Emergency room resource utilization by patients with low-back pain

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OBJECTIVE The objective of this study was to determine factors associated with admission to the hospital through the emergency room (ER) for patients with a primary diagnosis of low-back pain (LBP). The authors further evaluated the impact of ER admission and patient characteristics on mortality, discharge disposition, and hospital length of stay.

METHODS The authors conducted a retrospective analysis of patients with LBP discharged from hospitals according to the Nationwide Inpatient Sample (NIS) between 1998 and 2007. Univariate comparisons of patient characteristics according to the type of admission (ER versus non-ER) were conducted. Multivariate analysis evaluated factors associated with an ER admission, risk of mortality, and nonroutine discharge.

RESULTS According to the NIS, approximately 183,151 patients with a primary diagnosis of LBP were discharged from US hospitals between 1998 and 2007. During this period, an average of 65% of these patients were admitted through the ER, with a significant increase from 1998 (54%) to 2005 (71%). Multivariate analysis revealed that uninsured patients (OR 2.1, 95% CI 1.7–2.6, $p < 0.0001$) and African American patients (OR 1.5, 95% CI 1.2–1.7, $p < 0.0001$) were significantly more likely to be admitted through the ER than private insurance patients or Caucasian patients, respectively. Additionally, a moderate but statistically significant increase in the likelihood of ER admission was noted for patients with more preexisting comorbidities (OR 1.1, 95% CI 1.0–1.2, $p < 0.001$). An 11% incremental increase in the odds of admission through the ER was observed with each year increment (OR 1.1, 95% CI 1.0–1.2, $p < 0.001$). Highest income patients (\$45,000+) were more likely to be admitted through the ER (OR 1.3, 95% CI 1.1–1.6, $p = 0.007$) than the lowest income cohort. While ER admission did not impact the risk of mortality (OR 0.95, 95% CI 0.60–1.51, $p = 0.84$), it increased the odds of a nonroutine discharge (OR 1.39, 95% CI 1.26–1.53, $p < 0.0001$).

CONCLUSIONS A significant majority of patients discharged from hospitals in the US from 1998 to 2007 with a primary diagnosis of LBP were admitted through the ER, with more patients being admitted via this route each year. These patients were less likely to be discharged directly home compared with patients with LBP who were not admitted through the ER. Uninsured and African American patients with LBP were more likely to be admitted through the ER than their counterparts, as were patients with more preexisting health problems. Interestingly, patients with LBP at the highest income levels were more likely to be admitted through hospital ERs. The findings suggest that socioeconomic factors may play a role in the utilization of ER resources by patients with LBP, which in turn appears to impact at least the short-term outcome of these patients.

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KEY WORDS low-back pain; emergency room; resource utilization; socioeconomic status; uninsured patients; hospital admission; lumbar

LOW-BACK pain (LBP) is one of the most common and one of the most costly health conditions in the US.⁶ Approximately 70%–80% of the population will experience LBP at least once in their lifetime, with 2%–5% seeking medical attention each year.²⁸ Five percent of American workers will miss at least 1 day of work

due to LBP, which translates to an approximately \$50 billion loss in productivity, and total costs in excess of \$100 billion per year.²⁰

The estimated 2.6 million annual emergency room (ER) visits for LBP-related disorders represent 2.3% of all ER visits per year in the US.¹¹ Several recent studies

ABBREVIATIONS ER = emergency room; LBP = low-back pain; NIS = Nationwide Inpatient Sample.

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acknowledge the increasing prevalence of patients with LBP presenting to the ER,^{11–13,19,32} with significant associated costs,¹⁹ but there remains a paucity of research on factors—socioeconomic ones in particular—contributing to this phenomenon, as well as its impact on the outcomes of these patients. A greater understanding of the demographics and socioeconomic characteristics of patients with LBP admitted to the hospital through the ER, as well as the impact of ER admission on patient outcomes, may lead to more effective methods of treatment, better utilization of resources, and a reduction in the economic and financial burden of patients with LBP on ER services.

The aim of this study was to determine factors associated with hospital admission through the ER for patients with LBP. We also investigated the effect of ER admission on the posthospital outcomes of patients with LBP.

Methods

Data Source

This study used the Nationwide Inpatient Sample (NIS) database to analyze the routes of admission and outcomes of patients with LBP admitted to US hospitals between 1998 and 2007. Data were obtained from the Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality. The NIS contains discharge data from a sample of hospitals selected for inclusion in the database using a stratified random sampling technique. This produces a representative 20% subsample of all American nonfederal hospital discharges so that conclusions drawn from the database can be confidently generalized to the entire American medical community.

Inclusion and Exclusion Criteria for Cases Analyzed

Data were queried to identify hospital inpatient discharge cases with a primary diagnosis of LBP (ICD-9-CM diagnosis code 724.2) discharged between 1998 and 2007. Patients with spinal compression fracture (nontraumatic) as denoted by ICD-9-CM diagnosis code 733.13 were identified and such condition was adjusted in the multivariate models. Because the admission source was critical for this study, we excluded patients missing this variable; patients with missing race were also excluded.

Patient Characteristics

Patient characteristics included age, sex, race, median household income, primary payer (e.g., Medicare, Medicaid), discharge disposition (e.g., routine, transfer), and preexisting comorbidities documented according to the acceptable Elixhauser comorbidities.¹⁰ Age and decades were used as continuous variables. Race was described in detail (e.g., Caucasian, African American, Hispanic) and also coded as Caucasian versus non-Caucasian. Patients were considered non-ER admissions whenever routinely admitted or transferred from another hospital or long-term care facility; patients admitted through the ER were coded as such. We considered patients with expected primary payer of self-pay or no charges to be uninsured.

Outcomes of Interest

Assessing factors associated with the odds of being ad-

mitted through the ER was of particular interest in this study. Secondary outcomes evaluated included mortality and unfavorable discharge disposition (i.e., “nonroutine” discharge). Discharge disposition (binary outcome) was deemed “nonroutine” whenever transfer to another hospital or long-term care facility, home health care, or death occurred; otherwise, the patient was considered a routine discharge.

Statistical Analysis

Univariate chi-square and t-tests were used to evaluate associations between admission type (ER vs non-ER) and patient characteristics. Multivariate logistic and linear regression models were implemented to evaluate factors associated with an ER admission, odds of mortality, and the odds of a nonroutine discharge. Factors adjusted for in these multivariate models included a patient’s age, sex, race, insurance, comorbidities, median household income, hospital bed size, and spinal compression fracture. Adjusted odds ratio (OR), 95% confidence intervals (CIs), and corresponding p values were reported. Nationwide estimates were made possible through the SAS PROC SURVEY methodology. All analyses were conducted using SAS (version 9.1 for Windows, SAS Institute Inc.).

Results

General Descriptors

During the 10-year period, 183,151 patients with LBP were admitted to US hospitals. Of these, 118,962 (65.0%) were admitted through the ER (Table 1). Non-Caucasian patients with LBP had higher rates of admission through the ER compared with non-ER admissions (19.7% vs 14.3%, $p < 0.0001$). Fewer ER-admitted patients had private insurance (28.8% vs 33.0%, $p < 0.0001$), more had Medicaid insurance (10.6% vs 8.8%, $p < 0.0001$ compared with non-ER admissions. Additionally, ER-admitted patients had higher rates of preexisting comorbidities (score 3+: 11.6% vs 9.0%, $p < 0.0001$) compared with non-ER patients.

A preliminary description of outcomes for ER versus non-ER admissions is provided in Table 2. More patients with LBP who were admitted through the ER were discharged nonroutinely from the hospital compared with non-ER admissions (32.9% vs 23.7%, $p < 0.001$). Although mortality rates (0.51% vs 0.38%, $p = 0.08$) tended to be higher for ER-admitted patients, this did not reach statistical significance at the univariate level. Patients admitted through the ER had shorter hospital stays compared with non-ER patients (3.6 days vs 3.7 days, $p = 0.003$).

Factors Associated With an ER Admission

A patient’s insurance was found to be the strongest predictor for ER admission (Fig. 1). Uninsured patients were 2.1 times more likely to be admitted through the ER than private insurance patients were (OR 2.1, 95% CI 1.7–2.6, $p < 0.0001$). African Americans also had increased odds of ER admission (OR 1.46, 95% CI 1.2–1.7, $p < 0.0001$) compared with Caucasian patients. Additionally, patients with more preexisting comorbidities had a higher likelihood of admission through the ER (OR 1.1, 95% CI

TABLE 1. Characteristics of 183,151 patients with LBP by type of admission

Characteristics	All Cases		% ER	% Non-ER	p Value
	No.	%			
No. of cases	183,151	100	65 (n = 118,962)	35 (n = 64,189)	
Average age (yrs)	58.6		59.3	54.8	<0.0001
Females	114,568	62.6	62.5	62.7	0.67
Race					<0.0001
Caucasian	150,521	82.2	80.3	85.7	
African American	16,655	9.1	10.0	7.4	
Hispanic	13,389	7.3	8.2	5.7	
Asian/Pacific Islander	1836	1.0	1.1	0.8	
Native American	751	0.4	0.4	0.4	
Median household income (\$)					<0.0001
<24,999	4987	2.7	5.7	5.9	
25,000–34,999	24,538	13.4	26.2	31.7	
35,000–44,999	25,263	13.8	29.7	28.6	
>45,000	31,568	17.3	38.4	33.7	
Primary payer					<0.0001
Medicare	86,470	47.2	48	45.9	
Medicaid	18,176	9.9	10.6	8.8	
Private insurance	55,356	30.2	28.8	33.0	
Self-pay	7754	4.2	5.2	2.5	
Discharge status*					<0.0001
Routine	128,581	70.2	67	76.2	
Nonroutine	54,250	29.6	32.8	23.6	
Comorbidity score					<0.0001
0	76,675	41.9	39.3	46.6	
1	54,962	30.0	30.7	28.8	
2	31,960	17.5	18.4	15.6	
3+	19,554	10.7	11.6	9.0	

* Nonroutine discharge corresponds to transfers, home health care, against medical advice, and death.

1.0–1.2, $p < 0.0001$). An 11% incremental increase in the likelihood of ER admission was observed with each year increment (OR 1.1, 95% CI 1.0–1.2, $p < 0.0001$). Interestingly, patients with the highest yearly income (\$45,000+) were more likely to be admitted through the ER (OR 1.3, 95% CI 1.1–1.6, $p = 0.007$) compared with those at the lowest median household income level (Tables 3 and 4; \$1–\$24,999).

Comorbidities

A detailed analysis of the established and well-studied Elixhauser comorbidities¹⁰ is documented (Fig. 2, Tables 3 and 4). Hypertension was the most commonly documented comorbidity in both ER and non-ER cohorts (38% vs 33%, $p < 0.0001$), respectively. Diabetes was the next most frequent comorbidity documented (ER 14% vs non-ER 13%, $p < 0.0001$), followed by chronic pulmonary disease (ER 14% vs non-ER 13%, $p < 0.0001$), and depression (ER 11% vs non-ER 12%). Fluid and electrolyte disorders (ER 9% vs non-ER 6%, $p < 0.0001$), hypothyroidism (ER 9% vs non-ER 7%, $p < 0.0001$), deficiency anemia (ER 7% vs non-ER 6%, $p < 0.0001$), and obesity (ER 7% vs non-

ER 6%, $p < 0.0001$) were also documented in a significant fraction of patients.

Outcome Analysis

Multivariate models that adjusted for a patient's age, sex, race, admission type (ER vs non-ER), insurance, comorbidities, median household income, hospital bed size, and the occurrence of a spinal decompression fracture were evaluated (Table 3). We found no association between the type of admission (ER vs non-ER) and the risk of mortality (OR 0.95, 95% CI 0.60–1.51, $p = 0.84$). However, older age (OR 1.54, 95% CI 1.35–1.77, $p < 0.0001$), being male (OR 1.68, 95% CI 1.10–2.58, $p = 0.02$), having higher pre-existing comorbidities (OR 1.72, 95% CI 1.46–2.03, $p < 0.0001$), and lowest income (OR 2.36, 95% CI 1.13–4.91, $p = 0.02$) were significantly associated with an increased risk of mortality. Patients admitted through the ER were more likely to be discharged nonroutinely (OR 1.39, 95% CI 1.26–1.53, $p < 0.0001$) than the non-ER cohort. Older age patients (OR 1.68, 95% CI 1.63–1.72, $p < 0.0001$), with Medicare (OR 1.71, 95% CI 1.51–1.92, $p < 0.0001$), those with more preexisting medical conditions (OR 1.37, 95%

TABLE 2. Characteristics and outcomes of 183,151 patients with LBP

Variable	ER Cases	Non-ER Cases	p Value
Outcomes			
Mortality rate (%)	0.51	0.38	0.08
Nonroutine discharge rate (%)	32.9	23.7	<0.0001
Average length of stay (days)	3.6	3.7	0.003
Total charges (\$)	10,940	12,710	<0.0001
Hospital characteristics			
Bed size (%)			<0.0001
Small	13.8	19.4	
Medium	26.6	25.4	
Large	59.6	55.2	
Teaching Status (%)	41.1	40.0	0.47
Region (%)			<0.0001
Northeast	30.0	20.7	
Midwest	19.0	23.9	
South	31.3	38.6	
West	19.7	16.8	

CI 1.32–1.43, $p < 0.0001$), and documented as having a spinal compression fracture (OR 2.0, 95% CI 1.55–2.59, $p < 0.0001$) were significantly associated with an increased risk of nonroutine discharge. Male patients (OR 0.80, 95%

CI 0.74–1.72, $p < 0.0001$) and non-Caucasians (OR 0.82, 95% CI 0.72–0.94, $p = 0.003$) had a significant reduction in the odds of a nonroutine discharge.

Discussion

The extensive utilization of ER resources by patients with LBP has been well documented. Over the course of 2 studies, Friedman found that approximately 2.6–2.7 million patients visited the ER annually with a primary complaint of LBP.^{12,13} Through a survey of ER physicians, Elam et al. found that LBP was a frequent cause of visits to the ER, with 59% of ER physicians encountering patients with LBP 5–20 times per month, while 35% reported treating these patients more than 20 times every month.⁹ These patients often visit the ER multiple times and receive repeated diagnostic testing,² resulting in significant associated financial expenditures and only short-term pain relief for most.¹⁹ Similarly, in our analysis of a national database of patients admitted to US hospitals over nearly a decade, a total of 183,151 patients with a primary diagnosis of LBP were documented. Of these, a significant majority (65%) was admitted through the ER, with an almost 20% increase in this cohort over time, from 54% in 1998 to 71% in 2005.

Most epidemiological studies of patients with LBP have focused on issues such as various treatment methods and outcomes,^{7,17,22,29} as well as costs associated with these treatments,^{8,14,16,23,33} while only a handful have analyzed the impact of socioeconomic variables, including ethnic-

FIG. 1. Adjusted ORs for association of patient and hospital characteristics with likelihood of ER admission in patients with LBP.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

TABLE 3. Adjusted OR of mortality and nonroutine discharge

Characteristics	Mortality		Nonroutine Discharge	
	OR (95% CI)	p Value	OR (95% CI)	p Value
Age (decade increments)	1.54 (1.35–1.77)	<0.0001	1.68 (1.63–1.72)	<0.0001
Male vs female	1.68 (1.10–2.58)	0.02	0.80 (0.74–1.72)	<0.0001
Non-Caucasian vs other	0.74 (0.37–1.49)	0.40	0.82 (0.72–0.94)	0.003
ER vs non-ER admission	0.95 (0.60–1.51)	0.84	1.39 (1.26–1.53)	<0.0001
Insurance (ref: private)				
Medicare	0.69 (0.34–1.39)	0.29	1.71 (1.51–1.92)	<0.0001
Medicaid	0.63 (0.17–2.27)	0.48	1.42 (1.18–1.72)	0.0003
Uninsured	1.77 (0.49–6.33)	0.38	1.27 (0.97–1.67)	0.08
Elixhauser comorbidity score (per unit increment)	1.72 (1.46–2.03)	<0.0001	1.37 (1.32–1.43)	<0.0001
Median household income (ref: >\$45,000)				
\$1–\$24,999	2.36 (1.13–4.91)	0.02	0.96 (0.75–1.23)	0.75
\$25,000–\$34,999	0.56 (0.30–1.01)	0.07	0.96 (0.86–1.10)	0.52
\$35,000–\$44,999	0.99 (0.59–1.67)	0.96	0.98 (0.88–1.10)	0.75
Hospital bed size (ref: small)				
Medium	1.05 (0.52–2.10)	0.90	0.92 (0.80–1.10)	0.27
Large	1.00 (0.53–1.88)	0.99	0.94 (0.82–1.07)	0.35

ity and race, on the diagnosis and treatment of patients with LBP.^{4,5,20} To our knowledge, this is the first study to not only analyze the likelihood of visiting the ER, but to specifically focus on the interplay between socioeconomic factors and the likelihood of being admitted to the hospital through the ER, as well as the effect of this admission route on short-term outcome (i.e., discharge disposition and mortality) for patients with LBP. Identifying factors that increase the likelihood of patients with LBP utilizing ER resources can potentially lead to more targeted and preventative treatment strategies that would allow for both improved clinical outcomes as well as cost savings

for an already overburdened health care system in the US. In this study, we found that African American (OR 1.5, $p < 0.0001$) and uninsured (OR 2.1, $p < 0.0001$) patients were significantly more likely to be admitted through the ER, and admission through the ER significantly increased the likelihood of a nonroutine discharge for these patients, and tended to increase the risk of death as well.

It has been previously established that the inequities in access to health care resources for a variety of conditions can result from racial and ethnic factors.^{1,3,27} With regard to spinal conditions in particular, race and ethnicity have been found to influence health care providers' decisions to

TABLE 4. Parameter estimates and p values for multivariate analysis of in-hospital length of stay and total charges

Characteristics	In-Hospital Length of Stay		Total Charges	
	Estimate (days)	p Value	Estimate (\$)	p Value
Age (decade increments)	0.20	<0.0001	14	0.78
Males	–0.24	<0.0001	365	0.06
Non-Caucasians	0.20	0.0010	3020	<0.0001
ER admissions	–0.25	<0.0001	–2849	<0.0001
Insurance (ref: private)				
Medicare	0.42	<0.0001	1260	0.007
Medicaid	0.24	0.03	–181	0.54
Uninsured	–0.21	0.05	–851	0.01
Elixhauser comorbidity score (per score increment)	0.65	<0.0001	1561	<0.0001
Median income (ref: >\$45,000)				
\$1–\$24,999	–0.08	0.39	–5760	<0.0001
\$25,000–\$34,999	0.20	0.0003	–5409	<0.0001
\$35,000–\$44,999	0.11	0.05	–4676	<0.0001
Hospital bed size (ref: small)				
Medium	0.08	0.91	1865	<0.0001
Large	0.08	0.17	3810	<0.0001

FIG. 2. Comorbidity rates for patients by type of admission. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. ns = nonsignificant.

not only administer analgesic treatment,¹⁵ but also to order advanced imaging and recommend surgery for patients with LBP,³¹ as well as those with scoliosis.²⁵

Our finding that African Americans with LBP were almost twice as likely to not merely visit the ER, but to actually be admitted to the hospital via this route, may be reflective of these discrepancies in access to appropriate nonemergent health care services and treatments.

LBP is also one of the most common reasons for seeking medical care for the uninsured and poor, primarily through the ER.^{21,24} Friedman et al.¹³ found that as many as 42% of patients with LBP in the ER of 1 hospital were unemployed, many of whom were likely uninsured. This same study found that insurance status was associated with decisions to order advanced imaging and that uninsured patients in particular were less likely to undergo such studies.¹³ Moreover, patients with LBP who were discharged from the ER had substantial morbidity even months later, with 70% reporting functional impairment 1 week later, and nearly half still impaired after 3 months.¹² That our analysis revealed uninsured patients to be twice as likely to be admitted to the hospital via the ER, then, appears intuitive as these patients not only use ER services more often, but appear to receive suboptimal long-term benefit from these services and seemingly will eventually require hospitalization.

Patients of lower socioeconomic status have been found to have an increased prevalence of LBP,^{20,28} perhaps as a result of the types of manual labor involved in most lower-paying occupations.²⁸ Interestingly, in our analysis, pa-

tients with LBP in the lowest annual income groups (\$1–\$24,999 and \$25,000–\$34,999) were actually less likely to be admitted to the hospital through the ER (OR 0.76, 95% CI 0.63–0.93, $p = 0.006$) than those with relatively higher annual incomes ($\geq \$45,000$). Although this finding seems counterintuitive, there may be several explanations for this phenomenon. The first explanation is that the NIS database stratifies median income into only 4 groups (\$1–\$24,999, \$25,000–\$34,999, \$35,000–\$44,999, and \$45,000 and above). As such, the lowest income group can likely be considered to be those living below the poverty level. In a study of nonfederal hospitals that operated an ER in California in 2007, Hsia et al.¹⁸ found that, even after controlling for insurance status, lower-income patients visiting the ER were at higher risk for leaving without being seen. Although their study did not include exact income values and instead relied on census data to estimate mean income for patients within a certain zip code, the finding that the lowest-income patients were at the highest risk for leaving the ER without being seen may offer insight into our results concerning this group of patients. Our finding that, after multivariate analysis, the lowest-income patients in the NIS database were actually less likely to be admitted to the hospital through the ER may be a result of these patients actually leaving the ER without ever being seen by a physician, perhaps as a result of overcrowding of ERs in those areas that serve a high proportion of extremely low-income patients. Other studies have also documented socioeconomic status as a risk factor for “left before being seen” in US emergency departments.^{26,30}

Future research should include whether the admissions from ER versus non-ER were related to type and timing of operative treatment (see Supplemental Table for a preliminary analysis). In addition, it would be interesting to understand the differences in the cost of care if the patient is admitted on an emergency basis from the ER versus non-ER admission. These questions are likely best answered by other administrative databases such as Reuters Market Scan.

Limitations of the Study

There are several limitations to this study. First, the database is solely for admissions. Our data were limited to patient admission demographics (sex, race, median household income, primary insurance payer, type of admission) and hospital characteristics (bed size, teaching status, region of the country, location broken down as rural or urban) as contained in the database. Some information was missing, and we identified the number and percentage of patients where admission data were missing. Second, because all patients with LBP in the NIS are grouped under ICD-9-CM diagnosis code 724.2, we acknowledge the inability to assess the severity of a patient's LBP, or other underlying spinal pathologies (such as spondylolisthesis, stenosis, postlaminectomy syndrome, sagittal imbalance, and others) and thereby cannot comment on the role that these factors played in the decision to admit any particular patient. Thus, the diagnosis of LBP in the NIS was established by the admitting physician. Additionally, the patient's symptomatology leading to admission is not captured by the NIS. It cannot be determined whether every patient matched the same criteria for LBP, or whether any patients had radiculopathy, myelopathy, or even abnormal imaging. As such, this study cannot comment on the appropriateness of surgical versus nonsurgical treatment or the surgical treatment used.

Conclusions

A significant majority of patients discharged from hospitals in the US from 1998 to 2007 with a primary diagnosis of LBP were admitted through the ER, with more patients being admitted via this route each year. These patients were less likely to be discharged directly home compared with patients with LBP who were not admitted through the ER. Uninsured and African American patients with LBP were more likely to be admitted through the ER than their counterparts, as were patients with more pre-existing health problems. Interestingly, patients with LBP at the lowest income levels were less likely to be admitted through hospital ERs. Our findings suggest that socioeconomic factors may play a role in the utilization of ER resources by patients with LBP, which in turn appears to impact at least the short-term outcome of these patients. Moreover, patients at the lowest end of the income spectrum may be at higher risk for leaving the ER without ever being seen. More research should be directed at finding ways to improve nonemergent health care services for these populations that may potentially reduce the burden placed on ER services in the US.

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Disclosures

J. C. Liu is a consultant for Medtronic.

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Conception and design: Acosta. Acquisition of data: Drazin. Analysis and interpretation of data: Nuño, Patil. Drafting the article: Drazin, Yan. Critically revising the article: Drazin. Reviewed submitted version of manuscript: Drazin. Study supervision: Acosta, Liu.

Supplemental Information

Online-Only Content

Supplemental material is available with the online version of the article.

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