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 Chest Ultrasound in Children with Parapneumonic Effusion

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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 Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. In this paper, the panel provides recommendations for the role of chest ultrasound to evaluate parapneumonic effusion and empyema. 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. Community-acquired pneumonia, parapneumonic effusion, empyema, complicated pneumonia, chest ultrasound, computed tomography

In children with parapneumonic effusion, should chest ultrasound or cross-sectional imaging (i.e., CT, MRI) be used to determine the character and confirm the size of the parapneumonic effusion?

Recommendation: In children with radiographic evidence of a moderate to large parapneumonic effusion, the panel suggests obtaining a chest ultrasound over CT or MRI to characterize the size and complexity of the effusion *(conditional recommendation, very low certainty of evidence)*.

Remarks:

- If chest ultrasound is unavailable, computed tomography (CT) or magnetic resonance imaging (MRI) of the chest may be performed to characterize the size and complexity of the effusion.
- In children with a small parapneumonic effusion, chest ultrasound is generally not recommended.

INTRODUCTION

Parapneumonic effusion refers to a collection of fluid in the pleural space typically associated with pneumonia. A parapneumonic effusion may be uncomplicated, defined as a free-flowing and sterile pleural effusion, or complicated, defined as an effusion that is infected with bacteria or other organisms indicated by a positive culture, positive gram-stain, or evidence of marked inflammation. Parapneumonic empyema is a collection of purulent fluid in the pleural space associated with an underlying pneumonia. The amount and characteristics of pleural space disease inform treatment decision-making. As opposed to free-flowing fluid, collections with septations typically require adjunctive therapy.

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 the Pediatric Infectious Diseases Society (PIDS). This guideline provides recommendations for the radiographic evaluation of parapneumonic effusion and empyema. These recommendations replace previous statements in the initial iteration of this guideline [1, 2]. These recommendations are intended for use by healthcare professionals who care for patients with parapneumonic effusion and empyema.

METHODS

The panel's recommendation is based on evidence derived from a comprehensive systematic literature review and adheres 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 both 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 in the inpatient setting. Studies with adult populations and international populations in resource-limited areas were excluded. Randomized controlled trials and observational studies were screened for inclusion. The full search strategy is available in the Supplementary Material.

We assessed the risk of bias of included studies using the QUADAS-2 tool, following Cochrane DTA guidance [4]. This tool evaluates studies across four domains: patient selection, index test, reference standard, and flow and timing. Each domain was assessed for risk of bias. Judgments were made independently by two reviewers, with disagreements resolved by discussion or a third reviewer.

We conducted data analysis according to the Cochrane Handbook for Systematic Reviews of Diagnostic Test Accuracy guidelines [5]. For each included study, we extracted or reconstructed 2×2 tables (true positives, false positives, false negatives, true negatives) to calculate sensitivity and specificity, along with their 95% confidence intervals.

If the data allowed, we planned subgroup analysis by patient age - less than 5 years, 5 to 13 years, and 14 to 18 years – to determine the accuracy of diagnostic imaging modality per age group.

When appropriate, we used the bivariate random-effects model to generate summary estimates of sensitivity and specificity, accounting for within- and between-study variability and the potential correlation between these two measures. We performed analyses in RevMan Web for conducting the meta-analyses [6]. We assessed heterogeneity visually via forest plots, and explored sources of heterogeneity through subgroup analyses and meta-regression when data allowed.

SUMMARY OF EVIDENCE

A comprehensive literature search identified two observational studies assessing the accuracy of chest ultrasound and computed tomography (CT) in the evaluation of children with complicated pneumonia and parapneumonic effusion [7, 8]. Kurian et al. compared the use of chest ultrasound and chest CT in 19 children, aged 8 months – 17 years old, with complicated pneumonia and parapneumonic effusion [7]. Thareeb et al. evaluated the diagnostic ability of chest ultrasound compared with chest CT in children aged 45 days to 14 years old presenting with clinical signs and symptoms of pneumonia [8]. A total of 48 of these patients presented with complicated pneumonia. In these studies, compared to chest CT (index test), the chest ultrasound sensitivity was 0.94 (95% CI: 0.87-1.00), and specificity was 1.00 (95% CI: 0.40 to 1.00).

The overall certainty of evidence is very low due to risk of bias concerns (according to the QUADAS-2 assessment), along with serious concerns with imprecision of the results [4]. Refer to the Supplementary Material for the GRADE Evidence Profiles which detail the exact judgments affecting certainty of evidence for each outcome.

RATIONALE FOR RECOMMENDATION

For children needing further radiographic evaluation of parapneumonic effusion or empyema, a chest ultrasound typically provides required information that is comparable to chest CT necessary to guide the need for further intervention. If chest ultrasound is not available or results inconclusive, imaging with chest CT using low dose radiation or MRI can be considered.

Compared with other imaging modalities, benefits of chest ultrasound include the lack of radiation exposure, and the ability to perform at the patient's bedside, both for diagnostic monitoring (i.e., serial exams) and for assisting with therapeutic intervention (i.e., drainage). The panel members determined that contextual factors such as resources, feasibility, acceptability and equity for populations and health care systems across the United States probably favors the use of chest ultrasound.

The panel carefully considered a potential subgroup effect across patients from different age groups (i.e., less than 5 years, 5 to 13 years, and 14 to 18 years) and across patient strata with or without complicated pleural effusions; however, the data from the studies did not allow us to perform analysis on these subgroups. Therefore, this recommendation applies to patients between 3 months to 18 years of age with suspected or confirmed pleural effusion.

IMPLEMENTATION CONSIDERATIONS

Ultrasonography is readily available in most hospitals usually with minimal local implementation barriers. Any acute care clinical setting evaluating children with community-acquired pneumonia should be able to either perform a chest ultrasound on a child found to have a pleural effusion on chest radiograph or facilitate referral for additional evaluation.

RESEARCH NEEDS

Although chest MRI can detect complications associated with pneumonia (e.g. abscess/necrosis, consolidations, pleural effusions and empyema) its role requires further study, especially for situations where ultrasound or CT is not available [9].

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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.

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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 file.

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