
Do specialists order too many tests? The case of allergists and pediatric asthma

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Background: Is the practice style of specialists overly reliant on diagnostic tests? Health maintenance organization managers and other clinicians have been critical of the high cost practice styles of specialists, but if the specialists' practice style ultimately results in similar or lower total costs because of better outcomes in the treatment of exceptional cases, then such practice styles are cost-effective and should be encouraged. Indeed, if this is the case, not employing a test-intensive practice style could be considered negligent under a legal criterion.

Objective: We attempted to determine whether the care of pediatric asthmatic patients by allergists is characterized by more testing, but by better, less costly outcomes than care by non-allergists.

Methods: We used administrative data on pediatric asthmatic cases from a large health care plan from 1992 to determine whether patients treated by allergists received more tests, cost more, and had fewer asthmatic management breakdowns than patients treated by non-allergists. We used regression analysis to hold constant aspects of the patient's case mix.

Results: Although allergists ordered significantly more tests than non-allergists, their overall treatment costs were similar. Patients treated by allergists had fewer management breakdowns.

Conclusions: These results suggest that the allergists' test-intensive practice style is cost-effective.

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INTRODUCTION

The US health care system appears to have embarked on a course of substituting generalist care for specialist care.¹ This trend is seen in part in the recent growth in enrollments in managed care organizations, which have traditionally relied on staffing by generalists. Weiner² estimates that if the current trend toward enrollment in managed care organizations continues, by the year 2000 the supply of specialists will exceed the required number by over 60%. The trend toward generalist care is also seen in the increased payments to generalists under Medicare's resource based relative-value scale and in the residency match data that show over the last few years an increase in

the number of new physicians opting for family practice positions.

The impetus for this change is the view that specialists provide an unnecessarily intensive style or level of care. That is, because of their advanced training, the expertise that specialists bring to many of their patients is inappropriately high. Physicians with broader training could treat many of these cases just as successfully, and their fees would be lower. Further, specialists tend to employ a practice style that is intensive in the use of diagnostic and other tests. For many patients, such intensive testing also implies care that is inappropriate, unnecessary, and too expensive. As a result, managed care firms have adopted a stance of basing their care on the practice patterns of generalists, and using specialists only when it is clear that the patient requires their higher level of expertise.

The potential problem with this approach is that there are diseases for

which only a specialist would know when a higher level of expertise is required. Generalists, because of their lack of expertise and experience in an area, may not recognize the symptoms of a potentially difficult case upon presentation. Further, generalists may not be aware of (or may discount the probability of) some of the adverse manifestations of the disease. As a result, generalists may not prescribe all the tests necessary to diagnose the potentially most difficult cases. If these outlier cases are misdiagnosed and their subsequent mismanagement is sufficiently costly, then incurring the additional costs associated with specialist care to obtain the correct diagnosis for these rare cases may save enough money to compensate for the increased costs of all the other cases for which the use of specialists turned out in hindsight to be too intense.

In this study, we take a disease for which the diagnosis is often not obvious and for which the severity is variable³—pediatric asthma—and compare its management by allergists and non-allergists on three dimensions. First, we compare use of diagnostic tests to determine whether allergists indeed conform to expectations about the specialist's more test-intensive practice style. Second, we compare the expenditures of those treated by allergists with those treated by non-allergists. Finally, to shed additional light on the cost comparisons, we determine whether patients treated by allergists or non-allergists require more hospitalizations or emergency room visits—services that indicate a breakdown in the management of the disease.

METHODS

Data

The data come from United Health-Care's Center for Health Care Policy and Evaluation and represent all the

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claims processed during calendar year 1992 for 1574 members of one United HealthCare (UHC) health plan located in the northeast region of the US, all of which were identified as having pediatric asthma. The members were aged from birth to 21 years, and were all continuously enrolled in the plan during that year. All claims during the year were rolled up for each patient to determine annual procedure counts and expenditures.

The algorithm used to identify asthmatic patients was developed by UHC and based on combinations of diagnoses and drug prescriptions from the claims. United HealthCare evaluated the accuracy of their method of case identification by taking a 5% sample and comparing the asthmatic patients identified using their claims algorithm with patients identified as asthmatics by physician researchers using medical records. Their claims algorithm predicted true asthmatic patients accurately 95% of the time.⁴

The algorithm used to identify the physician primarily responsible for the patient's asthma management was also developed by UHC. It used the following hierarchical decision rule: the main physician responsible for a given patient's asthma care is either (1) the physician who sees the patient most often for asthma-related diagnoses, or (2) the physician who prescribes the most asthma medications, or (3) the physician who sees the patient most often regardless of diagnosis. This algorithm was occasionally unable to assign a main provider to a particular case, and as a result, the physician specialty variable is missing for 15 cases. These cases were excluded from the subsequent analysis.

Practice Style Differences

The first area of inquiry is whether allergists use a different practice style than non-allergists. It is widely assumed and evidence⁵ confirms that specialists such as allergists provide more expensive treatment because their fees are higher and because they order more diagnostic tests and other services. To test for the latter effect,

we estimated a series of regression equations where the dependent variables were the number of (1) spirometry tests, (2) chest radiographs, (3) sinus radiographs, (4) immunotherapy sessions, and (5) office visits. These were regressed on a dummy variable indicating whether the patient was seen by an allergist or not.

The central methodologic issue in any study comparing practice styles of physician types is how to hold constant case-mix severity. It is generally thought that the more severe patients select care from specialists. If we were not able to control for severity, then the expenditures of those treated by specialists may appear higher regardless of any differences in effectiveness favoring the specialist. We attempted to hold case-mix constant by including patient and treatment variables from our claims data in the regression. Severity of the case may be related to the patient's sex and age. Severity may also be related to the drug regimen used to treat the patient, so we also included five dummy variables representing whether the patient had any prescription during 1992 for (1) inhaled steroids, (2) oral steroids, (3) inhaled beta-agonists, (4) oral beta-agonists, and (5) antibiotic drugs. Patients admitted to the hospital or with emergency room visits may have more tests because they are likely to be the more severe cases and perhaps also because they are in closer proximity to some of the testing equipment when at the hospital. Finally, patients are likely to have more tests in the year they are initially diagnosed or they are seen by a new physician, so patients who were new to the plan in 1992 was also entered as a control variable.

The distributions of the spirometry, chest radiograph, sinus radiograph, and immunotherapy variables were skewed, violating the normality assumptions underlying ordinary least squares regression analysis. Accordingly, we transformed these variables into binary ones indicating whether the patient had any spirometry test, any chest radiograph, any sinus radiograph, and any immunotherapy session during

the year, and used logistic regression analysis instead. Although this transformation resulted in a loss of information, the estimates were more reliable. We, nevertheless, confirmed our results by re-estimating the same equations using the "continuous" form of the variables and ordinary least squares estimation. Finally, because the office visit variable more closely approximated a normal distribution, we used ordinary least squares on it.

Costs

If we find that allergists employ a more expensive practice style, does this practice style also result in more total expenditures for asthma diagnosis when all the consequences of these tests are factored in? To determine this, we totaled the claims for the year for each of the patients and regressed total claims for each patient on the same allergist dummy and case-mix control variables. Costs were measured by the total amounts claimed by providers during calendar year 1992.

Breakdowns in Management

Finally, we investigated whether there were any systematic differences in effectiveness of asthma management. One way to measure effectiveness of management is to look at whether or not a breakdown in management—a hospitalization or emergency room visit—has occurred. Again, we specified these as binary variables, representing whether or not the event occurred at all, because the distribution of the number of events was skewed. Accordingly, we performed separate regression analyses on whether or not a patient had an (1) emergency room visit and (2) an inpatient hospital stay during the year, regressing these dependent variables on the same explanatory variables used in the cost function regressions to control for case mix.

RESULTS

Variable definitions appear in Table 1 and means for all 1574 cases appear in Table 2. The means are also broken down by whether the main asthma manager was an allergist or non-all-

Table 1. Variable Definitions

Variable	Definition
Allergist	Whether the patient's primary physician is an allergist
Asthma specialist	Whether the patient's primary physician is an allergist or a non-allergist asthma specialist (defined as otolaryngologist, pulmonary specialist, or a physician with a allergist or pulmonary subspecialty)
Hospitalizations	Number of inpatient hospitalizations during 1992
ER visits	Number of emergency room visits during 1992
Spirometry tests	Number of spirometry tests during 1992
Chest radiographs	Number of chest radiographs during 1992
Sinus radiographs	Number of sinus radiographs during 1992
Immunotherapy sessions	Number of immunotherapy sessions during 1992
Office visits	Number of office visits during 1992
Female	Whether the patient is female
Age	Age of patient
Any inhaled steroids	Whether patient has prescription for inhaled steroids in 1992
Any oral steroids	Whether patient has prescription for oral steroids in 1992
Any inhaled beta-agonists	Whether patient has prescription for inhaled beta-agonists in 1992
Any oral beta-agonists	Whether patient has prescription for oral beta-agonists in 1992
Any antibiotics	Whether the patient has prescription for an antibiotic in 1992
New patient	Whether the patient is a new patient to the plan in 1992
Total claims	Total amount claimed by providers during 1992

gist. The allergist cases plus the non-allergist cases, however, sum to only 1,559 because of the missing physician specialty information.

The diagnostic test regression results appear in Table 3. The results show that allergists are significantly more likely to order spirometry tests, sinus radiographs, and immunotherapy sessions, and have significantly more office visits than non-allergists, but are not more likely to order a chest radiograph. The ordinary least squares results (not reported) were consistent with the logit results. These results mirror the difference in means from Table 2 broken down by allergist/non-allergist. The coefficient for office visits indicated that during the year, patients seen by allergists had over three more office visits than patients seen by non-allergists. We also used a standard log transformation of the office visit variable with much the same results. These results appear to conform to the

presumption that specialists practice a more intensive style of medicine than generalists.

The cost function results appear in Table 4. The insignificant negative coefficient on the allergist variable indicates that care by allergists costs about the same as care by non-allergists when all costs are considered, and may even cost less. Note that the difference in unadjusted means for this variable from Table 2 also favored the allergists. Upon closer inspection of the data, this result appears to be driven by the fact that one patient (a 3-year-old male) who was seen by a non-allergist had 10 inpatient hospitalizations, 11 emergency room visits, and more than \$84,000 in claims. The two next most expensive cases were also seen by non-allergists. This information suggests that outliers may be causing the non-allergists' patients to be as expensive as allergists' patients.

The management breakdown results appear in Table 5 and indicate that patients whose asthma is managed by allergists have an insignificantly lower likelihood of an emergency room visit but a significantly (at the .1 level) lower likelihood of a hospitalization. Again these results are consistent with the differences in means from Table 2. These results suggest that the outliers may not simply be a chance occurrence, but may actually represent the effects of systematically more effective allergist care on total costs.

DISCUSSION

This study has shown that pediatric asthmatic cases managed by allergists appear to be no more costly than cases managed by non-allergists. This is despite the fact that allergists order more tests and require more office visits, holding constant variables associated with the severity of the case. The evidence further suggests that allergists may achieve similar costs despite the increased testing because they are more effective in avoiding costly breakdowns in asthma management.

Statistical Outliers and the Theory of Specialist Care

The presence of apparent outliers in this analysis raises an interesting analytical and interpretational question. On the one hand, statisticians typically assume that the presence of outliers causes misleading results because these observations tend to exert a disproportionately large influence on the regression coefficients. On the other, the theory of why specialists (such as allergists) are better able to manage diseases (such as asthma) is essentially an outlier theory. That is, for normal cases of asthma, allergists and non-allergists may perform equally well. It is the unusually difficult case where the experience, expertise, and treatment style of the specialist is useful. When the potentially outlying asthmatic cases are managed by allergists, the allergists are likely to have already performed the additional tests, they are more likely to have the experience to know that such cases need special at-

Table 2. Variable Means

Variable	Entire Sample	Allergists	Non-Allergists
Allergist	0.34	1.00	0.00
Asthma specialist	0.36	1.00	0.03
Hospitalizations	0.09	0.06	0.12
ER visits	0.44	0.40	0.45
Spirometry tests	0.33	0.68	0.15
Chest radiographs	0.28	0.22	0.31
Sinus radiographs	0.08	0.12	0.05
Immunotherapy sessions	1.30	2.78	0.56
Office visits	9.64	11.40	8.83
Female	0.44	0.40	0.46
Age	10.18	11.58	9.41
Any inhaled steroids	0.13	0.21	0.08
Any oral steroids	0.26	0.30	0.24
Any inhaled beta-agonists	0.43	0.50	0.40
Any oral beta-agonists	0.47	0.32	0.56
Any antibiotics	0.80	0.74	0.83
New patient	0.05	0.05	0.06
Total claims	1828.16	1750.86	1875.95

tention, and are more likely to know how best to manage the case. When the potentially outlying cases are managed by non-specialists, they may not have the same level of experience and are therefore more likely to mismanage the case, resulting in a few cases with dramatically higher care expenditures.

Our analysis suggests that the cost outliers we observed may have a systematic rather than chance relationship to treatment by non-allergists. We found some evidence that asthmatic patients treated by allergists were less likely to have breakdowns in asthma management than those treated by non-allergists. To the extent that these breakdowns contributed to the outlier costs, we therefore have some evidence of a systematic relationship between these high cost observations and care by non-allergists.

Stated another way, the cost advantages of specialist care are concentrated to a large extent in their relatively greater effectiveness in treating exceptional cases. If analysts were to eliminate the exceptional cases (ie, outliers) from consideration, they would also be eliminating the best source of data in favor of specialists. One approach to determining whether these high cost observations should be discarded as outliers or be included in the analysis as representing the bene-

fits of specialist care is to include an additional analysis of the effectiveness of specialists (in this case, whether allergist had fewer breakdowns in asthma management). This approach could be used in other studies.

Learned Hand's Rule

If the ultimate costs of misdiagnosis and mistreatment are greater than the costs of the tests that were not performed, the generalist (who failed to perform the test) would be ruled liable under a criterion for negligence first used by the American jurist, Learned Hand. In an opinion from *US v. Carroll Towing Co.*, a shipping case from 1947, Judge Hand held that the owner of a ship that breaks from its moorings is liable for damages if an action that reduces the probability of injury is not performed and the cost of that action is less than the loss from that injury times the reduction in probability of injury.⁶ This rule has been applied generally to determine negligence, and implies that physicians are negligent if they fail to prescribe a test or perform a procedure for which the cost of the test or procedure is less than the expected loss from not performing it.^{7,8} For example, if a physician does not perform a \$100 chest radiograph on an asthmatic patient and this results in a lack of diagnostic information that raises the prob-

ability by 0.1 that the person will incur a \$1,500 hospital stay, then the physician is negligent under Hand's rule because \$100 is less than $0.1 \times \$1500$ or \$150. Although this rule was probably intended to be used to determine negligence on a case-by-case basis, it can also be used to determine the appropriateness (in the sense of non-negligence) of a style of medicine practiced by a group of physicians.

Specifically, if specialists employ a practice style where they prescribe more diagnostic tests than generalists in treating the same disease, then whether these tests are appropriate can be determined by comparing the overall costs of care by specialists with care by generalists. If, despite the additional spending on testing by specialists, the total expenditures for their patients are equal to or lower than the medical care expenditures of those treated by generalists, then their practice style is appropriate. (If the expenditures are equal, this implies that the costs of the additional tests exactly equal the increased treatment costs—ie, the expected losses—from not having performed the tests.) Under these circumstances, the practice style of the average generalist would be considered negligent under the application of the Hand's rule.

Clinical Versus Legal Standards for Appropriateness

It is interesting to speculate about why some clinicians and health maintenance organization managers may regard the allergists' practice style as inappropriate, but under Hand's rule, we would conclude the opposite. The allergists' practice style may be viewed as inappropriately test-oriented because, from a clinical point of view, so many of these tests may yield such little additional information on the average patient that the tests may be considered unnecessary. From Hand's legal perspective, however, the value of these seemingly unnecessary tests is enhanced because by using expected losses as the standard, the criterion explicitly takes into account not only the probability of loss but also the size of

Table 3. Practice Style Regression Results

Dependent Variable	Logit Regressions			
	Any Spirometry Tests	Any Chest Radiographs	Any Sinus Radiographs	Any Immunotherapy Sessions
Constant	−3.32068* .2958062† 0.000‡	−2.242752 .2865832 0.000	−4.602118 .4678963 0.000	−4.211465 .3660298 0.000
Hospitalizations	.2699057 .1836486 0.142	1.443511 .2111619 0.000	.3365988 .1910009 0.078	.0590023 .2234247 0.792
Emergency room visits	−.2085823 .0930113 0.025	.4720919 .0755163 0.000	−.0195063 .1237857 0.875	.0645963 .1028723 0.530
Female	.2475923 .143303 0.084	.0046965 .1424388 0.974	.4008037 .2193091 0.068	−.4199388 .1805599 0.020
Age	.0314952 .016767 0.060	−.0202798 .0169584 0.232	.0752641 .0245773 0.002	.1406495 .0207746 0.000
Any inhaled steroids	1.309209 .1926683 0.000	.4887525 .2164186 0.024	−.5141111 .3409644 0.132	.1952642 .2422682 0.420
Any oral steroids	.1862084 .1662534 0.263	.2984979 .1577209 0.058	.6624548 .2408852 0.006	.0130247 .2133855 0.951
Any inhaled beta-agonists	.858208 .1573263 0.000	−.012376 .1706336 0.942	−.4249764 .239739 0.076	−.4510775 .1921631 0.019
Any oral beta-agonists	.0922086 .1659056 0.578	.1993482 .1660871 0.230	−.583997 .2652689 0.028	−.0527429 .207638 0.799
Any antibiotics	.2922007 .1794224 0.103	.4993201 .2149615 0.020	.8669785 .3220117 0.007	.1053663 .209108 0.614
New patient	.1168265 .2860773 0.683	−.2596844 .3337369 0.437	.1595095 .4529523 0.725	.3466981 .3447139 0.315
Allergist	1.727515 .1459836 0.000	−.1537546 .1589854 0.333	.9222961 .2219335 0.000	1.514247 .1832537 0.000
Number of obs	1559	1559	1559	1559
chi2 (11)	372.55	195.67	63.55	167.32
Prob > chi2	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.2234	0.1270	0.0856	0.1522
Log Likelihood	−647.67146	−672.7734	−339.61104	−465.91982

* Coefficient.

† Standard error.

‡ Prob > |T|.

the loss. That is, whereas some clinicians may dismiss some potential eventualities as too rare to test for regularly, Hand's criterion weights the various probabilities by the size of the losses. As a result, tests for rare cases

that have large potential losses become appropriate.

Indeed, the evidence presented here may underestimate the cost-saving value of allergist tests and care, making the legal case in support of the

allergists' practice style even more persuasive. The value of the allergists' care and tests is represented in Hand's rule as the expected costs avoided. In this study, we have only considered the expected medical care costs avoided.

Other costs—such as the productivity costs from the time spent traveling, in treatment and recuperating, and the costs of pain and suffering—can also be avoided if the appropriate tests are done and a specialist's expertise applied. If these costs are added to the medical care costs (stemming from the tests not performed and expertise not applied), we may arrive at a more definite conclusion that the allergists' practice style is appropriate and the generalists' is not. Again, these costs do not typically enter the clinician's decision on whether to prescribe a test, but they would enter the court's decision on size of any loss from negligence.

It is worth emphasizing that for most patients, the additional tests may indeed prove unnecessary in that they do not provide any additional useful information—information that identifies these cases as potential outliers. From the perspective of the courts, too, most of the physicians who do not prescribe the additional tests would not be ruled negligent because in most cases no undue injury or loss has occurred. Negligence only occurs when a test is not done that would have identified an outlier, and the outlier is mistreated as a "normal" patient and unnecessarily large losses occur. It is the pretest probability and magnitude of loss that compels testing of all patients under Hand's rule.

Cost Biases

Because this study is not a randomized controlled trial, we are not certain we have adequately controlled for case-mix severity. If case-mix is not completely controlled for and allergists treat patients with a less severe case-mix than generalists, this might explain how allergists could have higher testing costs, but have similar overall costs. Fortunately, any case-mix bias is likely to go in exactly the opposite direction because allergists are more likely to see the more severe cases, and the more severe cases are more costly.

Also, specialists generally charge more per visit than generalists (ie, pediatricians, family practice physicians,

Table 4. Claims Regression

Variable	Parameter Estimates		prob > T
	Parameter Estimate	Standard Error	
Intercept	1424.719965	359.48614970	0.0001
Female	−73.298031	191.92905169	0.7026
Age	−18.705502	22.60671713	0.4081
Any inhaled steroids	1018.702496	312.11200818	0.0011
Any oral steroids	766.465994	225.77898982	0.0007
Any inhaled beta-agonists	−374.018368	222.17389534	0.0925
Any oral beta-agonists	94.549405	225.52324683	0.6751
Any antibiotics	617.358807	248.15725833	0.0130
New patient	−392.548446	415.56788528	0.3450
Allergist	−150.730394	208.89969695	0.4707

F Value = 5.168.

Prob > F = 0.0001.

R-square = 0.0292.

etc). The higher fees would predispose patients who are treated by allergists to be more costly. These two factors imply that our actual findings of equal total costs despite more allergist testing may be conservative. If these factors were eliminated, our results might show that allergists actually have lower costs.

Study Limitations and Advantages

One limitation is that these results represent the behavior of only one (albeit large) health plan in the northeastern portion of the country. It is unclear to what extent these results generalize to the entire county. Another limitation is the assumption that the low expenditures for allergists' patients are due at least in part to the information derived from the allergists' additional testing. Our data were not sufficient to determine whether this relationship actually existed. Allergists tended to be more successful in their management, but whether this was a function of their expertise or additional testing, or the interaction of the two is beyond the scope of this paper.

Finally, there is the cost versus charge issue. Clearly, these two variables are highly correlated, but whether they are sufficiently correlated to be able to make inferences about costs from claims data is not known. It can be argued, however, that the use of charge data also biases the analysis in

the direction of finding that allergist expenditures are higher because of the monopoly power traditionally associated with specialist care. If costs—represented by the actual payments made to physicians—were instead used, allergist payment fees may actually be more heavily discounted than the non-allergist payment fees because the current competitive environment is expected to place more downward pressure on fees that were established with monopoly rents than those that were established more competitively. If costs were therefore used instead of charges, the patients treated by allergists might be even less costly than the present analysis indicates.

One advantage of this study is that it sheds some light on the relative appropriateness of allergist and non-allergist care of pediatric asthmatic patients using claims data. Claims data have the advantages that they are inexpensive, readily available, and easy to access. A clinical study of the appropriateness of care would likely be much more expensive because it would require the application of alternative clinical judgements to medical records retrospectively or actual cases prospectively.

SUMMARY

The conventional explanation of why managed care organizations have tra-

Table 5. Regressions Measuring Asthma Management Breakdown

Dependent Variable	Any ER Visits	Any Hospitalizations
Constant	-1.399453* .2301896† 0.000‡	-2.806017 .4397076 0.000
Female	-.0544414 .1190656 0.647	.1437948 .2073696 0.488
Age	-.0011095 .0140356 0.937	-.0440493 .0256229 0.086
Any inhaled steroids	.6004397 .1826844 0.001	.7373703 .3263256 0.024
Any oral steroids	.761948 .1309333 0.000	.928133 .2165234 0.000
Any inhaled beta-agonists	-.2743753 .1406634 0.051	-.5127267 .2691211 0.057
Any oral beta-agonists	.0848997 .138818 0.541	.157755 .2483165 0.525
Any antibiotics	.3359387 .1662501 0.043	.4215686 .3563252 0.237
New patient	-.0763976 .2623578 0.771	-.0940182 .4837873 0.846
Allergist	-.1151231 .1304388 0.377	-.4611931 .250532 0.066
Number of obs	1559	1559
chi2 (9)	68.26	51.56
Prob > chi2	0.0000	0.0000
Pseudo R2	0.0372	0.0657
Log Likelihood	-883.09184	-366.71607

* Coefficient.

† Standard error.

‡ Prob > |T|.

ditionally built their practices on primary care physicians is costs: managed care organizations have felt that it is cheaper to use generalists than specialists. This study challenges this view. It

shows that while this may be true for most pediatric asthmatic patients, the presence of a few potentially high-expenditure outliers who are more effectively treated by the specialist's test-

intensive style may cancel any savings from generalists. Indeed, using Hand's legal criterion, not performing these tests may be considered negligent. This study suggests that managed care organizations may need to perform an empirical analysis of their assumptions to determine when and where the use of specialists is cost-effective.

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