

Chest pain in a pediatric emergency department: clinical assessment and management reality in a third-level Portuguese hospital

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Abstract

Background: Chest pain in children and adolescents is a common complaint in the emergency department (ED), being mostly benign. A thorough patient history and physical examination should be enough in most cases for its proper management. Regarding non-cardiac chest pain, anxiety plays an important role.

Methods: Retrospective analysis of all admissions in a pediatric ED of a Portuguese third-level hospital with a chief complaint of chest pain between January and December 2018. Chi-square test was used to compare different etiologies, considering a significance level of 5%.

Results: A total of 798 visits were included: 53.6% girls, 80.8% adolescents (mean age: 13 years old). According to the Pediatric Canadian Triage and Acuity Scale, 77.7% was prioritized as level IV: less urgent; 65.3% reported associated symptoms including dyspnea (31.8%), cough (18.2%), and palpitations (16.1%). In physical examination, 45.5% had alterations: 62.8% with chest wall tenderness. Further investigation was done in 84% of patients: 62.4% electrocardiograms (altered in 14.7%), 52.6% chest radiographies (altered in 17.1%) and 8.9% cardiac biomarkers (altered in 12.7%). The 3 main causes of chest pain were musculoskeletal (33%), idiopathic (24.4%) and psychogenic (21.6%), with 1.1% of cardiac etiology. Less than 3% needed hospital admission and 18.9% were oriented to an outpatient consultation. 7.1% readmissions reported. When compared to other causes as a group, psychogenic chest pain presented a statistically significant association with female sex, adolescence, psychiatric antecedents, previous stressful event, and normal physical examination. Of these, <30% were oriented to a pedopsychiatry/psychology consultation.

Conclusions: Opposing to the low priority level in triage, benign diagnosis found, and low hospital admissions, there was a high percentage of complementary diagnostic tests performed with few altered results. In psychogenic chest pain there was a low post-discharge referral. The authors highlight the importance of clinical algorithms to reduce unnecessary tests performed and readmissions and improve orientation and follow-up, particularly in psychogenic etiology.

Keywords: anxiety, chest pain, idiopathic chest pain, musculoskeletal chest pain, pediatric emergency department, psychogenic chest pain

Introduction

Chest pain in the pediatric population is a common complaint in the emergency department (ED). Acute chest pain in adults raises concern for coronary artery disease and myocardial infarction, requiring prompt cardiac evaluation to prevent unfortunate events. Because of this association in adults with cardiac disease and sudden death, chest pain in the pediatric population is also a

cause of distress especially in adolescents and their families. Media coverage of rare events of sudden cardiac death in young athletes contributes to this parental concern.¹⁻⁴

Fortunately, in children and adolescents, fatal heart disease is extremely rare and chest pain is generally a benign condition. Noncardiac causes of chest pain can include musculoskeletal, pulmonary, idiopathic, psychogenic and gastrointestinal causes.^{1,3,4} A cardiac etiology is found in a minority, reported in previous studies as 1% to 10%, despite more testing and consultation.^{2,5}

For physicians, identifying children at higher risk or definitively excluding a cardiac cause can be particularly challenging, because most young children and adolescents are not able to accurately characterize their pain.^{6,7} This can result in unnecessary complementary diagnostic tests (CDTs) or cardiology consultations and therefore in longer ED length of stay and higher costs.^{8,9} A careful patient history and a thorough physical examination should be enough in most cases for the proper management of this complaint.^{1,3-5}

Regarding noncardiac chest pain, anxiety plays an important role. Studies show higher levels of anxiety in these patients and the importance of considering psychiatric disorders in the etiology of the chest pain after ruling out cardiac and other

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acute medical causes.^{10–12} Also in this group, there is a higher recurrence of the symptom, associated with readmission in ED and school absenteeism.^{10,13}

In the authors' knowledge, there is no published data from Portugal on incidence and causes of chest pain in children.

The purpose of the present study was to investigate the clinical findings and management of children and adolescents presenting with chest pain to the pediatric ED of a third-level Portuguese hospital with pediatric cardiology available 24 hours a day, 7 days a week, in a 1-year follow-up period. A secondary purpose was to compare psychogenic chest pain with nonpsychogenic chest pain.

Methods

Ethical approval for this study (Ethical Committee No 405-19) was provided by the Ethical Committee of Centro Hospitalar Universitário São João (CHUSJ), Porto, Portugal on December 19, 2019.

Clinical processes of all admissions in CHUSJ pediatric ED with a chief complaint of chest pain were retrospectively reviewed from 1st of January to 31st of December 2018. Patients' records were assessed for demographic data, time of admission, triage level priority according to Pediatric Canadian Triage and Acuity Scale,¹⁴ pathological antecedents, pain characteristics and associated symptoms, findings on physical examination, CDTs performed and altered results, need for cardiology consultation, final diagnosis, and orientation.

A descriptive analysis of the collected data was performed, using Excel 365 software. Chi-square test was used to compare different causes of chest pain, considering a significance level of 5%.

Results

The pediatric ED of CHUSJ had an annual volume of 76,085 patients' visits in 2018. In this year, 798 visits were due to chest pain, approximately 1% of all admissions. Mean and median ages were 13 and 14 years, respectively, ranging from 1 to 17 years old: 80.8% were adolescents with 3.4% children younger than 5 years; 53.6% were girls (1.2:1).

The triage priority level according to the Pediatric Canadian Triage and Acuity Scale was in 77.7% of the episodes level IV (less urgent), 19.2% level III (urgent), and 3.1% level II (emergent). There was not any case prioritized as level I (resuscitation) or level V (nonurgent).

Visits during winter, spring, and fall were around 26.1% to 28.1%, with 18.1% of visits during the summer. Accordingly, most visits were in descent order of frequency in October, May, April, and January: 77.2% of all episodes were on a business day. Concerning visit hours, they were made mainly in the afternoon period (1–7 PM) in 41.7% and after dinner (8–11 PM) in 32.1%. There was no association between higher levels of triage priority (urgent or emergent) and admission during the night.

Fifty-seven patients (7.1%) have been seen more than once during the follow-up period for the same complaint: most of them 2 times in 1 year, 4 patients 3 times, 1 patient 5 times and another one 7 times.

Anamnesis and physical examination

The presence of pathological antecedents was reported in almost half of all episodes: 32.5% psychiatric (including history of

anxiety, depression, and attention deficit hyperactivity disorder), 28.3% respiratory (including history of wheezing or asthma) and 18.9% cardiovascular (including history of congenital heart defects or arrhythmia).

Pain duration was reported in almost half of the cases as more than 1 hour and <1 day, with <10% referring it as <15 minutes or >1 week. About localization of the chest pain, 33.7% mentioned it was a retrosternal pain, 23.6% in the left hemithorax, 16.7% an anterior pain, 7.1% in the right hemithorax, 3.2% a posterior pain, and 1.1% a subcostal pain. Concerning pain intensity, 28.8% referred it as a mild pain (1–3 in a scale of 1–10), 9.7% as a moderate pain (4–7), and 2% as a severe pain (8–10). Data were missing regarding pain duration, localization, and intensity in 11.4%, 17.9%, and 65.3%, respectively.

Associated with the pain, 65.3% of the patients mentioned at least 1 additional symptom, in descent order of frequency: dyspnea, cough, palpitations, gastrointestinal symptoms (including abdominal pain, heart burn, nausea, and vomiting), dizziness or lypotimia, fever, asthenia or tiredness, and syncope.

In 20.6% a previous stressful event was reported such as the death of a close relative or a school adjustment problem, against 22.1% who denied it. Data were missing concerning this aspect in the remaining clinical records.

In physical examination 45.5% of all children had at least 1 alteration: 62.8% with chest wall tenderness; 14% and 3.9% with pulmonary and cardiac auscultation alterations, respectively; and 10.5% with signs of anxiety such as hyperventilation, tremors, or hyperhidrosis. Physical examination alterations are presented in Figure 1.

ED management

After anamnesis and physical examination, further investigation meaning at least 1 CDT performed was reported in 84% of patients. Electrocardiogram (ECG) was performed in 62.4%, with altered results in 14.7% (including 17.8% of previously known ECG alterations). Chest radiographies were ordered in 52.6%, with alterations in 17.1%. Blood analysis was performed in 13%, with altered results in 19.2%. Cardiac biomarkers namely high-sensitivity troponin, creatine kinase-myocardial band and myoglobin were tested in 8.9% with alterations in 12.7%. CDTs performed and respective altered results presented in Figure 2.

Evaluation or discussion of the case with pediatric cardiology (available 24 hours) was requested in 10.6% of all cases.

Almost one fourth of the patients were medicated during their ED stay, 54.9% with an analgesic or anti-inflammatory, 21.2% with an anxiolytic, and 10.3% with a bronchodilator.

Final diagnosis and orientation

Final diagnostics were grouped into cardiac, gastrointestinal, idiopathic, miscellaneous, musculoskeletal, psychogenic, pulmonary, and traumatic chest pain, resumed in Figure 3. The 3 main causes were musculoskeletal: 33%, including costochondritis, thoracic neuritis, and pain of muscular origin; idiopathic: 24.4% and psychogenic: 21.6% when the pain was attributed to anxiety after excluding other causes (no cases related to other psychological disorders). Pulmonary chest pain occurred in 12.8% of the episodes, including acute asthma or wheezing, atypical and bacterial pneumonia, pneumothorax, and 1 case of plastic bronchitis. Compared to other causes, pulmonary chest

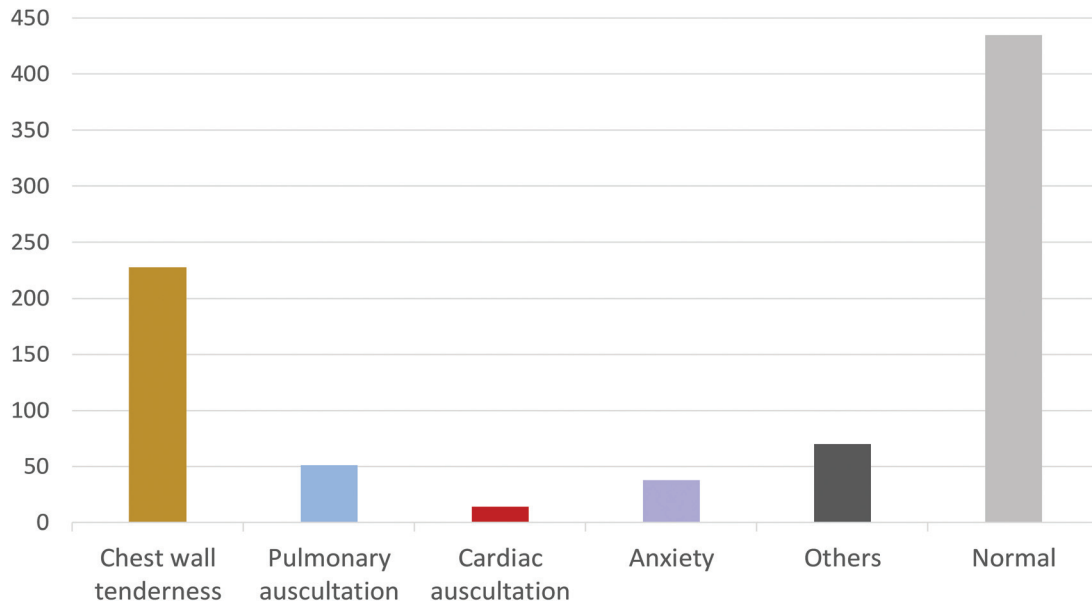


Figure 1. Physical examination alterations.

paint presented a statistically significant association with respiratory antecedents (present in 22.5%) and pulmonary auscultation alterations (present in 32.4%) (Table 1). Gastrointestinal chest pain was reported in 5.3% of cases including esophageal spasms and gastroesophageal reflux. Three cases were included in the miscellaneous category as the final diagnosis were sunburn, ovarian cyst, and pulmonary metastasis of a thoracic Ewing sarcoma. Cardiac chest pain was reported in 1.1% of cases: 2 cases of arrhythmia, 2 of myocarditis, 3 of myopericarditis, and 2 of pericarditis. Of these, 1 patient had cardiovascular antecedents, all were evaluated by pediatric cardiology and performed ECG, with altered results in 77.7% and 7 performed blood analysis including cardiac biomarkers, with altered results in 62.5%.

When compared to other causes, pulmonary or cardiac chest pain, presented a statistically significant association with higher triage priority levels (urgent or emergent).

Most patients, 71.4%, were discharged home without outpatient consultation or primary care provider orientation. Hospital admission was 2.8% including 9 cases of pneumothorax, 3 myopericarditis, 3 complicated bacterial pneumonias, 1 pneumomediastinum, 1 pneumoperitoneum, 1 infected bronchiectasis, 1 myocarditis, and 1 pulmonary metastasis of a thoracic Ewing sarcoma. These admissions included also 2 cases admitted in the pediatric intermediate and intensive unit: an arrhythmia with a Brugada syndrome’s ECG pattern and a diagnosis of plastic bronchitis, respectively. Approximately 18.9% were oriented to an outpatient consultation: 55.5% of these to

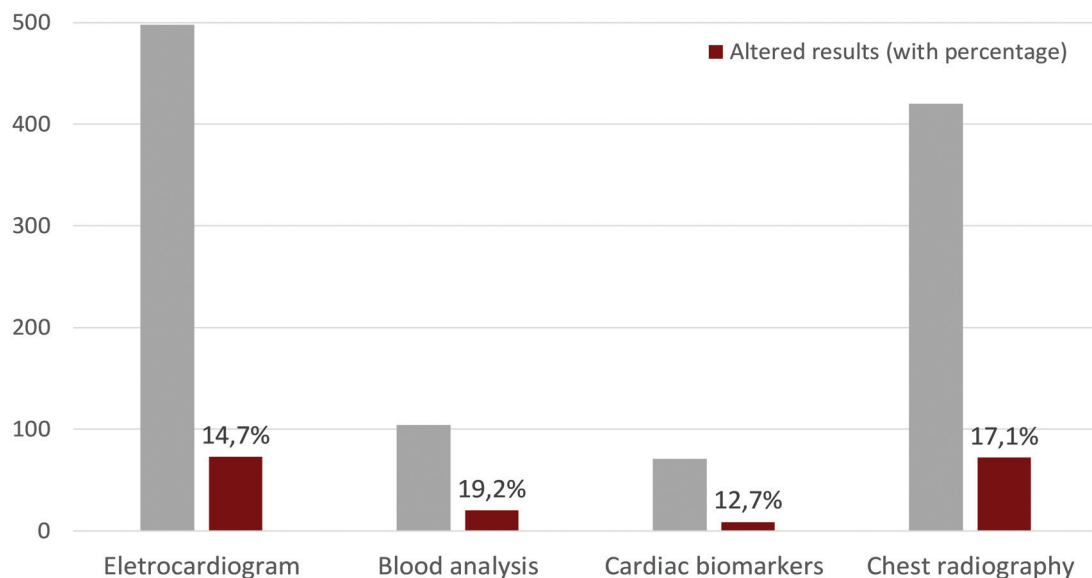


Figure 2. Complementary diagnostic tests performed and altered results.

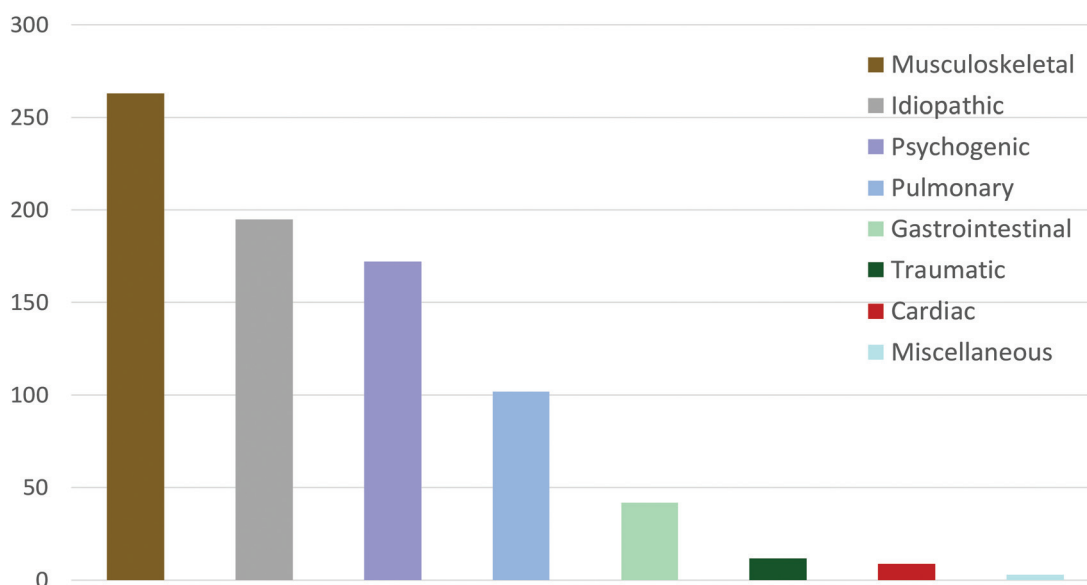


Figure 3. Causes of cardiac chest pain.

pediatric cardiology consultations and 35.6% to pedopsychiatry and/or psychology consultations. The ones oriented to cardiology consultations had ECG alterations previously unknown in 29.6%. Other reasons reported for cardiology orientation included relevant family history, recurrent pain, and pain with exertion or with palpitations or syncope associated. Seven percent of the patients were oriented to their primary care provider. Four cases were transferred from other hospitals for pediatric cardiology evaluation. All of them returned to their origin hospitals: 3 were discharged home and only 1 case needed hospital admission for troponin elevation in the likely context of the underlying disease (muscular dystrophy). No mortality was reported.

Anxiety and psychogenic chest pain

In addition to the 21.6% of chest pains included in the psychogenic cause, an additional 6.9% of other causes had anxiety as a second diagnosis, exacerbating the initial pain.

Of the children with a psychogenic etiology to their pain, 59.3% were discharged home without outpatient consultation or primary care provider orientation. Less than 30% were oriented to a pedopsychiatry and/or psychology outpatient consultation and around 9% to their family care provider. Twenty-four of

these patients (14%) have been seen more than once during the follow-up period for chest pain, including the 2 patients who were seen 4 and 7 times in 1 year, who were oriented to a pedopsychiatry consultation in the third and fifth visit, respectively.

When compared to other causes as a group, psychogenic chest pain presented a statistically significant association with female sex, adolescence, psychiatric antecedents, previous stressful event, and normal physical examination (Table 2).

Discussion

Chest pain in pediatric populations is often benign and infrequently due to serious cardiac or noncardiac diseases.^{2,7,13,15,16} This study found a cardiac etiology of 1%, hospital admissions around 3% (only with 2 cases with intermediate or intensive care need) and zero mortality, being musculoskeletal the most common etiology, as reported in previous studies.^{4,13,15,16} Opposing to these results and to the low priority level in triage, there was a high percentage of investigation performed, >80% of all children underwent at least 1 CDT, mostly ECG and chest radiographies, with altered results in <20%.

Table 1

Comparison of patient history and physical examination between pulmonary chest pain and nonpulmonary chest pain

	Total	Pulmonary chest pain (n=102)	Nonpulmonary chest pain (n=696)	P*
Pathological antecedents				.004
Respiratory	108 (13.5%)	23 (22.5%)	85 (12.2%)	
Nonrespiratory or absent	690 (86.5%)	79 (77.5%)	611 (87.8%)	
Physical examination				<.001
Altered pulmonary auscultation	51 (6.4%)	33 (32.4%)	18 (2.6%)	
Normal pulmonary auscultation	747 (93.6%)	69 (67.6%)	678 (97.4%)	

* Differences between groups were statistically significant at p <0.05.

Table 2
Comparison of demographic, anamnesis, and physical examination characteristics between psychogenic chest pain and nonpsychogenic chest pain

	Total	Psychogenic chest pain (n=172)	Nonpsychogenic chest pain (n=626)	P*
Sex				<.001
Male	370 (46.4%)	58 (33.7%)	312 (49.8%)	
Female	428 (53.6%)	114 (66.3%)	314 (50.2%)	
Age				<.001
Adolescent	645 (80.8%)	155 (90.1%)	490 (78.3%)	
Nonadolescent	153 (19.2%)	17 (9.9%)	136 (21.7%)	
Visit day				.058
Business day	616 (77.2%)	142 (82.6%)	474 (75.7%)	
Weekends	182 (22.8%)	30 (17.4%)	152 (24.3%)	
Pathological antecedents				<.001
Psychiatric	124 (15.5%)	71 (41.3%)	53 (8.5%)	
Nonpsychiatric	674 (84.5%)	101 (58.7%)	573 (91.5%)	
Previous stressful event				<.001
Present	164 (20.6%)	94 (54.7%)	70 (11.2%)	
Nonpresent	634 (79.4%)	78 (45.3%)	556 (88.8%)	
Physical examination				.012
Normal	535 (67.0%)	129 (75%)	406 (64.9%)	
Altered	263 (33.0%)	43 (25%)	220 (35.1%)	

* Differences between groups were statistically significant at $p < 0.05$.

Nowadays, in many diseases, clinical practice algorithms have been created to reduce practice variations and the high costs associated with unnecessary CDTs performed. This has been also true for chest pain in the pediatric population, with several studies showing that using a standardized approach can effectively streamline cardiac testing and reduce resource utilization, leading to a more cost-effective care.^{8,9} A recent study showed a statistically significant reduction on chest radiographies and ED length of stay with the implementation of a clinical pathway for chest pain in their pediatric ED. A reduction was also noted in other tests but without statistical significance and there was less variation in the proportion of troponins ordered. No cases of cardiac disease were missed with the implementation of the pathway and there was a higher rate of outpatient follow up for nonpathologic chest pain.¹⁷ These clinical algorithms have been created in the supported evidence that a careful and detailed patient history and physical examination should guide the need of CDTs and which are the ones more appropriated.^{1,3,4,18} Accordingly, this study showed in pulmonary chest pain a statistically significant association with respiratory antecedents and pulmonary auscultation alteration. Also, there was a statistically significant association between cardiac or pulmonary chest pain and higher triage priority levels (urgent or emergent), suggesting warning signs detected early in triage. In fact, studies showed that in the diagnosis of a cardiac chest pain, the most worrisome etiology for parents, there were suggestive findings in their symptoms, medical or family history, physical examination, and/or ECG that led to further investigation or referral to a pediatric cardiologist. This reassurance should be given to parents and public community in general.^{4,5}

Concerning psychogenic chest pain, we report a percentage around 20%, being the third main etiology in the population studied, with an additional 7% of anxiety as a second diagnosis. In addition, some cases classified as idiopathic chest pain may also have its origin in a psychopathological basis that went unnoticed. This study demonstrated statistically significant associations with psychogenic etiology including female sex,

adolescence, psychiatric antecedents, previous stressful event and normal physical examination, which can be clues to this diagnosis and need to be addressed when evaluating chest pain. Current studies have been highlighting the importance of psychiatric screening of this complaint in children, specially adolescents, even in ED scenarios. This should include, for example, an active search of previous stressful events in patient history or signs of anxiety or psychological distress in their physical examination.^{11,12,19} If this suspicion is raised in the emergency setting, children and adolescents can be oriented to an outpatient consultation and as suggest in a recent study, short screening tests as Beck Anxiety Inventory or The Conners Parent Rating Scale can be performed, increasing the early recognition and appropriate treatment of anxiety and other psychological disorders behind the pain.¹² Accordingly, a concerning aspect to address is the high recurrence of this symptom in youngsters, being associated with readmission in ED or cardiologic reevaluation. This study found 7% of re-admissions for chest pain in 1 year, with a higher percentage of 14% if considering only psychogenic causes. This ultimately interferes in children daily activities including not only school absenteeism, a marker of psychological distress, but also an extracurricular or sports activities refusal, loss of interests, and less interaction with pairs.^{10,13,19} This study reported a low referral postdischarge in psychogenic chest pain with <30% oriented to a pedopsychiatry and/or psychology consultation and <10% to their family care provider.

The authors intend to create and implement in CHUSJ pediatric ED, a clinical protocol to guide the approach and orientation of chest pain, to reduce the noticed CDTs overconsumption and readmissions and improve orientation and follow-up, particularly in psychogenic chest pain.

This study had some limitations. As a retrospective review that relied on medical records, it was not possible to complete all data in some cases, particularly in chest pain characterization, presence of previous stressful events, and physical examination alterations that were not always reported. In addition to these limitations, as this study was performed in a pediatric ED of a

third-level hospital with around 80,000 admissions a year, there was a considerable sample size with 798 visits for chest pain in 1 year.

Conflicts of interest

The authors declare no conflicts of interest.

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