Enhancing Care of Young Febrile Infants in Hawai'i: A Quality Improvement Initiative to Reduce Unnecessary Hospitalizations and Procedures

Jannet Lee-Jayaram, MD[1], Benetta Chin, MD[2], Robert Pantell, MD[3], Chieko Kimata, PhD[4], Jhenieve Inouye, BS[5], Eyrica Sumida, BS[6], Anna Ung, BS[6], Cheryl Okado, MD[2]

[1] John A Burns School of Medicine SimTiki Simulation Center, University of Hawai'i at Mānoa, [2] John A Burns School of Medicine Department of Pediatrics, University of Hawai'i at Mānoa, [3] School of Medicine Department of Pediatrics, University of California, San Francisco, [4] Patient Safety and Quality Services Department, Hawai'i Pacific Health, [5] Value-Based Care, Hawai'i Health Partners, [6] John A Burns School of Medicine, University of Hawai'i at Mānoa

Keywords: clinical practice guideline, febrile young infant, invasive bacterial infections, quality improvement

https://doi.org/10.62547/YMXL1170

Hawai'i Journal of Health & Social Welfare

Vol. 84, Issue 6, 2025

Abstract

Young infants under the age of 60 days are at high risk of invasive bacterial infection. Historically, several different criteria were developed to risk stratify this population and guide management yet since then epidemiology of invasive bacterial infection has changed. In 2021, the American Academy of Pediatrics released a clinical practice guideline on the evaluation and management of well-appearing infants aged 8 to 60 days with fever, with subcategories 8-21 days, 22-28 days, and 29-60 days. At the only pediatric hospital in the state of Hawai'i, practices for evaluation and management of infants 22-60 days differed from the published clinical practice guidelines. In 2022, a local quality improvement initiative was implemented in connection to a larger national quality improvement initiative to align the institution's practice with the guidelines, thereby decreasing unnecessary hospitalizations, procedures, and medications. After implementation, the admission rate for infants 22 to 60 days decreased significantly from 19% to 2% (P=.010). Lumbar puncture rates decreased for infants 22 to 60 days from 39 out of 47 (83%) to 12 out of 59 (20%) (P<.0001). There was a significant decrease in the number of infants 29 to 60 days with normal inflammatory markers and normal urinalysis who received antibiotics 74% to 20% (P<.0001). There was no increase in delayed diagnosis of invasive bacterial infection (P=NS). Within one year of implementation, there was significant change in clinical practice with adherence to the clinical practice guideline, resulting in fewer unnecessary hospitalizations, antibiotic administration, and lumbar punctures.

Abbreviations

AAP – American Academy of Pediatrics
CPG – clinical practice guideline
CSF – cerebrospinal fluid
EHR – electronic health record
IBI – invasive bacterial infections
KMCWC – Kapi'olani Medical Center for Women and Children
PED – pediatric emergency department
PEM – pediatric emergency medicine
PHM – pediatric hospitalist medicine
POC – pediatric outpatient care
QI – quality improvement
REVISE II – Reducing Excessive Variability in Infant Sepsis Evaluation II
UTI – urinary tract infection

INTRODUCTION

Young infants under the age of 60 days are at high risk of invasive bacterial infection (IBI) which include bacteremia and meningitis.[1,2] Historically, several criteria were developed to risk stratify this population.[3-5] However, over the past 30 years since these criteria were published, there have been multiple changes affecting their applicability including changing epidemiology of organisms responsible for IBI, more recent investigations documenting the decreasing risk for IBI with increasing infant age, development of a new biomarker called procalcitonin for systemic inflammatory response, and investigations demonstrating that time to detection of most pathogenic bacteria in blood and cerebrospinal fluid (CSF) cultures is within 24 hours.[6-8]

In August 2021, the American Academy of Pediatrics (AAP) released a clinical practice guideline (CPG) on the evaluation and management of well-appearing infants aged 8 to 60 days with fever.[9] Infants were stratified into 3 subgroups, ages 8 to 21 days, 22 to 28 days, and 20 to 60 days, based on their risk for IBI. Inflammatory markers (C-reactive protein, white blood cell count, absolute neutrophil count, and procalcitonin), urinalysis, and CSF fluid analysis were utilized to guide management. The new guidelines represented a departure from the historic criteria in that there was more potential for decreased hospitalization and decreased lumbar punctures in the older sub-groups of infants. Given the risks of hospitalization, outpatient management with good follow-up is preferred when deemed safe. Iatrogenic consequences and psychosocial impacts of hospitalization for both the infant and caregivers include exposure to nosocomial infections, intravenous catheter infiltration, disturbed sleep, disruption to the family unit, stress, and missed work for parents and caregivers.[10-14] Ad-

Table 1. Comparison of KMCWC Historic Practice and 2021 AAP CPG Recommendations for the Evaluation and Management of Well-Appearing Febrile Young Infants

KMCWC historic practice criteria	2021 AAP CPG
Admit infants ≤28 days	Admit infants ≤21 days Potential for no admission in qualifying infants 22 to 28 days
Admit infants 29-60 days old with positive urinalysis	Admit infants ≤28 days old with positive urinalysis Potential for no admission for qualifying infants 29 to 60 days
Lumbar puncture in all febrile infants <60 days old	Lumbar puncture in febrile infants ≤21 days old Potential for no lumbar puncture in qualifying infants 22 to 60 days
Infants 29 to 60 days discharged from the PED receive antibiotics	Potential for no antibiotics in qualifying infants 29 to 60 days

ditionally, from a resource utilization standpoint, avoiding unnecessary admissions can prevent over-crowding and save cost to the system[15-17]

The Kapiʻolani Medical Center for Women and Children (KMCWC) is an urban, university-affiliated tertiary care center and the only children's hospital in Hawaiʻi. The emergency department is staffed by fellowship-trained Pediatric Emergency Medicine (PEM) physicians and is the only dedicated pediatric emergency department (PED) in the state, treating more than 45 000 patients annually.[18] The majority of children hospitalized at KMCWC are cared for by the Pediatric Hospitalist Medicine (PHM) service. Practice at the institution therefore has the potential to affect the majority of Hawaiʻi's pediatric patients.

Prior to the release and widespread practice adoption of the 2021 AAP CPG at KMCWC, well-appearing young infants with fever were evaluated based on historic criteria. In general, febrile infants ⩽28 days were hospitalized, infants 29 to 60 days with positive urinalysis were hospitalized, all infants <60 days underwent a lumbar puncture, and infants 29 to 60 days discharged from the PED received antibiotics. These practices differed from recommendations of the 2021 AAP CPG and are presented in contrast in **Table 1**. Potential root causes are outlined in a fishbone diagram in **Figure 1**.

A quality improvement (QI) initiative was undertaken to align the institution's practice with the 2021 AAP CPG and decrease clinical variation in the care of well-appearing young febrile infants aged 22 to 60 days.

Methods

In May 2022, key stakeholders from the institution's PEM, PHM, Pediatric Outpatient Care (POC) department, local primary care community pediatricians, hospital administration and nursing worked collaboratively to develop and implement a QI initiative with the goal of reducing unnecessary investigations and hospitalizations. The local project was allowed to join the already ongoing national multicenter 103 hospital collaborative QI project sponsored by the AAP Value in Inpatient Pediatrics Network titled Reducing Excessive Variability in Infant Sepsis Evaluation II (REVISE II).[19] REVISE II primary aims were 90% adherence to obtaining appropriate lumbar puncture, appropriate discharge from the emergency department, and appropriate avoidance of antibiotics for infants 29-60 days, and appropriate discharge for hospitalized infants 8-60 days. REVISE II balancing measures were appropriate evaluation in infants 8-21 days and 22-60 days, return visits to the emergency department, readmissions to the hospital, and delayed diagnosis of bacteremia and/or bacterial meningitis. The local project utilized elements of the REVISE II interventional bundle, specifically the educational webinars, electronic health record (EHR) "query data pull," documentation and patient instruction templates, project database to create run charts, and Maintenance of Certification credits. Within 1 year of implementation, the overlapping site-specific aims were to reduce lumbar punctures in appropriately evaluated infants 29 to 60 days by 50% and reduce admission in appropriately evaluated infants 22 to 60 days by 25%. A designee of the Institutional Official of Hawaiʻi Pacific Health determined the project was not research subject to review by an Institutional Review Board (HPHRI Study Number 2022-047).

Behavior change was encouraged utilizing the REVISE II deimplementation frameworks previously described including intentional unlearning, substitution, engaging key stakeholders, encouraging buy-in, and providing audit and feedback.[20] The adopted hypothesis was that implementation of a clinical pathway that leveraged standardized and timely assessment, selective use of diagnostic testing, and optimized patient follow up would enable adherence to the AAP CPG, improve outcomes, cost effectiveness, and patient experience.

Site-specific interventions were as follows. The original 38-page AAP CPG was distilled by 1 author (CO) into a single page algorithm as seen in **Figure 2**, outlining the recommended evaluation and management for the 3 age groups. Local adaptions for a more conservative, expeditious, and simplified approach were made to make the algorithm locally applicable and consensus driven. The AAP CPG had various pathways depending on the availability of the inflammatory marker procalcitonin and results of a bagged urinalysis. The local algorithm differed from the AAP CPG by recommending inflammatory markers at 8 to 21 days, eliminating the option for bag urinalysis due to concern for prolonging PED visits, always including C-reactive protein and temperature >38.5C as primary inflamma-

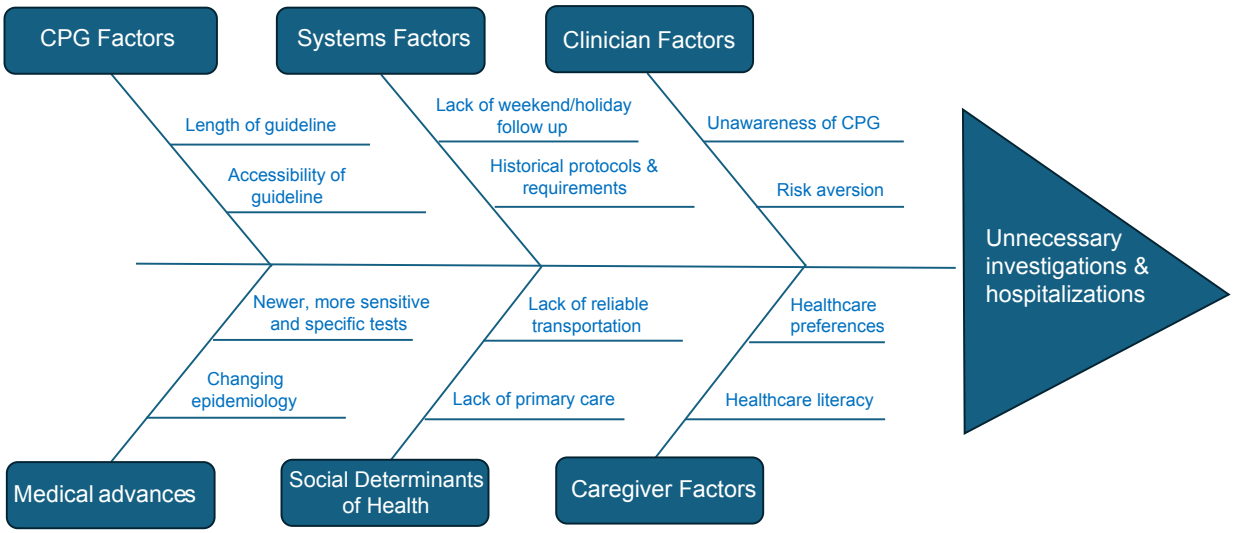

Figure 1. Fishbone Diagram of Potential Pre-Implementation Root Causes Leading to Unnecessary Investigations and Hospitalizations in Well-Appearing Young Febrile Infants

tory markers due to concern for limited procalcitonin availability, and including infants with bronchiolitis.

The flowchart was physically posted in the PED physician work areas. The AAP CPG and local flowchart were presented to various stakeholders at the PED and PHM division meetings, and at the hospital's Quality Council, Standard of Excellence, and Department of Pediatrics meetings. An institutional emergency department guideline outlining the AAP CPG recommended evaluation was created. A locally created educational webinar reviewing the AAP CPG and outlining the implementation plan was presented to the regional accountable care organization. Finally, an official letter was sent to all pediatric providers on the institution's medical staff that included CPG implementation plans, the created flowchart, and a link to the AAP CPG. Providers were advised that more infants may be discharged from the PED and require next day follow-up in their offices. Additionally, given that patients might require outpatient follow-up when primary care community pediatrician offices were closed, arrangements for follow-up to avoid a revisit to the PED were made through the POC clinic.

Data Collection

One year of retrospective pre-implementation data from May 2021 to April 2022 was collected to establish a baseline for the quality measures. Quality outcome measures were metrics that reflect impact of the intervention on the patient and balancing measures were unintended consequences of the intervention. Following pathway implementation, a monthly retrospective audit was conducted from May 2022 to April 2023 to assess both compliance with and performance of this QI initiative. Utilizing programming from the REVISE II EHR "data query pull," a report was generated identifying infants 8 to 60 days with fever who presented to the KMCWC PED.[19] A manual chart review was then conducted. Infants were excluded if they did not have a temperature ⩾38.0C measured in the ED or at home, presented with ill appearance, gestational age <37 weeks, chronic medical condition, focus of bacterial infection, high suspicion for HSV, antibiotic administration in past 48 hours, and vaccination in the past 48 hours.

Quality Outcome Measures

Outcome measure 1 evaluated the rate of hospital admissions, subcategorized by age, 22 to 28 days with normal inflammatory markers and normal CSF fluid analysis and 29 to 60 days with normal inflammatory markers. Infants who met these normal criteria in their age group were eligible for outpatient management. Outcome measure 2 evaluated the rate of lumbar punctures in infants 22 to 28 days with normal inflammatory markers and normal urinalysis and 29 to 60 days with normal inflammatory markers. Infants who met the normal criteria were eligible to not have a lumbar puncture. Outcome measure 3 evaluated the infants 29 to 60 days with positive urinalysis and normal inflammatory markers who were hospitalized. Infants who met these criteria were eligible for outpatient management. Outcome measure 4 evaluated infants 29 to 60 days with normal urinalysis and normal inflammatory markers who received antibiotics before discharge from the emergency room. Infants who met these normal criteria were eligible to not receive antibiotics prior to discharge from the emergency room.

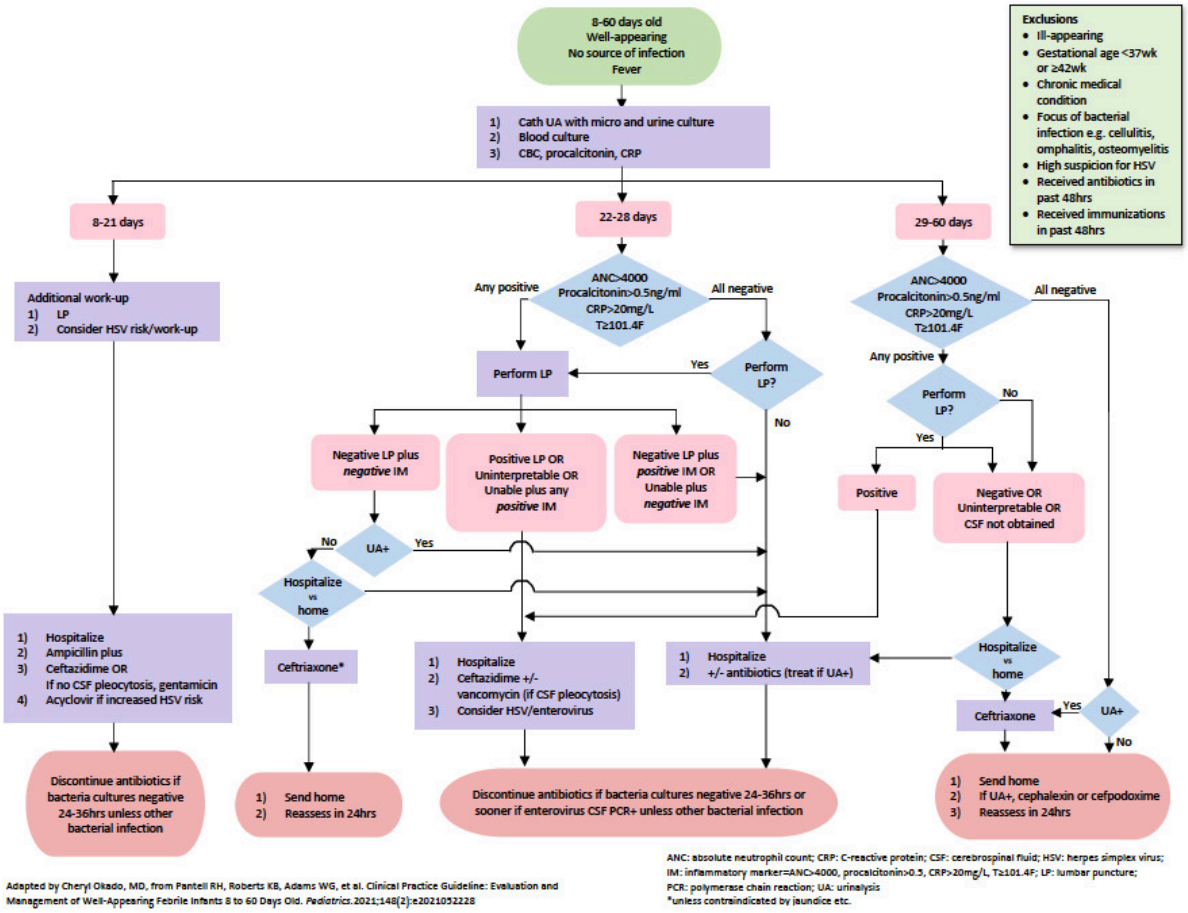

Figure 2. Local Adaptations to AAP CPG Algorithm Flowchart for Evaluation and Management of Well-Appearing Young Febrile Infants

Quality Balancing Measures

Balancing measure 1 evaluated infants 22 to 28 days with normal inflammatory markers, urinalysis and CSF, and 29 to 60 days with normal inflammatory markers discharged from the PED who returned to the PED within 7 days for any reason. Balancing measure 2 evaluated the infants 22 to 60 days without lumbar puncture or without antibiotics who were discharged from the PED or hospital and readmitted within 7 days with bacteremia or meningitis. See Table 2 for summary of quality measures.

Analysis

Demographic data of patients were summarized by descriptive statistics. Frequencies and percentages of these variables were compared between pre- and post-implementation groups using the chi-square test or Fisher's exact test. Statistical Process Control (SPC) charts were created to monitor the monthly rates of hospital admissions and lumbar punctures pre- and post- implementation, followed by a statistical analysis using the Fisher's exact test to compare the differences between the two periods. All statistical analyses were performed using SAS software version 9.4 (SAS Institute Inc., Cary, NC). A two-tailed *P*-value <.05 was considered to be statistically significant.

Results

There were no significant differences in the populations pre- and post-implementation with respect to age, sex, race, and ethnicity. As in Table 3, both pre- and post-implementation, about three-quarters of patients were aged 29-60 days, evenly distributed between male and female sex, 34-44% Native Hawaiian or Pacific Islander, 31-34% Asian, and over 90% non-Hispanic or Latino.

Quality Outcome Measures

Table 4 summarizes the results for quality outcome measures. For outcome measure 1, infants 22 to 28 days with normal inflammatory markers and CSF analysis that were eligible for outpatient management, 0 of 3 infants in the pre-implementation phase and 1 of 2 infants in the post-implementation phase were discharged home (*P*=.40). For infants 29 to 60 days with normal inflammatory markers, hospitalizations decreased significantly from 5 of 40 (13%) in the pre-implementation period to 0 of 50 (0%) in the post-implementation period (*P*=.015). The combined hospi-

Table 2. Local Quality Improvement Initiative for Well-Appearing Febrile Young Infants Outcome and Balancing Measures Descriptions

Quality Outcome Measure	22 to 28 days	29 to 60 days
1. Admission to hospital	Eligible for no admission if: • Normal inflammatory markers • Normal CSF	Eligible for no admission if: • Normal inflammatory markers
2. Lumbar puncture	Eligible for no lumbar puncture if: • Normal inflammatory markers • Normal urinalysis	Eligible for no lumbar puncture if: • Normal inflammatory markers
3. Admission to hospital for UTI	N/A	Eligible for no admission if: • Normal inflammatory markers • Positive urinalysis
4. Antibiotics before PED discharge	N/A	Eligible for no antibiotics if: • Normal inflammatory markers • Normal urinalysis
Quality Balancing Measure	**22 to 28 days**	**29 to 60 days**
1. Return to PED within 7 days	• Normal inflammatory markers • Normal urinalysis • Normal CSF	• Normal inflammatory markers
2. Bacteremia or meningitis	• No lumbar puncture • No antibiotics • Discharged home	• No lumbar puncture • No antibiotics • Discharged home

Table 3. Demographic Characteristics of Well-Appearing Young Febrile Infants Pre- and Post-Implementation of Local Quality Improvement Initiative

Demographic	Pre-implementation n=120		Post-implementation n=143		*P*-value
Age group	**n**	**%**	**n**	**%**	
0-21	15	13%	28	20%	.24
22-28	14	12%	12	8%	
29-60	91	76%	103	72%	
Sex					
Female	63	53%	66	46%	.31
Male	57	48%	77	54%	
Race					
Black	2	2%	4	3%	.27
Asian	37	31%	49	34%	
Native Hawaiian or Pacific Islander	53	44%	48	34%	
White	26	22%	33	23%	
Other	1	1%	2	1%	
Unknown	1	1%	7	5%	
Ethnicity					
Hispanic or Latino	7	6%	7	5%	.80
Non-Hispanic or Latino	110	92%	134	94%	
Unknown	3	3%	2	1%	

tal admission rate run chart for infants 22 to 60 days is in Figure 3 and decreased significantly from 8 of 43 (19%) to 1 of 52 (2%) (*P*=.010).

For outcome measure 2, the number of infants 22-28 days with normal inflammatory markers who received a lumbar puncture was 4 of 5 (80%) pre-implementation, and 2 of 4 (50%) post-implementation (*P*=.52). Infants 29 to

Table 4. Outcome Measures Results Pre- and Post- Implementation of Local Quality Improvement Initiative for Well-Appearing Febrile Young Infants

Age	Outcome 1[a] Hospital Admissions		*P*-value	Outcome 2[b] Lumbar Punctures		*P*-value	Outcome 3[c] Outpatient UTI		*P*-value	Outcome 4[d] Antibiotics		*P*-value
	Pre-	Post-		Pre-	Post-		Pre-	Post-		Pre-	Post-	
22 to 28 days	3 of 3 (67%)	1 of 2 (50%)	.40	4 of 5	2 of 4	.52	N/A	N/A	N/A	N/A	N/A	N/A
29 to 60 days	5 of 40 (13%)	0 of 50 (0%)	**.015**	35 of 42 (83%)	10 of 55 (18%)	**<.001**	0 of 1 (0%)	0 of 3 (0%)	N/A	25 of 43 (74%)	10 of 49 (20%)	**<.001**
22 to 60 days	8 of 43 (19%)	1 of 52 (2%)	**.010**	39 of 47 (83%)	12 of 59 (20%)	**<.001**	N/A	N/A	N/A	N/A	N/A	N/A

Footnote: Workup is as outlined in local adaptations to AAP CPG Algorithm Flowchart in Figure 2.

[a] Hospital admissions in ages 22 to 28 days and 29-60 days with normal age-appropriate workup.

[b] Lumbar punctures in ages 22-28 days with normal inflammatory markers and normal urinalysis and in ages 29 to 60 days with normal inflammatory markers.

[c] Hospital admissions in 29 to 60 days with positive urinalysis and normal inflammatory markers.

[d] Antibiotics given prior to discharge from PED in ages 29 to 60 days with normal inflammatory markers and normal urinalysis.

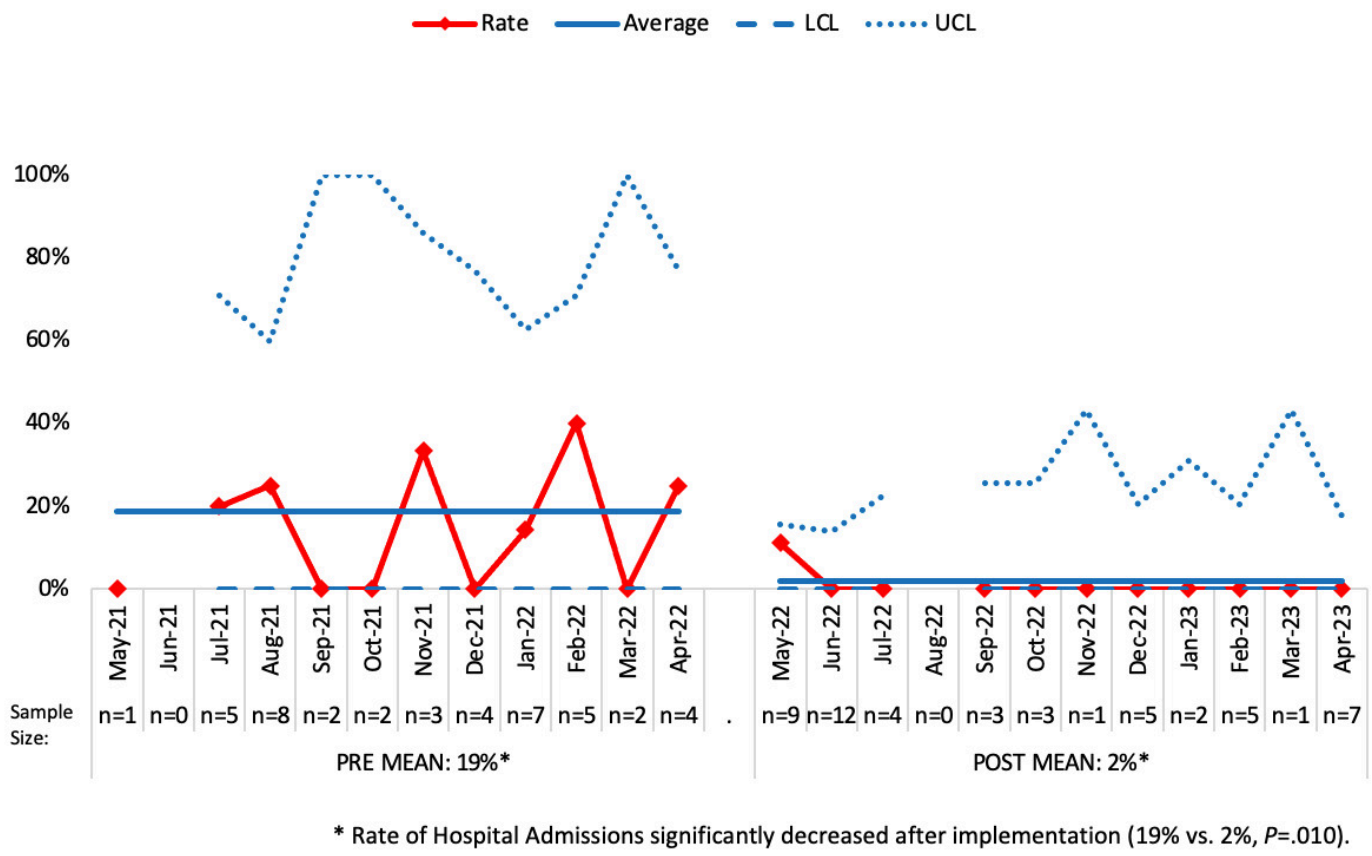

Figure 3. Rate of Hospital Admissions in Well-Appearing Young Febrile Infants Ages 22 to 60 Days Pre- and Post-Implementation of Local Quality Improvement Initiative

60 days with normal inflammatory markers who received a lumbar puncture decreased significantly from 35 of 42 (83%) to 10 of 55 (18%) (*P*<.001). When combined, as seen in **Figure 4**, lumbar punctures decreased for infants 22 to 60 days from 39 of 47 (83%) to 12 of 59 (20%) (*P*<.001).

For outcome measure 3, there was an inadequate number of patients 29 to 60 days with normal inflammatory markers and positive urinalysis to analyze statistically. There was 1 in the pre-implementation phase and 3 in the post-implementation phase; none were admitted.

For outcome measure 4, there was a significant decrease in infants 29 to 60 days with normal inflammatory markers and normal urinalysis who received antibiotics from 25 of 34 (74%) pre-implementation to 10 of 49 (20%) post-implementation (*P*<.001).

Balancing Measures

For return rates to the emergency department within 7 days for any reason, pre-implementation 7 of 35 (20%) and post-implementation 9 of 54 (17%) appropriately evaluated and discharged infants 22-60 days returned to the PED. There was no statistically significant change (*P*=.78).

Regarding delayed diagnoses of bacteremia or meningitis in infants managed in accordance with the guideline, in 22 to 60 days infants, there were 5 total cases of IBI. There was 1 bacteremia/UTI and 1 meningitis in the pre-implementation period versus 1 bacteremia, 1 bacteremia/UTI, and 1 meningitis post-implementation (*P*>.*99*). All of these were treated in a timely fashion.

Discussion

The largest change in the care of young febrile infants locally was in the rate of lumbar punctures performed in the 29 to 60 days age group from 83% to 18%. This is in keeping with REVISE II results where the primary aim of appropriately not obtaining a lumbar puncture had the highest adherence at 92.4%.[19] Lumbar punctures are painful procedures for infants, anxiety provoking for parents, and a frequent basis for unnecessary hospitalizations. Obtaining CSF in young infants is challenging as only 45% to 66% of lumbar punctures are successful on the first attempt and rates of unsuccessful or traumatic lumbar puncture in this age group have been reported to be as high as 18.6% to 23%.[21-23] Traumatic or unsuccessful lumbar punctures increase hospitalization rate 3 times compared to normal lumbar punctures.[21] Furthermore, even when CSF is successfully obtained, false positives can cloud clinical decision making. When combining the CSF results of 3 separate studies of young febrile infants, only 53 of 497(10.7%) positive bacterial cultures were pathogens.[24-26] Consequently, the elimination of a lumbar puncture is of direct benefit to the infant as well as with respect to workflow and resource utilization.

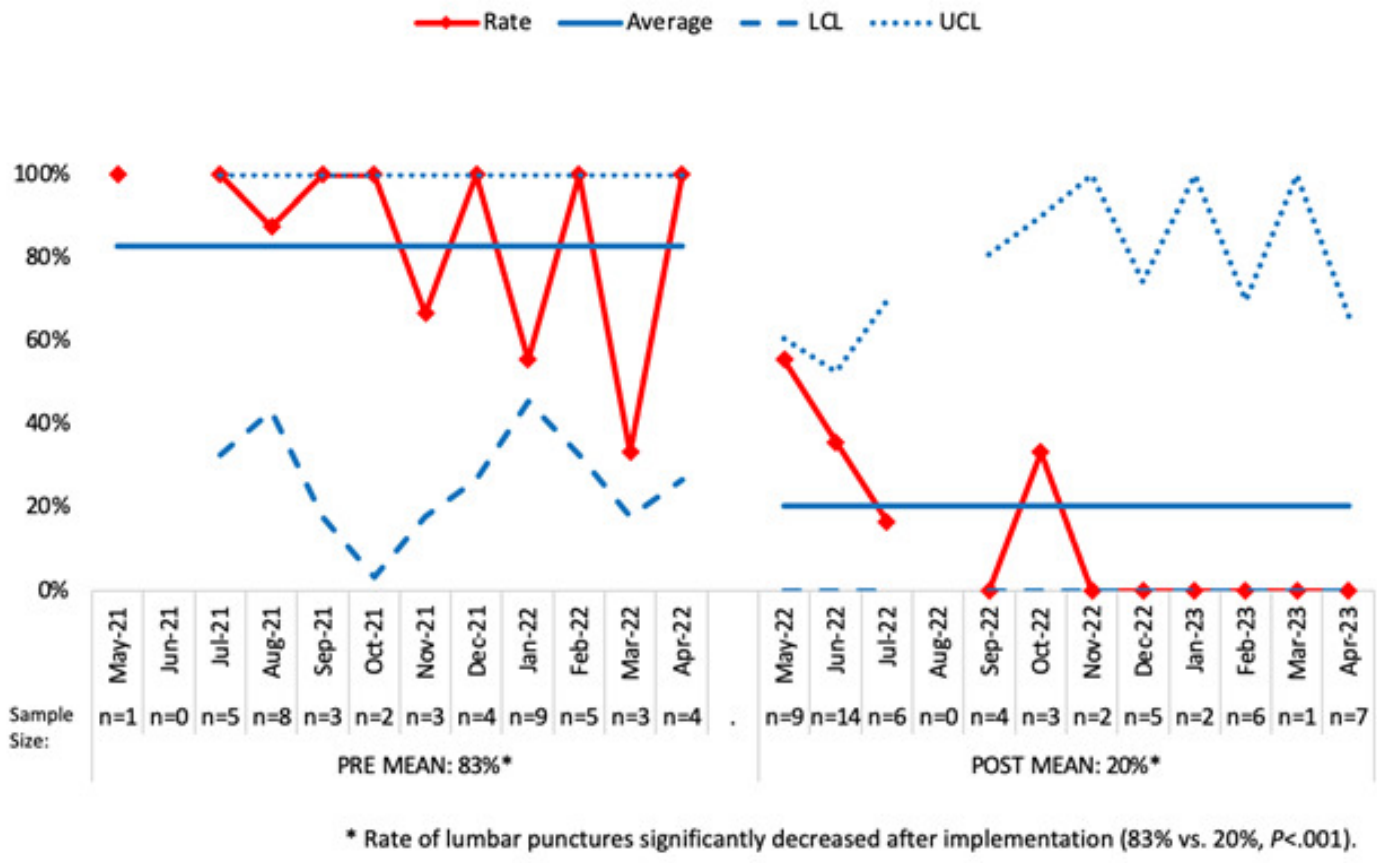

Figure 4. Rate of Lumbar Punctures in Well-Appearing Young Febrile Infants Ages 22 to 60 Days Pre- and Post-Implementation of Local Quality Improvement Initiative

Because of the small number of infants in the 22 to 28 days age group, only 5 infants with normal blood, urine, and CSF analyses were eligible for home discharge. There was insufficient statistical power to conduct any meaningful analysis. However, the REVISE II study had 2250 infants in this age group. While the analysis for potential increase in home discharge for eligible infants has yet to be reported, there was a significant increase post-implementation in discussions with parents about the harms and benefits of hospitalizations from 1.9% to 17.9%.[19]

With respect to balancing measures, there were no increased PED visits post-implementation. As there was a marked decrease in lumbar punctures and hospitalizations, it was critical to monitor delays in the detection and timely treatment of IBIs. While there was no increase in the delayed detection of IBIs post-implementation, a delayed detection case is very uncommon, and the local study did not have statistical power to address this without participating in a national collaborative. The REVISE II study which included 6549 infants in the pre- and 11 159 infants in the post-intervention periods had a similar rate of delayed IBI detection; pre- and post-intervention 0.4% v 0.3%, *P*=.74.[19]

By implementing established methods of behavior change the clinical care of febrile young infants at the institution was improved. Strengths of this QI initiative were interventions that were simple to implement that addressed capability, opportunity, and motivation by distilling the information, educating key stakeholders, and decreasing barriers to behavior change. A key strength of this study was its association with a national quality improvement project that provided legitimacy and additional tools to assist with implementation, audit and feedback and stakeholder engagement.

A limitation of this implementation work is that it cannot be excluded that the PEM physicians would have changed their clinical behavior on their own. The AAP CPG was released in 2021, and the interventions were implemented 9 months later. Clinical behavior may have changed eventually, however the dramatic rate of change, especially in the decreased number of lumbar punctures demonstrated in **Figure 4** run chart, speaks to the likely acceleration of clinical behavior change affected by the interventions. Additionally, during the implementation phase the institution's urgent care permanently closed due to lack of staffing. Therefore, patients requiring next day follow-up on Sundays or holidays were instructed to return to the emergency department for re-evaluation, and this may have affected clinician behavior. Clinicians may have been inclined to perform additional investigation or consider hospitalization given the lack of scheduled follow-up the following day.

While the primary goal was to implement recommendations of the first AAP CPG on fever management in young infants, another outcome was that local practice variance from national practice decreased. For the national network, the baseline frequency of lumbar punctures in keeping with

the AAP CPG was 78.5% whereas for the local institution it was 17%. With the advent of a nationally recognized guideline and participation in a multicenter collaborative, a rapid and dramatic change was implemented that currently resembles the clinical approach to febrile infants throughout the country. A post-implementation frequency for lumbar puncture performance of 80% was achieved over the entire year but was 92% for the last 10 months of the year.

In addition to developing a method to "safely do less" for infants in Hawai'i, there were a number of mutual benefits the local study had with the national collaborative.[27] The local contribution of patients comprised 10% of the Western region in the national study and while this institution was 1 of 103 hospitals, it provided 1.5% of the data. The local ethnic make-up also adds to the generalizability of the study. Importantly, the statistical power of the larger study allowed the ability to address balancing measures, without which there would be lingering concerns about the safety of the approach. In summary, a local team collaborating with a national network represents a model with documented and potential benefits that is worthy of ongoing support.

Conclusions

A method to "safely do less" for infants in Hawai'i was developed by the implementation of a locally applicable clinical algorithm based on the AAP CPG that leveraged standardized and timely assessment, selective use of diagnostic testing, and optimized patient follow up. Patient clinical outcomes, overall patient experience, and cost to the system were improved. The initiative has fostered a culture of collaboration and continuous improvement across the institution by supporting practice change and future steps include adapting the algorithm to make it applicable to other emergency departments that care for this patient population in the state.

Conflicts of Interests and Disclosures

Cheryl Okado was the REVISE II site lead for KMCWC. Robert Pantell is the first author of the AAP CPG.

Acknowledgements

The Reducing Excessive Variability in Infant Sepsis Evaluation (REVISE II) project was supported by the American Academy of Pediatrics.

Submitted: July 08, 2024 PDT. Accepted: February 17, 2025 PDT. Published: June 01, 2025 PDT.

References

1. Baskin MN. The prevalence of serious bacterial infections by age in febrile infants during the first 3 months of life. *Pediatr Ann*. 1993;22(8):462-466. doi:10.3928/0090-4481-19930801-06

2. Baraff LJ, Oslund SA, Schriger DL, Stephen ML. Probability of bacterial infections in febrile infants less than three months of age: a meta-analysis. *Pediatr Infect Dis J*. 1992;11(4):257-264. doi:10.1097/00006454-199204000-00001

3. Dagan R, Powell KR, Hall CB, Menegus MA. Identification of infants unlikely to have serious bacterial infection although hospitalized for suspected sepsis. *J Pediatr*. 1985;107(6):855-860. doi:10.1016/s0022-3476(85)80175-x

4. Baskin MN, O'Rourke EJ, Fleisher GR. Outpatient treatment of febrile infants 28 to 89 days of age with intramuscular administration of ceftriaxone. *J Pediatr*. 1992;120(1):22-27. doi:10.1016/s0022-3476(05)80591-8

5. Baker MD, Bell LM, Avner JR. Outpatient management without antibiotics of fever in selected infants. *N Engl J Med*. 1993;329(20):1437-1441. doi:10.1056/NEJM199311113292001

6. Powell EC, Mahajan PV, Roosevelt G, et al. Epidemiology of bacteremia in febrile infants aged 60 days and younger. *Ann Emerg Med*. 2018;71(2):211-216. doi:10.1016/j.annemergmed.2017.07.488

7. Biondi EA, Lee B, Ralston SL, et al. Prevalence of bacteremia and bacterial meningitis in febrile neonates and infants in the second month of life: a systematic review and meta-analysis. *JAMA Netw Open*. 2019;2(3):e190874. doi:10.1001/jamanetworkopen.2019.0874

8. Woll C, Neuman MI, Pruitt CM, et al. Epidemiology and etiology of invasive bacterial infection in infants ≤60 days old treated in emergency departments. *J Pediatr*. 2018;200:210-217e1. doi:10.1016/j.jpeds.2018.04.033

9. Pantell RH, Roberts KB, Adams WG, et al. Evaluation and management of well-appearing febrile infants 8 to 60 days old. *Pediatrics*. 2021;148(2). doi:10.1542/peds.2021-052228

10. Leidy NK, Margolis MK, Marcin JP, et al. The impact of severe respiratory syncytial virus on the child, caregiver, and family during hospitalization and recovery. *Pediatrics*. 2005;115(6):1536-1546. doi:10.1542/peds.2004-1149

11. Farias-Fernandez M, Rendon-Macias ME, Iglesias-Leboreiro J, Bernardez-Zapata I, Gordillo-Rodriguez L. Effects of hospitalization on children's sleep pattern irrespective of sleep problems history. *Bol Med Hosp Infant Mex*. 2021;78(4):279-286. doi:10.24875/BMHIM.20000277

12. Board R, Ryan-Wenger N. Long-term effects of pediatric intensive care unit hospitalization on families with young children. *Heart Lung*. 2002;31(1):53-66. doi:10.1067/mhl.2002.121246

13. DeAngelis C, Joffe A, Wilson M, Willis E. Iatrogenic risks and financial costs of hospitalizing febrile infants. *Am J Dis Child*. 1983;137(12):1146-1149. doi:10.1001/archpedi.1983.02140380006003

14. Paxton RD, Byington CL. An examination of the unintended consequences of the rule-out sepsis evaluation: a parental perspective. *Clin Pediatr (Phila)*. 2001;40(2):71-77. doi:10.1177/000992280104000202

15. Hoot NR, Aronsky D. Systematic review of emergency department crowding: causes, effects, and solutions. *Ann Emerg Med*. 2008;52(2):126-136. doi:10.1016/j.annemergmed.2008.03.014

16. Freund T, Campbell SM, Geissler S, et al. Strategies for reducing potentially avoidable hospitalizations for ambulatory care-sensitive conditions. *Ann Fam Med*. 11(4):363-370. doi:10.1370/afm.1498

17. Hall JL, Katz BZ. Cost of influenza hospitalization at a tertiary care children's hospital and its impact on the cost-benefit analysis of the recommendation for universal influenza immunization in children age 6 to 23 months. *J Pediatr*. 2005;147(6):807-811. doi:10.1016/j.jpeds.2005.06.031

18. Hawai'i Pacific Health. Kapi'olani Medical Center for Women and Children. Patients & Visitors: Emergency Department.

19. McDaniel CE, Kerns E, Jennings B, et al. Improving guideline-concordant care for febrile infants through a quality improvement initiative. *Pediatrics*. 2024;153(5). doi:10.1542/peds.2023-063339

20. McDaniel CE, House SA, Ralston SL. Behavioral and psychological aspects of the physician experience with deimplementation. *Pediatr Qual Saf*. 2022;7(1):e524. doi:10.1097/pq9.0000000000000524

21. Pingree EW, Kimia AA, Nigrovic LE. The effect of traumatic lumbar puncture on hospitalization rate for febrile infants 28 to 60 days of age. *Acad Emerg Med*. 2015;22(2):240-243. doi:10.1111/acem.12582

22. Hanson AL, Ros S, Soprano J. Analysis of infant lumbar puncture success rates: sitting flexed versus lateral flexed positions. *Pediatr Emerg Care*. 2014;30(5):311-314. doi:10.1097/PEC.0000000000000119

23. Nigrovic LE, Kuppermann N, Neuman MI. Risk factors for traumatic or unsuccessful lumbar punctures in children. *Ann Emerg Med*. 2007;49(6):762-771. doi:10.1016/j.annemergmed.2006.10.018

24. Leazer R, Erickson N, Paulson J, et al. Epidemiology of cerebrospinal fluid cultures and time to detection in term infants. *Pediatrics*. 2017;139(5). doi:10.1542/peds.2016-3268

25. Scarfone R, Murray A, Gala P, Balamuth F. Lumbar puncture for all febrile infants 29-56 days old: a retrospective cohort reassessment study. *J Pediatr*. 2017;187:200-205e1. doi:10.1016/j.jpeds.2017.04.003

26. Jaskiewicz JA, McCarthy CA, Richardson AC, et al. Febrile infants at low risk for serious bacterial infection--an appraisal of the Rochester criteria and implications for management. Febrile Infant Collaborative Study Group. *Pediatrics*. 1994;94(3):390-396. doi:10.1542/peds.94.3.390

27. Schroeder AR, Harris SJ, Newman TB. Safely doing less: a missing component of the patient safety dialogue. *Pediatrics*. 2011;128(6):e1596-7. doi:10.1542/peds.2011-2726