

# Assessing the Impact of Transplant Case Management on Clinical Outcomes

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Over the past decade, there have been more than 25,000 organ transplants per year in the United States, with some years seeing more than 30,000 transplants. Since 2010, the number of kidney transplants has increased by 37%, liver transplants have increased 41%, and heart and lung transplants have increased 52%. Demand for transplants also continues to rise, as newly listed candidates added to the waitlist outpace the number of transplants performed each year, often by as much as 6 times.<sup>1</sup>

Transplant care is highly specialized, with only 250 hospitals in the United States providing these services.<sup>2</sup> Patients must navigate a fragmented health care system to be referred for evaluation at a transplant center, be placed on the transplant list, finally receive a transplant, and then ultimately return home needing to adhere to a complex treatment plan that is critical to avoid organ rejection and achieve the promised benefits of this lifesaving procedure. Both transplant centers and health plans commonly offer case management to help patients navigate this complicated process, providing education and support to improve their clinical outcomes; however, there is limited evidence of the effectiveness of these programs. We conducted this study to evaluate the impact of a transplant case management program used by health plans on clinical outcomes among patients who receive a solid organ transplant.

## MATERIALS AND METHODS

### Program Design

Transplant Resource Services is a case management program operated by Optum for health plans for more than 30 years. The program attempts to enroll individuals upon notification by a transplant facility that they intend to proceed with evaluation or plan referrals (eg, other case management programs, employer's human resource department). Nurses with transplant experience telephonically support each participating member throughout the transplant phases of care, from referral all the way to post transplant. These case managers work with the members to provide education about their health plan benefits and about the Centers of Excellence (a network of transplant centers that meet rigorous evaluation criteria)

## ABSTRACT

**OBJECTIVES:** Case management is commonly used by health plans to attempt to improve the care received by their members who have complex needs, such as those who undergo transplantation. There are few observational studies evaluating the effects that transplant case management programs have on clinical outcomes following a solid organ transplant. This limits the understanding of the quantitative effectiveness of such programs.

**STUDY DESIGN:** This retrospective cohort study of solid organ transplant recipients with access to a transplant case management program used a case-control study design. Propensity score 1:1 matching was used to balance the comparison groups on demographic and pretransplant clinical characteristics.

**METHODS:** Health care claims data were used to determine whether program participation affected clinical outcomes following the transplant. A cohort of 1756 adults 18 years and older (878 cases and 878 controls) who had a solid organ transplant between 2018 and 2020 was followed beginning at the time of referral to transplant until 90 days following the transplant procedure.

**RESULTS:** Transplant recipients who participated in the case management program had significantly lower 30-day and 90-day rejection rates, fewer 90-day readmissions, lower discharge mortality and 90-day mortality, and fewer bed days post transplant compared with those who did not participate in case management.

**CONCLUSIONS:** Patients undergoing a solid organ transplant had improved clinical outcomes when they participated in a specialized case management program sponsored by their health plan.

*Am J Manag Care.* 2023;29(3):e85-e90. doi:10.37765/ajmc.2023.89334

## TAKEAWAY POINTS

This article examines the effect of a transplant case management program on clinical outcomes following transplant surgery and whether participating in the program affects those outcomes. These findings can help to:

- ▶ Understand the role of case management programs throughout the phases of transplant care, and
- ▶ Provide important direction for transplant case management programs worldwide.

available to them; they also help coordinate services, plan for the transplant process, implement the discharge care plan (including facilitating filling prescriptions for immunosuppressive medications, which often must be obtained from a specialty pharmacy), and continue to provide education and support for up to 1 year post discharge. At 3 separate points throughout their case management experience, each member completes an assessment to determine gaps in care or knowledge and to gauge their needs, behaviors, and attitudes. These assessments help guide the case managers and aid in prioritizing care. Once the transplant surgery is complete, case management nurses continue to educate patients, in addition to ensuring that they make and keep all necessary doctor appointments, get laboratory work done as needed, and follow all postoperative instructions provided by the doctors and care team.

### Study Design

We conducted a retrospective cohort study of patients 18 years and older in the United States who were drawn from a national health plan claims database and were identified as having received a solid organ transplant in the calendar years 2018, 2019, or 2020. Because all health plan members referred for a transplant evaluation were eligible for the program, we used a case-control design. The treatment group consisted of commercial health plan members who participated in transplant case management throughout the transplant phases of care, from the time to referral to 90 days post transplant ( $n=878$ ). The control group consisted of commercial health plan members who did not participate in case management during the transplant phases of care ( $n=878$ ). All study participants had to have been continually enrolled in the health plan from the time they were referred to transplant to 90 days post transplant. Individuals for whom the commercial health insurance was secondary to Medicare were excluded because of the potential for incomplete data.

The control group was selected by propensity score matching on demographic and pretransplant clinical characteristics, transplant organ type, and geographic region. Variables used to balance the 2 groups are shown in [Table 1](#). Sex, age, organ type, United Network for Organ Sharing region of their transplant center, and number of bed days prior to transplant were extracted from the members' health care claims. United States 2020 Census data were used to measure urban/rural type, median household income by zip code, and total physician concentration by zip code for each member. Cases and controls were matched 1:1. The Charlson Comorbidity Index (CCI)

score, a measure of disease burden and case mix widely used by health researchers, was calculated from the members' claims.

The Consumer Health Activation Index (CHAI) tool has been shown to be valid and reliable in estimating a patient's level of engagement in their own health. It considers more than 50 health decisions that are controllable by the individual, including clinical decisions, financial decisions, and the use of health

resources. The index, developed in 2007 by UnitedHealthcare, measures each decision through claims data, clinical data, and other health plan activities.<sup>3</sup> The CHAI was used in the propensity score matching of the current study to help control for differences in health literacy, engagement, and self-care across the 2 groups. It was calculated from each member's profile and claims.

### Data Sources

We used health plan claims data that included all inpatient and outpatient data for commercial health plan members who received an organ transplant between 2018 and 2020. Claims for the transplant recipients were then aligned with a clinical case management database to determine which members participated in case management.

### Clinical Outcome Measures

We compared the following clinical outcomes between the case and control groups: 30-day and 90-day readmission rates, emergency department (ED) visits within 30 days and 90 days of discharge, total number of bed days post transplant, 30-day and 90-day pneumonia rates, 30-day and 90-day organ rejection rates, discharge mortality rate, and 90-day mortality rate.

### Statistical Analyses

For the binary outcomes,  $\chi^2$  tests were used to measure the significance of the difference between the groups. For the measure of total bed days post transplant, a zero-inflated binomial regression was used due to the large number of patients who had 0 bed days. All measures were assessed using a .05 significance level.

This study was approved by Optum's Institutional Review Board.

## RESULTS

A total of 1756 patients across 136 transplant facilities were included in the study. Cases and controls were well matched ([Table 1](#)). There were no statistically significant differences between the 2 groups for any of the variables used in the matching process. At baseline, 63.2% were aged 45 to 64 years and 62.3% were men, as shown in [Table 1](#). Liver recipients made up 36.4% of the study population; 25.2% and 14.8% received a kidney from a deceased donor and a living donor, respectively; and 13.6% received a heart transplant. Only 2.5% of patients were registered for multiple organs. Patients

had a mean CCI score of 3.4 and a mean CHAI score of 0.52, and most lived in urban areas.

Results of the clinical outcomes are summarized in **Table 2**. The 30-day readmission rate was not significantly different between participants and nonparticipants for any of the organ types. Overall, case management participants had a 16.3% 90-day readmission rate compared with 20.1% in the nonparticipants ( $P = .040$ ). Heart transplant recipients who participated in case management had a significantly lower 90-day readmission rate (20.0%) than heart recipients who did not participate in case management (32.5%;  $P = .028$ ). Living donor kidney recipients who participated in case management also had significantly lower 90-day readmission rates compared with nonparticipants (9.5% vs 15.9%;  $P = .041$ ).

The number of ED visits within 30 days post discharge and within 90 days post discharge was significantly different only for heart transplant recipients. Among case management participants, heart transplant patients had a mean of 3.3 ED visits within 30 days, compared with 10.3 ED visits for nonparticipants ( $P = .033$ ). Heart transplant participants had a mean of 5.0 ED visits within 90 days, compared with 13.7 visits for nonparticipants ( $P = .021$ ).

The total number of bed days from transplant through 90 days post transplant was the outcome that demonstrated the largest differences between participants and nonparticipants. Overall, case management participants had a mean of 15.6 bed days in the 90 days following transplant surgery compared with 16.6 bed days for nonparticipants ( $P = .006$ ). Among liver recipients, participants had a mean of 22.2 bed days compared with 25.5 days for nonparticipants ( $P < .001$ ). Participants who underwent a lung transplant had a mean of 41.3 bed days compared with 47.6 days for nonparticipants ( $P < .001$ ). Finally, pancreas recipients who participated in case management had a mean of 9.3 bed days compared with 13.0 days among nonparticipants ( $P = .009$ ).

Both deceased donor and living donor kidney recipients who participated in case management had more bed days in the 90 days following transplantation than the nonparticipants. Among deceased donor kidney recipients, participants had a mean of 7.4 total bed days, whereas nonparticipants

**TABLE 1.** Baseline Characteristics of the Cohort by Case Management Participation

Characteristics	Program participation (n = 878)	No program participation (n = 878)
Male sex, %	62.5	62.0
Age in years at baseline, %		
18-34	14.8	14.0
35-44	18.4	18.5
45-54	28.8	27.7
55-64	34.8	35.0
≥ 65	3.2	4.7
Organ, %		
Heart	13.5	13.6
Kidney (deceased donor)	25.1	25.2
Kidney (living donor)	14.9	14.6
Liver	36.9	35.8
Lung	6.7	7.9
Pancreas	2.8	2.9
Multiple organ listing, %	2.6	2.3
Year of transplant, %		
2018	35.6	36.4
2019	35.0	34.8
2020	29.4	28.8
UNOS region of transplant center, %		
1	2.0	2.1
2	10.4	9.0
3	15.1	14.8
4	14.8	15.1
5	12.4	12.2
6	1.8	2.3
7	9.6	10.3
8	10.2	11.1
9	4.9	5.3
10	9.3	8.8
11	9.4	9.1
Mean Charlson Comorbidity Index score	3.36	3.34
Mean Consumer Health Activation Index score	0.52	0.51
Mean LOS in days in the 12 months before joining the registry	12.2	12.5
Urban/rural type, %		
Urban	83.7	83.2
Suburban	11.5	12.1
Rural	4.8	4.7
Median household income by zip code, %		
High	53.4	54.9
Medium	30.8	31.1
Low	15.8	14.0
Total physician concentration by zip code, %		
High	36.7	36.1
Medium	43.6	43.6
Low	19.7	20.3

LOS, length of stay; UNOS, United Network for Organ Sharing.

**TABLE 2.** Clinical Outcome Measures by Program Participation and Organ Type<sup>a</sup>

	Program participation (n=878)	No program participation (n=878)	P
<b>30-day inpatient readmission rate, %</b>			
Overall	10.5	12.3	.226
Heart	8.3	16.2	.063
Kidney (deceased donor)	11.8	7.1	.208
Kidney (living donor)	7.2	10.9	.172
Liver	16.1	17.2	.685
Lung	0.0	1.5	.330
Pancreas	0.0	0.0	—
<b>90-day inpatient readmission rate, %</b>			
Overall	<b>16.3</b>	<b>20.1</b>	<b>.040</b>
Heart	<b>20.0</b>	<b>32.5</b>	<b>.028</b>
Kidney (deceased donor)	17.7	16.5	.817
Kidney (living donor)	<b>9.5</b>	<b>15.9</b>	<b>.041</b>
Liver	23.8	25.4	.632
Lung	0.0	1.5	.330
Pancreas	0.0	0.0	—
<b>Emergency department visits within 30 days</b>			
Overall	8.2	9.1	.493
Heart	<b>3.3</b>	<b>10.3</b>	<b>.033</b>
Kidney (deceased donor)	5.9	7.2	.702
Kidney (living donor)	6.8	7.3	.832
Liver	9.9	10.7	.744
Lung	12.5	10.3	.689
Pancreas	20.7	7.4	.171
<b>Emergency department visits within 90 days</b>			
Overall	13.7	14.2	.723
Heart	<b>5.0</b>	<b>13.7</b>	<b>.021</b>
Kidney (deceased donor)	15.3	14.2	.833
Kidney (living donor)	11.7	11.4	.909
Liver	16.4	16.0	.899
Lung	14.1	16.2	.735
Pancreas	27.6	14.8	.273
<b>Total bed days post transplant</b>			
Overall	<b>15.6</b>	<b>16.6</b>	<b>.006</b>
Heart	42.6	44.4	.092
Kidney (deceased donor)	<b>7.4</b>	<b>6.6</b>	<b>.027</b>
Kidney (living donor)	<b>5.5</b>	<b>4.5</b>	<b>&lt;.001</b>
Liver	<b>22.2</b>	<b>25.5</b>	<b>&lt;.001</b>
Lung	<b>41.3</b>	<b>47.6</b>	<b>&lt;.001</b>
Pancreas	<b>9.3</b>	<b>13.0</b>	<b>.009</b>

(continued)

had 6.6 days ( $P = .027$ ). Among living donor kidney recipients, participants had a mean of 5.5 total bed days compared with 4.5 days among nonparticipants ( $P < .001$ ).

Both pneumonia measures showed significant differences among liver recipients, but no significant differences appeared in recipients of other organs. Among liver recipients who participated in case management, 1.5% developed pneumonia within 30 days, whereas 5.0% of nonparticipant liver recipients did so ( $P = .013$ ). Just under 3% of liver recipients who participated in case management developed pneumonia within 90 days compared with 6.9% of liver recipients who did not participate in case management ( $P = .015$ ).

Overall, members who participated in the case management program had a 5.5% 30-day rejection rate and a 9.0% 90-day rejection rate compared with 8.7% ( $P = .009$ ) and 12.6% ( $P = .020$ ), respectively, of members who did not participate in case management. When examined by individual organ type, case management participants who received a heart had significantly lower 30-day rejection rates (22.5% vs 35.0%;  $P = .033$ ) and 90-day rejection rates (33.3% vs 48.7%;  $P = .016$ ) compared with nonparticipants who received a heart. Case management participants who received a liver had significantly lower 30-day rejection rates (3.4% vs 7.8%;  $P = .014$ ) and 90-day rejection rates (6.5% vs 11.6%;  $P = .024$ ) compared with nonparticipants who received a liver.

Case management participants overall had lower discharge mortality rates (0.8% vs 2.6%;  $P = .003$ ) compared with nonparticipants; however, this was due to differences in the liver transplant recipients and was not observed in the other transplant types. For liver recipients, participants had a 0.6% discharge mortality rate compared with 4.4% for nonparticipants ( $P = .002$ ).

For 90-day mortality, living donor kidney recipients who participated in case management had a 0.0% mortality rate compared with 2.3% among nonparticipants ( $P = .024$ ). Liver recipient participants had a 2.8% 90-day mortality rate compared with 6.9% among nonparticipants ( $P = .009$ ). The overall 90-day mortality rate was also significantly different between case management participants and nonparticipants (2.3% vs 5.0%;  $P = .002$ ).

## DISCUSSION

Case management is commonly used to attempt to remove barriers to care and improve outcomes for patients who have complex needs. Although every case management program is distinct in its offerings and operations, they can all be viewed as complex interventions for the conditions they target. For instance, case management programs all have many interacting components, require a wide variety of actions and behaviors between those who deliver it and those who receive it, require flexibility in its delivery, and have diverse outcomes.<sup>4</sup> Further, to be successful, advanced levels of patient self-care, self-responsibility, and self-management are required.<sup>5</sup> Evaluating the effectiveness of case management is challenging because there is rarely a standard intervention; rather, the appropriate care model is typically tailored to match the patients' specific needs. Further, given variable rates of engagement, determining an appropriate comparison group can often be difficult.<sup>4</sup> For these reasons, very few studies have been conducted that assess whether case management leads to fewer complications and better clinical outcomes.

Although there are numerous care management programs for individuals undergoing transplant, this is the first study to demonstrate an improvement in clinical outcomes with the use of such programs, to our knowledge. We found that health plan members who engaged with case management, compared with those who did not do so, appeared to do better across a range of clinical outcomes, including readmissions, pneumonia, rejection, and mortality. Although this is the first study to our knowledge on the effectiveness of a health plan case management program, our results are consistent with those of a small, randomized trial of case management in patients undergoing living-donor renal transplants. Schmid et al found that recipients who were randomly assigned to telemedically supported case management had a reduction of unplanned inpatient acute care, fewer costs, and lower nonadherence rates compared with those who did not receive case management.<sup>5</sup>

Hospital readmissions are often used as an indicator of health care quality and a focus of case management programs because it is

**TABLE 2.** (Continued) Clinical Outcome Measures by Program Participation and Organ Type\*

	Program participation (n = 878)	No program participation (n = 878)	P
Pneumonia within 30 days, %			
Overall	<b>1.3</b>	<b>2.6</b>	<b>.037</b>
Heart	3.3	4.3	.705
Kidney (deceased donor)	0.8	0.8	.987
Kidney (living donor)	0.5	0.0	.317
Liver	<b>1.5</b>	<b>5.0</b>	<b>.013</b>
Lung	0.0	1.5	.330
Pancreas	0.0	0.0	—
Pneumonia within 90 days, %			
Overall	2.7	4.2	.088
Heart	5.8	8.6	.418
Kidney (deceased donor)	3.4	2.4	.638
Kidney (living donor)	1.8	0.5	.177
Liver	<b>2.8</b>	<b>6.9</b>	<b>.015</b>
Lung	1.5	0.0	.330
Pancreas	0.0	0.0	—
30-day rejection rate, %			
Overall	<b>5.5</b>	<b>8.7</b>	<b>.009</b>
Heart	<b>22.5</b>	<b>35.0</b>	<b>.033</b>
Kidney (deceased donor)	3.4	1.6	.364
Kidney (living donor)	2.7	3.2	.766
Liver	<b>3.4</b>	<b>7.8</b>	<b>.014</b>
Lung	0.0	1.5	.330
Pancreas	0.0	0.0	—
90-day rejection rate, %			
Overall	<b>9.0</b>	<b>12.4</b>	<b>.020</b>
Heart	<b>33.3</b>	<b>48.7</b>	<b>.016</b>
Kidney (deceased donor)	6.7	3.2	.194
Kidney (living donor)	4.5	4.6	.984
Liver	<b>6.5</b>	<b>11.6</b>	<b>.024</b>
Lung	0.0	1.5	.330
Pancreas	0.0	0.0	—
Discharge mortality rate, %			
Overall	<b>0.8</b>	<b>2.6</b>	<b>.003</b>
Heart	4.2	6.0	.524
Kidney (deceased donor)	0.0	0.0	—
Kidney (living donor)	0.0	0.5	.315
Liver	<b>0.6</b>	<b>4.4</b>	<b>.002</b>
Lung	0.0	1.5	.330
Pancreas	0.0	0.0	—
90-day mortality rate, %			
Overall	<b>2.3</b>	<b>5.0</b>	<b>.002</b>
Heart	6.7	7.7	.759
Kidney (deceased donor)	0.0	2.4	.092
Kidney (living donor)	<b>0.0</b>	<b>2.3</b>	<b>.024</b>
Liver	<b>2.8</b>	<b>6.9</b>	<b>.009</b>
Lung	4.7	4.4	.939
Pancreas	0.0	3.7	.288

\*Bold indicates  $P < .05$ .

estimated that 75% of readmissions are avoidable. Readmissions after organ transplantation are common and differ from those following many other surgical procedures because of the severity of illness, complexity of the procedure, and complications that often arise from immunosuppression.<sup>6</sup> We found that participation in case management was associated with a meaningful 4% fewer readmissions over the 90 days following transplant, with the greatest impact among heart transplant recipients (12.5% difference) and living donor kidney recipients (6.4% difference). In addition, there were 1.0 fewer bed days post transplant among case management participants, with the greatest difference observed among lung transplant recipients (6.3 days). We also observed a significant difference in the clinical outcomes of ED visits, pneumonia, transplant rejection, and mortality.

Case management is a multifactorial intervention tailored to the individual participant's unique needs, which makes it challenging to try to determine what might be the causal mechanism for an impact on these clinically important outcomes. One possible mechanism may be discerned from the aforementioned study performed by Schmid et al, who found a substantial impact of case management on medication nonadherence in patients undergoing renal transplant.<sup>5</sup> They reported that the prevalence of nonadherence over the 1-year study period was 17.4% in the intervention group vs 56.5% in the standard aftercare group ( $P = .013$ ). Further research is needed to understand whether health plan–sponsored case management programs have the same impact on medication adherence, especially for the immunosuppressive medications that are critical to the long-term success of the transplants. In addition, it will be important to better understand why these effects were observed in only the kidney transplant population and whether there is opportunity to improve outcomes among other transplant recipients.

One unexpected finding was that deceased donor kidney transplant patients who participated in the program had worse clinical outcomes, by most metrics, than those with no program participation. Although most of these differences were not statistically significant, these findings warrant additional research.

Although the scope of the current analysis focuses on events following the transplant procedure, it is important to note that case management could have significant impacts on events prior to the transplant surgery that could also affect clinical outcomes. Further research is needed to evaluate whether case management has an impact on the time lags from referral to evaluation to wait-listing to transplant. Longer time periods between each phase of transplant care can also affect transplant outcomes. For instance, longer dialysis periods prior to kidney transplantation may be associated with worse outcomes post transplant.

### Limitations

As already mentioned, a limitation of this study is the comparison of participants with nonparticipants, as it is the patient's choice

whether to engage in the case management program. Propensity score matching was used to ensure comparability between the cohorts on demographic and clinical characteristics, as well as health literacy and engagement. Use of the CHAI helps to ensure that the 2 cohorts are comparable on health behavior, but it is possible that there are still unmeasurable factors not considered with this tool that could be associated with participation bias.

It is also possible that the outcomes are influenced by the transplant facility itself, as each facility has its own nuances in how it manages patients. Case managers in the current study may not always integrate center-specific protocols into their case management. Further, transplant facility size could also affect clinical outcomes, but such information was not captured for this study.

## CONCLUSIONS

Patients undergoing a solid organ transplant had improved clinical outcomes when they participated in a specialized case management program sponsored by their health plan. Further studies are needed to determine the effectiveness of other case management programs, including those provided by the transplant centers themselves, and whether such programs are duplicative or synergistic in supporting these complex patients. In addition, future efforts should identify the components of the case management intervention that have the greatest impact, as well as ways to increase participation in these programs. ■

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**Source of Funding:** OptumHealth.

**Author Disclosures:** Drs Crossman, Bannister, Bonagura, and Malin and Ms Krishnaswamy are currently employed by Optum, which owns and operates the case management program discussed in this article. Dr Bannister owns stock in UnitedHealth Group, of which Optum is a subsidiary.

**Authorship Information:** Concept and design (AC, WB, AB, JM); acquisition of data (GK); analysis and interpretation of data (AC, GK, WB); drafting of the manuscript (AC, JM); critical revision of the manuscript for important intellectual content (AC, WB, AB, JM); statistical analysis (GK); and supervision (AC, AB).

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## REFERENCES

1. OPTN/SRTR 2019 Annual Data Report. Scientific Registry of Transplant Recipients. Accessed November 15, 2021. [https://srrt.transplant.hrsa.gov/annual\\_reports/2019\\_ADR\\_Preview.aspx](https://srrt.transplant.hrsa.gov/annual_reports/2019_ADR_Preview.aspx)
2. United Network for Organ Sharing (UNOS). The National Organ Transplant System. Accessed November 15, 2021. <https://unos.org/solutions/research-data-analytics-transplant/>
3. Wolf MS, Smith SG, Pandit AU, et al. Development and validation of the Consumer Health Activation Index. *Med Decis Making*. 2018;38(3):334-343. doi:10.1177/0272989X17753392
4. Lambert AS, Legrand C, Cés S, Van Durme T, Macq J. Evaluating case management as a complex intervention: lessons for the future. *PLoS One*. 2019;14(10):e0224286. doi:10.1371/journal.pone.0224286
5. Schmid A, Hils S, Kramer-Zucker A, et al. Telemedically supported case management of living-donor renal transplant recipients to optimize routine evidence-based aftercare: a single-center randomized controlled trial. *Am J Transplant*. 2017;17(6):1594-1605. doi:10.1111/ajt.14138
6. Paterno F, Wilson GC, Wima K, et al. Hospital utilization and consequences of readmissions after liver transplantation. *Surgery*. 2014;156(4):871-878. doi:10.1016/j.surg.2014.06.018

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