

# Impact of a specialized multidisciplinary tracheostomy team on tracheostomy care in critically ill patients

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**Background:** A multidisciplinary tracheostomy team was created in 2005 to follow critically ill patients who had undergone a tracheostomy until their discharge from hospital. Composed of a surgeon, surgical resident, respiratory therapist, speech-language pathologist and clinical nurse specialist, this team has been meeting twice a week for rounds involving patients who transitioned from the intensive care unit (ICU) to the medical and surgical wards. Our objective was to assess the impact of this multidisciplinary team on downsizing and decannulation times, on the incidence of speaking valve placement and on the incidence of tracheostomy-related complications on the ward.

**Methods:** This study was conducted at a tertiary care, level-1 trauma centre and teaching hospital and involved all patients who had received a tracheostomy during admission to the ICU from Jan. 1 to Dec. 31, 2004 (preservice group), and from Jan. 1 to Dec. 31, 2006 (postservice group). We compared the outcomes of patients who required tracheostomies in a 12-month period after the team was created with those of patients from a similar time frame before the establishment of the team.

**Results:** There were 32 patients in the preservice group and 54 patients in the postservice group. Under the new tracheostomy service, there was a decrease in incidence of tube blockage (5.5% v. 25.0%,  $p = 0.016$ ) and calls for respiratory distress (16.7% v. 37.5%,  $p = 0.039$ ) on the wards. A significantly larger proportion of patients also received speaking valves (67.4% v. 19.4%,  $p < 0.001$ ) after creation of the team. Furthermore, there appeared to be a decreased time to first tube downsizing (26.0 to 9.4 d) and decreased time to decannulation (50.4 to 28.4 d), although this did not reach statistical significance owing to our small sample size.

**Conclusion:** Standardized care provided by a specialized multidisciplinary tracheostomy team was associated with fewer tracheostomy-related complications and an increase in the use of a speaking valve.

**Contexte :** On a créé en 2005 une équipe multidisciplinaire de trachéostomie chargée de suivre jusqu'à leur congé d'hôpital les patients en état critique qui avaient subi une trachéostomie. Constituée d'un chirurgien, d'un résident en chirurgie, d'un thérapeute respiratoire, d'un orthophoniste et d'une infirmière clinicienne spécialisée, l'équipe se réunit 2 fois par semaine pour visiter des patients qui sont passés des soins intensifs aux services de médecine et de chirurgie. Nous voulions évaluer l'effet de cette équipe multidisciplinaire sur la réduction du diamètre des canules et le temps écoulé jusqu'à la décanulation, sur l'incidence de la mise en place de membranes vocales et sur l'incidence de complications reliées à la trachéostomie dans le service.

**Méthodes :** Cette étude qui s'est déroulée dans le centre de traumatologie de niveau 1 et de soins tertiaires d'un hôpital universitaire a porté sur tous les patients qui ont subi une trachéostomie au moment de leur admission aux soins intensifs du 1 janvier au 31 décembre 2004 (groupe avant le service) et du 1 janvier au 31 décembre 2006 (groupe après le service). Nous avons comparé l'évolution de l'état de santé des patients qui ont dû subir une trachéostomie pendant 12 mois après la création de l'équipe à celle de l'état de santé des patients pendant une période semblable avant la création de l'équipe.

**Résultats :** Il y avait 32 patients dans le groupe antérieur à la création de l'équipe et 54 patients dans le groupe postérieur à la création de l'équipe. Dans le contexte du nouveau service de trachéostomie, on a constaté une diminution de l'incidence du blocage de la canule (5,5 % c. 25,0 %,  $p = 0,016$ ) et des appels pour cause de détresse respiratoire (16,7 % c. 37,5 %,  $p = 0,039$ ) dans les services. Un pourcentage beaucoup

plus important de patients ont aussi reçu des membranes vocales (67,4 % c. 19,4 %,  $p < 0,001$ ) après la création de l'équipe. De plus, les périodes écoulées avant la première réduction du diamètre de la canule (26,0 à 9,4 d) et le temps écoulé jusqu'à la décanulation (50,4 à 28,4 j) ont semblé diminuer, même si les chiffres n'ont pas atteint la signification statistique à cause de la petite taille de l'échantillon.

**Conclusion :** La prestation de soins normalisés par une équipe multidisciplinaire spécialisée en trachéostomie a été associée à une réduction du nombre de complications reliées à la trachéostomie ainsi qu'à une augmentation de l'utilisation d'une membrane vocale.

**T**racheostomy is a common procedure in the intensive care unit (ICU) and is being performed with increasing frequency in critically ill patients.<sup>1</sup> This trend is partly owing to the development of the percutaneous technique as well as to evidence supporting early tracheostomy decreasing the duration of mechanical ventilation.<sup>2</sup>

With more tracheostomies performed on patients in the ICU, a greater number of patients are being discharged from the ICU to medical and surgical wards with tracheostomy tubes in situ. Since the advent of the percutaneous technique, these patients no longer benefit from the follow-up of the operating surgeon and surgical team. Often they are lost to follow-up on transfer from the ICU. Ward staff with varying levels of experience are then required to assume the responsibility of tracheostomy care. However, serious tracheostomy-associated complications exist (e.g., tube blockage causing respiratory failure, respiratory infection, hemorrhage). These complications must be prevented as well as recognized and managed promptly on the wards. Complications, such as death from tube blockage, have occurred at our institution and have been reported at others.<sup>3,4</sup> These adverse events underscore the need for specialized knowledge and regular follow-up in the care of patients with tracheostomy tubes.

To better meet the complex care needs of patients transferred with a tracheostomy tube from the ICU to the wards, a multidisciplinary tracheostomy team was created at the Montreal General Hospital. The team follows these patients on medical and surgical wards until they undergo decannulation or are discharged from hospital.

This study was designed to assess the impact of a dedicated specialized multidisciplinary service on tracheostomy care outcomes (downsizing, decannulation, speaking valve use) and the incidence of tracheostomy-related complications.

### *The tracheostomy team*

The Montreal General Hospital is a level-1 trauma centre with a 24-bed ICU. Patients with a tracheostomy tube can be discharged from the ICU to medical or surgical beds on 5 different floors.

Prior to the development of the team, tracheostomy care decisions were left to the discretion of the original admitting service. Furthermore, these decisions about downsizing and decannulation were not necessarily made with the input of the surgeon who performed the procedure. Daily care

plans, such as suctioning schedules, were optimized by respiratory therapists only when called by nurses, whose experience with tracheostomies was variable. The management was inconsistent, and tracheostomy-related complications were occurring owing to poor follow-up.

To help improve this situation, the tracheostomy service was piloted in the summer of 2005. By March 2006, it consisted of a general surgeon, a general surgery resident, a respiratory therapist, a speech-language pathologist and a clinical nurse specialist. Since then, the team has been meeting twice weekly to discuss patients with tracheostomy tubes who have been transitioned from the ICU to medical and surgical wards. Decisions regarding downsizing, decannulation, changes to daily tube care (e.g., increased suctioning) and use of a speaking valve are discussed and communicated in written progress notes to the treating team of doctors and nurses. The specific roles of each team member are detailed in Box 1.

The team is actively involved in the management of ward patients with a tracheostomy until the time of decannulation or discharge from hospital. Whereas most tracheostomies are performed by surgeons/intensivists from the tracheostomy team, the timing of the tracheostomy is at the discretion of the attending ICU physician and the admitting physician.

#### **Box 1. Roles of tracheostomy team members**

##### **Staff surgeon**

- Head of the team
- Coordinates the team's activities

##### **Resident**

- Responsible for bedside rounds
- Performs decannulation and downsizing with the assistance of the respiratory therapist

##### **Respiratory therapist**

- Performs a bedside check of the tracheostomy tube, the oxygen delivery system and the spare emergency tracheostomy tube
- Discusses daily tracheostomy care issues with the nursing staff, patient and family

##### **Speech-language pathologist**

- Assesses the patient's ability to tolerate a speaking valve (i.e., assess level of consciousness, airway protection, phonation, management of secretions)
- Provides recommendations regarding speaking valve use and/or augmentative communication strategies

##### **Clinical nurse specialist**

- Assists with discharge planning
- Coordinates family meetings

## METHODS

Two groups were compared in this study. A historical control group comprised all patients who had received a tracheostomy from Jan. 1 to Dec. 31, 2004, before the implementation of the tracheostomy service (preservice group). The second group included all patients who had received a tracheostomy from Jan. 1 to Dec. 31, 2006, after the implementation of the service (postservice group). Patients were identified using the ICU records database as having received a tracheostomy during their admission to the ICU. Chart review identified which patients were transferred to medical and surgical wards with a tracheostomy tube in situ. The Research Ethics Board of the Montreal General Hospital approved the study protocol.

For both groups, we collected data through manual chart review, which included reviewing progress notes of the medical, surgical, nursing, respiratory therapy and speech-language pathology staff as well as relevant consultation reports and operative notes. When possible, we correlated the data with information found in the prospectively collected ICU database. For the postservice group, data were also correlated with a separate prospectively collected data set kept by respiratory therapy and speech-language pathology staff. Also, separate records from the speech-language pathology department were used to supplement and corroborate the dates of speaking valve use in the preservice group.

The information collected included sex, age, admitting diagnosis, Acute Physiology and Chronic Health Evaluation (APACHE) II scores, the indication for tracheostomy and the type of tracheostomy. We also recorded the dates of tube changes, decannulation, speaking valve placement, discharge from ICU, return to the ICU for respiratory decompensation and discharge from hospital.

We noted tracheostomy-related complications occurring while the tube was in situ. The complications included tube blockage, displacement, accidental decannulation, cuff rupture, ostomy site ulceration or cellulitis, respiratory infection, bleeding, calls for respiratory distress and death. Respiratory infection was identified by documented initia-

tion of antibiotics for new positive sputum cultures, consolidation on chest radiographs or clinical suspicion of respiratory infection. Calls for respiratory distress included any urgent call to medical, surgical and nursing staff or a respiratory therapist, with a documented drop in oxygen saturation to less than 88%.

### Statistical analysis

We performed our statistical analysis using the SAS System, version 8.2 (SAS Institute). Patient characteristics at baseline were summarized using proportions or means and standard deviations (SDs) as appropriate. We used Student *t* tests or Wilcoxon rank-sum and Kruskal–Wallis tests to compare clinical variables between the preservice and postservice groups for normally and non-normally distributed data, respectively. We used a multivariate Cox hazard regression model to identify factors associated with the placement of a speaking valve while controlling for the effect of the factors already known to affect recovery, such as age and traumatic brain injury. Variables with bivariate significance ( $p < 0.10$ ) were entered into the regression. For this analysis, the hazard ratio (HR) and 95% confidence interval (CI) for each significant variable are presented.

We performed a subgroup analysis in the traumatic brain injury group in whom time to downsizing and decannulation was assessed in relation to whether the patient was followed by the tracheostomy service. A similar subgroup analysis was performed for patients who received care on nonsurgical wards. We considered results to be significant at  $p < 0.05$ .

## RESULTS

### Study population

Over the 12-month period preceding the creation of the tracheostomy service (preservice group), 48 patients received tracheostomies. In the 12-month period afterwards (postservice group), 89 patients received tracheostomies. From the postservice group, we excluded 7 patients

**Table 1. Demographic and clinical characteristics of patients who received tracheostomies before and after the establishment of a multidisciplinary tracheostomy team**

Characteristic	Group; % (95% CI)*		<i>p</i> value
	Preservice, <i>n</i> = 32	Postservice, <i>n</i> = 54	
Age, mean (SD) yr	46.3 (21.2)	55.0 (21.7)	0.06
Male sex	71.9 (54.6–84.4)	66.7 (53.4–77.8)	0.64
APACHE II, mean (SD) score	25.1 (7.3)	27.1 (8.1)	0.28
Presence of traumatic brain injury	46.9 (30.9–63.6)	61.1 (47.8–73.0)	0.26
Ward location on surgery floor	78.1 (61.2–89.0)	75.9 (63.1–85.3)	1.00
Tracheostomies performed with open technique, %	93.5 (79.9–98.3)	36.5 (25.4–50.4)	< 0.001

APACHE = Acute Physiology and Chronic Health Evaluation; CI = confidence interval; SD = standard deviation.  
\*Unless otherwise indicated.

because they were managed independently by otolaryngology ( $n = 6$ ) or thoracic surgery ( $n = 1$ ) staff. We excluded 9 patients from the postservice group because in the first 2 months a respiratory therapist was not present regularly at the biweekly tracheostomy team meetings. We included in our analysis a total of 86 patients (32 in the preservice group and 54 in the postservice group) who were discharged with tracheostomy tubes from the ICU to medical and surgical wards.

**Demographic and clinical characteristics**

As presented in Table 1, the only significant difference between the 2 groups with respect to demographic and clinical characteristics was the proportion of tracheostomies performed with an open technique.

Of the 32 patients in the preservice group, the indications for tracheostomy were as follows: expected prolonged ventilator dependence ( $n = 21$ ), improved pulmonary toilet ( $n = 8$ ), head and neck procedures ( $n = 2$ ) and upper airway compromise ( $n = 1$ ). Of the 54 patients in the postservice group, the indications for tracheostomy were expected prolonged ventilator dependence ( $n = 52$ ) and improved pulmonary toilet ( $n = 2$ ).

**Complications**

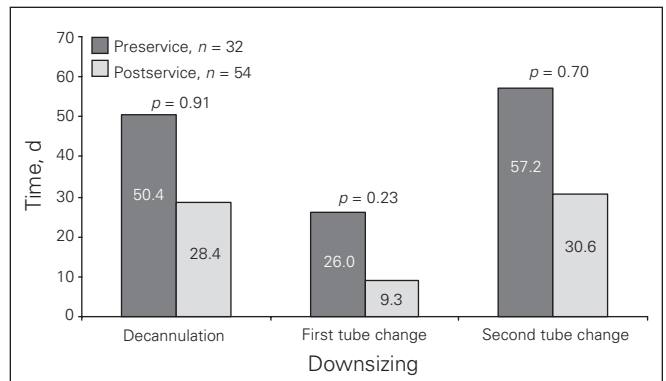
Under the new service, there was a significant decrease in the number of patients with tube blockage and in the number of calls on the wards for respiratory distress. No difference was found with respect to technical complications (displacement, accidental decannulation, cuff rupture), in ostomy site complications or in the rate of respiratory infection. Mortality was similar in both groups. Of all 86 patients, 1 patient in the preservice group died from unexpected respiratory failure (aspiration). There was no significant difference between groups in the number of patients who returned at least once to the ICU for respiratory decompensation (Table 2).

**Tracheostomy downsizing and decannulation**

In the preservice and postservice groups, respectively, 59.4% and 68.5% of patients underwent decannulation ( $p = 0.48$ ). In the postservice group, there was a trend of decrease in the mean (and standard deviation [SD]) number of days to first downsizing (26.0 [SD 76.7] to 9.3 [SD 10.9],  $p = 0.23$ ), in days to second downsizing (57.2 [SD 128.7] to 30.6 [SD 27.4],  $p = 0.70$ ) and in days to decannulation (50.4 [SD 98.6] to 28.4 [SD 26.0],  $p = 0.91$ ; Fig. 1).

We performed subgroup analyses for patients who sustained traumatic brain injuries ( $n = 48$ ). There was a significant decrease in the number of days to first downsizing (24.5 [SD 12.5] to 16.6 [SD 10.1],  $p = 0.047$ ; Fig. 2). This finding was confirmed through Cox regression analysis, which showed an increased HR for reduced time to first tracheostomy tube change for the postservice group compared with the preservice group (HR 2.4, 95% CI 1.2–5.0,  $p = 0.023$ ). When adjusted for age, the type of tracheostomy and APACHE II score, the HR remained significant (HR 2.62, 95% CI 1.02–6.71,  $p = 0.045$ ). There was no significant decrease between the groups in time to decannulation.

We also performed a subgroup analysis for patients who



**Fig. 1.** Comparison of downsizing and decannulation times in days between patients before (preservice) and after (postservice) the establishment of the multidisciplinary tracheostomy team.

Complication	Group; % (95% CI)		p value
	Preservice, n = 32	Postservice, n = 54	
Calls for respiratory distress	37.50 (22.9–54.8)	16.70 (9.0–28.7)	0.039
Tube blockage	25 (13.3–42.1)	5.50 (1.9–15.1)	0.016
Bleeding	0	5.60 (1.9–15.1)	0.29
Cellulitis or ulceration	3.10 (0.6–15.8)	5.60 (1.9–15.1)	1.00
Respiratory infection	12.50 (5.0–28.0)	13.00 (6.4–24.4)	1.00
Technical complication (displaced, accidental decannulation, cuff rupture)	3.10 (0.6–15.8)	3.70 (1.0–12.5)	1.00
Return to ICU at least once	18.80 (8.9–35.3)	14.80 (7.7–26.6)	0.76
All-cause mortality	19.6 (9.2–36.3)	18.5 (10.4–30.8)	0.88

CI = confidence interval; ICU = intensive care unit.

received care on nonsurgical wards ( $n = 20$ ). Time to downsizing and decannulation were not significantly different after the tracheostomy service was established.

### Speaking valves

The proportion of patients in the postservice group who received a speaking valve increased from 19.4% (95% CI 8.9%–35.3%) to 67.4% (95% CI 53.4%–77.8%;  $p < 0.001$ ). Unadjusted Cox hazard regression analysis revealed an increased HR for speaking valve placement under the tracheostomy service (HR 4.8, 95% CI 2.0–11.6,  $p < 0.001$ ). When adjusted for age, the type of tracheostomy and the presence of traumatic brain injury, the HR was 4.60 (95% CI 1.55–13.60,  $p < 0.001$ ).

## DISCUSSION

This study was designed to analyze the impact of a specialized multidisciplinary service dedicated to the care of patients with a tracheostomy tube. The main findings were that the tracheostomy service resulted in fewer calls for respiratory distress, fewer events of tube blockage, more frequent use of speaking valves and a trend toward shortened time to downsizing and decannulation.

### Complications

There are very few reports on dedicated tracheostomy services and their effect on outcomes in patients admitted to hospital. Norwood and colleagues<sup>3</sup> describe a respiratory therapist–led team that followed patients from tracheostomy tube placement in the ICU through to discharge from hospital. With a study population size similar to ours (ward patients:  $n = 20$  in the preservice group,  $n = 51$  in the postservice group), they found a significant decrease in all tracheostomy-related complications (blockage, tube displacement, wound infection). Our results are consistent with their findings of decreased complications,

although we did not find a significant decrease in all complications. It is possible that our study was not sufficiently powered to demonstrate these differences. Since biweekly progress notes from the tracheostomy team provided more rigorous written documentation, complication underrecording may have been greater in the preservice group than in the postservice group.

The smaller number of calls for respiratory distress and events of tube blockage that we observed after the establishment of the tracheostomy service are important improvements. We attribute these decreases first to better daily tube care. Under the tracheostomy team, there are more frequent evaluations by respiratory therapy staff who then directly communicate any recommendations to the nursing staff. Second, the education provided by the tracheostomy team leads to a better understanding of tracheostomy-related issues by residents and nursing staff. Finally, more appropriate downsizing schedules set by the multidisciplinary team may also explain the improvement. For instance, inappropriately early downsizing in a patient who has substantial secretions that would be better handled with a larger tube intuitively increases the likelihood of respiratory distress and tube blockage.

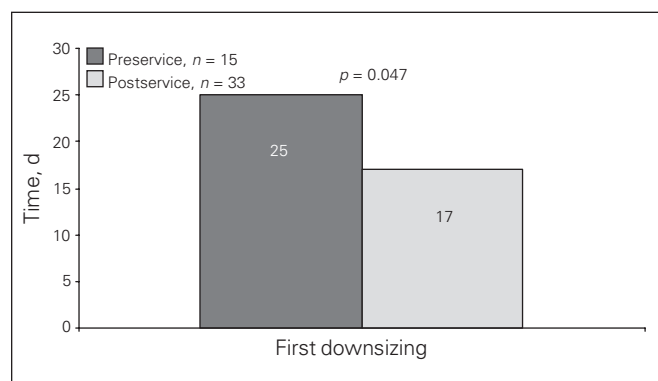
We feel that the expertise of the respiratory therapist, speech-language pathologist and physicians on the tracheostomy team is as critical to improving care as regular structured assessments. Less resource-intensive interventions, such as a checklist for nurses and treating physicians, might reduce complications; however, the full tracheostomy team is essential for teaching and developing appropriate care plans.

Tracheostomies were performed more frequently with the percutaneous technique in the postservice group. When compared with open tracheostomy, the percutaneous technique has been associated with lower wound infection rates, equivalent rates of clinically relevant bleeding and equivalent rates of pneumonia.<sup>1,5</sup> A larger proportion of percutaneous tracheostomies would not, however, account for a difference in the number of calls for respiratory distress or events of tube blockage.

### Downsizing and decannulation times

Whereas we have no strict protocol for downsizing and decannulation, it is our standard practice to downsize the tracheostomy tube before decannulation. Before starting corking trials, we prefer to downsize (usually to a 6-French gauge cuffless tracheostomy tube) to allow for sufficient airflow and improved secretion clearance around the tracheostomy. In certain cases, if there is not enough air flow with a 6-French gauge, we may downsize to a 4-French gauge before decannulation. Of all 86 patients in our study, only 3 went directly to decannulation without downsizing.

The decision to decannulate is made on a case-by-case basis. Before decannulation, patients must have sufficient



**Fig. 2.** Comparison of time to first downsizing in patients with traumatic brain injuries before (preservice) and after (postservice) the establishment of the multidisciplinary tracheostomy team.

neurologic capacity to protect their upper airway, be able to manage their secretions and tolerate corking trials. If an operative intervention is expected, decannulation is delayed.

We found that time to downsizing and decannulation decreased after implementation of the tracheostomy service. In a study with a larger sample size, this trend could have shown significance. Furthermore, the subgroup analysis of patients with traumatic brain injuries did show a significant decrease in time to first downsizing. This was confirmed with Cox regression analysis, adjusted for age, type of tracheostomy and APACHE II score. We believe that the decreased time to downsizing and decannulation is a result of more appropriate and timely downsizing and decannulation schedules set by the tracheostomy team. In another study of an intensivist-led tracheostomy team, Tobin and Santamaria<sup>4</sup> reported a significant reduction in decannulation time from ICU discharge.

We hypothesized that patients on nonsurgical wards would benefit the most from the tracheostomy team. However, with a minority of patients on medical wards ( $n = 20$ ), the small subgroup size may have limited our ability to detect a significant difference in downsizing and decannulation times.

### Speaking valve use

The presence of a speech-language pathologist on the team is the major factor accounting for the increase in speaking valve use, as demonstrated in both univariate and multivariate analysis. Patients are known to the speech-language pathologist as soon as the procedure is performed, so evaluations are undertaken earlier. Also, more physician and respiratory therapist input during tracheostomy service rounds helps the speech-language pathologist gauge a patient's likelihood to tolerate a speaking valve. In patients who immediately tolerate corking after downsizing, there is no need for a speaking valve. However, in our patient population with a high proportion of traumatic brain injuries and borderline level of consciousness, we often have patients who may not tolerate corking but do well with a speaking valve. Although not formally validated, we feel that speaking valve use as soon as appropriate improves patient quality of life.

### CONCLUSION

Making decisions about tracheostomy management requires specialized knowledge. Prior to the establishment of our institution's tracheostomy team, variable experience levels existed among the medical and nursing staff responsible for the care of patients with tracheostomy tubes on wards. Such a scenario can lead to inconsistent management with the potential for serious complications. With a

tracheostomy service, daily tube care can improve through regular expert evaluation and through education of the medical and nursing staff. With a specialized service, decision-making is centralized to those with the required expertise, which leads to more consistent evidence-based management. However, even among those clinicians with experience in tracheostomy care, Stelfox and colleagues<sup>6</sup> reported that significant variability in opinions existed concerning the appropriate timing for decannulation. This is true in part because guidelines for tracheostomy management do not exist. Forming a tracheostomy team creates the working group necessary to develop institutional practice guidelines based on current available evidence. A team also provides a platform facilitating research evaluating particular tracheostomy care practices.

While a prospective study with a larger population is required, our study shows that closer follow-up and more consistent management provided by a specialized multidisciplinary tracheostomy team has a favourable impact on tracheostomy care at a large university hospital.

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**Competing interests:** None declared.

**Contributors:** Drs. de Mestral, Fata, Razek and Khwaja designed the study. Dr. de Mestral, Ms. Fong and Ms. LeBlanc acquired the data, which Drs. de Mestral, Iqbal and Khwaja analyzed. Drs. de Mestral, Iqbal and Khwaja wrote the article. All authors reviewed the article and approved its publication.

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