Energy conservation, minimum steps, and adaptations when needed: A scoping review

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Abstract

Background/objective: Although many therapeutic approaches use energy conservation, only a few effectively report the steps involved. Thus, it is intended to identify energy conservation practices to be organized in flexible and adaptable stages.

Methods: A scoping review was carried out, whose search strategies were applied in seven databases (CINAHL, Cochrane Library, Portal BVS, PsycINFO, PubMed, Scopus, and Web of Science) following guidelines by Arksey and O'Malley on the Rayyan software. Searches were carried out from January 2010 to December 2020. Inclusion of referred publications with different study designs, participation of adults with or by demands of energy conservation, joint protection, and control of fatigue and/or pain. Exclusion of productions without an occupational therapist or involving merely pharmacological or surgical therapeutic strategies.

Results: 653 articles were identified, after the selection and eligibility steps, 30 articles were full review, 18 articles were included and 635 excluded. Energy conservation studies have been increasingly focusing on neurological and systemic diseases, especially regarding symptoms of fatigue and pain. The findings were arranged in six strategies whose interventions are essentially based on guidelines and setting goals for patients, client-centered approach. Merely supervised interventions are less frequent. The number of sessions is closed, but the duration of treatment is not yet.

Conclusions: The signs of pain and fatigue are confirmed as indicators of energy conservation strategies, this delivery can be condensed from planning and organization, priorities, activity analysis, balance between activity and rest, outsourcing of tasks and physical/environmental adaptation. Trial Registration, OSF: https://osf.io/rsyq4.

Keywords

energy conservation, fatigue, pain management, occupational therapy, rehabilitation

Introduction

Diseases with different symptoms of pain and fatigue may require treatment with energy conservation principles (Racine et al., 2020). Such symptoms are potentially limiting physical and functional factors and each case should be analyzed for the compatible strategy with the clinical status to be indicated (Beckerman et al., 2013). It is possible to apply energy conservation techniques to different diseases with relative success and well-defined steps (Velloso & Jardim, 2006b), whose main goals are based on trainings of Activities of Daily Living (ADL) (Mahoney et al., 2020).

Learning about the proper steps of carrying out energy conservation may help occupational therapist (OT)s to understand the appropriate techniques, and customize the treatment to patients with different functional status who may require customized care in different contexts and environments, ranging from hospitalization (Farragher et al., 2020), outpatient care (Van Heest et al., 2017), and home care (Morgan & DiZazzo-Miller, 2018), as well as to learn the best choice to be carried out with the patient.

Therefore, the dissemination of energy conservation strategies becomes an important conduct. In addition, the

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recognition that every activity/occupation increases energy consumption depending on individual variables, environmental profile, type of activity and lifestyle (Severis et al., 2022). Thus, it is possible to consider the activity/task/occupation as contextualized physical activities, whose intensities can be measured by the Metabolic Task Equivalent (MET). It is known that the types of activity are associated with a range of energy cost values in four categories: quiet, light-intensity, moderate-intensity and vigorous-intensity (Guidoux et al., 2017). This categorization is not yet within the scope of energy conservation.

Thus, the understanding that every activity/task/occupation has an energy cost moves away from energy conservation as a synonym for rest and brings it closer to a set of strategies that favor mobility compatible with the priority needs of the patient. Therefore, the estimated MET for activities/tasks/occupations contextualized in energy conservation strategies may vary between the categories described by Guidoux et al. (2017). As predicted in other studies, the MET tends to be a relevant indicator of energy consumption in ADL as a function of intensity, duration and type of activity/task/occupation (Caballero et al., 2020). The METs can be estimated by questionnaires or by oxygen uptake.

As MET estimation is not yet common in energy conservation, the biggest indicators for monitoring these strategies tend to be pain/fatigue symptoms, present in a range of health alterations that admittedly interfere with occupational participation (Farragher et al., 2020) and life quality (Mahoney et al., 2020) as well as compromise the full execution of occupational tasks (Vendrusculo-Fangel et al., 2019), ADL (Morgan & DiZazzo-Miller, 2018), work (De Bloom et al., 2015), leisure (Lemoignan et al., 2010), and social interaction (Crowe et al., 2014). Regarding these symptoms and related consequences, despite the underlying disease, advising energy conservation procedures becomes an alternative when associated with other practices and approaches to support the treatment, such as Client-Centered Approach (Norberg et al., 2017), Task-Oriented Training (Hsieh et al., 2018), Occupation-Based Practice (Morgan & DiZazzo-Miller, 2018), Training of ADL (Mahoney et al., 2020), behavioral change strategy (Mallik et al., 2005), and participation and self-management (Wolf et al., 2017).

Such scope of options for energy conservation strategies may produce consistent differences among the interventions, despite the solid theoretical background, at least since the studies developed by Packer et al. (1995) (Månsson Lexell et al., 2020; Quinn & Hynes, 2020). Indeed, this issue has emerged in more recent publications. Thereby, it has become increasingly important to conduct studies addressing the steps most frequently used by researchers when defining a therapeutic approach based on energy conservation techniques. This may assist the professional to devise planning and therapeutic practice. Thus, we believe that understanding energy conservation principles by means of well-defined steps that can be flexible for each clinical case could be more relevant than the strict standardization of pre-defined procedures for any pathological manifestation.

Thereby, identifying studies based on energy conservation with the participation of an OT may assist other professionals in organizing and arranging the most frequent techniques and approaches. Such knowledge may favor the structuring of flexible, individualized programs without losing the essence of classic grounds. For such purpose, we researched the topic on Joanna Briggs Institute (JBI) and Open Science Framework (OSF) platforms and found no similar ongoing studies to this approach. Thus, we aim to select energy conservation practices in clinical scenarios that require such technique, and group the sequency of therapeutic approach to introduce a well-defined set of steps to be individualized by professionals on each case.

**Methods**

This scoping review followed the approach by Arksey and O’Malley (2005) and JBI Methodology guidelines (Peters et al., 2020). The research question was established according to the PCC mnemonic (Population, Concept and Context) (Figure 1), defined as follows: How should OTs promote energy conservation strategies as therapeutic option regardless of the underlying disease? This approach was recorded on the OSF Platform (https://osf.io/rsyq4). The final version of this study has been verified based on the criteria defined by the Preferred Reporting Items for Systematic reviews and Goal-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist (Tricco et al., 2018).

**Search strategy**

The searches were carried out between January 31 and April 30, 2021, following PRISMA recommendation adapted to scoping review (PRISMA-ScR). The following scientific platforms were researched: CINAHL, Cochrane Library, Portal BVS, PsycINFO, PubMed, Scopus, and Web of Science. In general, the descriptors were consulted as Descriptors in Health Sciences (DeCS) and Medical Subject Headings (MeSH), in English “Occupational Therapy” and alternative terms, in addition to “Energy Conservation” and alternative terms. The time window of search was delimited between January 1, 2010, and December 31, 2020 (Figure 2).
Of the six researchers, two of them were previously trained in the stages of the study, only after reaching the agreement index (Kappa) greater than 0.61 did the scoping review stages begin. Disagreements between independent investigators were resolved by consensus among them. If the doubt persisted, a third blind researcher decided the disagreement.

**Eligibility criteria**

Eligibility was based on the following inclusion criteria: clinical, observational, and experimental – randomized or not – studies; study protocols; participation of adults (≥18 years); addressing any pathology whose clinical chart requires moments of rest, or control of pain and/or fatigue, and joint protection; updates on any therapeutic environment; presence of OT in the technical team, and/or research team; treatment approach including occupational therapy; texts fully available in English. The following exclusion criteria were adopted: publications without clear presence of an OT – even though specific attributes of the profession were present; therapeutics without addressing principles, strategies, or techniques of energy conservation; texts with generic descriptions or unclear procedures hampering the study reproductivity; gray literature; primarily pharmacological interventions or based on experimental surgeries, and review papers of any method.
Evidence source screening
At the identifying step, papers were screened through active search on the scientific platforms. The results generated were then imported in an extension compatible with Online Program Rayyan (Ouzzani et al., 2016) – an electronic tool used along the next steps of this review. Studies on the effectiveness of this tool demonstrate sensitivity values above 97%, being a reliable tool for excluding ineligible records, but requiring manual monitoring for finding eligible records (Valizadeh et al., 2022), as performed here. The device Rayyan assisted in removing repeated titles and in the preliminary analysis while selecting relevant titles for the study. The remaining papers were subjected to the eligibility criteria through sequential analysis of abstract and/or keywords. This process was finalized by sourcing the papers available for a thorough analysis to confirm their inclusion and further metadata extraction.

Metadata extraction
The papers included provided the information that consolidated the main objective of each study, arranged as the following metadata, in addition to authorship/year: (1) objectives; (2) study designs; (3) underlying disease; (4) procedures – (a) duration of each session (in minutes), (b) number of sessions, (c) duration of treatment (in weeks or months), strategy (conduction of energy conservation), and (5) draft of main result.

Analysis and introduction of results
The analysis of results was established by the individualized method of the tabulated metadata, focusing on the frequency of occurrences and generation of inferences on the findings. The outcomes were analyzed as to the description of the OTs’ actions based on energy conservation associated or not with the private practices of the profession. Data found were arranged descriptively on a specific table. Finally, the findings were clustered to cover a visual layout of results presentation.

An arbitrary notation was adopted to favor the visualization of the outcomes reached by each study and to assist the general interpretation. Namely: (+) the study indicates significant gains, notably in the main variables; (+) the study suggests gains in some variables and maintenance of others, especially for the secondary variables, and indifferent impact among the main variables; (O) the study found no gains at all, or no significant differences among the variables, and (NC) the study design is NOT APPROPRIATE for result inferences extraction.

Agreement degree
Kappa Index was used to analyze the agreement degree between the independent researchers on the selection of papers (k) based on the following interpretation: Poor (0); Mild (0–0.20); Fair (0.21–0.40); Moderate (0.41–060); Substantial (0.61–0.80), and Near Perfect (≥0.81). The data were analyzed on the SPSS Program (IBM®, version 20) with statistical significance at values of p < 0.05.

Results
In total, 653 papers were identified, out of which 117 repeated titles were removed. After the preliminary analysis of titles and abstracts, 437 papers did not demonstrate to have relevant content for the study and 99 were selected. 30 papers met the eligibility criteria, out of which the full reading of those available resulted in the effective inclusion of 18 papers for metadata extraction (Figure 3). The agreement degree revealed by the Kappa Test assesses the index of 0.717 ± 0035 (p < .001). Such result demonstrates that the reliability between independent researchers was “substantial”, thus suggesting homogeneity of procedures.

The objectives of the papers included and analysis of results from arbitrary notation allowed inferring the outcomes for each approach (Table 1). Their combined visualization allows to infer that using energy conservation principles favors most of the approaches – 10/18 (2[+1] and 8 [+/-]). However, among these outcomes, a considerable number of those papers found no significant results in any of the variables analyzed (8[±]), notably for the primary findings (Table 1).

Among the papers included, the search of approach designs found a predominance of randomized and controlled studies (n=9), followed by study protocols (n=4) (Figure 4), in addition to viability, case, cohort, and pilot studies (Figure 4). In combination, these data suggest that despite the traditional topic, there is still an active re-formulation of the content and search for evidence-based procedures on the best method for energy conservation strategies.

These data also reveal that chronic diseases are the most eligible to interventions based on energy conservation principles (Figure 4). In turn, acute diseases appear somewhat timidly in this context (Figure 4). However, the main clinical consequences of these diseases include symptoms of fatigue and/or pain (n = 11), symptoms that currently seem to be decisive for indicating energy conservation strategies (Figure 4).

When considering the objectives and underlying diseases in the included studies, the procedures for the interventions ranged with time windows, number of sessions, and treatment duration heterogeneously introduced (Figure 4). A larger analysis shows that the most frequent duration of the sessions varied from 45 to 60 min (n = 9), the most common number of sessions ranged between 3 and 7 meetings (n = 10), and the most common treatment duration extended from 5 to 8 weeks (n = 7) (Figure 4). These
findings suggest a certain consensus on the number and duration of sessions, but also a considerable dispersion on the treatment duration and patient follow-up.

The analysis of objectives, now combined with the interventions described in the methods section of the included papers, also showed that most of them (n = 13) are structured in closed sessions to provide guidelines and information, as well as to teach energy conservation attitudes, often remotely. In patient follow-up scenarios, the approach in most of the studies was applied to offer instructions, education, and training of energy conservation strategies, with subsequent meetings (Figure 4).

In contrast to a lesser extent (n = 5), some studies focused on interventions with supervised follow-up – the training of the energy conservation strategy encompassed the sessions per se for a further execution of what has been learned (Figure 4).

These two delivery methods reveal that the most common procedure occurs in response to the chronic diseases profile, which require prolonged and more interspersed care to favor adaptations along time according to the patient’s clinical status.

According to such inference, selecting the common strategies of energy conservation in the included papers allowed a six-method grouping or by general principles (Figure 4). This finding seems to follow a logic sequency when applying these strategies but can also be rearranged and individualized according to the patient’s need and/or disease limitations. Thereby, the included papers enable to interpret that the most common format of decision making occurs with patient participation, suggesting that the planning of these methods is based on a client-centered approach.

Finally, the studies show at least four approach groups most frequently used to compose the delivery of energy conservation principles to the patient, namely: (1) Instrumental Activities of Daily Living (IADL, n = 8); (2) Activities of Daily Living (ADL, n = 5); (3) Work and

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**Figure 3.** PRISMA-ScR flowchart. Caption: occupational therapist (OT).
Leisure (n = 3), and (4) General Procedures (n = 5) (Figure 4).

Discussion

This scoping review demonstrates the expansion of energy conservation-based research over the last decade. There has been progress towards systemic and neurological diseases, whose clinical conditions evolve with important signs of fatigue and/or pain. In general, it is inferred that the results are mostly described with relative success and are individualized. Data on the duration and number of sessions seem to be more cohesive, unlike treatment duration, which is not as consistent among the proposals. Interventions occur more commonly by providing patients with guidelines than by supervising the practices taught, whose methods were clustered into six strategies which vary from defining goals with important links to the client-centered approach, combined with behavioral change due to the limitations imposed by the diseases.

More recently, among the diseases found, Multiple Sclerosis (MS) has received the majority of interventions

Table 1. General introduction of the papers selected and outcomes inferred.

| Order (#) | Authorship/Year | Objective/Approach | Outcomes |
|----------|-----------------|--------------------|----------|
| #1.      | (Beckerman et al., 2013) | Efficacy of three rehabilitation strategies in reducing fatigue and improving social participation in patients with MS. | NC       |
| #2.      | (Blikman et al., 2017) | Efficacy of an intervention of individual energy conservation management on fatigue and participation in individuals with MS. | Ø        |
| #3.      | (Finlayson et al., 2011) | Efficiency of fatigue management provided by a program based on teleconference with groups of individuals with MS. | ±        |
| #4.      | (Guidetti et al., 2018) | Viability of the evidence-based occupational therapy program on the capacity of ADL in individuals with chronic diseases. | NC       |
| #5.      | (Hersche, Weise, Michel, Kesselring, Barbero, et al., 2019) | Development of an education Program in energy management in hospitalized patients due to MS related fatigue. | ±        |
| #6.      | (Hersche, Weise, Michel, Kesselring, Bella, et al., 2019) | Viability of an intervention based on a group of education in energy management in hospitalized patients due to MS related fatigue. | ±        |
| #7.      | (Ijspeert et al., 2013) | Efficacy of a multidisciplinary intervention program for patients with subacute Neuropathic Amyotrophy. | ±        |
| #8.      | (Kim et al., 2017) | Chronic fatigue related problems after cardiac arrest and energy conservation intervention and Problem Solving therapy. | ±        |
| #9.      | (Kim et al., 2019) | Viability of using tablet for energy conservation based on the Problem Solving therapy x health education for heart failure. | ±        |
| #10.     | (Kos et al., 2016) | Efficacy of TO individual program in self-management x relaxing in the performance and satisfaction of ADL for MS related fatigue. | ±        |
| #11.     | (Martinsen et al., 2017) | Effect of individualized OT on COPD and occupational problems experienced by individuals in daily life. | Ø        |
| #12.     | (Murphy et al., 2011) | Efficacy of an individualized intervention based on the activity pace over fatigue, NC pain, and physical function. | ±        |
| #13.     | (Norberg et al., 2017) | Experience of patients and professionals in a home program of energy conservation strategies on heart failure. | ±        |
| #14.     | (O’Riordan et al., 2017) | Impact of management and education of activities on fatigue for occupational participation and fatigue management. | Ø        |
| #15.     | (Rosenbek Minet et al., 2015) | Viability of individualized home training x counseling program by video conferencing on COPD after hospitalization. | NC       |
| #16.     | (Veenhuizen et al., 2015) | Viability and cost-effectiveness of “Energetic” program based on self-management group for social participation, physical resistance, and fatigue. | +        |
| #17.     | (Veenhuizen et al., 2019) | Efficacy of the “Energetic” program in self-management group for aerobic training, energy conservation management, and fatigue prevention. | +        |
| #18.     | (Wingårdh et al., 2020) | Energy conservation techniques after learning how to reduce energy expenditure during activities severe COPD. | +        |

Overview of outcomes (n = 18)
2(+); 8(±); 3(Ø), and 5(NC)

Caption: (#) Papers selected; Activities of Daily Living (ADL); Multiple sclerosis (MS); Chronic Obstructive Pulmonary Disease (COPD); Occupational therapy (OT); (+) gains in main variables; (±/+ −) secondary gains or maintenance among variables; (Ø) no gains or no significant differences among results, and (NA) Not appropriate to extract inferences on outcomes.
based on energy conservation principles. The literature confirms that MS has been treated with such therapeutic approach for at least 20 years (Mathiowetz et al., 2001). Combined with the other involvements found, it is possible to infer that a significant part of the interventions was indicated to favor the management of fatigue (Tur, 2016) and pain (Racine et al., 2020) symptoms. This notation is well represented in the specialized literature and highlights energy conservation techniques oriented both to fatigue management (Grill & Cole, 2021) and to pain management strategies (Racine et al., 2020), or even approaches with treatment focused on both symptoms (Murphy et al., 2011). Therefore, deciding on the indication of energy conservation techniques is usually associated with defining goals, often linked to a satisfactory performance of tasks, such as ADL (Wingårdh et al., 2020) and IADL (Campos & Toldrá, 2019), in response to the aforementioned status of fatigue (Holberg & Finlayson, 2007) and pain (Shing et al., 2019). Here, studies with similar approaches and favorable outcomes were found (Quinn & Hynes, 2020; Racine et al., 2020). Besides, there are findings acknowledges the possibility of individualizing energy conservation according to patient needs, such as occupations. Such an argument reinforces the importance of identifying the six most frequent

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**Figure 4.** Introduction of metadata. Caption: Activities of Daily Living (ADLs); Instrumental Activities of Daily Living (IADL); and Occupational Therapy (OT). Order of articles presented in Table 1 (#).
strategies among the publications included. This may favor the adaptation, with good reports in current references (Månsson Lexell et al., 2020; Wingårdh et al., 2020). It is believed that this finding may be consequences of behaviors based on the Customer-Centered Approach, whose effectiveness is also described in the literature (Quinn & Hynes, 2020).

Thereby, to emphasize the possibility of individualization and preserving the classic principle of the energy conservation technique, this research points to the most common and more recently used strategies. Namely:

The first method of the six strategies of energy conservation mapped herein is defined by a planning based on the knowledge of limitations caused to the individual by the disease. In this context, the publications instruct to develop an individualized list of activities and tasks (Dreiling, 2009), including specific activities (Norberg et al., 2010), with defined standards for each performance, time required, and short- and long-term goals to be reached. Also if necessary, more time should be provided to perform slower running activities (Dreiling, 2009; Velloso & Jardim, 2006a). Such a strategy is followed by the second method – defining priorities for the planned activities. For this purpose, the professional can instruct the patient to eliminate unnecessary activities, as a whole or partially (Holberg & Finlayson, 2007; Velloso & Jardim, 2006a), by properly prioritizing basic tasks, such as ADL (Månsson Lexell et al., 2020).

The papers included show that both strategies mentioned are supported by the third method – analysis of activity focused on mechanical factors of the task and the patient’s body position (Månsson Lexell et al., 2020). Thereby, this method conceives the activity in steps and indicates the most favorable execution mechanics or modification for other parts of the body to assist in the performance (Dreiling, 2009; Holberg & Finlayson, 2007; Velloso & Jardim, 2006a). Difficulties in the good progress of this third method may require to reinforce the forth – providing a balance between activity and rest (Månsson Lexell et al., 2020). Such a new strategy is met in two slopes: one that assigns the need of rest throughout the day (Holberg & Finlayson, 2007), and another that allows a strategic stop to rest in key moments while performing a given activity (Dreiling, 2009; Holberg & Finlayson, 2007). Should any impossibility occur, the fifth method allows to ask for help during parts of the activity or to transfer the whole task to others (Dreiling, 2009; Holberg & Finlayson, 2007; Månsson Lexell et al., 2020; Norberg et al., 2010; Velloso & Jardim, 2006a). In this case, the (self-)acknowledgement of limits and behavioral change prevail (Mallik et al., 2005; O’Riordan et al., 2017).

Finally, the sixth method seems to complement the previous strategies. It concerns the prediction of auxiliary mobility devices and assistive technology required for the cases (Dreiling, 2009; Holberg & Finlayson, 2007; Norberg et al., 2010; Quinn & Hynes, 2020), or even environment arrangement, including modifying the standard of activity/task/work (Dreiling, 2009; Holberg & Finlayson, 2007; Månsson Lexell et al., 2020; Norberg et al., 2010; Velloso & Jardim, 2006a). Mobility devices, adaptations and orthoses are beneficial for modulating mechanical efforts and/or overloads in key regions of the body, such as joints (Povlak & Valdes, 2020). However, the association of these benefits with daily activities is not yet consolidated in the literature (Norberg et al., 2010). Thus, all the methods reported here are good representations of the performance in energy conservation.

Despite the gaps, some points have already been consolidated, such as the application of these strategies along with the patient. This occurs primarily through guidelines, notably information on the disease and on how to proceed with the instructions in tasks and daily activities, in contrast to the supervised patient follow-up, counting for less in this context. This may be strongly related to the clinical status of the disease. The Acute conditions seem to require a closer follow-up by the professional, while chronic conditions allow a close follow-up due to worsening and/or need of periodic treatment reviews (Lubi, 2019). Regardless of the conduct adopted, the results found demonstrate the viability and efficacy of the therapeutic approach (Asano & Finlayson, 2014).

Conversely, the individualized results do not highlight in the same proportion of importance the benefits attributed to energy conservation. Few studies have demonstrated solid positive results, while several others report partial or irrelevant results for the variables studied. In this context, it is believed that the assessment instrument of choice may influence the final interpretation of findings. Such hypothesis is reinforced by studies with the elderly population characterizing the need to improve the functional assessment tools, since they do not satisfactorily represent the development observed for this specific public (Wales et al., 2016). Related assessments corroborate such an argument, like the performance in ADL and IADL developed in contexts of special populations (Pashmdarfard & Azad, 2020).

Study limitations

It is worth mentioning some limitations involved in the selection presented. One of them is the eligibility of publications only in the English language, which may have excluded relevant papers in native languages other than English. Such papers could have deepened or altered our interpretations. Another limitation refers to the absence of searches on local scientific platforms, a procedure that may have hidden differences among regional professional conducts on the topic. Finally, despite being our object of study, interventions based on client-centered practices and
behavioral change also represent a limitation. The systematized requirements for the searches performed herein did not expand these findings.

Conclusions

Given the foregoing, we conclude that energy conservation-based treatment can be easily applied in the six strategies grouped herein representing the most common techniques and adapted to each case. Delivery occurs primarily by providing both guidelines to the patients and close supervision of the planned goals with special attention to the symptoms of pain and fatigue. Further studies should inform on the optimum duration, number, and frequency of sessions, as well as on the treatment duration. Likewise, prospective research should assess the weight of Client-Centered Approach in relation to other procedures for defining the best delivery approach for energy conservation-based practices. Still, further proposals should address potential regional particularities when performing energy conservation strategies.

Acknowledgements

The authors acknowledges CAPES, a Brazilian free access platform for searching and sourcing referred publications.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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