Survey of Sedation and Analgesia Practice Among Canadian Pediatric Critical Care Physicians*

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**Background:** Despite the fact that almost all critically ill children experience some degree of pain or anxiety, there is a lack of high-quality evidence to inform preferred approaches to sedation, analgesia, and comfort measures in this environment. We conducted this survey to better understand current comfort and sedation practices among Canadian pediatric intensivists.

**Methods:** The survey was conducted after a literature review and initial focus groups. The survey was then pretested and validated. The final survey was distributed by email to 134 intensivists from 17 PICUs across Canada using the Research Electronic Data Capture system.

**Results:** The response rate was 73% (98/134). The most commonly used sedation scores are Face, Legs, Activity, Cry, and Consolability (42%) and COMFORT (41%). Withdrawal scores are commonly used (65%). In contrast, delirium scores are used by only 16% of the respondents. Only 36% of respondents have routinely used sedation protocols. The majority (66%) do not use noise reduction methods, whereas only 23% of respondents have a protocol to promote day/night cycles. Comfort measures including music, swaddling, soother, television, and sucrose solutions are frequently used. The drugs most commonly used to provide analgesia are morphine and acetaminophen. Midazolam and chloral hydrate were the most frequent sedatives.

**Conclusion:** Our survey demonstrates great variation in practice in the management of pain and anxiety in Canadian PICUs. Standardized strategies for sedation, delirium and withdrawal, and sleep promotion are lacking. There is a need for research in this field and the development of evidence-based, pediatric sedation and analgesia guidelines. (Pediatr Crit Care Med 2016; 17:823–830)

**Key Words:** analgesia; pediatric intensive care; sedation; survey

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*See also p. 885.

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Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal’s website (http://journals.lww.com/pccmjournal).

Dr. Cave received support for travel from UCSD (Payment made on behalf of the International Conference on Pulmonary Hypertension in Children for expenses and travel to speak at the 2015 conference). Ms. Sheppard’s research coordinator position is supported by the Women and Children’s Health Research Institute. The remaining authors have disclosed that they do not have any potential conflicts of interest.

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DOI: 10.1097/PCC.0000000000000864

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Stress secondary to pain and anxiety is common in patients in PICUs and can impede recovery and delivery of care (1). Children admitted to PICUs experience pain and anxiety for a variety of reasons including underlying illness, invasive procedures, mechanical ventilation, monitoring, separation from parents, and loss of self-control (2). Children with inadequate sedation and/or analgesia are at risk of loss of vascular access, unplanned extubation, self-injury, post-traumatic stress disorder, and impaired neurodevelopment (3).

Treating patients to avoid these complications is challenging. In children, the distinction between pain, anxiety, and delirium can be challenging, in part, due to developmental communication limitations and critical illness. Also, the most commonly used drugs (narcotics and benzodiazepines) can put patients at risk for hemodynamic and respiratory instability, prolonged mechanical ventilation, withdrawal symptoms, delirium, nosocomial infection, and critical illness neuromyopathy; all of which increase length of stay and healthcare costs (1, 4, 5). Although less harmful, nonpharmacological interventions may decrease the need for these medications, they have
not been adequately evaluated in PICU (5). Finally, there is a lack of high-quality studies providing evidence for preferred approaches to sedation/analgesia and comfort measures in this environment. Previous surveys in other countries and systematic reviews on the topic have shown large variations in practice between pediatric intensive care physicians and within countries (6–15). However, none of these studies have shown superior outcomes with one treatment regimen versus another.

The purpose of this survey was to gain a better understanding of the use of drugs and comfort measures for sedation/analgesia in Canadian PICUs in order to inform future interventional trials.

METHODS

Survey Development
A MEDLINE and EMBASE literature review was conducted to identify the most commonly used drugs, sedation scores, sedation–analgesia algorithms/protocols, pharmacy support, clinical practice guidelines, nonpharmacological comfort measures, and previous surveys in critically ill children. After identifying potential items from the literature search, focus group meetings with the Sedation Withdrawal and Analgesia Team (SWAT) at the Stollery Children’s Hospital were conducted to identify other relevant items to be included in the questionnaire. The SWAT is a multidisciplinary team that includes pediatric intensivists, nurses, and pharmacists from the general and cardiovascular PICUs at the Stollery Children’s Hospital in Edmonton, Alberta, Canada. After the main domains and items were identified, a draft questionnaire was developed. The draft questionnaire was then reviewed by four intensivists with experience in survey methodology to determine clarity of the instrument, and a final revision was agreed upon.

Survey Pretesting and Validation
The survey was pilot tested and validated among five pediatric intensivist members of the Canadian Critical Care Trials Group (CCCTG) using a clinical sensibility tool (16). This was followed by semistructured feedback on each question in the survey regarding its comprehensiveness and wording, presence of any redundant or inappropriate items, and whether the questionnaire addressed the objectives of the survey. The pilot-test responses were not included in the main reported survey results.

Survey Characteristics
The survey consisted of 23 questions and four clinical scenarios that varied depending upon the work setting (i.e., cardiac and/or general PICU). The questions were primarily closed ended, consisting of binary (yes/no), nominal, and ordinal response formats. Of the 27 questions, 14 also contained open-ended components. The survey had four main sections. The first section included general questions about the respondents and their units including the use of sedation/analgesia protocols, assessment scores, and comfort measures. The second section included questions on their use of drugs to provide sedation and analgesia to mechanically ventilated critically ill children. The third section asked about the minimal clinically important difference (MCID) that intensivists thought would be relevant in sedation/analgesia trials, and the need for future studies on nonpharmacological comfort measures. Finally, the fourth section included clinical scenarios of mechanically ventilated critically ill children with either chest tubes (as a clear source of pain) or poor heart function (Appendix I, Supplemental Digital Content 1, http://links.lww.com/PCC/A269).

Survey Distribution
An email notification was sent 1 week prior to distribution of the survey to all potential participants. A week later, an invitation email was sent with an introductory letter and the link for the survey. The survey was distributed by email using an electronic, secure, survey distribution and collection system (Research Electronic Data Capture [REDCap]) hosted by the University of Alberta (17). REDCap is a secure, web-based application that anonymizes data, aggregates results, and ensures that individual responses are not identified. The survey was initially emailed to all 146 pediatric intensive care physicians and subspecialty critical care residents/fellows from all 17 PICUs across Canada. Intensivists in training have an active role in the prescription of sedation and analgesia, especially during night hours. Hence, they were included in this survey.

The participants’ email contact list was generated by the investigators and expanded upon by contacting intensivists, administrative assistants, and program directors in each PICU. The first invitation was emailed in March 2015, and up to three reminders were sent weekly to those who did not respond. As an incentive for completion of the survey, a donation to the Canadian Intensive Care Foundation was advertised if the response rate was higher than 70%. The survey was closed on April 2015. Completion and submission of the survey indicated consent to participate. Ethical approval for this study was obtained from the University of Alberta Health Research Ethics Board.

Statistical Analysis
Data were analyzed using the statistical data analysis package, STATA (Stata Statistical Software: Release 10, 2007; StataCorp LP, College Station, TX). Descriptive methods with mean, sd, and proportions were used to describe the responses. Prespecified categories were created for operational beds and proportion of mechanically ventilated patients in the respondent’s units to identify large- and/or high-acuity PICUs. Large-acuity PICUs were defined as having more than 10 beds. High-acuity PICUs were defined as having more than 50% of the patients on mechanical ventilation. Incomplete surveys were included as the information provided for the answered questions contribute to the evidence around a specific topic within the survey. For each particular question, the denominator is based on the number of respondents.

RESULTS

Demographics of the Respondents
After the initial email notification, we identified 11 physicians no longer working in PICU and one on leave who was...
not available to answer emails during the study period (Fig. 1). The overall survey response rate was 73% (98/134) (Table 1). At least one clinician from each of the 17 PICUs across Canada responded. Ten surveys were returned incomplete and were included in final statistical analysis. Demographics and characteristics of the respondents are shown in Table 1.

**Sedation/Analgesia Assessment and Protocols**

Eighty-three (84%) intensivists responded that sedation and analgesia scores are commonly used in their units. Among those who reported the use of scores, COMFORT (n = 38; 41%) and COMFORT B (n = 14; 15%) were the most common sedation scores, whereas Face, Legs, Activity, Cry, and Consolability (FLACC) (n = 42; 45%) and the Visual Analog Scale (n = 20; 22%) were the most common scores to assess pain (Figure 1). Withdrawal scores were commonly used with the majority of the respondents using Withdrawal Assessment Tool-1 (n = 61; 65%) followed by the Neonatal Abstinence Scoring System (Finnegan Tool; n = 33; 35%); 11% (n = 10) only use clinical suspicion, whereas 4% (n = 4) do not screen for withdrawal (Fig. 2). When asked about the use of a delirium score, 84% (n = 78) responded that they do not use any delirium score, whereas 12% (n = 11) did not know whether they were being used in their unit. The remainder indicated the use of a delirium score reported using either the Pediatric Confusion Assessment Method for the Intensive Care Unit or the Cornell Assessment of Pediatric Delirium (Fig. 3) Daily interruption of continuous sedation and analgesia is practiced by only 5% (n = 5) of respondents.

Most respondents (n = 60; 64%) indicated that they do not have routinely used sedation/analgesia protocols. When used, 82% of protocols (n = 28) are physician led, followed by those led by nurses and pharmacists. Seventy-seven percent of the respondents (n = 75) reported having a pharmacist present during rounds 3–5 days a week, 14% (n = 14) have one present 6–7 days a week, and 7% (n = 7) never have pharmacists present during rounds.

**PICU Environment, Noise, and Sleep Promotion**

Most intensivists reported working in a PICU with a combination of single and shared rooms (69%), whereas 31% reported having only single rooms. The median (interquartile range [IQR]) proportion of patient’s rooms with access to natural light is 80% (50–97%) (Table 1). The majority of respondents (n = 66; 70%) have no protocols in place to reduce light exposure or protocols to promote day/night cycles. Those who do use dimming of lights at night/sleep time (n = 22; 100%), mask/eye covers (n = 7; 32%), and other interventions (n = 3; 14%). When intensivists were asked about noise reduction strategies in their PICU, the majority responded that they do not use any (n = 59; 60%), 20% (n = 19) reported using earplugs, 14% (n = 13) use headphones, 12% (n = 11) have noise detectors with visual alarms, and 2% (n = 2) use other methods.

**Sedation and Analgesia Agents**

Pediatric intensivists were asked to report the frequency of continuous infusions for sedation and analgesia in critically ill intubated children, and the use of adjunct medications in the same patients. Midazolam and morphine are the agents most commonly used to provide continuous sedation in the PICU. Propofol is used as continuous infusion by at least 60% of the respondents. Chloral hydrate, diphenhydramine, and clonidine
are the most common adjunct sedatives (Fig. 4). Morphine is the most common agent for continuous analgesia in intubated critically ill children. Acetaminophen and ibuprofen are by far the most common adjunct analgesics (Fig. 5).

In order to further determine which sedative/analgesic agents are more frequently administered as a continuous infusion and how they are combined, intensivists were presented with two clinical scenarios according to their scope of practice (i.e., cardiac vs general PICU). They were asked their preference for sedation/analgesia regarding continuous infusion versus intermittent dosing and their first, second, and third medication choices for the initial and subsequent sedative/analgesic agents (in case the first choices were not adequate). Most (89%) general PICU intensivists presented with the case of a 6-month-old infant on mechanical ventilation with a chest tube, chose a continuous infusion. Morphine was the first choice for 65% of the responders, with midazolam (71%) as a second choice and dexmedetomidine (64%) as a third choice. Presented with a 10-year-old hemodynamically unstable mechanically ventilated patient with severe sepsis, almost all of the general PICU intensivists (90%) decided to start a continuous infusion for sedation. In this case, fentanyl was the first choice (40%) followed by midazolam (32%) as a second choice and ketamine (32%) as a third choice.

Cardiac PICU physicians were presented with the case of a hemodynamically stable, intubated neonate post arterial switch repair with a mediastinal chest tube. Among cardiac intensivists, 96% decided to start a continuous infusion, with most of the respondents (63%) selecting morphine as their first choice. Midazolam (54%) and dexmedetomidine (46%) were the most common second and third choices, respectively. Presented with a case of a 7-year-old intubated patient with cardiomyopathy and very poor heart function, cardiac intensivists (87%) also chose to use a continuous infusion. Fentanyl was the first choice for 43% of the respondents, followed by dexmedetomidine (39%) and midazolam (38%).

Nonpharmacological Comfort Measures

Physicians were asked about nonpharmacological comfort measures for their intubated mechanically ventilated patients. The most common interventions, each used by approximately 75% of respondents, were soother/pacifier, television and videos, music, and swaddling. Sucrose solutions, holding by nurse/caregiver, rocking, noise reduction, and reading were each reported by 30–50% of respondents (Fig. 6). For those respondents who use music for their intubated patients, 94% use music played at the head of the bed, 43% use music played by a music therapist, and 41% use music played with headsets. The type of music is usually selected by parents/family members (91%) and nurses (73%), followed by music therapists (31%).

Future Steps

Pediatric intensivists were asked their opinion on whether nonpharmacological interventions or therapies to promote
comfort in pediatric critical care (e.g., music therapy) should be studied in a randomized controlled trial. Eighty-five percent of the respondents answered positively. In order to inform the sample size of future studies, physicians were also asked about the MCID for sedation/analgesia in critical care whether a new safe and effective pharmacological or nonpharmacological intervention was made available to them. Intensivist reported a median (IQR) reduction in use of sedating or analgesic medications by 20% (20–25%).

**DISCUSSION**

This study shows that pain/sedation and withdrawal symptoms are routinely assessed in Canadian PICUs. On the other hand, sedation guidelines and protocols to safely minimize sedation, to prevent delirium and withdrawal symptoms, and to promote sleep are lacking. Despite great variation in practice, morphine and midazolam are the most common drugs administered to provide sedation, whereas morphine and fentanyl are the most common choices for analgesia. Nonpharmacological comfort measures are commonly used in Canadian PICUs.

Although the majority of children admitted to PICUs require some degree of sedation/analgesia, there are currently no clear guidelines on how this should be provided and which interventions are more effective. The last similar attempt was done almost 10 years ago when the U.K. Pediatric Intensive Care Society proposed clinical guidelines (18). Although informative, these guidelines have not been updated to reflect current knowledge and new therapies. During the same time period, adult guidelines have been published highlighting the importance of pain assessment, light levels of sedation, use of nonpharmacological interventions, sleep promotion, and prevention of delirium (19). The use of guidelines, especially in combination with bundles that include spontaneous breathing trials and early mobilization, has shown to safely reduce sedation requirements, days on mechanical ventilation, ICU length of stay, and delirium (20–22). Even more, this approach has also reduced cost related to ICU care.

One of the key points of developing sedation guidelines and protocols is the objective assessment of pain and agitation using validated, pediatric-specific tools. The majority of Canadian pediatric intensivists reported the use of sedation/pain scores for the daily assessment of their patients, most commonly using COMFORT and FLACC. This proportion is similar to that reported by Twite et al (12) in their survey of program directors in the United States. In a more recent survey, Kudchadkar et al (9) found that although 70% of the respondents have sedation scores in place in their units, only 42% use them routinely to determine patient-care goals. Other studies have reported the use of sedation/pain scores by only 20–50% of the units surveyed (6,10,11,13,14). Whether these scores are actually used in the daily management of patients is not clear. The majority of previous surveys also report the COMFORT scale as most commonly used (9,12,14). Although more accurate and easy to use, COMFORT B is not commonly used (23). FLACC is frequently used to assess pain in a wide range of ages and circumstances; however, its validity outside the original population has recently been challenged (24). Surprisingly, tools that have never been validated for children, like the Richmond Agitation-Sedation Scale, are being used (25).

Despite existing, validated tools for the screening of opioid and benzodiazepine withdrawal symptoms, previous surveys have not explored the use of these instruments in the usual care of critically ill children (6,9–15,26,27). According to our results, among Canadian pediatric intensivists, withdrawal scores are frequently used in Canadian PICUs. The routine use of tools to detect and treat withdrawal symptoms might help to understand its risk factors, prevent its occurrence, and adequately treat those who develop symptoms.

Delirium has been increasingly recognized as a frequent complication of critical care and has been clearly associated with negative outcomes including mortality; adult sedation guidelines recommend its routine monitoring (18,28). However, there is a lack of high-quality pediatric studies, and current prevalence estimates range from 13% to 28% (29). Furthermore, the best approach for prevention, detection, and management of pediatric delirium is unclear. Any treatment strategy, however, depends on recognition and routine monitoring as the necessary first step. Our study shows that delirium screening is not routinely done in Canadian PICUs, calling for the need for quality improvement initiatives to address this issue.

Although recommended by adult and pediatric sedation guidelines, sedation protocols have failed to demonstrate a clear benefit in terms of concrete outcomes (14,30–35). A systematic review conducted by Poh et al (30) highlighted the lack of evidence to support the use of sedation protocols and...
algorithms in pediatric critical care. Since then, three pre- and postprotocol implementation pediatric studies, and a recent large cluster randomized controlled trial found no clear benefits in the use of sedation protocols (31–34). As one of the authors mentioned, a complex relationship between wakefulness, sedation, pain, and agitation may exist (32). In our survey, sedation protocols are used only by 36% of the respondents. In contrast to most recent studies, the majority of responding physicians in our survey are using physician as opposed to nurse-driven protocols (9, 31, 32).

It seems intuitive that a quiet environment with exposure to natural light during the day and reduced exposure to artificial light during the night will help to promote normal day/night cycles. There is evidence that suggests that single rooms improve quality of sleep and reduce the prevalence of delirium in ICU settings (36, 37). Most Canadian PICUs still have a combination of single (mainly for isolation purposes) and shared rooms. Access to natural light is common, but protocols to reduce exposure to noise and light at nighttime are lacking. Simple interventions like eye masks, earplugs, and other noise reduction strategies have been recommended by pediatric and adult guidelines but were infrequently reported in our survey (18, 19).

In order to provide sedation for intubated children, Canadian intensivists prefer to use drugs as a continuous infusion, with midazolam and morphine as the most common agents. These results are similar to previous surveys that report midazolam as the first choice for sedation (6, 9–11, 14). Despite recommendations not to use propofol in critically ill children, especially as a continuous infusion, our survey shows that propofol is still being used (although we did not determine the dose or duration being used) (18). We also explored the use of adjunct intermittent drugs used in combination with continuous infusions. Chloral hydrate, diphenhydramine, and clonidine are common choices, something that has not been shown in previous surveys. When the intention is to provide analgesia to intubated children, respondents also prefer to use continuous infusions with morphine as their first choice. Acetaminophen is by far the most common option to provide adjunct pain relief. Interestingly, when general and cardiac pediatric intensivists were presented with a case in which the patient was hemodynamically unstable, fentanyl became their first choice to provide sedation/analgesia. This may be due to the lower prevalence of hypotension with synthetic opioids (18). As a second choice, general intensivists were more likely to use midazolam whereas cardiac intensivists preferred dexmedetomidine.

Compared to previous surveys, dexmedetomidine has become a frequent choice for second- or third-line therapy. Our survey shows that dexmedetomidine and clonidine use are increasing (6, 10, 12–15). Interestingly, dexmedetomidine is being used for pain management when it actually has very limited analgesic effect (19).

Nonpharmacological comfort measures have been recommended by pediatric and adult sedation guidelines (18, 19). Comfort measures are commonly used in PICUs despite the lack of evidence of efficacy or guidelines on implementation, possibly

TABLE 1. Respondents’ Characteristics

<table>
<thead>
<tr>
<th>Demographics</th>
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<tbody>
<tr>
<td>Physicians</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff</td>
<td>80</td>
<td>(83)</td>
</tr>
<tr>
<td>Subspecialty Critical Care Fellows or Residents</td>
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<td>(12)</td>
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<tr>
<td>Clinical Assistants or Associates</td>
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<td>(5 )</td>
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<tr>
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<td>(37)</td>
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<td>Cardiac only</td>
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<td>&gt; 20</td>
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Clinical Assistants or Associates are physicians with pediatric critical care training but without a staff attending position in the PICU.
based on presumption of effectiveness based on data in other pediatric populations, ease of use and relatively low cost. In our survey, soother/pacifier, television/videos, music, and swaddling were the most common interventions. Self-initiated, patient-directed music has been shown to reduce the frequency and the intensity of sedation in critically ill adults (38). Neonatal studies have also demonstrated some physiologic and behavioral benefits of music to provide comfort (39). A high proportion (75%) of our respondents are using music in their units. However, the majority provides this intervention with music played at the head of the bed as chosen by parents/family with little intervention from a music therapist. Whether this is an effective way to provide music to critically ill children remains unknown. Previous studies have shown that the use of noise cancellation with headphones by itself may provide some benefit (39).

In order to inform future studies, we asked the respondents whether nonpharmacological interventions to promote comfort in pediatric critical care (e.g., music therapy) should be further studied and what would be a meaningful outcome. Canadian pediatric intensivists expressed interest in formal study of nonpharmacological interventions in the PICU and provided an estimation of what intensivists would consider a meaningful and significant outcome for these studies.

This study has several strengths. This is the first Canadian survey on sedation and analgesia in critically ill children. The survey was developed and validated using strict methodology with the support of a multidisciplinary team (SWAT) and a group with extensive experience in clinical research (CCCTG). Unlike some of the previous surveys that used the PICUs as the unit of analysis, we have conducted our study at a physician level. We have achieved a response rate higher than 70% with answers from every PICU in Canada, making our results representative of common practice among Canadian pediatric intensivists. In keeping with the adult recommendations, we have explored the use of not only sedation/analgesia drugs but also sedation, withdrawal and delirium assessment, ICU environment, sleep promotion, and nonpharmacological interventions. Nonpharmacological comfort measures have not been well studied in previous surveys. We have also been able to obtain information not only on those drugs used as a continuous infusion but also about agents used as adjuncts by intermittent doses. Using clinical scenarios, we were able to establish the intensivists’ preference when faced with hemodynamically stable and unstable patients.

Our study also has limitations. It was conducted in one country, representing only Canadian practice. Response bias, although unlikely based on the high response rate, cannot be excluded. Stated responses may not reflect what is actually taking place at the patients’ bedside, and we cannot determine whether scores and protocols are actually used to direct goals of care. Although actively involved in the administration of sedation and analgesia, and especially in the use of nonpharmacological comfort measures, PICU nurses were not surveyed. This is because physicians are responsible for prescribing sedation and analgesia in Canadian PICUs, and nurse-driven protocols for this in Canada are rare. It is possible that physicians were not aware of some nursing practices in this area, particularly regarding nonpharmacological measures. It is important that future work considers both physician and nursing perspectives.

Due to the length of the survey, we were not able to obtain details on dosing and frequency of the different pharmacological and nonpharmacological interventions.

**CONCLUSION**

Almost every critically ill child will receive sedation and analgesia at one point or another during his/her PICU stay. We believe that the administration of sedation and analgesia has a great impact on the outcome of critically ill children, and that the use of nonpharmacological interventions has the potential to improve outcomes. However, our survey demonstrates that there is great variation in practice and that implementation of strategies to safely minimize sedation, to prevent delirium and withdrawal symptoms, and to promote sleep are lacking. The results of this survey highlight the need for research in this field, including pharmacokinetic/pharmacodynamic dosing, and the development of evidence-based pediatric sedation and analgesia guidelines.

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