

# The Runaway Croup Train: Off the Pathway and Through the Woods

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A previously healthy, fully immunized 23-month-old girl presented to the emergency department (ED) with 1 day of fever, cough, hoarseness, stridor only with agitation, and no drooling or retractions. She was given acetaminophen and dexamethasone 0.6 mg/kg orally. After these interventions, she improved and took a Popsicle. A chest radiograph and lateral neck radiograph were read as “prevertebral soft tissue thickening at the level of C5-C7, which can be seen with retropharyngeal infection versus projection or positioning.” This prompted an otolaryngology consult. Bedside flexible fiber-optic nasolaryngoscopy in the ED revealed mild to moderate swelling of the epiglottis with scattered foci of edema and erythema on the laryngeal surface of the epiglottis, mobile and moderately edematous vocal folds bilaterally, and moderate to severe subglottic stenosis, which are all findings typical of viral croup. Laboratory studies revealed a normal white blood cell count of 10.1 k/ $\mu$ L (reference range: 6–17.5), elevated C-reactive protein of 8.0 mg/dL (reference range: <0.9), elevated procalcitonin of 1.08 ng/mL (reference range: <0.5), and a normal chemistry. A nasal swab for respiratory pathogen polymerase chain reaction (PCR) was obtained. A diagnosis of epiglottitis was made, the patient was made NPO, maintenance intravenous fluids were started, intravenous ampicillin-sulbactam and intravenous dexamethasone were given and scheduled every 6 hours, and admission to the PICU was arranged. Three hours after admission to the PICU, the respiratory pathogen panel was reported as positive for parainfluenza virus 3, and 12 hours after admission, the patient was transferred from the ICU to the inpatient ward. The patient did not require any additional interventions in the ICU other than scheduled intravenous antibiotics and steroids. The next morning, 9 hours after transfer from the ICU, antibiotics and steroids were discontinued, and the patient was discharged with instructions to see the pediatrician the next day.

High-value care delivers the “right care to the right patient at the right time.”<sup>1</sup> Despite the data indicating that children with croup who respond to dexamethasone do not need a radiograph or additional interventions, great variability exists in the use of additional diagnostic tests and treatments.<sup>2</sup> This case highlights several points of discussion related to low-value care, including the indications for and interpretation of imaging and laboratory tests, the indications for and interpretation of laryngoscopy, communication among providers, clinical pathways, and the financial and other costs to the patient and family due to overtesting and overtreatment.

## INDICATIONS FOR AND INTERPRETATION OF IMAGING AND LABORATORY TESTS

Guidelines and clinical pathways for the management of croup do not recommend a routine radiograph.<sup>3–6</sup> A chest radiograph may show the classic “steeple sign” of subglottic narrowing, and a lateral neck film may show

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hypopharyngeal overdistention during inspiration. However, these are not necessary for diagnosis or treatment. Guidelines do recommend a radiograph when concerning features suggest alternative etiologies such as epiglottitis, retropharyngeal abscess, peritonsillar abscess, airway foreign body, bacterial tracheitis, congenital abnormality, or subglottic hemangioma.<sup>5-7</sup> Concerning features include drooling, tripod posture, significant trismus, limited neck range of motion, or lethargy or inconsolable agitation, all of which were absent in this patient. The pretest probability of epiglottitis in this case was incredibly low given that the patient was immunized and well appearing. The incidence of epiglottitis since the introduction of the *Haemophilus influenzae* type b vaccine in 1985 is 0.7 cases per 100 000 persons immunized.<sup>8-10</sup> For comparison, the incidence of childhood acute lymphoblastic leukemia is 3.4 cases per 100 000 persons per year.<sup>11</sup> Although cases of epiglottitis caused by *Streptococcus*, *Staphylococcus*, *Klebsiella*, and other bacteria are seen, these cases are rare, especially in a patient without concerning features. Similarly, for retropharyngeal abscess, the patient had no pain with swallowing or with neck movement, making the pretest probability low. Finally, the patient responded appropriately to the initial administration of steroids, had presenting symptoms of <24 hours' duration, and was not septic appearing, making bacterial tracheitis also highly unlikely.

Guidelines do not recommend routine respiratory viral PCR in croup, except in cases for influenza testing for prophylaxis or cohorting of patients.<sup>5</sup> PCR testing has been shown to decrease the rate of radiographs ordered in the ED but has not been shown to decrease antibiotic use, length of stay in the ED, or blood or urine testing.<sup>12-15</sup> In this case, the swab was collected in the ED and resulted 5 hours later, after nasolaryngoscopy had been performed and the patient had been admitted to the ICU on scheduled intravenous steroids and antibiotics. Although results of the swab were reported after these interventions, the positive result

on the swab helped in de-escalating care over the subsequent hours.

## INDICATIONS FOR AND INTERPRETATION OF LARYNGOSCOPY

Flexible fiber-optic nasolaryngoscopy can afford utility in the evaluation of certain conditions of the nasal airway, nasopharynx, oropharynx, hypopharynx, and larynx such as complicated epistaxis, upper airway foreign body, angioedema, and acquired and congenital laryngeal abnormalities such as paradoxical vocal fold motion disorder, vocal fold immobility, and laryngomalacia.<sup>16</sup> Fiber-optic nasolaryngoscopy is also indicated when there is clinical suspicion of laryngeal edema secondary to an acute process of the head and neck, such as deep neck space infections or laryngeal and/or neck trauma.<sup>17</sup> However, fiber-optic nasolaryngoscopy would be contraindicated if epiglottitis were truly suspected given the risk of agitation leading to loss of airway and death.<sup>18</sup> In croup, fiber-optic nasolaryngoscopy may show edema of the glottis and subglottic region, and this does not equate with a diagnosis of epiglottitis unless the child has impending airway compromise.<sup>19</sup>

## COMMUNICATION AMONG PROVIDERS

Communication among providers at a teaching institution is critical to delivering appropriate care. Studies have revealed that medical errors involving trainees often occur because of a breakdown in teamwork, including issues surrounding communication and handoff.<sup>20,21</sup> Because of the large number of links in the chain of communication at a teaching hospital (ED resident to otolaryngology resident, otolaryngology resident to senior resident, and fellow to attending, then back to ED resident, to ED attending, and PICU attending), there are opportunities for miscommunication. The patient was labeled as "epiglottitis" on the basis of epiglottic inflammation seen on nasolaryngoscopy, but the clinical picture was inconsistent with bacterial epiglottitis. Once this label was applied, historical memory of the severity of epiglottitis led to intensive intervention.

## CLINICAL PATHWAYS

In an effort to improve care in the ED, clinical pathways have been developed. In this case, pathways would not have recommended a radiograph, the results of which led to radical overtreatment of the patient. Because the patient lacked concerning features, an appropriate disposition would have been discharge from the hospital with close follow-up. Clinical pathways are used to help standardize care and have been shown to decrease length of stay and hospital admission, with good parental satisfaction and without reported adverse effects.<sup>22,23</sup> If a pathway had been used in this case, the patient might have been spared unnecessary testing and interventions. According to clinical pathways, if the patient has stridor at rest and 1 other clinical factor, such as retractions, tachypnea, agitation, restlessness, lethargy, or difficulty talking or feeding, then a recommendation is made to give racemic epinephrine. Pathways do not recommend repeat doses of dexamethasone because they have not been shown to have benefit.<sup>24,25</sup> Although this patient would have been well suited to a pathway, it is important to note that pathways do not replace provider judgment. Providers must continually assess patients for response to treatment and decide when it is appropriate to deviate from pathway recommendations.

## FINANCIAL AND OTHER COSTS TO THE PATIENT, FAMILY, AND HEALTH CARE SYSTEM

The costs to the patient and family in this case included the discomfort of flexible nasolaryngoscopy, the pain of venipuncture, the discomfort for a 23-month-old patient of being NPO, and the side effects of intravenous fluids, steroids, and antibiotics, as well as the stress, anxiety, and remarkable expense brought on by admission to the ICU.

Value care includes wise resource allocation and avoiding unnecessary cost to the patient, family, and health care system. ICU admission provides high-value care when needed for critically ill children, but for children who may receive

appropriate care as an outpatient or on the floor, the cost of ICU admission bends the value curve the other way. Authors of a Finnish study found that the cost of ICU admission for infants with bronchiolitis was 4 times greater than admission to the ward and 20 times greater than outpatient management.<sup>26</sup> To quantify the cost of hospital admissions for croup in the United States, annual charges were \$58 million from 1998 to 2010 for parainfluenza virus-associated croup hospitalizations with an average length of stay of 1 day.<sup>27</sup> With health care representing 17.9% of gross domestic product in 2017, physicians have a responsibility to use resources wisely.<sup>28,29</sup>

Parental stress associated with ICU admission is well documented in the literature, including posttraumatic stress symptoms.<sup>30–32</sup> Parents experience stress in the ICU setting even if the child is not the most critically ill. Parents identify the ICU environment, including monitor alarms, venipuncture, and the sheer number of team members as significant sources of stress and anxiety.<sup>33</sup> Finally, this family or the health care system now faces the costs for otolaryngology consultation, laryngoscopy, ICU care, and inpatient treatment, undoubtedly logarithmically higher than the appropriate ED evaluation and discharge from the hospital.

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