SPECIAL ARTICLE

Top Articles in Pediatric Hospital Medicine: July 2019 to June 2020

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The last academic year has been filled with discussions of inequality, overuse, and a chance to reflect on our own biases within medicine. As a field, we took a momentous step forward with the first set of physicians qualifying and sitting for the Pediatric Hospital Medicine (PHM) Subspecialty Boards. This event, however, was embroiled with concerns around gender disparities and inequity, sparking petitions signed by thousands of physicians, and calls for accountability and transparency within our systems. Fast forward 4 months and the world was turned upside down in the face of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic. Pediatric hospitalists in locations like New York City converted pediatric units to adult units, precepted internal medicine residents, and within a period of weeks organized the Pediatric Overflow Planning Contingency Response Network. Finally, police violence, killings, and protests have brought systemic racism to the forefront as a public health crisis. We care for children regardless of their cultural backgrounds, gender orientation, and socioeconomic status (SES); as such, we as a community have the chance to play a critical role in instigating change for addressing and uprooting systemic racism.

In this context, we have reviewed with a critical lens articles published from July 2019 through June 2020 to winnow down the expanse of literature over this past 12 months into the Top Articles for PHM (an annual presentation at the PHM conference). In undertaking this endeavor, we reviewed 11 925 articles from 19 journals (Table 1). We conducted this review in 3 steps, detailed in Fig 1. In the first step, we reviewed article titles and eliminated articles on the basis of a series of questions to broadly assess relevance. In the second step, we conducted an abstract review of 918 articles. Given that hospitalists practice in many different settings, we considered the scope of PHM when eliminating articles within the second step. In the third step, we conducted an in-depth full-text review of 163 articles. Each article was categorized, summarized, and then evaluated for strengths and weaknesses. Although the ultimate decisions were subjective, from these articles we chose the final list of top articles.

Below we discuss each of the top articles and its implication to practice.

"GLUCOSE PROFILES IN HEALTHY TERM INFANTS IN THE FIRST 5 DAYS: THE GLUCOSE IN WELL BABIES (GLOW) STUDY" AND "LOWER VERSUS TRADITIONAL TREATMENT THRESHOLD FOR NEONATAL HYPOGLYCEMIA"

The Glucose in Well Babies study by Harris et al[1] is a prospective, observational study of continuous glucose levels for 67 term infants without risk factors for hypoglycemia. Continuous glucose monitors were placed within 1 hour

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of birth and remained in place until 120 hours. In this study, the authors found that 39% of infants had at least 1 serum glucose measurement <47 mg/dL, a commonly accepted threshold for treatment of hypoglycemia in at-risk infants, and 10% had levels <36 mg/dL. No infant required intervention or had an adverse outcome, although infants without risk factors for hypoglycemia have the physiologic ability to respond to low glucose levels when they experience hypoglycemia.

The second study, by van Kempen et al,[2] is a multicenter, noninferiority randomized control trial of 689 neonates born at >35 weeks' gestational age, who had an indication for routine hypoglycemia screening (eg, infant of a mother with diabetes, late-preterm delivery, small or large for gestational age) and a birth weight >2000 g. Infants were randomly assigned 1:1 to either receive treatment at glucose thresholds <36 mg/dL or <47 mg/dL. Outcome measures were (1) psychomotor development at 18 months by the Bayley Scales of Infant and Development and (2) measures of burden, efficacy, and health care use. Infants in the lower treatment threshold group were found to have no difference in cognitive or motor development compared with those in the higher threshold group. In addition, infants in the lower threshold group received fewer glucose measurements and less therapeutic interventions such as nasogastric tube placement or intravenous glucose. No infant in either group experienced clinical signs or symptoms of hypoglycemia, and both groups had similar durations of breastfeeding and length of stay (LOS).

Nearly half of term infants without risk factors for hypoglycemia in the Glucose in Well Babies study experienced glucose levels below standard treatment thresholds for hypoglycemia (47 mg/dL). In addition, at-risk infants within the second study when treated at lower thresholds (37 mg/dL) had fewer interventions without adverse events. Current treatment protocols should be evaluated to reduce unnecessary testing and treatment of infants at risk for hypoglycemia.

"REDUCING VARIABILITY IN THE INFANT SEPSIS EVALUATION (REVISE): A NATIONAL QUALITY INITIATIVE" AND "PATHWAYS FOR IMPROVING INPATIENT PEDIATRIC ASTHMA CARE (PIPA): A MULTICENTER, NATIONAL STUDY"

Biondi et al[3] led a quality improvement (QI) initiative across 124 university and community hospitals to standardize and improve appropriate hospitalization and LOS for febrile infants 7 to 60 days. Through participation in a national QI collaborative, data were collected on >20 000 infants who were evaluated for fever without a source. The Value in Inpatient Pediatrics Network and study team provided hospitalists and emergency department physicians with tools for change management, including data support, mobile applications, webinars, coaching, and a Listserv. Overall, the proportion of patients meeting appropriate hospitalization criteria increased from 75% to 82% during the study period. The proportion of patients meeting appropriate LOS criteria also increased by 15%, without any increases in missed infections. However, even after the intervention, >50% of patients did not meet appropriate LOS criteria.

Also through the Value in Inpatient Pediatrics Network, Kaiser et al[4] led a diverse group of 68 hospitals to improve evidence-based care for 12 000 children hospitalized with asthma exacerbations. Through a learning collaborative model, pathway implementation was associated with higher odds of early metered dose inhaler bronchodilator administration (adjusted odds ratio = 1.18) and caregiver referral to smoking cessation (adjusted odds ratio = 1.93) but was not associated with improvements in LOS.

Translating evidence into bedside practice is challenging and requires context-specific implementation and multidisciplinary collaboration. Participating in national QI collaboratives, however, improves the quality of care for children hospitalized across the spectrum of hospital settings.

"PERFORMANCE OF THE MODIFIED BOSTON AND PHILADELPHIA CRITERIA FOR INVASIVE BACTERIAL INFECTIONS"

In this study, Lyons et al[5] evaluated the diagnostic accuracy of the modified Boston and Philadelphia criteria for well-appearing febrile infants. They conducted a retrospective, cross-sectional study of 10 928 infants 29 to 60 days of life who were evaluated for meningitis across 23 hospitals. Primary outcomes included growth of a pathogenic bacteria in a blood or cerebrospinal fluid culture. Within the cohort, 264 infants (2.4%) had an invasive bacterial infection (IBI) with 71 (0.6%) infants with bacterial meningitis and 198 (1.8%) with bacteremia. When applied retrospectively, the modified Boston criteria misclassified 79 infants with bacteremia or meningitis as low risk, giving a 62.7% sensitivity and 59.2% specificity. Similarly, the Philadelphia criteria misclassified 62 infants with an IBI as low risk, giving a 72.7% sensitivity and 46.1% specificity. Only 4% of infants classified as high risk actually had an IBI.

TABLE 1 Journals Reviewed From July 2019 Through June 2020

Academic Medicine
Academic Pediatrics
BMJ
BMJ Archives of Disease in Childhood
BMJ Quality & Safety
Clinical Pediatrics
Hospital Pediatrics
JAMA
JAMA Pediatrics
Journal of Hospital Medicine
Journal of Pediatrics
Journal of Pediatric Infectious Disease
Lancet
Journal of Medical Education
New England Journal of Medicine
Pediatrics
Pediatric Critical Care Medicine
Pediatric Infectious Disease Journal
Pediatric Quality & Safety

BMJ, British Medical Journal; JAMA, Journal of American Medical Association.

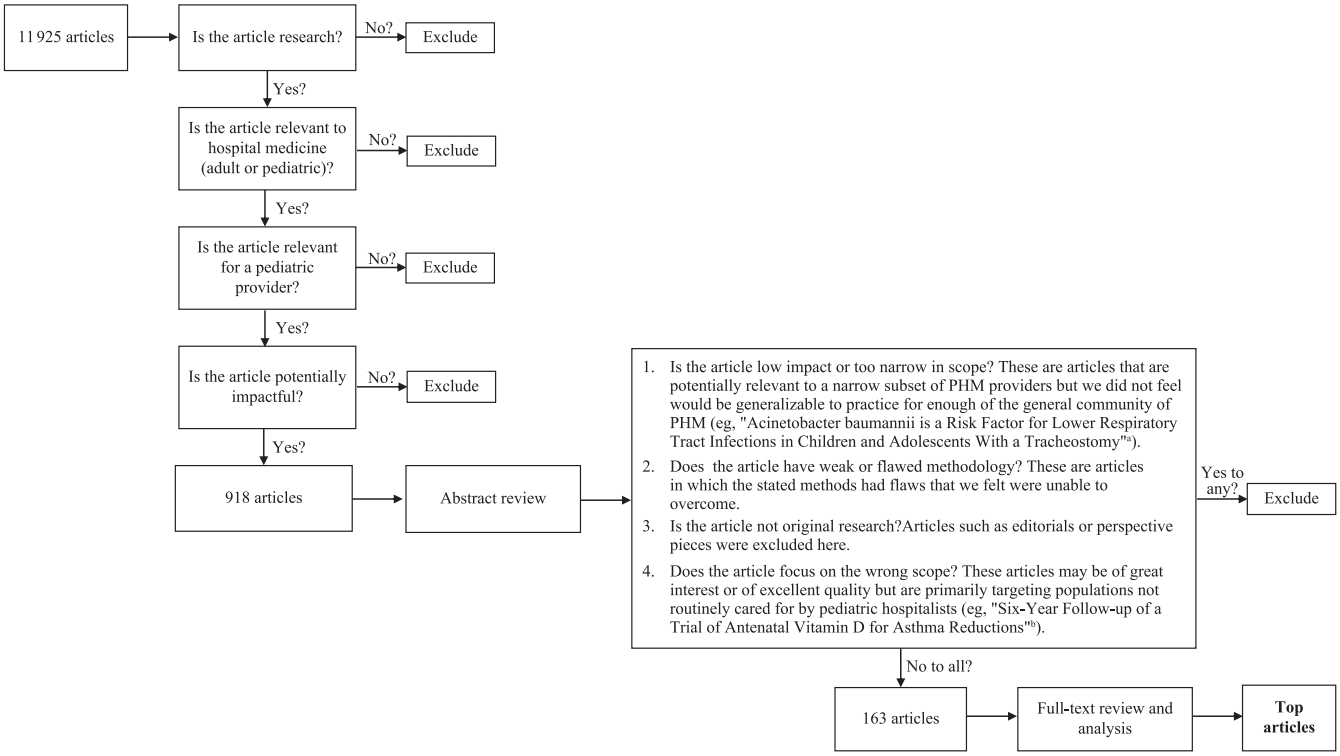

FIGURE 1 Methodology for reviewing and selecting the top articles. [a] Ref 43. [b] Ref 44.

One-third of infants with an IBI were misclassified by using the modified Boston and Philadelphia criteria in this study. The high negative predictive value is driven by low prevalence rather than a high-performing test, and strong consideration should be given to discontinue the use of these 2 criteria. Risk stratifying well-appearing febrile infants is more complicated than a binary determination and although there have been other criteria published since the Boston and Philadelphia criteria that include more modern diagnostics, including procalcitonin, further research using modern biomarkers should be developed to reconceptualize risk stratification in well-appearing febrile infants.

"PREVALENCE OF CONTINUOUS PULSE OXIMETRY MONITORING IN HOSPITALIZED CHILDREN WITH BRONCHIOLITIS NOT REQUIRING SUPPLEMENTAL OXYGEN"

Leading a group of 56 hospitals in the Pediatric Research in Inpatient Settings Network, Bonafide et al[6] conducted a cross-sectional study of pulse oximetry overuse in >3600 observations of nonhypoxemic children admitted during the 2018–2019 viral bronchiolitis season. The results revealed that nearly half of all children hospitalized with viral bronchiolitis remained on continuous pulse oximetry despite being off oxygen. Such results reveal wide variations in pulse oximetry overuse (adjusted overuse rate: 6%–82%) with a substantial proportion of variation at the hospital level.

Given that mild, transient hypoxemia has been revealed to have no long-term negative outcomes and that continuous pulse oximetry prolongs LOS in viral bronchiolitis, future research should be used to examine ways to systematically deimplement this overused technology.

"COST-EFFECTIVENESS OF SCREENING ULTRASOUND AFTER A FIRST FEBRILE URINARY TRACT INFECTION IN CHILDREN AGES 2-24 MONTHS"

In this study, Gaither et al[7] created a decision analytic model to simulate a population of children presenting with a first febrile urinary tract infection (UTI). Building the model on the basis of patients enrolled in the Randomized Intervention for Children with Vesicoureteral Reflux and the Careful Urinary Tract Infection Evaluation trials, they compared the cost-effectiveness of obtaining a renal bladder ultrasound (RBUS) after the first febrile UTI (intervention group) versus waiting until a second UTI (control group) in children ages 2 to 24 months. The recurrent UTI rate was 19.9% within the intervention group and 21.0% in the control group. Ninety-one patients with their first febrile UTI would have to undergo an RBUS to identify 1 patient who had an underlying anomaly that would lead to a recurrent UTI. In addition, 21% of children in the intervention group were subjected to unnecessary voiding cystourethrograms because of false-positives on the screening ultrasound. This unnecessary and invasive testing is reduced by 60% in the control group. Ultimately, the authors found that a screening RBUS after the first febrile UTI in children older than 2 months was not cost effective, even if the cost of obtaining a RBUS was free.

Increasingly, major genitourinary anomalies are diagnosed prenatally, and when scaled to a population level, a screening RBUS after the first UTI is not cost-effective. In children >2 months of age presenting with a first febrile UTI, consider deferring an RBUS unless the child experiences a recurrent UTI.

"A QUALITY IMPROVEMENT INITIATIVE TO REDUCE GASTROSTOMY TUBE PLACEMENT IN ASPIRATING PATIENTS"

Using QI methodology, McSweeney et al[8] aimed to reduce the rates of gastrostomy tube placement in children with oropharyngeal aspiration on videofluoroscopic swallow study. Through creation of an evidence-based guideline, the multidisciplinary team decreased placement by >50% (10.9%–5.2%) that was sustained for >3 years after implementation. This large decrease was also associated with lower rates of hospital reuse (emergency department visits, hospitalizations) and costs.

Gastrostomy tube placement is associated with higher hospitalization rates, costs, and postoperative complications. Many children with oropharyngeal dysphagia and aspiration on videofluoroscopic swallow study may be able to safely avoid gastrostomy tube placement with a standardized criteria and approach. The evidence-based guideline created in this single-center study could be implemented in similar settings with potential improvement in patient outcomes and lower costs.

"IMPACT OF SOCIOECONOMIC STATUS ON OUTCOMES OF PATIENTS WITH KAWASAKI DISEASE"

Retrospectively examining >900 patients hospitalized with Kawasaki disease at one freestanding children's hospital, Dionne et al[9] studied the association between neighborhood SES and quality of care for Kawasaki disease. Those in the lowest SES quartile were more likely to present for treatment later, have intravenous immunoglobulin treatment delayed beyond 10 days, and have longer LOS. In a subgroup of white children (for whom there was sufficient power), those in the lowest SES quartile were associated with future development of large or giant coronary artery aneurysms.

Addressing disparities in SES, including improving access to health care, and removing structural racism barriers may mitigate the lifelong consequences caused by common pediatric diseases, such as Kawasaki disease.

"EFFECT ON PATIENT SAFETY OF A RESIDENT PHYSICIAN SCHEDULE WITHOUT 24-HOUR SHIFTS"

In a multicenter cluster-randomized, crossover trial, Landrigan et al[10] compared serious medical errors made by resident physicians when working shifts ≥24 hours to shifts ≤16 hours in 6 PICUs. In an analysis of 38 821 patient-days, residents working shifts ≤16 hours made 50% more serious medical errors than those working shifts ≥24 hours. However, the rates of serious errors made by residents increased proportionately to resident workload. The relative risk of serious medical errors made by a resident increased by ∼10% per additional patient (relative risk = 1.09). Accordingly, sites with the highest resident-to-patient workloads also experienced the most errors when transitioning from longer to shorter shifts because these further increased the individual resident workload.

Transitioning to shorter shift lengths has serious implications on patient safety if the necessary infrastructure and support is not in place to mitigate the increase in patient workload and volume.

"THE PATIENT EXPERIENCE DEBRIEF INTERVIEW: HOW CONVERSATIONS WITH HOSPITALIZED FAMILIES INFLUENCE MEDICAL STUDENT LEARNING AND REFLECTION"

In this mixed-methods cluster-randomized trial involving medical students from 2 institutions during their core pediatric clerkship, Chua et al[11] evaluated the effect of a patient debrief interview on students' depth of reflection and learning from a given experience. At the completion of their pediatric clerkships, students were asked to write a reflective essay about their experience. Students within the intervention arm during their clerkship used the debrief interview tool to facilitate a conversation between a primary caregiver of a hospitalized patient and themselves. Essays were scored for reflective capacity on the basis of a standardized rubric, and the content was analyzed inductively. Students who conducted the interviews with families to understand their experiences demonstrated higher levels of critical reflection when reflecting on their own clerkship experience and described experiences that were focused more on patient rather than physician or professional development.

Patients are often our best educators. Incorporating an intentional opportunity for students to explore the experience of patients and families can facilitate building a patient-centered lens for students and can be integrated into student curricula across diverse hospital settings.

"GENDER DIFFERENCES IN EARNINGS OF EARLY- AND MIDCAREER PEDIATRICIANS"

In a survey of >1200 early- and midcareer pediatricians across a variety of work settings, Frintner et al[12] explored pay disparities by gender. Unadjusted, women earned $51 000/year less than men. After adjusting for labor force characteristics (eg, years in practice, race and/or ethnicity), specific job characteristics (eg, setting, hours worked, primary specialty), and work-family characteristics (eg, marital status, number of children, part-time status), women still earned $8000/year less than what men earned. By using the fully adjusted pay disparity ($8.000/year) and assuming investment return ranges of 3% to 7%, the earnings disparity may lead to a pretax loss of $400 000 to $800 000 over a 30-year career.

Employers ought to provide (and physicians should demand) transparency about physician pay. Employers should examine and mitigate any pay inequity.

CLINICAL TAKEAWAYS

Beyond the selection of the top articles, in our full review of the 163 articles, we uncovered many other impactful studies, which have implications to practice when taken in context together. This next section highlights 6 areas in which the literature in this past year provides opportunity for further improvement in the care for hospitalized children.

The Discharge Processes and Follow-up for Infants With Prenatal Substance Exposure

Through a holistic approach to discharging infants with neonatal abstinence syndrome that included referrals to a primary care physician, early intervention, in-home nursing, developmental outpatient clinic, and referral to gastroenterology or infectious disease if exposed to hepatitis C, Crook et al[13] increased the percentage of infants receiving all the indicated discharge follow-up from 2.6% to 60.3%. This is particularly important given that only half of infants born to mothers positive for hepatitis C received outpatient testing, leading to an estimated risk of 60% of infants positive for hepatitis C going undiagnosed.[14]

Antibiotic Stewardship for Common Pediatric Illnesses

Antibiotic overuse is seen in children hospitalized with asthma,[15] pneumonia,[16,17] skin and soft tissue infections,[17] and UTIs.[18,19] Infants with suspected early-onset sepsis (EOS) are a key population for whom studies this year have helped decrease antibiotic overuse. Integration and use of the EOS calculator is feasible and safe and reduces antibiotic therapy.[20,21] Repeat physical examination assessments even in newborns with suspected EOS can safely reduce antibiotic use.[22] If antibiotics must be started, consider stopping after 24 hours if the culture results remain negative,[23,24] and if the culture results are positive, consider switching to oral amoxicillin.[25] Lastly, in the context of late-onset sepsis, including infants <32 weeks of age or <1500 g, the sensitivity and specificity of the C-reactive protein is 62% and 74%, respectively.[26] Given the poor test characteristics, we should stop using C-reactive protein to guide decision-making in late-onset neonatal sepsis.

Lumbar Punctures in Febrile Infants <60 Days of Life

Compared to the first week of life, the incidence of IBI drops by 89% at 4 weeks of life.[27] In a subanalysis from REVISE (Reducing Variability in the Infant Sepsis Evaluation), Wang et al[28] demonstrate that well-appearing infants >30 days old with a positive urinalysis result had 0 cases of bacterial meningitis and may not need a lumbar puncture. In a single-center study of infants <30 days with a UTI, Cano and co-workers[29] showed that if the procalcitonin was 0.35 ng/mL, the infant was low risk for bacterial meningitis and proposed that lumbar puncture could be avoided. In addition, afebrile infants with only a history of fever have a lower odds of serious bacterial infections,[30] and a prediction model involving the highest temperature, age, urinalysis, and absolute neutrophil count may help to stratify infants <60 days at low risk of an IBI.[31]

OVERUSE OF HIGH-FLOW NASAL CANNULA IN VIRAL BRONCHIOLITIS

High-flow nasal cannula for bronchiolitis is associated with increased intensive care use,[32] is costly when used early in therapy rather than as a rescue,[33] and does not reveal a lower rate of treatment failure compared to low-flow nasal cannula.[34] These studies should prompt a consideration of the efficacy of high-flow nasal cannula for the treatment of bronchiolitis, particularly with ongoing overuse without clear evidence of effectiveness.

HEALTH DISPARITIES IN HOSPITALIZED CHILDREN AND FAMILIES

Families with limited English proficiency experience barriers in using interpreter services.[35] Families with low health literacy have decreased comprehension of discharge instructions with higher rates of adherence errors.[36] Black, Asian, and Hispanic infants are less likely to receive human donor milk than white non-Hispanic infants.[37] In addition, we can continue to improve on screening for social risk factors for children when hospitalized[38] and asking about firearms and firearm safety in the household.[39]

SARS-COV-2 AND MULTISYSTEM INFLAMMATORY SYNDROME IN CHILDREN

Although the evolving SARS-CoV-2 pandemic spared significant serious respiratory morbidity in children, pediatric hospitalists were on the frontlines of identifying a Kawasaki-like syndrome in children with evidence of previous or recent SARS-CoV-2 infection. Notably, Jones et al[40] published 1 of the first case reports of a 6-month-old infant with SARS-CoV-2/Kawasaki disease in *Hospital Pediatrics* on April 7, 2020. Since this initial case report, larger case series out of Italy revealed a 30-fold increase in Kawasaki and Kawasaki-like illness between February and April 2020 when compared to the previous 5 years.[41] Nearly 80% of patients in the SARS-CoV-2 cohort demonstrate SARS-CoV-2 immunoglobulin M or immunoglobulin G antibodies. These patients were older (mean age 7.5 years), demonstrated more severe illness (eg, cardiac involvement, Kawasaki disease shock syndrome), and required corticosteroid therapy. This new disease, initially called pediatric inflammatory multisystem, was renamed multisystem inflammatory syndrome in children (MIS-C) in May 2020 by the World Health Organization and the Centers for Disease Control and Prevention. In late June, Feldstein et al[42] published a report of 186 patients in the United States diagnosed with MIS-C; of those patients, half received vasoactive support, 20% received mechanical ventilation, and 2% died. Given the rapid evolution of the SARS-CoV-2 pandemic, the true morbidity and mortality for children may not be known for some time. The risk of misdiagnosis of Kawasaki disease in the setting of SARS-CoV-2 and overdiagnosis of MIS-C may subject children to overtreatment and harms.

CONCLUSIONS

As we continue to reflect critically on the literature, we look forward to this next year and the incredible research that will continue to advance our field.

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