2026 Clinical Practice Guideline Update by the Infectious Diseases Society of America and the Pediatric Infectious Diseases Society on The Management of Community-Acquired Pneumonia in Infants and Children Older than 3 Months of Age: The Use of Pleural fluid drainage compared to Surgical Debridement

Shawn D. St. Peter[1], Krow Ampofo[2], Thomas Brogan[3], Michael D. Cabana[4], Claudia Espinosa[5], Todd A. Florin[6], Jeffrey S. Gerber[7], Michelle Gill[8], Debra L. Palazzi[9], Mark Sawyer[10], Angela M. Statile[11], Derek J. Williams[12], Sheena Patel[**], Samir S. Shah[14*], Mark I. Neuman[15*]

[1]Children's Mercy Kansas City, Kansas, USA; [2]University of Utah, Utah, USA; [3]University of Washington School of Medicine, Seattle Children's Hospital, Washington State, USA; [4]Division of Academic General Pediatrics, Albert Einstein College of Medicine, New York, USA; [5]Division of Pediatric Infectious Diseases, University of South Florida, Florida, USA; [6]Division of Emergency Medicine, Ann & Robert H. Lurie Children's Hospital of Chicago, Department of Pediatrics, Northwestern University Feinberg School of Medicine, Illinois, USA; [7]Division of Infectious Diseases, Children's Hospital of Philadelphia and Department of Pediatrics, Perelman School of Medicine at the University of Pennsylvania, USA; [8]Divisions of Pediatric Allergy & Pulmonary Medicine and Infectious Diseases, Washington University School of Medicine, Missouri, USA; [9]Division of Infectious Diseases, Texas Children's Hospital and Baylor College of Medicine, Texas, USA; [10]Division of Pediatric Infectious Diseases, UC San Diego School of Medicine, California, USA; [11]Division of Hospital Medicine, Cincinnati Children's Hospital, Ohio, USA; [12]Vanderbilt University, Department of Pediatrics, Tennessee, USA; [13]Clinical Affairs and Practice Guidelines, Infectious Diseases Society of America, Virginia, USA [14]Divisions of Hospital Medicine and Infectious Diseases, Cincinnati Children's Hospital Medical Center, Ohio, USA [15]Division of Emergency Medicine, Boston Children's Hospital, Massachusetts, USA

*co-senior authors, **lead methodologist

ABSTRACT. This paper is part of a larger clinical practice guideline on the diagnosis and management of parapneumonic effusion and empyema in children, developed by the Infectious Diseases Society of America. In this paper, the panel provides recommendations on the choice of pleural fluid drainage by chest tube with fibrinolysis versus mechanical debridement. The panel's recommendations are based upon evidence derived from systematic literature reviews and adhere to a standardized methodology for rating the certainty of evidence and strength of recommendation according to the GRADE (Grading of Recommendations Assessment, Development, and Evaluation) approach.

Key words. Empyema, pediatric, fibrinolysis, decortication

In a child in whom pleural drainage is indicated, should chest tube placement with fibrinolysis be performed in preference to surgical debridement (i.e., Video-assisted thoracoscopic surgery)?

Recommendation In children and adolescents (3 months to 18 years) with pneumonia-associated empyema in whom pleural drainage is indicated, the panel suggests using chest tube drainage and intrapleural fibrinolytics rather than surgical debridement as first-line therapy in most cases *(conditional recommendation, very low certainty of evidence).*

Remark(s):

- While comparative evidence consistently shows similar outcomes after fibrinolysis and surgical debridement, chest tube placement with fibrinolysis is less invasive and less costly. Additionally, it can often be performed as a bedside procedure, eliminating the need for general anesthesia.
- VATS may be reserved for a subset of patients, such as those with extensive loculation and those with refractory disease after chest tube placement with fibrinolysis.

- The decision on the approach to pleural drainage can be influenced by the availability of local resources and personnel.

*A **strong** recommendation means most informed people would choose the recommended course of action and* only a small proportion *would not.*
*A **conditional** recommendation means the majority of informed people would choose the suggested course of action but* many *would not.*

INTRODUCTION

The approach to management of pleural empyema remains an area of debate. The historical recommendation was tube thoracostomy alone, though research has since confirmed the superiority of tube thoracostomy with pleural debridement versus chest tube alone. Options for reducing the burden of pleural empyema include operative (i.e. surgical debridement) or chemical (i.e. infusion a fibrinolytic agent) approaches.

This guideline is part of a larger clinical practice guideline on the diagnosis and management of parapneumonic effusion and empyema in children, developed by the Pediatric Infectious Diseases Society (PIDS) and the Infectious Diseases Society of America (IDSA), and has been endorsed by the Pediatric Infectious Diseases Society (PIDS). This guideline provides recommendations for the choice of pleural fluid drainage by chest tube with fibrinolysis versus surgical debridement. This recommendation reinforces the previous IDSA/PIDS recommendation with additional data [1, 2]. The primary audience for this recommendation is clinicians treating patients with empyema.

METHODS

The panel's recommendations are based on evidence derived from a comprehensive systematic literature review and adhere to a standardized methodology for rating the certainty of evidence and strength of recommendation according to the GRADE (Grading of Recommendations Assessment, Development, and Evaluation) approach [3]. The recommendations are labeled as "strong" or "conditional" according to an evaluation of the certainty of evidence, the balance between benefits and harms, patients' values and preferences, resources/cost, and other factors such as acceptability, feasibility, and equity. More details about the systematic review and guideline development processes are presented in the Supplementary Material.

A comprehensive literature search (through July 2024) was conducted as part of a systematic review. Key eligibility criteria at the topic and clinical question levels guided the search and selection of studies for inclusion. For this question, the panel considered patients 3 months to 18 years of age with parapneumonic effusion defined as empyema. Studies with adult or international populations in resource-limited areas were excluded. Randomized controlled trials and observational studies were screened for inclusion.

Included studies were assessed for risk of bias using the Cochrane Risk of Bias Tool for RCTs and the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-1) tool for observational studies [4, 5]. Where applicable, study outcome data were pooled via meta-analysis using the random effects model

Included studies underwent critical appraisal according to the GRADE approach. An assessment of the benefits and harms of care options informed the recommendation(s) [3]. Details of the systematic review and guideline development processes are available in the Supplementary material.

SUMMARY OF EVIDENCE

A comprehensive search identified a total of 7 (4 randomized, controlled and 3 observational) studies addressing the panel's prioritized outcomes [6-12].

Four randomized controlled trials compared chest tube drainage with fibrinolytics with thoracoscopy [6-9]. All of these studies included children (<18yrs of age) who presented with radiographic evidence of parapneumonic effusion or empyema with indication for drainage. Likewise, three retrospective cohort studies compared VATS debridement with chest tube drainage with fibrinolytics in children [10-12].

Surgical debridement was associated with 1.14 fewer days in the hospital than chest tube drainage with fibrinolytics; however, this difference was not found to be statistically significant (95% CI -3.38 to 1.10) [6-9]. Two observational studies also assessed length of stay, both of which found no significant differences between the surgical debridement and chest tube drainage [10, 11].

The included studies provide conflicting results regarding the need for further intervention. While 3 observational studies reported surgical debridement being associated with fewer subsequent procedures (10.3% vs 24.5%; RR 0.45; 95% CI 0.33-0.60) [10-12], 3 randomized controlled trials found no difference in the pooled risk of undergoing further interventions between surgical debridement and chest tube drainage (17.3% vs 16.8% RR 1.01; 95 CI 0.56 to 1.82) [6, 7, 9].

Surgical debridement was associated with fewer chest tube days (MD -1.9; 95% CI -3.78 to 0.02) but no statistical difference in duration of supplemental oxygen requirement (MD -2.3; 95% CI -6.52 to 1.91).

The overall certainty of the evidence is very low due to serious risk of bias concerns (according to the Cochrane Risk of Bias tool and ROBINS-I tool), as well as issues with imprecision due to the small number of events, a wide 95% CI, and inconsistency with large I-squared values when data was pooled.

RATIONALE FOR RECOMMENDATION(S)

While the included studies demonstrated similar outcomes between surgical debridement and chest tube drainage with fibrinolytics, the panel conditionally suggests chest tube drainage with fibrinolysis over surgical debridement. The panel took into consideration the higher costs associated with surgery as well as the feasibility. Surgical debridement requires general anesthesia and other risks inherent to operative procedures and requires specialized surgical training and expertise exceeding that of thoracostomy. The panel discussed that some hospitals may not have the necessary expertise or resources to perform VATS in children of all ages. Taken together, these factors favor the use of chest tube drainage with fibrinolysis.

IMPLEMENTATION CONSIDERATIONS

The ability to perform a thoracostomy, possibly with sedation, and to administer fibrinolytics on a scheduled basis are required to implement these recommendations.

RESEARCH NEEDS

Further research should help characterize the safety profile of these alternate approaches, particularly since2 interventions, including iatrogenic adverse events that have not been sufficiently assessed for either intervention. There was insufficient evidence to make recommendations for different subgroups.

Acknowledgments: First, the panel would like to acknowledge the previous panel, under the leadership of John Bradley, for their work on the previous iteration of this larger guideline. The panel would like to acknowledge the contributions of Elena Guadagno, medical librarian, for the creation and execution of PICO-specific literature search(es). Rebecca Goldwater and Loretta Dzanya provided project coordination. The panel would also like to acknowledge the following organizations and selected external reviewers for their review of the draft manuscript: the American Academy of Pediatrics (AAP), the Pediatric Infectious Diseases Society (PIDS), Drs. Annabelle De St. Maurice, Jason Newland, Nanda Ramchandar, Pranavi Sreeramoju, and Surabhi (Sara) Vora.

Samir S. Shah is chair of the pediatric CAP guideline panel. Mark Neuman is the vice-chair of the panel. Shawn St Peter and Krow Ampofo served as clinical leads for the questions addressed in this manuscript. Remaining panelists assisted with conception and design of the analysis, interpretation of data, drafting and revising the recommendations and manuscript, and final approval of the recommendations and manuscript to be published. Nigar Sekercioglu and Sheena Patel, methodologists, were responsible for general project management, designing and performing the systematic review, and leading the panel according to the GRADE process.

Financial support. This work was supported by the Infectious Diseases Society of America.

Possible conflicts of interest. Evaluation of relationships as potential conflicts of interest is determined by a review process. The assessment of disclosed relationships for possible COIs is based on the relative weight of the financial relationship (i.e., monetary amount) and the relevance of the relationship (i.e., the degree to which an association might reasonably be interpreted by an independent observer as related to the topic or recommendation of consideration). The following panelists have reported relationships with the indicated companies since 2018, when guideline development began; these relationships are **unrelated to the topic of community-acquired pneumonia (CAP)**. **K.K.A.** served as a scientific advisor for Merck; served as an advisor for Janssen Pharmaceuticals; received research funding from the National Institute of Allergy and Infectious Diseases (NIAID), the Centers for Disease Control and Prevention (CDC), and the State Government of Utah; receives research funding from Merck. **M.D.C.** served as an advisor for BioGaia, Thermo Fisher, Genentech, Novartis, and Nestlé; engaged in activities with the International Scientific Association for Probiotics and Prebiotics (ISAPP); served as a member of the U.S. Preventive Services Task Force (USPSTF); served as chair of the American Academy of Pediatrics Committee on Pediatric Research; received research funding from the Agency for Healthcare Research and Quality (AHRQ). **C.E.** served as an advisor for Sanofi, Janssen Pharmaceuticals, and Gilead; received honoraria from Sanofi, Astellas, the Kentucky Rural Health Association and Medavera for collaboration on the writing and publication

of a manuscript addressing the use of molecular techniques in respiratory infections; received research funding from AstraZeneca, Merck, Enanta Pharmaceuticals, Clinetic, the National Institutes of Health (NIH), Melinta Therapeutics, Novavax, and Moderna; receives research funding from AHRQ, the Florida Department of Health, and CDC; serves as a member of the American Academy of Pediatrics Committee of Infectious Diseases and as a Board Director (District III) for the AAP Florida Chapter. **T.A.F.** received honoraria from DiaSorin and Medscape/WebMD; served in editorial roles with Pediatric Research and Pediatric Emergency Care; served as a council member for the Society for Pediatric Research; received research funding from the National Heart, Lung, and Blood Institute (NHLBI) and the Patient-Centered Outcomes Research Institute (PCORI); served as strategy and operations officer for the Society for Pediatric Research; serves on the Pediatric Academic Societies Board of Directors. **J.S.G.** received research funding from AHRQ, NIH, CDC, and PCORI. **M.G.** served as president of the Society for Pediatric Research; served as a member of the Society for Pediatric Research Board of Directors; served as a member of the Pediatric Academic Societies Board of Directors; served as ambassador for North American Regional Societies for the Society for Pediatric Research; receives research funding from NIAID; receives research funding from the St. Louis Children's Hospital Foundation. **D.L.P.** received royalties from UpToDate; received honoraria from the American Academy of Pediatrics: Pediatrics Review and Education Program (PREP) for Infectious Diseases, JAMA Pediatrics, and UpToDate; received honoraria from Lurie Children's Hospital and the American Medical Association (AMA); received research funding from AHRQ and the Pew Charitable Trusts; owned intellectual property from Elsevier; served as associate editor for the Journal of the Pediatric Infectious Diseases Society (JPIDS) and the American Academy of Pediatrics PREP ID; serves on the Pediatric Infectious Diseases Society (PIDS) Board of Directors and Executive Committee; serves as president of PIDS. **M.S.** received research funding from the County of San Diego Health and Human Services Agency. **A.M.S.** received research funding from PCORI, the Children and Youth with Special Health Care Needs National Research Network (CYSHCNet), and the Gerber Foundation; reported a family relationship in which a spouse served as a consultant for echocardiography study interpretation for the Midwest Cardiovascular Research and Education (MCORE) Foundation. **D.J.W.** received research funding from AHRQ and NIH for work related to the Seattle-based Pediatric Health Information Partnership (P-HIP) initiative aimed at improving pediatric mental health care; serves on the Executive Council for the Pediatric Research in Inpatient Setting (PRIS) Network; serves on the Editorial Board for the Journal of Hospital Medicine; receives research funding from AHRQ and NIH. **S.S.S.** served in editorial roles with JAMA Pediatrics for the American Medical Association; served as senior deputy editor and then editor-in-chief for the Journal of Hospital Medicine for the Society of Hospital Medicine; served as associate editor for the Journal of the Pediatric Infectious Diseases Society; served as a Committee on Infectious Diseases member for the American Academy of Pediatrics; served as vice-chair for Pediatric Research in Inpatient Settings; received honoraria from the Society of Hospital Medicine; received research funding from NIAID, NHLBI, PCORI, and the Ohio Department of Public Health. **M.N.** served as associate editor for Pediatrics for the American Academy of Pediatrics; received research grants from Harvard University; serves as Co-Editor-in-Chief of Pediatric Emergency Care; receives honoraria from Wolters Kluwer for editorial roles with UpToDate and Pediatric Emergency Care; provides medical expert consultation, including medical record review and expert testimony in legal cases for law firms on issues not related to pneumonia.

The following panelists have reported relationships with the indicated companies since 2018, when guideline development began; these relationships are **related to the topic of community-acquired pneumonia (CAP)**. **K.K.A.** served in advisory roles involving patient enrollment for clinical trials with Johnson & Johnson and Merck related to lumicitabine, tedizolid, ceftolozane/tazobactam, and bezlotoxumab (all such relationships are no longer active). **D.L.P.** served on a data safety monitoring board for Pfizer for a trial related to azithromycin; received honoraria from Medscape related to an educational podcast (relationship ended in 2024); owns intellectual property related to educational materials for Elsevier; receives other remuneration from the AMA. **D.J.W.** received research funding from NIH/NIAID for work related to Vanderbilt/ICE-CAP/R01AI125642 and Vanderbilt/VTEU/HHSN272201300023I, CDC for work related to Vanderbilt/NVSN/U01IP001063 and AHRQ for work related to R01HS029331, the Reducing Overuse of Antibiotics with Decision Support (ROADS) study aimed at testing the safety and effectiveness of clinical decision support to promote antibiotic stewardship in lower respiratory tract infections in children; received in-kind research support from bioMérieux for procalcitonin assays related to CAP decision-making (this relationship is no longer active); reported a family relationship in which a spouse is employed by Pfizer and the funds are paid directly to them. **M.N.** served as a member of the Guideline Development Group of the World Health Organization for the Diagnosis and Management of Pneumonia and Diarrhea in Children. **All other authors reported no disclosures**.

Additional Information: More detailed information on the analysis and development of recommendations is available in the Supplementary material.

References

1. Bradley JS, Byington CL, Shah SS, et al. Executive summary: the management of community-acquired pneumonia in infants and children older than 3 months of age: clinical practice guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. Clin Infect Dis **2011**; 53(7): 617-30.
2. Bradley JS, Byington CL, Shah SS, et al. The management of community-acquired pneumonia in infants and children older than 3 months of age: clinical practice guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. Clin Infect Dis **2011**; 53(7): e25-76.
3. Guyatt GH, Oxman Ad Fau - Vist GE, Vist Ge Fau - Kunz R, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. **2008**; (1756-1833 (Electronic)).
4. Higgins JPT, Altman DG, Gøtzsche PC, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ **2011**; 343.
5. Sterne JA, Hernán MA, Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. BMJ **2016**; 355.
6. Marhuenda C, Barcelo C, Fuentes I, et al. Urokinase versus VATS for treatment of empyema: a randomized multicenter clinical trial. Pediatrics **2014**; 134(5): e1301-7.
7. Sonnappa S, Cohen G, Owens CM, et al. Comparison of urokinase and video-assisted thoracoscopic surgery for treatment of childhood empyema. Am J Respir Crit Care Med **2006**; 174(2): 221-7.
8. St Peter SD, Tsao K, Spilde TL, et al. Thoracoscopic decortication vs tube thoracostomy with fibrinolysis for empyema in children: a prospective, randomized trial. J Pediatr Surg **2009**; 44(1): 106-11; discussion 11.
9. Cobanoglu U, Sayir F, Bilici S, Melek M. Comparison of the methods of fibrinolysis by tube thoracostomy and thoracoscopic decortication in children with stage II and III empyema: a prospective randomized study. Pediatr Rep **2011**; 3(4): e29.
10. Griffith D, Boal M, Rogers T. Evolution of practice in the management of parapneumonic effusion and empyema in children. J Pediatr Surg **2018**; 53(4): 644-6.
11. Livingston MH, Colozza S, Vogt KN, Merritt N, Butter A. Making the transition from video-assisted thoracoscopic surgery to chest tube with fibrinolytics for empyema in children: Any change in outcomes? Can J Surg **2016**; 59(3): 167-71.
12. Shah SS, Hall M, Newland JG, et al. Comparative effectiveness of pleural drainage procedures for the treatment of complicated pneumonia in childhood. J Hosp Med **2011**; 6(5): 256-63.