ABSTRACT

OBJECTIVES: The health care system faces ongoing challenges due to low-value care. Building on the first pediatric hospital medicine contribution to the American Board of Internal Medicine Foundation Choosing Wisely Campaign, a working group was convened to identify additional priorities for improving health care value for hospitalized children.

METHODS: A study team composed of nominees from national pediatric medical professional societies was convened, including pediatric hospitalists with expertise in clinical care, hospital leadership, and research. The study team surveyed national pediatric hospitalist LISTSERVs for suggestions, condensed similar responses, and performed a literature search of articles published in the previous 10 years. Using a modified Delphi process, the team completed a series of structured ratings of feasibility and validity and facilitated group discussion. The sum of final mean validity and feasibility scores was used to identify the 5 highest priority recommendations.

RESULTS: Two hundred seven respondents suggested 397 preliminary recommendations, yielding 74 unique recommendations that underwent evidence review and rating. The 5 highest-scoring recommendations had a focus on the following aspects of hospital care: (1) length of intravenous antibiotic therapy before transition to oral antibiotics, (2) length of stay for febrile infants evaluated with maternal risk factors for sepsis, (3) phototherapy for neonatal hyperbilirubinemia, (4) antibiotic therapy for community-acquired pneumonia, and (5) initiation of intravenous antibiotics in infants with maternal risk factors for sepsis.

CONCLUSIONS: We propose that pediatric hospitalists can use this list to prioritize quality improvement and scholarly work focused on improving the value and quality of patient care for hospitalized children.
The American Board of Internal Medicine Foundation’s Choosing Wisely (CW) campaign was introduced in 2012 in response to high levels of wasteful spending in health care.\textsuperscript{1,2} In 2013, the Society of Hospital Medicine (SHM) participated in the campaign, contributing a list of 5 pediatric hospital medicine (PHM) tests and treatments to be questioned by patients and doctors.\textsuperscript{3} Since initial publication, the CW lists have inspired numerous improvement initiatives,\textsuperscript{4–10} including many in PHM.\textsuperscript{11–16} CW recommendations also informed the creation of benchmarks, guidelines,\textsuperscript{17,18} and studies to better define and measure value.\textsuperscript{19–23}

The prevalence of waste in health care remains a pressing concern today.\textsuperscript{24–26} In the field of pediatrics, health care spending has increased by >50\% in the United States over the past 2 decades,\textsuperscript{27,28} and up to 30\% of this spending is on low-value care practices that prolong hospitalizations and increase use without improving patient outcomes.\textsuperscript{29,30}

In recognition of the ongoing challenges posed by low-value care and building on the original SHM CW effort, the SHM sought to delineate new priorities for improving health care value for hospitalized children. In April 2018, the SHM sponsored the development of a second CW list for PHM with the support of the Academic Pediatric Association (APA) and the American Academy of Pediatrics (AAP). The goal of this proposal and our study was to (1) engage the PHM community to identify additional areas of focus and (2) use a modified Delphi process to prioritize these suggestions and identify 5 new recommendations to improve the value of care provided to hospitalized children.

**METHODS**

**Study Design**

For this study, we used a modified Delphi process,\textsuperscript{31–35} with an expert panel informed by input from the PHM community and published evidence. Delphi processes are designed to incorporate expert opinion over a series of structured anonymous ratings\textsuperscript{31–35} and are commonly used when evidence is sparse, low quality, or conflicting, as is often encountered in pediatrics.\textsuperscript{3,34–38}

**Panelist Nomination and Selection**

A working group composed of nominees from national professional PHM groups (the SHM Pediatrics Special Interest Group [SIG], the AAP Section on Hospital Medicine, and the APA Hospital Medicine SIG) was convened. The leadership of each national professional PHM group reviewed curricula vitae and nomination letters and selected nominees on the basis of administrative, education-based, or research experience working in high-value care. Existing guidance for Delphi panels recommends panel sizes between 6 and 15 to promote sufficient diversity of opinion and to allow for group interaction.\textsuperscript{32,33} Therefore, a 9-member working group, with 3 members representing each organization, and a nonvoting moderator (R.Q.) were selected. Group members included individuals with expertise in clinical research, quality improvement, and administration and with experience in multiple clinical settings, including community and freestanding children’s hospitals and neonatal, acute care, and postoperative surgical care environments.

**PHM Community Engagement and Topic Generation**

Following published guidance for Delphi processes, which typically draw on expert opinion to generate the initial list of recommendations for rating,\textsuperscript{31,32} the working group solicited potential CW recommendations from the PHM community, adapting a previously published approach using an open online survey.\textsuperscript{34} The choice was made to use an open online survey over a targeted survey approach to maximize the potential for engagement from a broad group of pediatric hospitalist stakeholders. A response rate was not used because of low utility in this survey format.\textsuperscript{35} The survey’s free response fields (Supplemental Fig 3) instructed each respondent to suggest up to 4 recommendations that (1) addressed common conditions seen by pediatric hospitalists, (2) were within the scope of influence of a PHM practitioner, (3) had evidence supporting reduced use, and (4) were associated with significant financial, physical, or emotional harm for patients and/or families. The survey was distributed to 5 national e-mail LISTSERVs in the PHM community (List of E-mail LISTSERVs in the Supplemental Information). This project was reviewed by the Colorado Multiple Institutional Review Board and determined to be not human subjects research.

The working group then used an iterative process to condense similar recommendations (Fig 1). During the first round, individual working group members reviewed a subset of recommendations for clarity and excluded recommendations that were undecipherable or pertained to practices that were out of scope for practicing hospitalists. During the second round, the entire working group convened to review recommendations, edit further for clarity, and merge similar recommendations.

**Literature Review**

The working group conducted targeted literature reviews focused on the practices identified in this condensed list of recommendations. Literature searches occurred via PubMed, Medline, and/or the Cochrane database. Searches included keywords from each recommendation (eg, “pneumonia,” “treatment,” etc) and were limited to studies published during the 10 previous years (2009–2019). As part of the literature review, working group members considered studies examining...
prevalence, cost, risk, benefit, and patient outcomes of the identified practices. High-quality study designs were prioritized; however, in keeping with guidance on conducting literature searches for Delphi studies, studies with lower-quality designs were included when literature was limited, with a goal of synthesizing available evidence on a topic. In topic areas in which pediatric literature was nonexistent, working group members were instructed to include select relevant adult studies. The working group reviewed and added to literature reviews on the basis of a review of reference lists, knowledge of key studies, and personal reference libraries. Literature summaries were then generated and distributed to working group members.

**Rating Sessions**

After reviewing the evidence summaries, members of the group rated each of the candidate recommendations for feasibility and validity on a 9-point scale (Fig 2). Two rating rounds were pursued, consistent with previously published adaptations of modified Delphi processes. Working group members submitted the first-round scores independently to the moderator. Anonymized aggregate scores and score distributions for each recommendation were then reviewed during a group conference call, allowing time for discussion. During the call, the group also made additional minor wording modifications for clarity. Panel members independently rated the remaining recommendations and resubmitted these to the moderator. The final score for each recommendation was calculated as the sum of mean feasibility and mean validity scores for the panel. The top 5 recommendations were reviewed by the AAP Executive Committee, representatives from 15 AAP sections and committees, and by the hospitalist sections of the SHM and the APA before final endorsement by these organizations.

**RESULTS**

There were 207 survey respondents, which generated 397 initial recommendations.
Respondents self-identified primarily as practicing hospitalists (195) across a broad geographic range (Table 1). After condensing recommendations, 74 recommendations underwent evidence review. During the modified Delphi process, 8 additional recommendations were merged. The final total validity and feasibility scores for the remaining 66 recommendations were sorted (Supplemental Fig 4) and the highest total scores were used to generate the final 5 recommendations (Table 2), which are presented below with evidence summaries.

### Do Not Prescribe Intravenous Antibiotics for Predetermined Durations for Patients Hospitalized With Infections Such as Pyelonephritis, Osteomyelitis, and Complicated Pneumonia: Consider Early Transition to Oral Antibiotics

Recent studies have revealed that strategies for early transition to oral antibiotics achieve equal or better outcomes for common inpatient infections and are safer than prolonged intravenous antibiotics in children.42-45 The use of intravenous lines, such as peripherally inserted central catheters, which are often necessary for prolonged intravenous antibiotics, can lead to complications, such as clot formation or line infections.46 Line placement may require sedation or anesthesia, which has accompanying risk and costs.47 Also, the pain associated with line placement for intravenous treatments can significantly affect patient experience.48 Antibiotic courses of set durations are often not based on high-quality evidence and ignore individual response to treatments, which can vary significantly from patient to patient.49 Early transition to oral antibiotics based on individual patient clinical and laboratory responses are patient and family centered and improve the value of care for hospitalized children through avoiding pain, reducing adverse events, and reducing length of hospital stay and need for postdischarge home care.

### Do Not Continue Hospitalization in Well-Appearing Febrile Infants Once Results of Bacterial Cultures (ie, Blood, Cerebrospinal, and/or Urine) Have Been Confirmed Negative for 24 to 36 Hours if Adequate Outpatient Follow-up Can Be Ensured

For well-appearing infants 7 to 90 days old admitted with concern for serious bacterial infection, routinely continuing hospitalization beyond 24 hours to confirm negative culture results does not reveal a significant reduction in missed infections. Studies on well-appearing infants reveal a low risk of positive culture results beyond 24 hours.50,51 One retrospective study of 160 818 term infants for whom 4255 blood cultures were collected found that results of only 2% were positive (incidence rate 0.57 in 1000).52 A retrospective study of 1145 infants aged ≤30 days included 1244 blood and 632 cerebrospinal fluid cultures, from which 6 (0.5%) had a time to notification >24 hours.53 In a multicenter retrospective

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**TABLE 1 Survey Results**

<table>
<thead>
<tr>
<th>Respondent demographics</th>
<th>n (%)</th>
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<tbody>
<tr>
<td><strong>Provider type</strong></td>
<td></td>
</tr>
<tr>
<td>Pediatric hospitalist</td>
<td>195 (95)</td>
</tr>
<tr>
<td>Pediatric hospitalist fellow</td>
<td>1 (0.5)</td>
</tr>
<tr>
<td>Advance practice provider</td>
<td>2 (1.0)</td>
</tr>
<tr>
<td>Other</td>
<td>8 (3.9)</td>
</tr>
<tr>
<td><strong>Practice setting</strong></td>
<td></td>
</tr>
<tr>
<td>Children’s hospital</td>
<td>152 (74)</td>
</tr>
<tr>
<td>Community hospital</td>
<td>52 (25)</td>
</tr>
<tr>
<td>Other</td>
<td>1 (0.5)</td>
</tr>
<tr>
<td><strong>Practice location (United States)</strong></td>
<td></td>
</tr>
<tr>
<td>Midwest</td>
<td>58 (28)</td>
</tr>
<tr>
<td>Northeast</td>
<td>33 (16)</td>
</tr>
<tr>
<td>South</td>
<td>61 (30)</td>
</tr>
<tr>
<td>West</td>
<td>54 (26)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommendation categories</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Use categories</strong></td>
<td></td>
</tr>
<tr>
<td>Diagnostic testing</td>
<td>179 (45)</td>
</tr>
<tr>
<td>Medication</td>
<td>96 (24)</td>
</tr>
<tr>
<td>Resource use</td>
<td>62 (16)</td>
</tr>
<tr>
<td>Procedures and interventions</td>
<td>53 (13)</td>
</tr>
<tr>
<td>Other</td>
<td>7 (2)</td>
</tr>
</tbody>
</table>
Do not prescribe IV antibiotics for predetermined durations for patients hospitalized with infections such as pyelonephritis, osteomyelitis, and complicated pneumonia. Consider early transition to oral antibiotics.

Do not continue hospitalization in well-appearing febrile infants once results of bacterial cultures (ie, blood, cerebrospinal, and/or urine) have been confirmed negative for 24–36 h if adequate outpatient follow-up can be ensured.

Do not initiate phototherapy in term or late preterm well-appearing infants with neonatal hyperbilirubinemia if their bilirubin levels are below levels at which the AAP guidelines recommend treatment.

Do not use broad-spectrum antibiotics, such as ceftriaxone, for children hospitalized with uncomplicated CAP. Use narrow-spectrum antibiotics, such as penicillin, ampicillin, or amoxicillin.

Do not use phototherapy in term or late preterm well-appearing infants with neonatal hyperbilirubinemia if their bilirubin levels are below levels at which the AAP guidelines recommend treatment. Do not use broad-spectrum antibiotics, such as ceftriaxone, for children hospitalized with uncomplicated CAP. Use narrow-spectrum antibiotics, such as penicillin, ampicillin, or amoxicillin.

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the development of multidrug-resistant organisms while achieving similar or better outcomes.

**Do Not Start Intravenous Antibiotic Therapy on Well-Appearing Newborn Infants With Isolated Risk Factors for Sepsis, Such as Maternal Chorioamnionitis, Prolonged Rupture of Membranes, or Untreated Group B Streptococcal Colonization; Use Clinical Tools, Such as an Evidence-Based Sepsis-Risk Calculator, to Guide Management**

Early-onset sepsis (EOS) incidence has declined since 1995,59–71; however, it remains a disease with high mortality and morbidity. Previous guidelines recommended universal laboratory testing and antibiotic treatment in at-risk infants.72 Initiating antibiotic therapy often necessitates transferring an infant to a higher level of care, which incurs increased LOS, increased cost, physical separation of the mother and infant, decreased maternal-infant bonding, and increased parental anxiety.73 In addition, a prospective study found that exposure to antibiotics in the first week of life was associated with an increased risk of wheezing disorders by 36 months.74 A 2018 meta-analysis also revealed that antibiotic exposure in infancy is associated with an increased risk of childhood overweight and obesity.75 Antibiotic exposure can also alter the gut microbiome and possibly increase the risk of necrotizing enterocolitis.76

In a 2017 multicenter study, the neonatal EOS risk prediction model was examined in 1.5 million mother-infant dyads, informing the creation of a sepsis-risk calculator.77 Subsequently, the AAP updated its policy addressing EOS78 advising a risk-stratified approach. Systematic reviews, a meta-analysis, and multiple implementation studies have revealed that the use of the sepsis-risk calculator is associated with substantial reductions in antibiotic use (with no increase in missed EOS cases), reduced health care use and cost, and improved bonding and breastfeeding rates.79,80 Given the data supporting the use of evidence-based sepsis-risk calculators, these tools have the potential to improve value for infants with suspected EOS.

**DISCUSSION**

Through a modified Delphi process that leveraged existing literature and input from the PHM community, we identified new priority areas of low-value care. The 5 highest-scoring recommendations focused on the following: (1) length of intravenous antibiotic therapy before transition to oral antibiotics, (2) LOS for febrile infants evaluated for serious bacterial infection, (3)initiation of phototherapy for neonatal hyperbilirubinemia, (4) antibiotic therapy for CAP, and (5) initiation of intravenous antibiotics in infants with maternal risk factors for sepsis. Compared to the initial PHM recommendations,3 which were focused on aspects of hospital care, the new recommendations highlight opportunities to transition patient care out of the hospital sooner and/or avoid hospitalization. The conditions covered in these recommendations rank among the most common and costly reasons for pediatric hospital admission,81 suggesting substantial opportunities for improving the value of care.

These recommendations may reflect a greater awareness in the PHM community of hospitalization as a risk in and of itself. Adverse events occur frequently during pediatric hospitalization, with estimated event rates as high as 26% to 36% of admissions.82–84 The risks of hospitalization are also likely disproportionately borne by Black and Latino children and children from families who possess limited English proficiency, who experience greater rates of adverse events during and after hospitalization.85–88 In addition to safety, families undergo financial burden due to hospitalization, which extends beyond medical expenses.89,90 Safely implementing these recommendations will necessitate engagement and coordination between hospitalists and community pediatricians to transition care back to the community sooner. Transitioning care earlier to the community setting may also require engagement with hospital leadership because the fee-for-service model under which most hospital systems operate91 could be a financial disincentive.

Infections remain a common reason for pediatric hospitalization,91 and there is increasing recognition of the risks of antibiotic overuse. Community-acquired infections due to resistant bacteria have continued to increase.92 Especially in young children, antibiotics-related alterations of the microbiome may have health implications in later childhood, such as allergies, obesity, and asthma.93–95 In addition to concerns about the direct effect of antibiotics, risks related to the mode of administration have emerged, specifically complications due to intravenous therapy, including central-line thrombosis and extravasation.96–98 The new recommendations are focused on reducing or limiting antibiotic exposure in specific clinical scenarios, reflecting an evolving paradigm on the appropriate treatment of infections in hospitalized infants and children. This evolution creates opportunities for reducing the risks of antibiotic therapy while preserving or improving patient outcomes.

The majority of the recommendations is focused on the newborn patient population and reflects a growing understanding of the impacts of overuse in this patient population in whom screening for rare outcomes can lead to overdiagnosis and overtreatment.99–101 The inclusion of these recommendations also reflects the engagement of a broad group of stakeholders in the PHM community and Delphi panel, including those who primarily practice in a neonatal care environment.

There are limitations to the approach we took in creating these recommendations. First, some of the evidence against low-value practices was lower quality, including primarily observational studies. However, the highlighted current practices often possess little or no evidence of improved patient outcomes to support their use and have the potential to cause harm.49,102 The Delphi method also allowed
us to leverage expertise to evaluate recommendations in the face of a paucity of evidence.\textsuperscript{31–33} Second, participation was limited to LISTSERV members; thus, these priorities may not fully reflect the priorities of the entire PHM community. Also, nonphysician, PHM stakeholders were not directly included in this work but would be important for future expansions on this work. This limitation is partially addressed by the creation of a study team that included individuals with clinical experience and practice in a broad range of areas from university-affiliated and community sites as well as neonatal hospitalists. Third, in addition to the top 5 identified, many recommendations on the candidate list (Supplemental Fig 4) had strong validity and feasibility and are important targets for overuse of medical resources. There remains continued need for future iterations of CW to identify how best to prioritize remaining opportunities to reduce overuse.\textsuperscript{103}

Seven years after the original PHM CW recommendations, challenges to widespread adoption remain, and studies have revealed minimal or modest improvements in practice.\textsuperscript{104} Several concepts and methods may facilitate the implementation of these new recommendations. Multicenter quality improvement networks, many of which targeted initial CW recommendations, offer one model for widening the reach of these recommendations. Building quality improvement capacity and offering usable evidence-based tools may protect against backsliding over time.\textsuperscript{108} Implementation science, specifically the field of deimplementation,\textsuperscript{109} also offers opportunities to increase knowledge about the contextual factors, including culture and existing care systems, that influence interventions’ effectiveness and sustainability. Leveraging multisite approaches, increasing the use of rigorous implementation methods, and ongoing study will maximize the impact of these new recommendations.

**CONCLUSIONS**

Through engagement with the PHM community and the use of a modified Delphi process, we identified 5 new practices in PHM that should be questioned by clinicians, patients, and families as potential overuse. We believe these practices highlight opportunities in which there is the greatest feasibility and support from the community, experts, and evidence to reduce waste in PHM. The impact of these recommendations will depend on the PHM community’s response and integration of robust implementation science and quality improvement initiatives in the future. We once again call the PHM community to action to improve the value of care for hospitalized children.

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Choosing Wisely in Pediatric Hospital Medicine: 5 New Recommendations to Improve Value

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Hospital Pediatrics 2021;11;1179
DOI: 10.1542/hpeds.2021-006037 originally published online October 19, 2021;

The online version of this article, along with updated information and services, is located on the World Wide Web at:
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