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Do Hospital Closures Affect Patient Time in an Ambulance?

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Overview of Key Findings

When a hospital closes in a community, patients needing emergency care may spend more time in an ambulance to receive care in an emergency department (ED). We explore how hospital closures affect the time a patient travels from an incident location where 9-1-1 was called to the ED in an ambulance.

- Rural patients average an estimated 11 additional minutes in an ambulance the year after a hospital closure in their zip code, a 76% increase compared to before the closure.
- Urban and suburban patients have no change in transportation time in zip codes where a hospital closes.
- Patients over 64 years old in rural areas spend 14 additional minutes in an ambulance after a hospital closes, doubling their time in an ambulance.

Background

When a hospital closes in a community the emergency department (ED), in general, also closes. Patients transported in an ambulance for an emergency must then travel to another hospital for treatment. For many patients, this could mean additional time to medical care. For certain health conditions, the additional time in an ambulance may change the health outcomes for the patient. Our study explores how patient time in an ambulance for 9-1-1 calls changes when a hospital closes in the zip code of the incident.

A hospital closure is defined as "a facility that stopped providing general, short-term acute inpatient care."[1] From 2010-2015 over 120 hospitals closed in the U.S., with nearly half of those located in rural areas.[2] These closures changed where ambulance services transported patients and most likely increased the time in an ambulance getting to the next closest ED. Earlier studies found patients were farther from the next ED when a hospital closed.[3,4] Others found a greater time and distance traveled to an ED led to greater mortality rates among heart attack and trauma patients.[5,6] Intuition suggests that patients are in an ambulance longer after the nearest hospital closes, however, no one has previously measured the travel time change. Our study is the first we are aware of that measures change in time in an ambulance based on reported ambulance trips.

We explore how hospital closures affect the time a patient travels from an incident location where 9-1-1 was called to the ED in an ambulance. Our study compares transport time in an ambulance one calendar year prior to and one calendar year after a hospital closes in the zip code of the incident. We study hospital closures in communities in the U.S., both rural and urban, for the years 2011-2014 where we have zip codes of hospital closures matched to ambulance call data.

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Methods

Hospital Data. For our analysis, we wanted a file of geographic areas where a hospital closed linked to all ambulance calls before and after the closure. By combining several data sources, we created a file summarizing hospitals and hospital characteristics at the zip code level. We obtained a list of confirmed hospital closures from the University of North Carolina Sheps Center for Health Services Research[7] and the Health Resources and Services Administration (HRSA)[8] that included rural and urban area closures. The files were merged to create one unduplicated set of closed hospitals. Our file contained 91 closures in the years 2011 to 2014. Figure 1 shows all closures with rural closures shown as diamonds. States with the most closures were Texas (20), California (7), and Alabama (7). These closures were linked to the Hospital Compare data available from Centers for Medicare & Medicaid Services (CMS).[9] From these data, we assembled a file of general information about all hospitals for the years 2011-2014.[10] The information in the file was summarized to the zip code level.

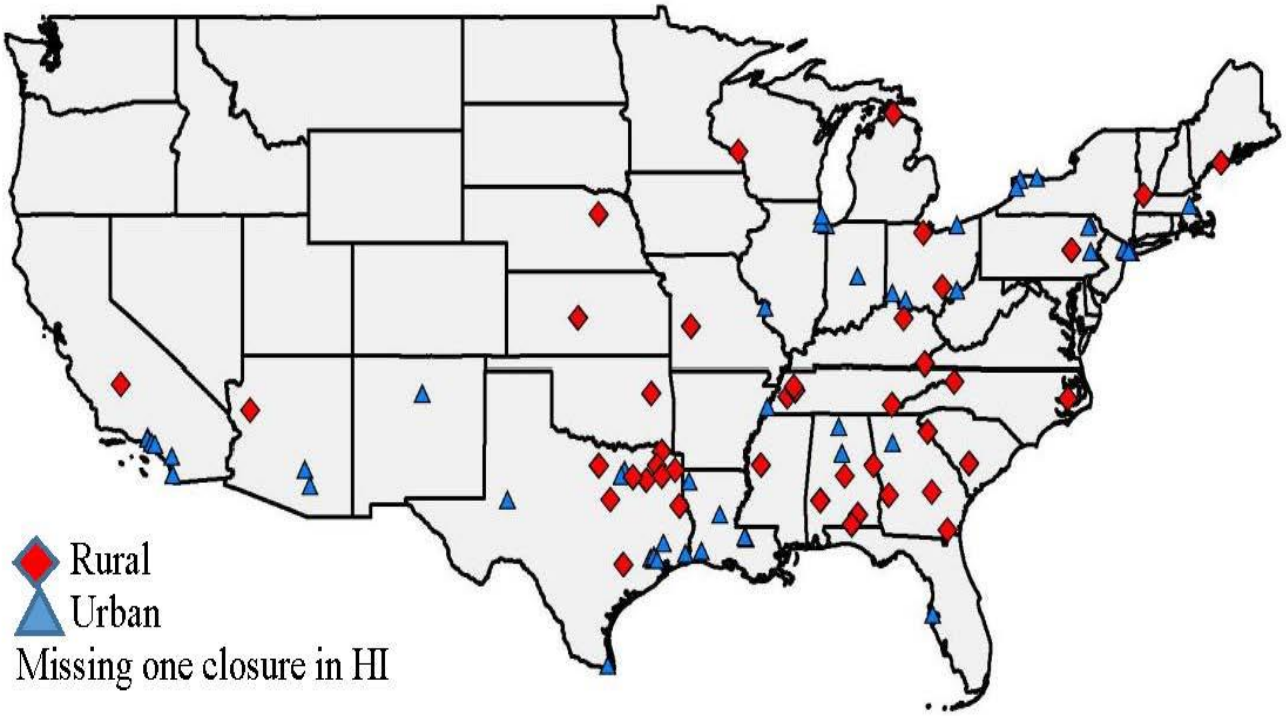


Table 1 shows the characteristics of the closed hospitals. The closures were divided evenly in rural and urban areas. The facilities ranged in size from small hospitals (10th percentile) with 20 beds to large hospitals (90th percentile) with 206 beds. The closed rural hospitals, shown in column 2, were smaller, averaging just 39 beds as opposed to 108 beds for all closed hospitals. The medium (50th percentile) and large rural hospitals (90th percentile) that closed were smaller than all closed hospitals. All closed hospitals were smaller on average than the open hospitals (column 3), which averaged 193 beds. Most hospitals, closed and open, were the sole hospital in the zip code.

Table 1. Characteristics of All Closed, Rural Closed and Open Hospitals and Closures Selected for the Study, 2011-2014

	All Closed	Rural Closed	Open (mean over 4 years)
Number of hospitals (all years)	91	43	4,709
Urban (%)	53.9	-	59.1
Rural (%)	46.2	-	46.6
In zip code with one hospital (%)	78.0	90.7	92.2
Mean number of beds	108.3	38.8	193.3
Small hospital – 10th percentile	20	20	25
Medium hospital – 50th percentile	53	34	107
Large hospital – 90th percentile	206	70	475

Ambulance Data. The second task was to assemble a file with the total time a patient is transported in an ambulance from the scene of an incident to the ED. The study uses data from the National Emergency Medical Services Information System (NEMSIS), which is a national repository of ambulance call data.[11,12] The data are a convenience sample, meaning they are voluntarily collected from each jurisdiction in a state. In 2015, 47 states and DC reported data to NEMSIS. Four states – Delaware, Massachusetts, Ohio, and Texas – reported no data in any year. The NEMSIS data represent the number of transports and not the number of patients affected by the change in ambulance call times. We could not calculate the change in the number of ambulance trips pre- and post-hospital closure because of the style of reporting calls.

Based on information about which jurisdictions reported to NEMSIS, we estimated there were 50 hospital closures that we could match to NEMSIS. The characteristics of the sample hospitals are summarized in column 1 of Table 2. Our sample set of hospitals looks similar to all closed hospitals as seen in column 2 of Table 1. The rural closed hospitals selected in column 3 of Table 2 look similar to those in column 3 of Table 1. Because not all jurisdictions report to NEMSIS, we wanted to see if closures in these areas looked very different from all closures and the closures selected for our analysis. Column 4 of Table 2 shows that these closures are more likely to be located in an urban area and less likely to be the only hospital in the zip code. They are about the same size in terms of number of beds. Based on this comparison, we do not view the data available from NEMSIS as a major limitation of our analysis.

Table 2. Hospital Closures Selected Compared to Closures Not Selected

Characteristics	Closures selected for study	Rural closures selected for study	Closures not selected
Number of hospitals (all years)	50	27	41
Urban (%)	43.5	-	63.4
Rural (%)	56.5	-	36.6
In zip code with one hospital (%)	82.6	88.9	75.6
Mean number of beds	96.2	34.3	100.9
Small hospital – 10th percentile	20	16	22
Medium hospital – 50th percentile	49	25	62
Large hospital – 90th percentile	253	60	206

Since the NEMSIS data are confidential, we could not link the hospital closure zip code file directly to the ambulance data. We provided the staff managing NEMSIS with the zip code and year of where and when a hospital closed. They returned a data file stripped of all hospital and zip code identifiers. The file contained all ambulance calls one calendar year prior and one calendar year after a closure for all calls originating in a matched zip code. The emergency incident took place in the zip code where the hospital closed. The ambulance could transport patients outside the zip code to a rural or urban hospital. We do not know how many zip codes matched. The final file has 73,000 ambulance calls for the years 2010-2015.

The ambulance file contains individual patient, incident, and ambulance service characteristics on a single call. All calls were 9-1-1 calls with emergency transport to a hospital. NEMSIS assigned the 2003 USDA Urban Influence Codes (UIC) to an area of an incident based on the zip code of the reporting ambulance service. The geographic areas are urban (UIC 1,2), suburban (UIC 3,5), rural (4,5,8,9), or wilderness (UIC 7,10,11,12).[13] We labeled calls as rural if they were rural or wilderness, and as urban if they were urban or suburban.

For each call, ambulance personnel reported the duration of different portions of the service: time to incident location, time at incident, and transport time to ED. The total call time is the summation of all three parts. Records with total call times fewer than 10 minutes and greater than 120 minutes were dropped to adjust for extreme outliers. We hypothesized that when a hospital closes in an area, the most affected segment of an ambulance trip time would be from the incident location to the ED. If the ambulance service did not move after a hospital closed, the time to incident location should have remained unaffected by the hospital closure. Attending to the patient at the incident scene should also have been unaffected by the hospital closure.

Table 3. Mean of Ambulance Transport Times in NEMSIS by groups, 2010-2015 (minutes)

	All Transport Times (n=21,563,263)	Study Transport Times (n=72,525)
All calls	14.7	14.6
Without Hospital-based, rural and urban	14.9	14.9
Rural	16.9	21.3
Without Hospital-based, rural	17.3	21.5
Urban	14.3	12.9
Over 64 years old, rural	16.9	22.0

Some ambulance services are managed by a hospital, which we refer to as hospital-based services. The NEMSIS data have the organizational type of the service so we can identify hospital-based ambulance services. These may be for-profit or non-profit per the management of the hospital, and the EMS personnel are hospital employees. The reason to discuss these services is that if a hospital closes that operates an ambulance service, most likely the service also stops. This would directly lead to increased transport times. In our analysis, we calculated results with and without hospital-based ambulance services.

Analysis. We evaluated the time patients travel in an ambulance from an incident location to an ED. The data were pooled for all closure years, 2011-2014. We compared the mean transport time one calendar year prior and one calendar year after the hospital closed in the zip code. We tested if these mean times were statistically significantly different ($P < .01$). For the analysis, we were interested in evaluating differences in transport times in a zip code broken out by the following characteristics: all calls, all calls without hospital-based ambulance services, calls in rural zip codes, calls in urban zip codes, rural calls without hospital-based ambulance services,

and rural calls for patients over 64 years old. For comparison, Table 3 shows the average transport times for all calls in NEMSIS data for 2010-2015. We also compared our times calculated from NEMSIS to those in a study which summarized transport times from 20 states reported in 30 years of ambulance literature. The transport times for urban and rural areas were 10.77 and 17.28 minutes, respectively.[14] The times in Table 3 fall within this range.

Findings

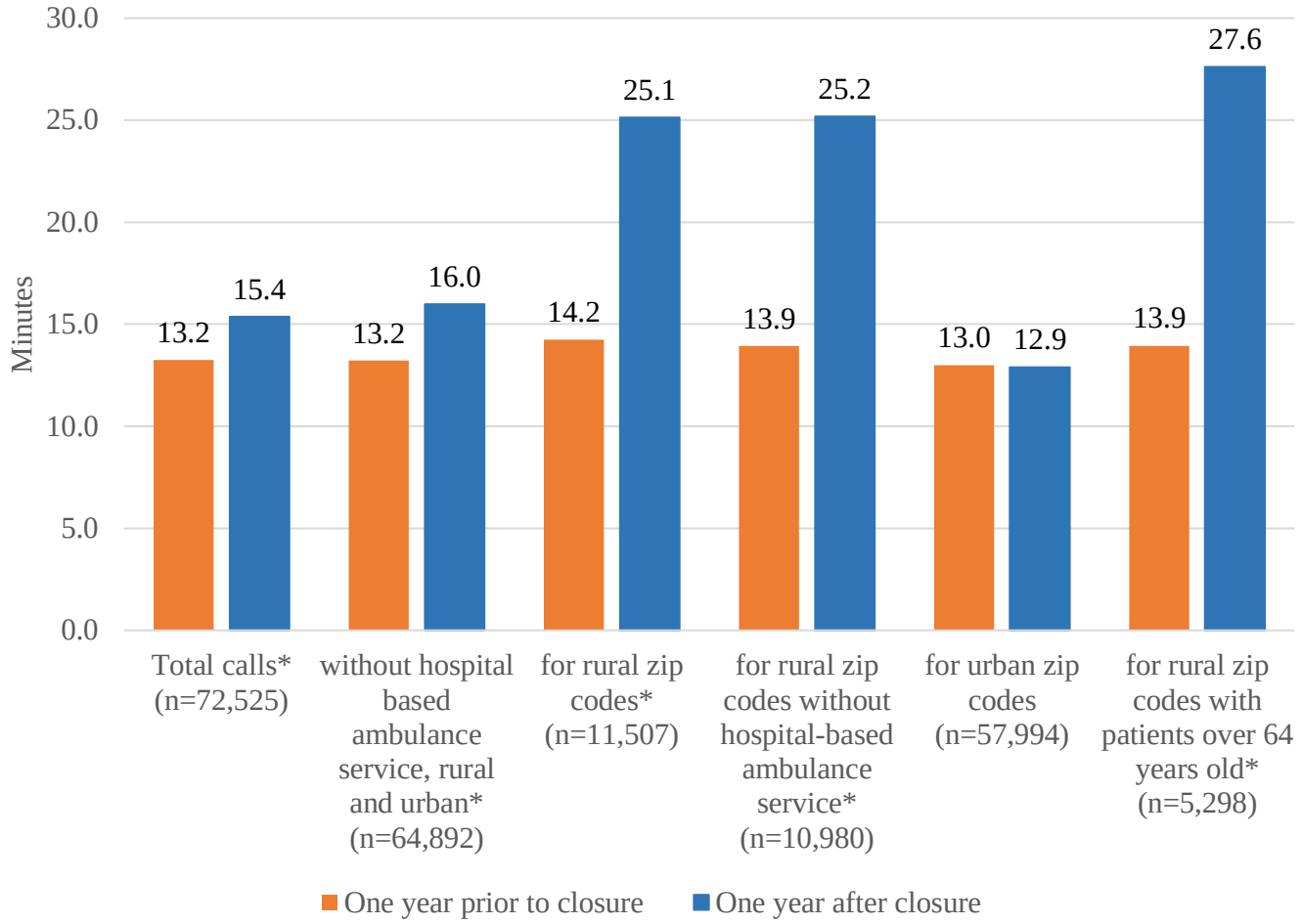
For all calls in our study, rural and urban, the mean time in an ambulance one year prior to a hospital closure was 13.2 minutes. After the hospital closed in the zip code, it increased to 15.4 minutes as shown in Figure 2. We compared this to the average time for all calls in NEMSIS in 2010-2015 which was 14.7 minutes as shown in Table 3. The times before the closure were faster on average, which may result from the patients living closer to the closing hospital than other patients in outlying areas. After the closure they have further to go. On average over all years studied, the time in our sample is 14.6 minutes as shown in Table 3.

To eliminate their influence on the results, we calculated the means without the hospital-based ambulance services. The prior time remained at 13.2 minutes whereas the post closure time increased slightly to 16.0 minutes. The differences in mean times were statistically significantly different.

When hospitals close, one primary concern is how the closure affects rural patients. For those calls defined as rural, the mean transport time one year prior to a closure was 14.2 minutes, one minute slower than the mean time for all calls. The transport time increased to 25.1 minutes after the hospital closed, a statistically significant increase of 10.9 minutes or a 76.4% increase. As a check, we did the same analysis excluding the hospital-based ambulance services. The transport times increased similarly from 13.9 minutes to 25.2 minutes, an 11.3-minute increase. As shown in the last bars of Figure 2, patients over 64 years old living in rural areas had a similar change in transport times as all rural patients. The times increased from 13.9 minutes to 27.6 minutes, a 13.7-minute or 97.9% increase.

One might predict hospital closures in rural areas would lead to greater transport times than in urban and suburban areas. We compared the mean times in rural and urban zip codes. The mean transport time for urban patients prior to a closure was 13.0 minutes and 1.0 minute faster than in rural areas. The transport time after a closure averaged 12.9 minutes, a statistically insignificant difference from the prior times. As we hypothesized, rural patients living in a zip code where a hospital closed were more affected by a hospital closure than urban patients.

Figure 2. Comparison of Mean Transport Times One Year Prior and One Year After a Hospital Closure in 2011-2014 in a Zip Code by Characteristics (n=72,525 ambulance calls)



Note: Asterisks indicate statistically significant differences, ($P < .01$)

We had to consider that some closed hospitals maintained an ED after inpatient care was suspended, however, our data were incomplete in which areas maintained an ED. We thought about how this affected our results. We found that regulations on standalone EDs during our study period were largely unfavorable to creating a separate ED from a hospital. Standalone EDs were rare as they could not bill Medicare for services as non-hospital affiliated units.[15] In addition, states' regulations on opening a standalone ED varied widely from unrestrictive to no state policy in place.[16] If EDs opened on sites of closed hospitals, this means our results were low estimates of the change in time in an ambulance.

Conclusions and Potential Policy Implications

When hospitals close, rural patients in that zip code spend more time in an ambulance than prior to the closure. In addition, they spend more time than urban patients facing closures. Our results are for zip codes where a hospital closed and should not be used to draw conclusions about transport times for rural patients who may have relied on a closed hospital but do not reside in the zip code of that closed hospital. We can conclude that ambulance transport times for rural patients living in the zip code of a closed hospital are more greatly impacted by such closures than urban patients. When a hospital (and its ED) closes, it is important to think about who is

most likely affected by the closure and how the changes impact their access to care. Studies found communities, rural and urban, where hospitals closed tended to have a higher percentage of elderly and poor residents in addition to higher unemployment rates and a higher percentage of blacks and Hispanics.[4,17,18] For rural patients, more than half the hospitals in the country are located in rural areas and are the primary source of emergency medical services in these communities. When asked to rank attributes of rural health care facilities in a recent study, rural residents strongly valued access to emergency services through EDs in their communities.[19]

Over the years, policymakers at the local, state, and Federal levels have prioritized maintaining local access to emergency services. For example, in 1997, the Medicare Rural Hospital Flexibility grant was established to, among other goals, assist in maintaining emergency services in rural areas.[20] Access to emergency department services in communities, especially rural communities, persists as a priority for the Medicare program. In the 2017 annual report of the Medicare Payment Advisory Commission (MedPAC), the commissioners stressed the need to find more efficient and financially stable ways to deliver emergency services in rural communities. In the MedPAC report, they stated while there was reduced demand for inpatient hospital care, there was still need for emergency care among Medicare beneficiaries.[2] In a future working paper we will provide an expanded analysis of this question using a comparison group of zip codes where no hospital closed.[21]

In summary, when hospitals close, rural patients requiring ambulance services are disproportionately affected.. Our work measures one aspect of how access to emergency care through ambulance services changes for patients when a hospital closes.

References

1. U.S. Department of Health and Human Services Office of Inspector General. Trends in Rural Hospital Closure 1990-2000. May 2003(OEI 04-02-00610).
2. Medicare Payment Advisory Commission. Hospital inpatient and outpatient services. In: *Report to the Congress: Medicare Payment Policy*. Washington, DC: MedPAC; 2017:63-94.
3. Hsia RY, Kanzaria HK, Srebotnjak T, Maselli J, McCulloch C, Auerbach AD. Is Emergency Department Closure Resulting in Increased Distance to the Nearest Emergency Department Associated with Increased Inpatient Mortality? *Ann Emerg Med*. 2012;60(6):707-715.e704.
4. Kaufman BG, Thomas SR, Randolph RK, et al. The Rising Rate of Rural Hospital Closures. *J Rural Health.* 2016;32(1):35-43.
5. Jena AB, Mann NC, Wedlund LN, Olenski A. Delays in Emergency Care and Mortality during Major U.S. Marathons. *N Engl J Med.* 2017;376(15):1441-1450.
6. Buchmueller TC, Jacobson M, Wold C. How far to the hospital?: The effect of hospital closures on access to care. *J Health Econ.* 2006;25(4):740-761.
7. The Cecil G. Sheps Center for Health Services Research, Chapel Hill, NC. http://www.shepscenter.unc.edu/programs-projects/rural-health/rural-hospital-closures/. Accessed December 12, 2017.
8. We received a list of closures per a data request from HRSA on January 9, 2017.
9. U.S. Centers for Medicare & Medicaid Services. Hospital Compare. 2010-2106. https://data.medicare.gov/data/hospital-compare. Accessed July 2017.
10. U.S. Centers for Medicare & Medicaid Services. Hospital Compare. 2010-2016. https://www.medicare.gov/hospitalcompare/About/What-Is-HOS.html. Accessed August 9, 2017.
11. Mann NC, Kane L, Dai M, Jacobson K. Description of the 2012 NEMSIS Public-Release Research Dataset. *Prehosp Emerg Care.* 2015;19(2):232-240.

12. NEMSIS. National EMS Database NEMSIS Research Data Set v. 2.2.1, 2015 User Manual. In: NEMSIS Technical Assistance Center, ed. Salt Lake City, UT: NEMSIS; 2016.
13. MacKenzie EJ, Carlini AR. Characterizing Local EMS Systems. Washington, DC: National Highway Traffic Safety Administration; 2013.
14. Carr BG, Caplan JM, Pryor JP, Branas CC. A meta-analysis of prehospital care times for trauma. *Prehospital Emergency Care*. 2006; 10(2):198-206.
15. U.S. Centers for Medicare & Medicaid Services. *Requirements for Provider-based Off-campus Emergency Departments and Hospitals that Specialize in the Provision of Emergency Services.* Bethesda, MD: CMS; January 11, 2008.
16. Walker K, Higgins H. State of the Nation: Policy for Owning and Operating a Freestanding Emergency Department. 2015. http://jfsem.org/state-of-the-nation-policy-for-owning-and-operating-a-freestanding-emergency-department-2/. Accessed October 24, 2018.
17. Thomas SR, Kaufman BG, Randolph R, Thompson K, Perry JR, Pink GH. A Comparison of closed rural hospitals and perceived impact. *Findings Brief.* Chapel Hill, NC: NC Rural Health Research Program; April 2015. https://www.ruralhealthresearch.org/mirror/10/1000/comparison-of-closed-rural-hospitals-and-perceived-impact.pdf. Accessed October 24, 2018.
18. McLafferty S. Neighborhood characteristics and hospital closures: A comparison of the public, private and voluntary hospital systems. *Soc Sci Med*. 1982; 16(19):1667-1674.
19. Allen JE, Davis AF, Hu W, Owusu-Amankwah E. Residents' Willingness-to-Pay for Attributes of Rural Health Care Facilities. *J Rural Health.* 2015;31(1):7-18.
20. Information about the Medicare Rural Hospital Flexibility (FLEX) Program may be found at www.ruralcenter.org/tasc. Accessed October 24, 2018.
21. Troske S, Troske K, Davis AF. Hospital Closures and Patient Time in an Ambulance. *Working Paper,* 2019.

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