

# Current Practice and Rationale of Prescribing Dexamethasone for Pediatric Patients Hospitalized for Asthma

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## ABSTRACT

**Objective:** Dexamethasone use for pediatric asthma exacerbations in the emergency department is supported in literature as a beneficial alternative to prednisone; however, there is limited data in the hospital setting. This study assesses factors that influence pediatric hospital providers' steroid choice for patients hospitalized for status asthmaticus.

**Methods:** A survey was developed to assess factors influencing steroid prescribing practices. It was completed by our institution's pediatric hospitalists and advance practice providers in June 2019 and April 2021. Responses were summarized using descriptive statistics, interrater agreement was analyzed with Cohen's kappa statistic, and bivariate comparisons were analyzed with chi-square tests.

**Results:** Thirty-six of 39 providers completed the survey in 2019; 31 of 43 completed it in 2021. They reported wide disagreement with the use of dexamethasone in both surveys (2019 vs 2021: 34% vs 55% in favor, 43% vs 35% neutral, 23% vs 9% opposing,  $P=0.191$ ). There was a self-reported increase in prescribing frequency of dexamethasone from 2019 to 2021 ( $P=0.007$ ). There was moderate agreement with prescribing dexamethasone for patients with poor oral tolerance or medication noncompliance (2019:  $\kappa=0.485$ ,  $P=0.002$ ; 2021:  $\kappa=0.281$ ,  $P=0.048$ ). There was moderate agreement with prescribing prednisone for patients with higher severity of baseline asthma or current exacerbation (2019:  $\kappa=0.537$ ,  $P<0.001$ ; 2021:  $\kappa=0.500$ ,  $P<0.001$ ). Length of the dexamethasone course did not influence prescribing practices ( $P>0.05$ ).

**Conclusions:** In our inpatient setting, prednisone is preferred for severe asthma cases, while dexamethasone is preferred for patients with poor oral tolerance or medication noncompliance. The length of the dexamethasone course did not influence providers' steroid choice.

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## INTRODUCTION

Asthma is the most common chronic medical condition among children worldwide.<sup>1</sup> In the United States, the prevalence of asthma among children is 8.5% and as high as 18% for children living in poverty.<sup>1</sup> It is the second most common cause of pediatric hospitalizations.<sup>2</sup> Over the span of 4 years, 16.7% of children with asthma had emergency department (ED) visits, and 4.7% were hospitalized for asthma, with the highest rates among children aged 0 to 4 years.<sup>3,4</sup>

Steroids are an essential component for status asthmaticus treatment. The standard of care in children has been a 5-day course of prednisone, with daily dosing because of its relatively short half-life.<sup>5</sup> However, the length of the course, taste, and associated nausea and vomiting side effects of prednisone can lead to noncompliance.<sup>6</sup> Dexamethasone, on the other hand, is relatively long-acting and can be administered as a 2-dose course, with the second dose administered 36 to 48 hours after the first.<sup>5</sup> Dexamethasone is also considered more tolerable than prednisone but may be less commonly available than prednisone

at community pharmacies. Both steroids are usually covered by private insurance and Medicaid. Additionally, dexamethasone is associated with a shorter length of hospital stay and lower health care costs.<sup>5</sup>

Over the past decade, there has been substantive research comparing the use of a 2-dose course of dexamethasone with

the use of prednisone in emergency care-based settings. Two randomized controlled trials found that dexamethasone had similar rates of unscheduled visits to medical facilities for worsening symptoms and similar hospitalization rates from the ED, improved compliance, and fewer side effects when compared to a 5-day prednisone course prescribed in ED settings for patients who were discharged from the ED.<sup>6-9</sup> Additionally, a meta-analysis showed that there was no difference between the 2 steroid courses in ED reutilization or hospital readmission rates up to 30 days after the initial ED visit.<sup>10</sup> In 2016, Children's Wisconsin ED implemented these findings into a new asthma protocol, in which dexamethasone is frequently ordered as a 2-dose course, with the assumption that the patient would be discharged and take the first dose in the ED and the second dose 36 hours later at home. If the patient is hospitalized instead of discharged from the ED, the caregiver sometimes has the second dose of dexamethasone that was provided in the ED.

While there has been extensive research evaluating the efficacy of prednisone and dexamethasone in the ED setting and demonstrating increased compliance with dexamethasone, there is limited evidence regarding the use of dexamethasone in the inpatient setting, where the acuity and severity of disease is often higher. As a result, there is wide variability in hospitalists' prescribing practices for pediatric patients hospitalized for status asthmaticus.<sup>5,11</sup> Currently, only a single small study has explored the factors influencing providers' prescribing practices and contributing to this variability.<sup>11</sup> Our study aims to further investigate the patient- and provider-related factors that influence the medical decision-making process of prescribing dexamethasone versus prednisone in pediatric patients hospitalized for status asthmaticus.

## METHODS

We obtained institutional review board approval for our survey. Survey questions and design were informed by a comprehensive review of existing literature and focused group discussions with 6 physicians in the Pediatric Hospital Medicine Section at Children's Wisconsin, from which a list of factors was identified that may contribute to a provider's choice of prescribing prednisone or dexamethasone for a pediatric patient with status asthmaticus.<sup>6,7,12</sup> A pilot survey was conducted to test the instrument, after which the survey was finalized for distribution.

The anonymous electronic survey was sent to 39 hospitalists in the Pediatric Hospital Medicine section in June 2019 and to 43 hospitalists in April 2021, as a result of provider turnover and new hires. The survey was limited to pediatric hospitalists and advanced practice providers. It did not include pediatric pulmonologists, as patients with status asthmaticus are primarily cared for by hospitalists; patients hospitalized on the primary pulmonology team for asthma typically have other comorbidities—such as cystic fibrosis—resulting in different, individualized treatment plans.

The survey also did not include allergists/immunologists, as they act as consultants at our institution.

The survey assessed the following: providers' years in practice (1-5 years, 6-10 years, more than 10 years), opinions on prescribing dexamethasone, frequency of prescribing dexamethasone, and steroid preference based on patient and institutional factors. Patient factors included smoke exposure in the home, severity of baseline asthma, poor asthma control, history of medication noncompliance, severity of current exacerbation, and poor tolerance of oral medications. Institutional factors included prednisone being the standard of care, the limited evidence level of dexamethasone for inpatient asthma, the availability of dexamethasone at the in-house outpatient pharmacy, whether the caregiver already has a second dose of dexamethasone in their physical possession from the ED, and the length of course of dexamethasone. Some questions were formatted using a Likert scale. Other questions presented respondents with a particular patient factor and offered the choices of "prednisone," "dexamethasone," or "does not influence" their decision.

Survey responses were summarized using descriptive statistics, Cohen's kappa statistic was used to analyze interrater agreement, and bivariate comparisons were analyzed with chi-square tests. Cohen's kappa coefficient was interpreted as follows: slight  $\leq 0.20$ , fair 0.21-0.40, moderate 0.41-0.60, substantial 0.61-0.80, and almost perfect 0.81-1.00. Differences in responses between the 2019 and 2021 surveys were analyzed with a chi-square test. In the instance that a respondent did not complete a question, they were excluded from the analysis of that question. Statistical significance was defined as  $P \leq 0.05$ , and all analyses were performed using SPSS 27.0 (IBM Corp, Armonk, NY).

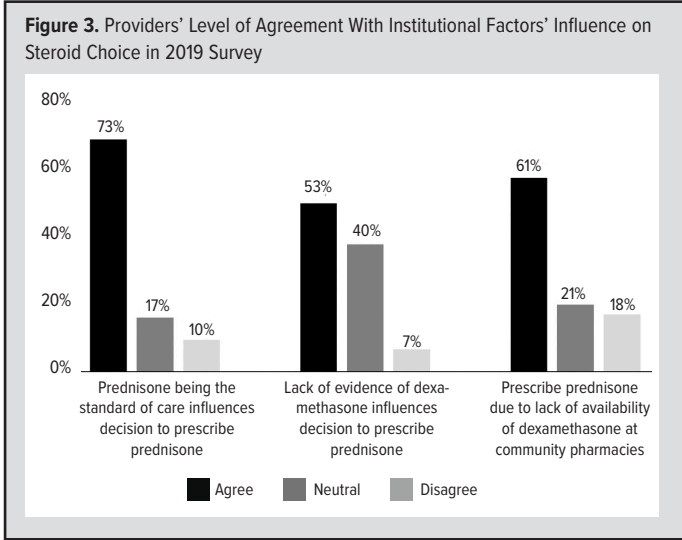
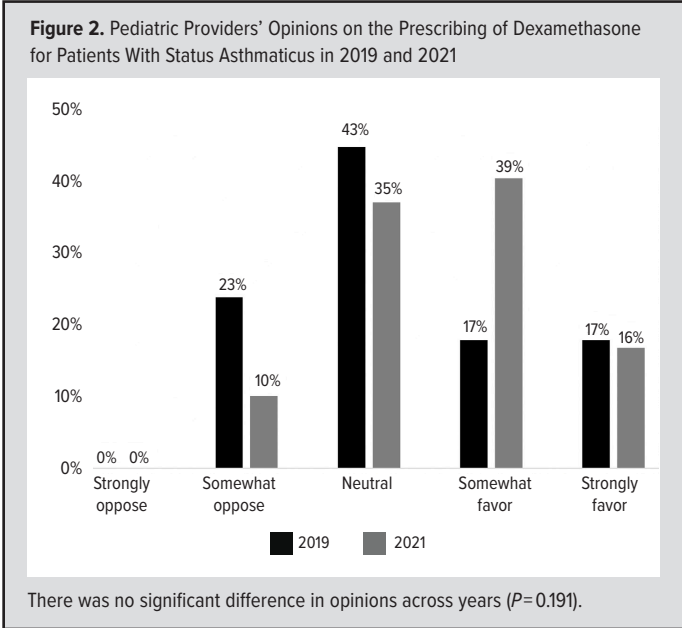
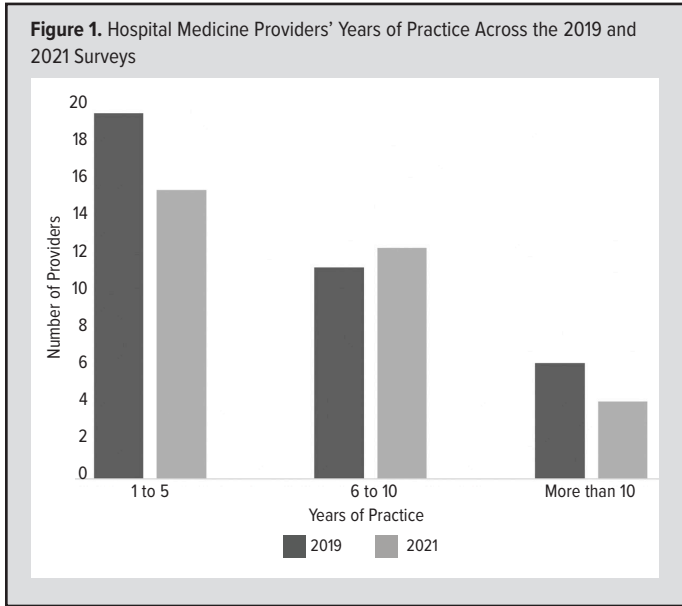
## RESULTS

Thirty-six out of the 39 providers completed the survey sent in June 2019, with a total of 32 hospitalist attendings and 4 advanced practice providers. Thirty-one out of 43 providers completed the survey in April 2021, with a total of 26 attendings and 5 advanced practice providers.

### Providers' Opinions on Dexamethasone

Providers' years of practice across the 2019 and 2021 survey respondents are shown in Figure 1. In the 2019 survey, providers reported wide variability regarding the use of dexamethasone, with 34% in favor, 43% neutral, and 23% opposing (Figure 2). This variability was consistent in 2021, with 55% in favor, 35% neutral, and 10% opposing (Figure 2). There was not a significant difference in this variability between years ( $P=0.191$ ). Additionally, the provider's years of practice did not affect their opinions regarding the use of dexamethasone (2019:  $P=0.887$ ; 2021:  $P=0.065$ ). There was a significant increase in reported prescribing frequency of dexamethasone from 2019 to 2021 ( $P=0.007$ ).

In the 2019 survey, most respondents agreed that the current status of prednisone as the standard of care influences their deci-



sion to prescribe prednisone. Seventy-three percent agreed with this statement, 17% were neutral, and 10% disagreed (Figure 3). Similarly, the lack of evidence of dexamethasone for inpatient use influenced the majority's decision to prescribe prednisone, with 53% in agreement, 40% neutral, and 7% opposing (Figure 3). When asked whether they will prescribe prednisone if the resident physician prefers it, 60% agreed, 37% were neutral, and 3% disagreed. When asked whether they will prescribe dexamethasone if the resident physician prefers it, 43% agreed, 33% were neutral, and 24% disagreed. There were no significant differences in the responses to these questions on the 2021 survey ( $P>0.05$ ).

**Patient Factors**

Smoke exposure in the home was not an influential factor, with over 90% of respondents in both surveys indicating it had no impact on their decision-making. For patients with poor asthma control, there was an increasing preference for dexamethasone in 2021 compared to 2019 (0% vs 19% preferred dexamethasone, respectively;  $P=0.019$ ). Fair-to-moderate agreement between providers was found regarding the decision to prescribe dexamethasone for patients with poor oral tolerance or a history of medication noncompliance (2019:  $\kappa=0.485$ ,  $P=0.002$ ; 2021:  $\kappa=0.281$ ,  $P=0.048$ ). There was also moderate agreement regarding the decision to prescribe prednisone for patients with a more severe baseline asthma classification or with a more severe current exacerbation (2019:  $\kappa=0.537$ ,  $P<0.001$ ; 2021:  $\kappa=0.500$ ,  $P<0.001$ ) (Figure 4).

**Institutional Factors**

Providers were more likely to agree with the use of prednisone due to lack of availability of dexamethasone at community pharmacies, with 61% in agreement, 21% neutral, and 18% in disagreement in 2019 (Figure 3). There was no difference in the responses in 2021 ( $P=0.618$ ). Similarly, providers in 2019 reported that the availability of dexamethasone at the in-house outpatient pharmacy affected their decisions to prescribe dexamethasone, with 39% in agreement, 39% neutral, and 22% in disagreement. Over the last 2 years, there has been significantly increased influence of in-house outpatient pharmacy availability of dexamethasone on prescribing practices, with 72% of providers in 2021 agreeing that this influenced their prescribing decisions ( $P=0.028$ ).

The ED having already provided the patient with a second dose of dexamethasone and the length of the 2-day course of dexamethasone did not significantly influence prescribing practices (2019:  $\kappa=0.147$ ,  $P=0.191$ ; 2021:  $\kappa=0.0066$ ,  $P=0.384$ ), and there were no significant changes in these factors over the 2 years ( $P>0.05$ ).

**DISCUSSION**

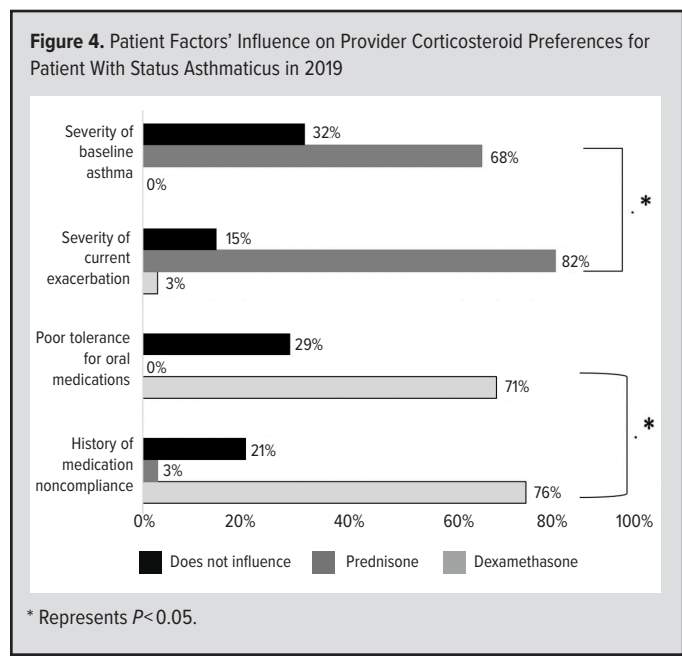
Without specific patient context, pediatric hospitalist providers' general opinions about the use of dexamethasone demonstrates

wide variability, which likely results in inconsistency in patient care. Despite this variability, we have found a significant increase in self-reported prescribing frequency of dexamethasone over the last 2 years. This may be due to increased provider comfort and familiarity with prescribing dexamethasone over time, as well as increased discussions of steroid choice at section meetings and resident teaching conferences as a result of this study. There were no substantial changes in local acute care practice guidelines or available comparative evidence for steroid prescribing practices for pediatric patients with status asthmaticus during this time-frame.

While there was a reported increase in dexamethasone use, prednisone was still preferred for patients with more severe asthma, suggesting that providers are less likely to deviate from the standard treatment for those with a higher severity of illness. Furthermore, hospitalists were more likely to disagree with a resident physician's choice of dexamethasone when compared to prednisone. Survey responses suggest these findings may be due to key reported factors that influence providers' decisions. For example, a hospitalist may disagree with a resident choosing dexamethasone for a patient with severe asthma because they feel prednisone is the standard of care. Similarly, they may disagree with a resident's choice of dexamethasone for a patient with mild persistent asthma because they believe a patient's family may have difficulty accessing dexamethasone at a community pharmacy.

The length of the dexamethasone course was not identified as an influential factor; however, a history of poor oral medication tolerance or medication noncompliance significantly affected the decision to prescribe dexamethasone. This suggests that the providers at our institution are not prescribing dexamethasone specifically because of the shorter duration. It is mainly prescribed as an alternative to prednisone when there are patient factors that conflict with the use of prednisone, such as noncompliance and poor oral tolerance. This correlates with a previous study which showed that children treated with dexamethasone were less likely to vomit in the ED and at home.<sup>5</sup>

Furthermore, institutional factors also played a role in prescribing practices. Dexamethasone had not historically been readily available at many community pharmacies, particularly in pediatric-friendly formulations, which likely influenced the providers' decision to prescribe prednisone. Over the past 2 years, there has been a significant increase in the self-reported frequency of prescribing dexamethasone and the influence of the availability of dexamethasone at the outpatient pharmacy within our hospital, despite no significant changes in dexamethasone availability. This may be due to increased discussions about dexamethasone amongst providers leading to increased comfort and, thus, more usage of the institution's outpatient pharmacy. Additionally, the lack of agreement regarding the continuation of the ED's second dose of dexamethasone demonstrates that there is not a consensus



on whether the evidence supporting the use of dexamethasone in ED settings can be extrapolated to the inpatient setting. This has remained consistent over the past 2 years and is congruent with previous studies that have acknowledged there is limited evidence for the use of dexamethasone for patients hospitalized with status asthmaticus.<sup>13</sup>

To our knowledge, there is only one other study that investigates factors influencing providers' prescribing practices in pediatric patients hospitalized for asthma. Both our survey and a survey by Cotter et al<sup>11</sup> found wide variability in prescribing practices and found that the severity of current exacerbation, history of severe asthma, and limited data of dexamethasone in the inpatient setting affected providers' decisions to prescribe prednisone. Dr Cotter and colleagues' survey did not identify medication tolerability as an influential factor. Our findings, however, demonstrated that in addition to these factors, a patient's history of noncompliance or poor oral tolerance influence providers' decisions to prescribe dexamethasone. This difference may be attributable to the population of respondents, which included hospitalists, pulmonologists, and advanced practice providers. In Cotter et al's study, pulmonologists were less likely to agree with the use of dexamethasone in the inpatient setting, which may account for medication tolerability not being considered an influential factor. Overall, the similar findings of both surveys demonstrate that the variability in prescribing practices for pediatric patients with status asthmaticus is a widespread trend rather than isolated to a single institution.

The wide variability observed in both this study and the previous survey are representative of the significantly limited body of research regarding the use of dexamethasone compared to prednisone in the inpatient setting. Existing literature

has focused primarily on differences in outcomes of patients given dexamethasone versus prednisone in the ED setting, with a small number of studies focusing on the inpatient setting. A systematic review and meta-analysis that included 6 randomized controlled trials and 1 quasi-randomized control trial—all in the ED setting—compared relapse rates with oral dexamethasone versus prednisone.<sup>14</sup> The study concluded that there was no difference in relapse rates between patients prescribed dexamethasone and prednisone. However, the power of this meta-analysis was limited by the small sample size of 3 of the included studies.<sup>14</sup> Additionally, there has been only 1 multicenter retrospective cohort study that investigated the effectiveness of dexamethasone versus prednisone in pediatric patients hospitalized with asthma.<sup>5,11</sup> This study demonstrated that patients who received dexamethasone had a shorter length of stay and a lower cost of admission, with no significant differences in intensive care unit or readmission rates compared to patients who received prednisone. However, this study is limited in that it is an observational study and severity of illness was not included.<sup>5</sup>

Given the results of our survey study and the previously published survey,<sup>11</sup> severity of baseline asthma and current exacerbation are significant factors that affect provider decision-making and prescribing practices. Our study adds to the growing body of literature by demonstrating that not only does a patient's baseline asthma severity and severity of exacerbation influence provider steroid choice, but a patient's history of noncompliance or poor oral tolerance does as well. Additionally, the lack of availability of dexamethasone at community and in-house pharmacies was influential. We also demonstrate an increase in self-reported dexamethasone prescribing practices, which may be due to increased discussions of the topic and, consequently, increased usage of our hospital's outpatient pharmacy. These results demonstrate factors that further contribute to the variability in steroid choice for patients hospitalized with asthma, despite a lack of substantial evidence demonstrating comparative effectiveness.

While this study highlights the practices at our single institution, the matter of steroid choice has become a subject of variability throughout many hospitals across the United States.<sup>5,11</sup> Both the patient and institutional factors that this survey identified can influence patient outcomes, which are subject to this variability. For example, patients with a history of noncompliance may not complete their prednisone course, leading to readmission. Likewise, patients with a history of severe asthma may have a readmission after being prescribed dexamethasone. Further studies are needed to examine the subsequent impact of these steroid prescribing practices on outcomes, such as length of hospital stay, ED reutilizations, and hospital readmissions, in order to bring better consensus and standardization of steroid prescribing for hospitalized patients with status asthmaticus.

## Study Limitations

Limitations of this study include variability in the interpretation of survey questions among respondents, response bias, and conflicting patient factors influencing responses to specific survey questions. For example, providers may consider a patient who has both severe asthma and noncompliance when completing the survey, which may contribute to more variability when deciding between prednisone and dexamethasone. Additionally, while the majority of survey respondents were the same between 2019 and 2021, a few were unique to either survey and responses were not paired due to technological limitations in the first survey. Hospitalist meetings were held in-person in 2019, allowing for promotion of completing the survey. Due to the conversion of nonessential hospital work to virtual in response to COVID-19, promotion to complete the survey was held virtually in 2021, potentially leading to the decreased response rate. This can limit the ability to draw conclusions regarding the change in opinions over time. The results of this survey may not be generalizable as the cohort of respondents are from the Pediatric Hospital Medicine section of a single institution, and there may be variability with patient placement, availability of dexamethasone, and other institutional factors that influence prescribing practices at other institutions.

## CONCLUSION

This study demonstrates that there is wide variability in steroid prescribing practices for inpatient management of status asthmaticus in pediatric patients within 1 institution. Although this variability has remained consistent over the past 2 years, there has been an overall increase in self-reported dexamethasone prescribing frequency. The limited evidence supporting dexamethasone use contributes to this variability, as do a variety of influential patient and institutional factors. These factors include the severity of current exacerbation, severity of baseline asthma, history of medication noncompliance, history of poor oral tolerance, and availability of dexamethasone at community pharmacies.

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