased total charges and increased length of stay among patients coded for ASD, DDD, THA, and TKA conditions. Increased total charges and length of stay were defined as the values that were ≥60th percentile of the overall dataset for each parameter. The threshold for statistical significance was set to $p < 0.05$. All analyses were performed using SPSS Statistics 24 (IBM Corp., Armonk, NY, USA).

3. Results

3.1. General analysis

3.1.1. Patient population

5,001,416 patients met the inclusion criteria. Demographics varied significantly between the groups. Cardiac patients were the oldest, while DDD were the youngest (73.8 vs. 55.2 years, $p < 0.001$). Lung cancer patients had the highest Deyo score, and the lowest Deyo score was found in DDD patients (5.51 vs. 0.26, $p < 0.001$). The majority of MSK patients were females (68.2% of ASD, 61.4% for THA, and 63.9% for TKA), significantly different from the frequency of female gender among medical comorbidities (47.6% for DM, 47.6% for LC; $p < 0.001$). MSK patients were less likely to be African American (4.1% of ASD, 5.6% of THA) vs. (26% of DM, 18% of Cardiac; $p < 0.001$). In all patient categories except DDD, patients were more likely to be insured through Medicare than any other type of insurance. DDD patients were more likely to have private insurance, while cardiac, LC, and DM patients were less likely to be insured with private insurance ($p < 0.001$). ASD patients had the highest total charges ($151,534) and second longest hospital stay (5.67 days) after LC patients (7.24 days) (all $p < 0.001$; Table 1).

3.1.2. Psychological disorders

ASD, DDD, and LC patients had the highest prevalence of any psychological disorders when compared to all other conditions listed in Table 2 (37.5%, 36.5%, and 35.7%, respectively, $p < 0.001$). The THA group had a significantly higher prevalence of psychologically impaired (any psychological illness) patients when compared to the Cardiac group (27% vs. 26%, $p < 0.001$). TKA patients had the lowest prevalence of any psychological illness (24.1%) (Table 2). In details, the LC group had the highest percentage of patients with substance abuse disorder (23.2%), followed by DDD (18.6%); TKA patients (6.3%) had the lowest prevalence. ASD and DDD showed the highest percentage of patients with depressive disorders (16% and 13.6%, respectively), followed by TKA (10.2%), and last by Cardiac (6.9%). Similarly, the ASD group had the highest percentage of patients with sleep and anxiety disorders (7.1%, and 6.7%, respectively), with TKA (5.3%) and DDD

Table 1
Demographics of patient groups sorted by varying types of musculoskeletal disorders. Abbreviations: Adult spinal deformity (ASD), lumbar degenerative disc disease (DDD), Total hip arthroplasty (THA), total knee arthroplasty (TKA), Diabetes Mellitus (DM), Primary Lung Cancer (LC), and Cardiac disease.

		Patient Groups							P-Value
Demographics		*ASD*	*DDD*	*THA*	*TKA*	*DM*	*LC*	*Cardiac*	P-Value
Sample Size		31,790	275,556	727,801	1,020,081	1,057,447	280,919	1,607,822	–
Age (years)		62.99	55.22	68.68	66.27	56.16	66.93	73.80	< **0.001**
Deyo Index		0.3676	0.2645	0.4289	0.2834	1.8209	5.5136	2.1354	< **0.001**
Gender	*Male*	31.80%	43.50%	38.60%	36.10%	52.40%	52.40%	48.20%	< **0.001**
	Female	68.20%	56.50%	61.40%	63.90%	47.60%	47.60%	51.80%	
Race	*White*	89.40%	84.70%	88.10%	85.40%	54.60%	80.30%	71.90%	< **0.001**
	Black	4.10%	6.10%	5.60%	6.50%	26.00%	10.90%	18.00%	
	Hispanic	3.30%	5.40%	3.10%	4.70%	14.20%	4.20%	6.20%	
	Asian or Pacific Islander	0.90%	0.90%	1.00%	1.00%	1.70%	2.30%	1.50%	
	Native American	0.20%	0.40%	0.30%	0.40%	0.80%	0.30%	0.40%	
	Other	2.00%	2.40%	1.90%	2.10%	2.80%	2.00%	1.90%	
Insurance	*Medicare*	52.00%	31.60%	60.60%	55.30%	44.50%	56.20%	76.00%	< **0.001**
	Medicaid	2.70%	4.80%	2.90%	2.50%	16.20%	8.50%	6.80%	
	Private Insurance	39.70%	50.10%	33.30%	38.20%	25.30%	28.60%	12.00%	
	Self-Pay	0.60%	0.90%	0.80%	0.40%	9.30%	3.30%	3.20%	
	No Charge	0.10%	0.10%	0.%1	0.10%	0.90%	0.40%	0.30%	
	Other	4.90%	12.60%	2.20%	3.40%	3.80%	3.10%	1.60%	
Total Charges (US Dollars)		151,534	83,255	44,047	41,253	27,713	43,332	31,017	< **0.001**
Length of Stay (Days)		5.67	3.63	4.37	3.54	5.03	7.24	5.46	< **0.001**

(5.7%) being second on the list (Table 2).

3.2. Musculoskeletal diseases analysis

For all musculoskeletal groups, patients with psychological disorders were more likely to be young, white females. Patients with psychological disorders had significantly higher Deyo scores when compared to patients with no psychological disorders in ASD (0.43 vs. 0.33, respectively, $p < 0.001$), DDD (0.32 vs. 0.23, $p < 0.001$), THA (0.52vs. 0.4, $p < 0.001$) and TKA (0.37 vs. 026, $p < 0.001$) procedures. In addition, psychologically-distressed patients had significantly less median household income in every MSK group.

In spinal procedures, revision surgeries showed greater rates of patients with psychological disorders when compared to those who had primary procedures (36.50% vs. 42.20%, $p < 0.001$ for ASD and 36.20% vs. 41.30%, in DDD, respectively, $p < 0.001$). However, both TKA and THA revision procedures showed lower rates when compared to primary procedures (25.0% vs. 19.8%, $p < 0.001$ and 27.6% vs. 21.2%, respectively, $p < 0.001$). Both revision ASD and DDD procedures had a significantly higher prevalence of patients with substance abuse (11.0% vs. 12.8%, $p < 0.001$ and 17.6% vs. 18.4%, respectively, $p < 0.008$) and depressive disorders (15.2% vs. 19.8%, $p < 0.001$ and 13.6% vs. 17.7%, respectively, $p < 0.001$). Revision THA and TKA patients were less likely to have substance abuse, depressive, sleep or anxiety disorders (Table 3).

3.3. Regression analysis

For all MSK patients, having a psychological disorder was the most significant predictor of increased total hospital costs. Logistic regression models showed that psychologically-distressed patients had the highest OR (1.15–1.339) and the highest Beta coefficients (0.14–0.292) to predict increased hospital charges. Deyo score was also found to be a significant predictor in all groups (Table 4).

In predicting increased hospital length of stay, the regression model revealed that within DDD and THA groups, psychological burden was a significant predictor (OR = 1.024 and 1.147, respectively, $p < 0.05$). However, among ASD, DDD and TKA patients, gender was the strongest predictor of increased hospital length of stay; within THA patients the Deyo index was the strongest predictor (Table 4).

4. Discussion

This study illustrates the high prevalence of psychological disorders in MSK patients admitted for surgical treatment, as more than 1 in 3 ASD or DDD patients were found to have some form of psychological disorder. Only 1 in 4 patients undergoing arthroplasty of the hip or knee were concomitantly coded with psychological disorders. Patients with psychological burdens were found to be primarily young, white females. These patients also had a lower median household income and an increased number of comorbidities. Psychological disorders also significantly contributed to greater hospital costs and were a significant predictor of extended length of hospital stay among DDD and THA patients.

When compared to patients admitted for non-surgical conditions such as lung cancer, diabetes mellitus, and cardiac diseases, patients undergoing spinal surgeries had a higher prevalence of psychological disorders; however, those undergoing arthroplasty of the hip or knee

Table 2
Incidence of psychological burden in patients hospitalized for musculoskeletal disorders. Abbreviations: Adult spinal deformity (ASD), lumbar Degenerative disc disease (DDD), total hip arthroplasty (THA), total knee arthroplasty (TKA), diabetes mellitus (DM), lung cancer (LC), and cardiac disease.

Patients' Groups								
	ASD	DDD	THA	TKA	DM	LC	Cardiac	P-Value
Any Psychological Disorder	37.5%	36.5%	27.0%	24.1%	31.4%	35.7%	26.0%	< **0.001**
Substance Disorder	12.2%	18.6%	9.00%	6.30%	14.9%	23.2%	9.10%	< **0.001**
Depressive Disorder	16.0%	13.6%	9.40%	10.2%	10.9%	7.20%	6.90%	< **0.001**
Sleep Disorder	7.10%	5.20%	3.30%	5.30%	2.80%	1.90%	3.80%	< **0.001**
Anxiety Disorder	6.70%	5.70%	4.10%	4.30%	3.00%	5.20%	3.40%	< **0.001**

Table 3
Comparisons between incidence rates of psychological illness in primary and revision surgical cases of musculoskeletal (MSK) diseases (adult spinal deformity [ASD], degenerative disc disease [DDD], total hip arthroplasty [THA], and total knee arthroplasty [TKA]).

		Any Psychological Condition	Substance Disorder	Depressive Disorder	Sleep	Anxiety
ASD	*Primary*	36.50%	11.00%	15.20%	7.70%	6.30%
	Revision	42.20%	12.80%	19.80%	8.50%	7.50%
	P-Value	**P < 0.001**	**P < 0.001**	**P < 0.001**	P = 0.053	**P = 0.003**
Degenerative	*Primary*	36.20%	17.60%	13.60%	5.90%	5.50%
	Revision	41.30%	18.40%	17.70%	7.70%	5.90%
	P-Value	**P < 0.001**	**P = 0.008**	**P < 0.001**	**P < 0.001**	**P = 0.049**
THA	*Primary*	27.60%	8.50%	9.60%	3.70%	4.10%
	Revision	21.20%	7.20%	8.60%	0.80%	2.70%
	P-Value	**P < 0.001**	**P < 0.001**	**P < 0.001**	**P < 0.001**	**P < 0.001**
TKA	*Primary*	25.00%	6.20%	10.50%	6.20%	4.30%
	Revision	19.80%	5.60%	9.30%	1.70%	2.80%
	P-Value	**P < 0.001**	**P < 0.001**	**P < 0.001**	**P < 0.001**	**P < 0.001**

joints had a lower prevalence. Patients undergoing spinal revision procedures had an increased prevalence of psychological disorders, especially in the form of substance abuse and depression. Among patients who underwent revision arthroplasties, there was a lower prevalence of psychological disorders when compared to those who underwent primary procedures.

There is currently a paucity of evidence pertaining to the prevalence of concomitant psychological burden in patients with musculoskeletal disorders undergoing surgery. A note-worthy objective of this study was to highlight the significance this issue. Earlier prospective studies that were done on a much smaller scale had similar findings showing a significant prevalence of psychological distress in various surgical patients. Bhandari et al.[11] showed that of 215 orthopaedic trauma patients in ten orthopaedic clinics, over 1 in 5 patients met the criteria for psychological distress.

The findings of the present study warrant attention because of the well-known effects of a patient's mental state on preoperative planning and admission as well as postoperative recovery and outcomes. A prospective study of 304 adults undergoing various elective surgeries found that preoperative depression or anxiety had a significant influence on postoperative pain.[12] The pain and disability components of MSK conditions are significant generators of psychological stress. Sinikallio et al.[13,14] found that depression was independently associated with surgical outcome variables such as pain and disability following lumbar spinal procedures. A study that focused on shoulder surgery patients found that postoperative depression had a significant effect on surgical outcomes.[15] A systemic review by Vissers et al.[16] found that poor preoperative mental health and pain were association with poor TKA outcomes; however, this study showed no association with THA outcomes.

The management of orthopaedic patients may need to be supplemented with an evaluation of their mental health in order to ensure a good plan for mental recovery. Gold et al.[17] showed that following total joint arthroplasties, depression was strongly associated with increased risk of readmission within 90 days. Our study showed that the physiological burden of a MSK disease significantly contributes to increased hospital costs and may also contribute to increased length of hospital stay. Psychological comorbidities not only affect patients but may also have deleterious fiscal effects on cost of care. The benefits of addressing the burden of psychological disease in these patients may not only result in an increase in the patient's quality of life but may also reduce the socioeconomic burden of their conditions.

The goal of all physicians is to guide and treat their patients using a holistic approach to care. Despite this idea, physicians often overlook patients' mental health in favor of focusing on their physical health. The stigmatization and lack of awareness about mental health may cause patients to be reluctant to seek help, and may lead to lack of screening patients by care providers, which could potentially lead to lack of recognition of treatment of associated psychological burden.[18–20] This study supports the viewpoint of physical and mental health being strongly interdependent, calling for adoption of a more integrated approach that involves treating the patient as a whole in order to provide the best possible quality of care.

Urging surgeons to recognize signs and symptoms of mental health

Table 4
Independent predictors of increased total hospital costs and increased hospital length of stay in adult spinal deformity (ASD), lumbar Degenerative disc disease (DDD), total hip arthroplasty (THA), and total knee arthroplasty (TKA) patients based on a regression model controlling for age, gender, and Deyo score.

	Total Hospital Charges				*Length of Stay*		
MSK Group	Variable	OR [95% Confidence Interval]	β Coefficient	P-Value	OR [95% Confidence Interval]	β Coefficient	P-Value
ASD	*Psych*	1.250 [1.120–1.397]	0.224	**< 0.001**	1.034 [0.983–1.088]	0.034	0.191
	Deyo	1.120 [1.034–1.214]	0.114	**0.005**	1.162 [1.121–1.205]	0.150	**< 0.001**
	Age	1.001 [0.997–1.005]	0.001	0.610	1.004 [1.002–1.006]	0.004	**< 0.001**
	Gender	0.907 [0.810–1.016]	−0.097	0.092	1.408 [1.337–1.481]	0.342	**< 0.001**
DDD	*Psych*	1.150 [1.120–1.181]	0.140	**< 0.001**	1.024 [1.007–1.040]	0.024	**0.004**
	Deyo	1.060 [1.038–1.083]	0.059	**< 0.001**	1.201 [1.186–1.217]	0.183	**< 0.001**
	Age	0.992 [0.991–0.993]	−0.008	**< 0.001**	1.014 [1.013–1.014]	0.014	**< 0.001**
	Gender	0.986 [0.961–1.011]	−0.007	0.270	1.291 [1.271–1.311]	0.256	**< 0.001**
THA	*Psych*	1.284 [1.269–1.299]	0.250	**< 0.001**	1.147 [1.134–1.160]	0.137	**< 0.001**
	Deyo	1.185 [1.178–1.192]	0.170	**< 0.001**	1.322 [1.314–1.329]	0.279	**< 0.001**
	Age	0.993 [0.992–0.993]	−0.007	**< 0.001**	1.040 [1.039–1.040]	0.039	**< 0.001**
	Gender	0.910 [0.900–0.920]	−0.094	**< 0.001**	1.315 [1.302–1.329]	0.274	**< 0.001**
TKA	*Psych*	1.339 [1.325–1.354]	0.292	**< 0.001**	0.941 [0.932–0.950]	−0.061	**< 0.001**
	Deyo	1.195 [1.186–1.204]	0.178	**< 0.001**	1.155 [1.147–1.162]	0.144	**< 0.001**
	Age	0.997 [0.996–0.997]	−0.003	**< 0.001**	1.016 [1.015–1.016]	0.016	**< 0.001**
	Gender	0.931 [0.922–0.940]	−0.071	**< 0.001**	1.222 [1.212–1.233]	0.201	**< 0.001**

disorders may prove to be the best tool in this regard. Some patients may not seek treatment on their own or may not even realize that they are suffering from a psychological disorder. By accounting for mental health in pre- and postoperative assessment, patients can be appropriately referred for psychological evaluation and treatment. Services that provide psychological counseling and support are made available to patients at medical facilities; thus, task lies in determining whether or not these services are utilized when required. Determining presence of psychological burden may lead to improved quality of care, decreased socioeconomic burden of care, and improved patients' quality of life.

We acknowledge limitations in our study design, which are mostly due to the reliance on National Inpatient Sample (NIS) data, which only includes inpatient data without follow-up and lacks patient-reported outcomes as well as specific details pertaining to the patients' surgical procedure(s). ICD-9-CM coding also limited our ability to determine the etiology of the psychological disorders as well as details or duration of diagnosis and treatment. Furthermore, there is no information about the chronicity of the listed conditions; thus, we are unable to determine whether the psychological disorder was present prior to surgery or whether it developed postoperatively. From the database, we could only determine that these patients were coded as having psychological conditions during the hospital admission for the surgical procedure. The accuracy of the database is dependent on the accuracy of the coders inputting the information. While these limitations are significant, they did not obscure our experimental design or our findings. Our data determined the prevalence and its associated likelihood of psychological burden in MSK patients and proposed no indication of causality.

5. Conclusion

This study explored the psychological burden associated with the hospital course of musculoskeletal disorders' patients. The prevalence of psychological disorders in orthopaedic patients was found to be highly significant in our study. Psychologically distressed patients were more likely to be young, white females with an increased number of comorbidities and lower incomes. Furthermore, the psychological impairment group had an increased length of hospital stay and increased total hospital costs. Augmenting preoperative evaluation with psychological screening, patient counseling, and adequate psychological support are recommended to complement to management of patients for musculoskeletal disorders.

Conflicts of interest

There were no direct or indirect conflicts of interests or disclosures that were related to any aspect of this work. The authors have the following disclosures to report:

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