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A Clinical Guideline for the Endoscopic and Medical Management in Children with Recurrent Croup

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Croup is a common respiratory condition seen in the pediatric population that can occur in up to 15% of children typically between the ages of 6 months and 6 years old¹. Croup has a 1.5 times higher incidence seen in boys than girls, with peak incidence seen between 7 months to 36 months^{2,3}. It is frequently caused by a viral infection and manifests as “seal-like” barking cough and respiratory distress. Less commonly, roughly 5% but as high as 6.4% of children experience recurrent croup which is defined as at least 2 episodes of croup or croup-like symptoms^{4,1}. Currently there is not a strict guideline as to when endoscopic procedures like bronchoscopy and laryngoscopy should be pursued in the setting of recurrent croup. Previous studies have linked a history of asthma, gastroesophageal reflux disease (GERD), and intubation among other risk factors in children to recurrent croup and identified those risk factors as possible indications^{5,6}. The objectives of this project are to extend the current understanding of risk factors for recurrent croup and to develop a medical treatment pathway which will utilize risk factors as indicators for the use of endoscopic procedures to identify underlying airway pathologies for recurrent croup in the pediatric population at Lehigh Valley Health Network (LVHN).

The treatment for croup and recurrent croup has evolved over last few decades. The primary management had once been the recommendation of inhalation of humidified air⁸. Since then, multiple studies, including a Cochrane Collaboration review, have shown that children with mild to moderate croup did not improve with inhalation of humidified air^{9,10}. Currently, the use of corticosteroids, mainly the use of oral corticosteroids, has become the new standard management of croup¹¹. Other treatment options include the use of racemic epinephrine and nebulized L-epinephrine^{7,11,12}.

Problem Statement

Currently within the LVHN there is no established pathway indicating when invasive procedures should be consulted in the management of recurrent croup between the pediatricians, pediatric otolaryngologists (ENT), and family medicine physicians. This study builds upon the work of JC Hiebert et al¹³, by incorporating new study data published since their report and aims to use the findings to build LVHN’s own clinical pathway for the management of croup patients.

This project was a designed quality improvement project by Dr. Sri Chennupati of the pediatric ENT department. PubMed database searches were conducted using MeSH terms “recurrent croup” AND “bronchoscopy” OR “endoscopy”. All prospective or retrospective studies on the pediatric population published between 1990 and 2019 were included. Only fully accessible publications were included in this study. Recurrent croup was defined as two or more episodes of croup. A bronchoscopic or endoscopic finding of significance was either deemed significant by the authors or defined as grade II and great subglottic stenosis, requiring surgical intervention, or repeat bronchoscopy for surveillance as established by Jabour et al¹⁴. All relevant published studies were checked for references and citations to ensure all notable studies were included. Any publications that are case reports and/or of non-English language were excluded. The meta-analysis only included studies in which patient risk factors were able to be linked to individual patients (Figure 1). Case reports were excluded from the meta-analysis.

Review Manager 5.4 was used to determine the overall odds ratio and its 95% confidence interval for each risk factor associated with recurrent croup. Sample data was added under dichotomous data type. The inverse variance statistical method was used, with a fixed effect analysis model. Study confidence intervals and total confidence intervals were set to 95%. The studies were sorted by year of study on the forest plots.

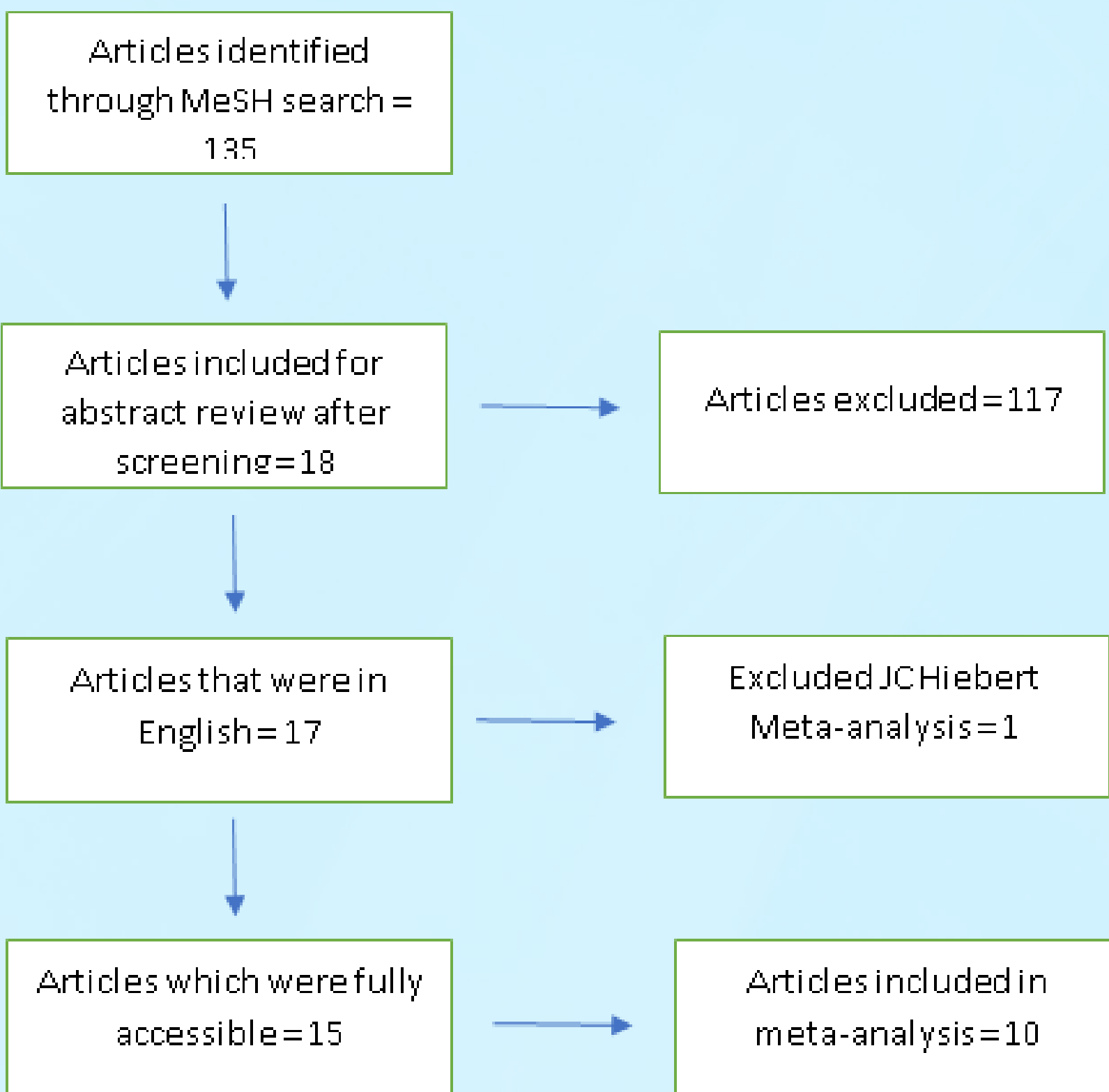


Figure 1: Search strategy

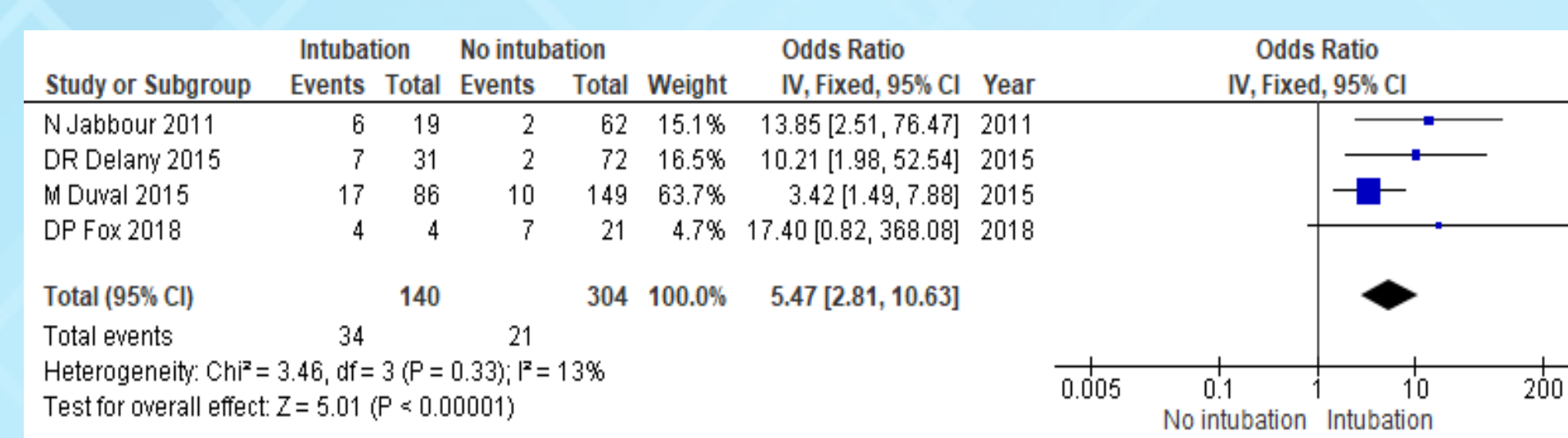


Figure 2 - History of Intubation vs No Intubation, outcome: Significant findings on bronchoscopy.

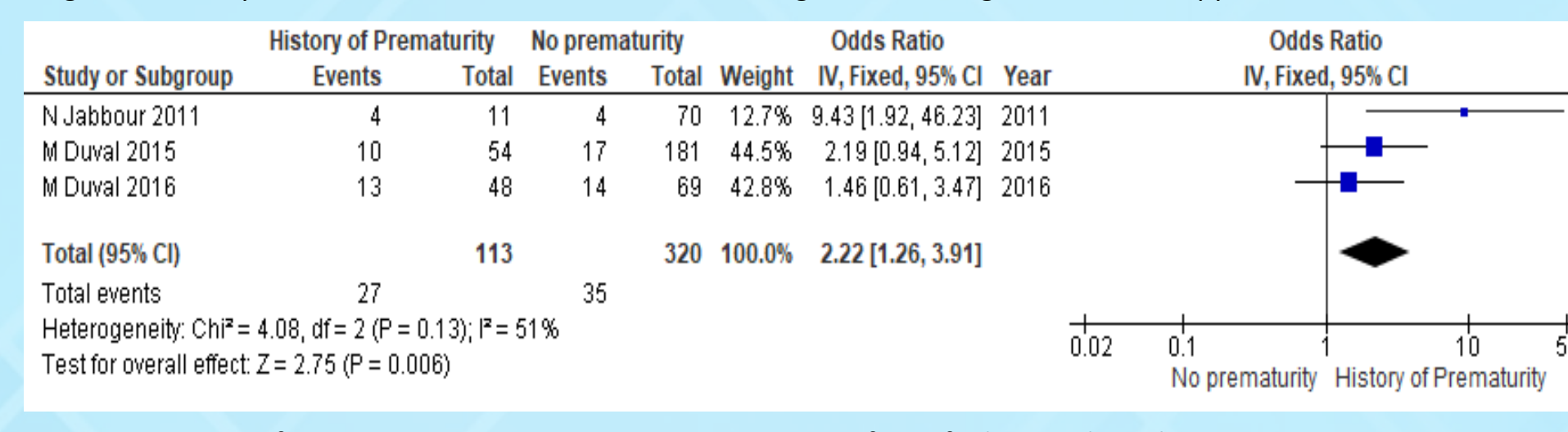


Figure 3 - History of Prematurity vs No prematurity, outcome: Significant findings on bronchoscopy.

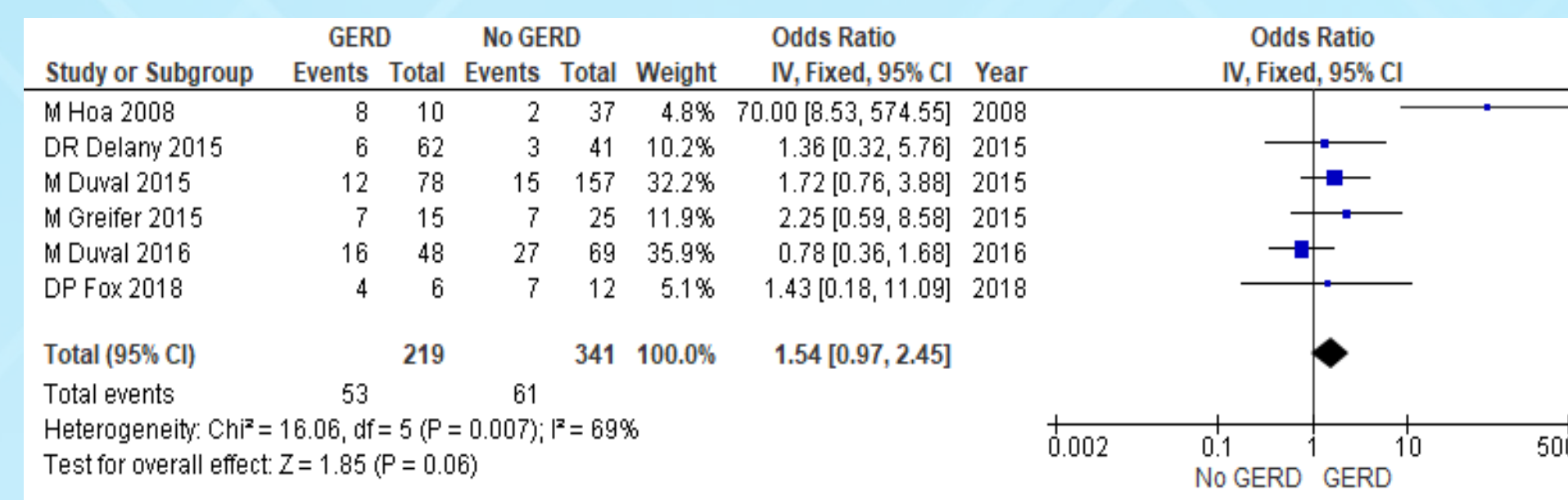


Figure 4 - History of GERD vs No GERD, outcome: Significant findings on bronchoscopy.

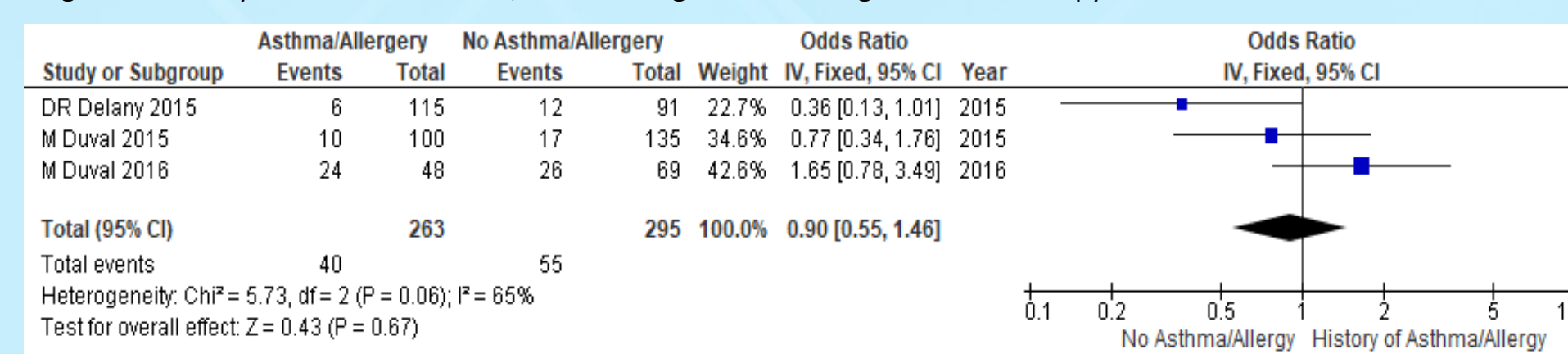


Figure 5 - History of Asthma/Allergy vs No Asthma/Allergy, outcome: Significant findings on bronchoscopy.

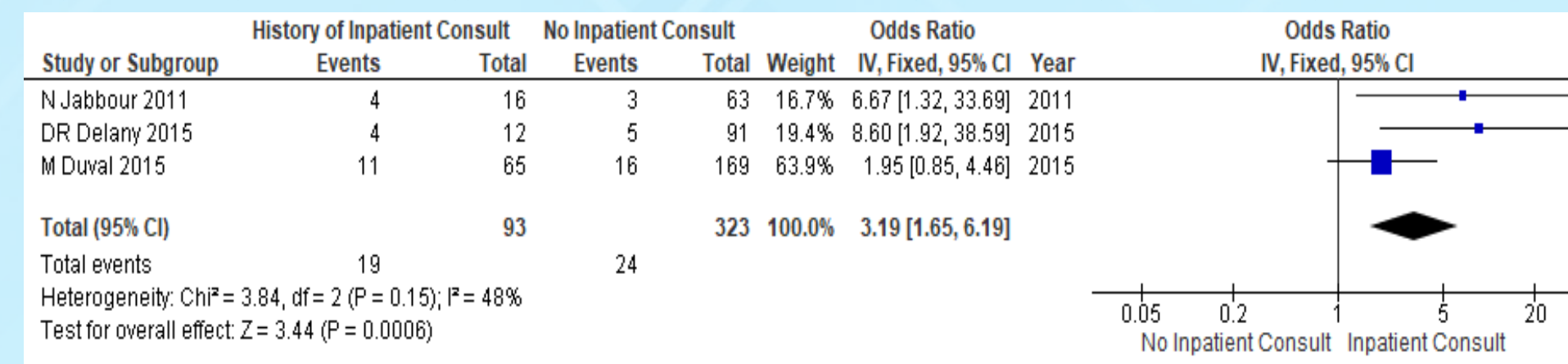


Figure 6 - History of Inpatient Consult vs No Inpatient Consult, outcome: Significant findings on bronchoscopy.

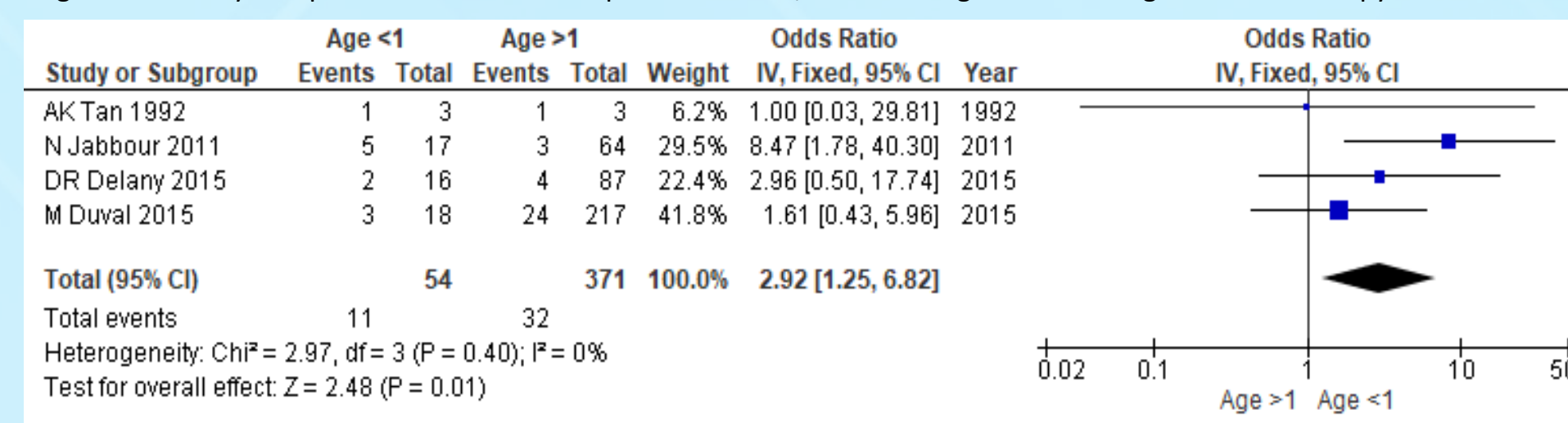


Figure 7 - Age <1 vs Age >1, outcome: Significant findings on bronchoscopy.

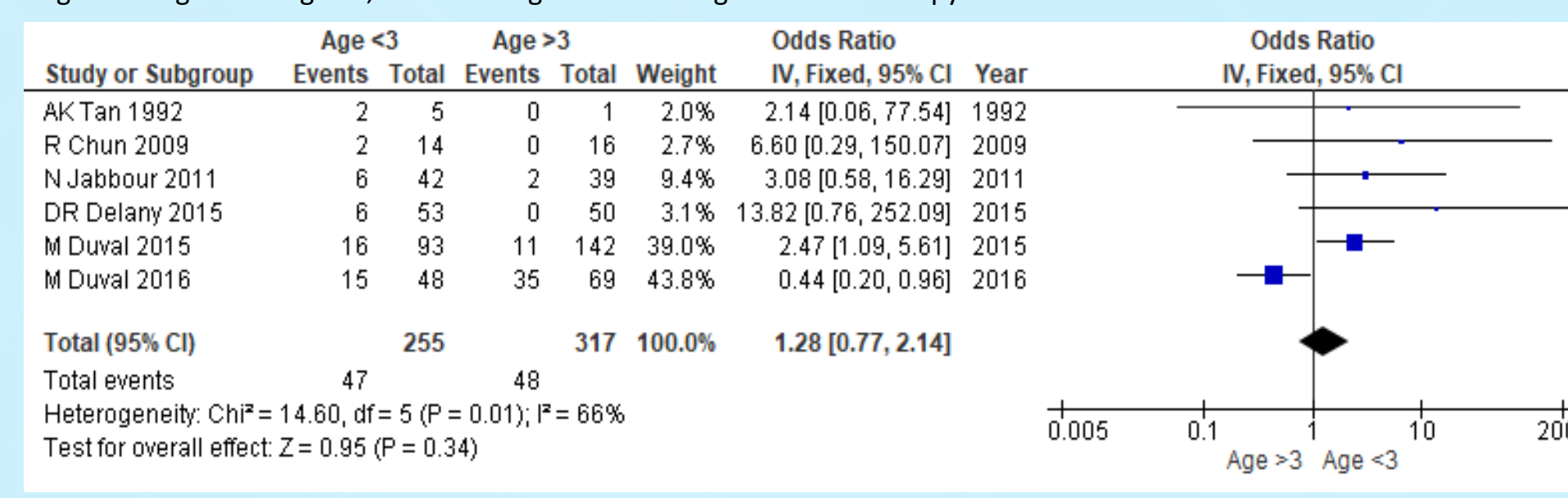


Figure 8 - Forest plot of comparison: Age <3 vs Age >3, outcome: Significant findings on bronchoscopy.

After going through the Pubmed data base using the search parameters as described above, a total of 135 articles were found that was published between 1990 and 2019. Articles were then screened and only those that dealt with pediatric patient population with a history of recurrent croup and have undergone bronchoscopy or laryngoscopy were reviewed. Articles to which there was limited access were excluded. One article published in Russian was excluded. Meanwhile, the article on meta-analysis of croup published by JC Hiebert et al¹³ in 2016 was excluded as this study aims to update the new findings since that publication.

A total of 15 articles was reviewed including 1258 pediatric patients who were diagnosed with recurrent croup and underwent some sort of invasive diagnostic study. Of those 1258 patients, 182 had shown significant finding(s). Meta-analysis was done to study the association between certain pre-procedural risk factors and significant intra-procedural findings. Our data showed that risk factors, including previous intubation [OR = 5.47, 95% CI = 2.81-10.63], history of prematurity [OR = 2.22, 95% CI = 1.26-3.91], history of inpatient consult for croup [OR = 3.19, 95% CI = 1.65-6.19], and patient age <1 [OR = 2.92, 95% CI = 1.25-6.82], are associated with significant procedural findings. A previous history of GERD [OR = 1.54, 95% CI = 0.97-2.45] and Asthma/Allergies [OR = 0.90, 95% CI = 0.55-1.46] did not show statistically significant association. In addition, patient age <3 [OR = 1.28, 95% CI = 0.77-2.14] also did not display statistically significant association to procedural findings.

Based on these new findings and recommendations from LVHN’s own pediatric emergency medicine physician Dr. Susan Yaeger, a clinical management pathway for croup and recurrent croup is proposed (Figure 9). Those patients who have the clinical diagnosis of croup should be assessed for severity according to the Westley scoring system. Mild cases can be managed with outpatient treatment by family medicine, pediatrics, and pediatric ENT, but these patients should be followed up regularly. Those who are scored as moderate or severe croup should be advised to go to the Emergency Department for further assessment. Standard treatment should be given to these patients, who should be checked on once an hour for 2 hours. If patients’ symptoms have been clinically improved and meet discharge criteria, they can be discharged and followed up as outpatients. If patients’ symptoms are not improved and/or meet admission criteria, they should be hospitalized and receive 3 doses of epinephrine treatment. If patients’ conditions are still not improved after treatment with 3 or more doses of epinephrine, or if it is a case of recurrent croup, a pediatric ENT should be consulted. From this point, the pediatric ENT physician can choose to proceed with invasive procedure or reassure the parents depending on whether the patient has certain risk factors with significant associations with endoscopic findings. This clinical pathway is proposed to assist in physician’s clinical decision making. Each patient’s history is unique and then should be considered when making decisions on the best management plan.

The data shows that 182 out of 1258 patients had significant findings on invasive diagnostic studies. This means over 85% of patients underwent unnecessary invasive procedure. In order to better align the current approach to recurrent croup to the SELECT teachings, this report by a multi-disciplinary team of pediatric hospitalist, pediatric otolaryngologist, and pediatric emergency medicine physician led by Dr. Chennupati aims to aid physicians in their decision-making process. With a focus on values-centered patient care, by identifying significant patient risk factors, invasive diagnostic procedures can become targeted towards patients with a higher chance of positive findings, thus sparing pediatric patients from potential unnecessary iatrogenic trauma. By recommending a simple chart review on pediatric recurrent croup patients to identify significant risk factors, the hope is for this process to reduce the number of endoscopic procedures. In the long run, this will not only reduce general healthcare cost for patients, but also improve the overall patient care experience for both the child and their patients.

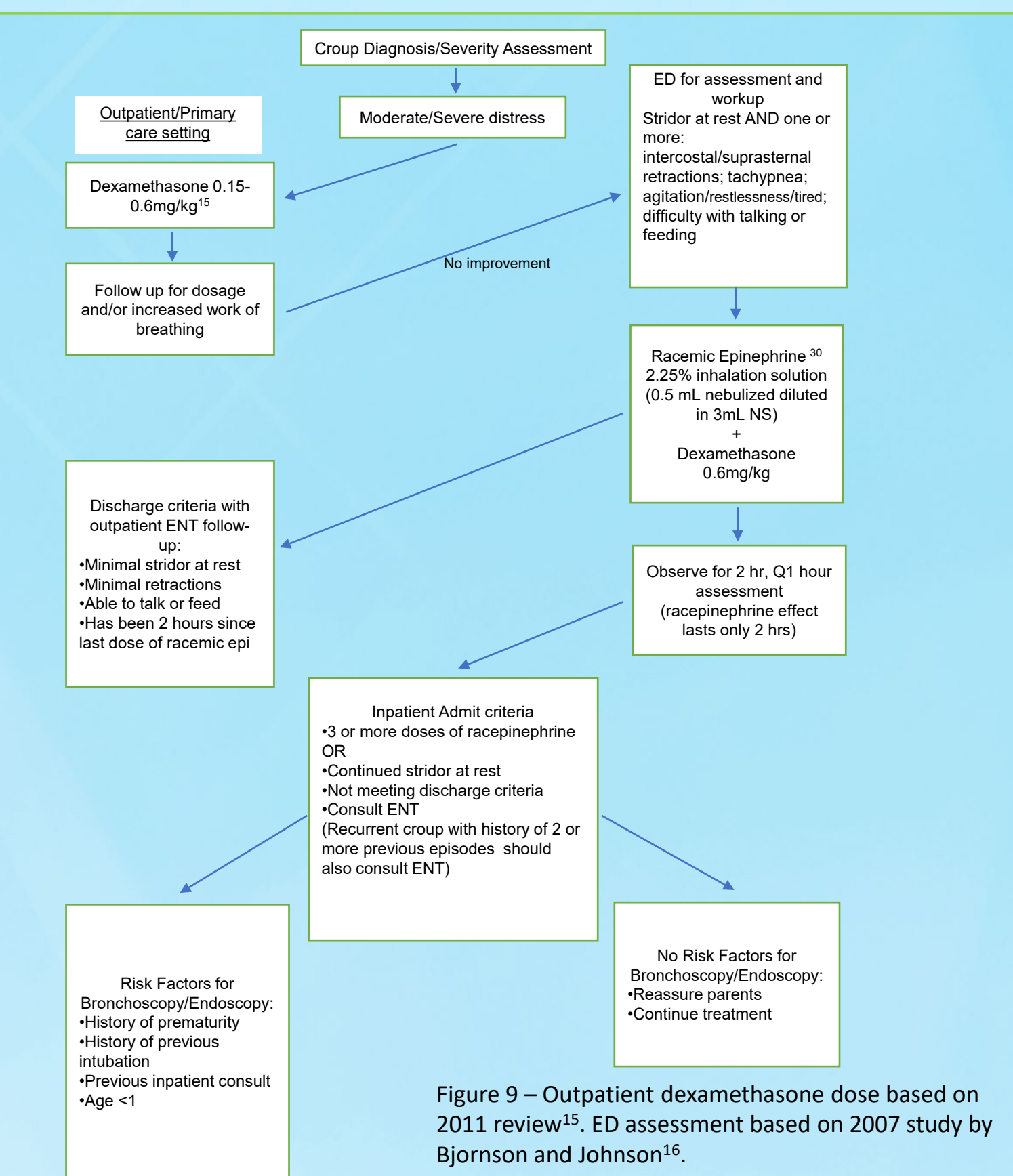


Figure 9 – Outpatient dexamethasone dose based on 2011 review¹⁵. ED assessment based on 2007 study by Bjorsson and Johnson¹⁶.

The chance of any significant finding during an endoscopic exam for recurrent croup is low. Most often, bronchoscopy or laryngoscopy is performed just for the purpose to facilitate a parent’s ease of mind. There should be a higher threshold before considering performing an invasive procedure on a child. Those children with risk factors associated significant endoscopic findings, such as a history prematurity, previous intubation, inpatient consult for croup, and age <1, should be strong candidates for endoscopic procedures. Physicians should utilize these indicators to assist in their clinical decision making when selecting patients for bronchoscopy or laryngoscopy.

An inherent weakness for this study is that all data were originated from outside sources and may not accurately reflect the patient population seen at LVHN. We hope to address this shortcoming with an internal chart review of LVHN pediatric patients with croup and recurrent croup once there has been IRB approval.

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