

Physicians' and Nurses' Perspectives on the Decision to Perform Lumbar Punctures on Febrile Infants ≤ 8 Weeks Old

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ABSTRACT

OBJECTIVES: There is wide variation in the decision of whether to perform lumbar punctures (LPs) on well-appearing febrile infants ≤ 8 weeks old. Our objectives were to identify factors that influence that decision and the barriers and facilitators to shared decision-making about LP with parents of febrile infants.

METHODS: We conducted semistructured interviews with 15 pediatric and general emergency medicine physicians and 8 pediatric emergency medicine nurses at an urban, academic medical center. Through interviews, we assessed physicians' practices and physicians' and nurses' perspectives about communication and decision-making with parents of febrile infants. Two researchers independently reviewed the transcripts, coded the data using the constant comparative method, and identified themes.

RESULTS: Five themes emerged for factors that influence physicians' decisions about whether to perform an LP: (1) the age of the infant; (2) the physician's clinical experience; (3) the physician's use of research findings; (4) the physician's values, particularly risk aversion; and (5) the role of the primary care pediatrician. Barriers and facilitators to shared decision-making identified by physicians and by nurses included factors related to their perceptions of parents' understanding and acceptance of risks, parents' emotions, physicians' assessment of whether there is clinical equipoise, and availability of follow-up with the primary care pediatrician.

CONCLUSIONS: Differences in physicians' values, use of research findings, and clinical experience likely contribute to decisions of whether to perform an LP on well-appearing febrile infants. Incorporation of parents' preferences through shared decision-making may be indicated, although there are barriers that would need to be overcome.

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Dr Aronson conceptualized and designed the study, developed the interview guides, performed the qualitative interviews, conducted the data analyses, interpreted the data, and drafted the initial manuscript; Ms Schaeffer contributed to the design of the study, developed the interview guides, performed the qualitative interviews, conducted the data analyses, and interpreted the data; Drs Fraenkel and Shapiro contributed to the design of the study and interpreted the data; Dr Niccolai contributed to the design of the study, development of the interview guides, and conduct of the data analyses and interpreted the data; and all authors reviewed and revised the manuscript critically for important intellectual content, approved the final manuscript as submitted, and agree to be accountable for all aspects of the work.



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Febrile infants ≤ 8 weeks old who are evaluated in emergency departments (EDs) routinely undergo extensive diagnostic evaluations to assess whether they have an invasive bacterial infection (IBI),¹ including potentially life-threatening bacterial meningitis.² Several algorithms use a combination of age, clinical appearance, and results of urine and blood tests to classify febrile infants as either low or not low risk for having an IBI.^{3,4} Although $\sim 0.5\%$ of all febrile infants have bacterial meningitis,⁵ prevalence among infants classified as low risk by these algorithms may approach 0%.^{3,6} In deciding whether to perform a lumbar puncture (LP) on a low-risk infant, clinicians must weigh the risks of death or neurologic sequelae in the unlikely event that the infant has bacterial meningitis⁷ with the risks of an LP, which include stress and anxiety for parents, the potential for an unsuccessful procedure, which could lead to unnecessary hospitalization, and the extraordinarily rare serious complications of the procedure.^{8,9} Consequently, there is wide variation in the decision to perform LPs on low-risk febrile infants.^{1,10}

Although differences in institutional clinical practice guidelines may explain some of this variation,¹⁰ researchers have not examined individual physicians' perspectives on the decision to perform an LP or on including parents in the decision-making. To include judgments about whether the benefits of an LP outweigh the risks, parents' preferences can be incorporated through a shared decision-making process in which the parent participates with the physician in making the decision.^{11,12} However, little is known about whether physicians currently use (or potentially would use) a shared decision-making approach for decisions about LP on low-risk febrile infants or perceived barriers and facilitators, including those identified by nurses who have an important role in communicating with parents. Our objectives were to learn (1) the factors that influence physicians' decisions about whether to perform an LP and (2) barriers to and facilitators of shared decision-making with parents of low-risk febrile infants for decisions about LPs.

METHODS

Study Design and Population

We conducted one-on-one, semistructured interviews with pediatric emergency medicine (EM) physicians and nurses from an urban, academic medical center. The pediatric EM physicians and nurses all worked in the medical center's pediatric ED that has $\sim 38\,000$ visits annually; senior pediatric EM fellows, who practice as attending physicians in a community ED affiliated with the academic medical center, were also included. To include the perspectives of physicians who provide care to febrile infants in a general ED, we also interviewed 2 general EM physicians from the same academic medical center who worked at the center's general ED (which does not evaluate children) as well as an affiliated general ED with an annual volume of 4000 pediatric visits per year. None of the EDs had a clinical practice guideline for management of febrile infants. The study was approved by the institutional review board, and written informed consent was obtained from each participant. A small monetary incentive was provided for participation.

Pediatric EM physicians were invited to enroll during a division meeting and through follow-up e-mails. Nurses and the general EM physicians were contacted through e-mails sent to the pediatric ED nursing listserv and to physicians who worked at the affiliated ED, and respondents were then recruited to participate. Purposeful sampling was used to specifically recruit physicians and nurses with >10 years of experience.^{13,14}

Interviews

Individual semistructured interviews were conducted by 2 researchers (a pediatric EM attending physician and a research associate trained in qualitative interviewing) between January and September 2018. Interviews were audio recorded and were transcribed verbatim by a professional transcription service. Separate interview guides were used for physicians and nurses. Through interviews, we assessed physicians' practices and perspectives on communication and decision-making with parents of febrile infants and physicians'

and nurses' perceptions of shared decision-making in the ED, including with febrile infants. Interview questions were open-ended and included prompts and probes to encourage participants to elaborate and clarify responses.¹⁵ The 2 interviewers met weekly to review transcripts and iteratively revise the interview guides. Specific questions asked by the interviewers are shown in Table 1.

Data Analysis

Two researchers independently reviewed all transcripts and coded the data using the constant comparative method of grounded theory.^{14,15} Separate coding structures were developed for physician and nurse respondents, and the codes were applied to categorize the data. The researchers met weekly to compare codes and to resolve discrepancies. The coding guides were iteratively revised, each transcript was re-coded using the final versions, and the codes were combined into themes. Thematic saturation, which occurs when no new concepts emerge,^{14,15} was achieved after interviews with 15 physicians and 8 nurses. ATLAS.ti (version 8) was used for data management.

RESULTS

Of the 15 physicians who agreed to participate, 11 (73.3%) were pediatric EM attending physicians, 2 (13.3%) were pediatric EM fellows, and 2 (13.3%) were general EM attending physicians. Fourteen of the physicians (93.3%) completed their residency and/or fellowship at a different institution. Physicians' median age was 39 years old (range 30–58 years), and their years of experience as an attending physician (including the fellows) ranged from 1 to 21 years. Four of the 8 nurses had worked in a general ED. Nurses' median age was 39.5 years old (range 27–58), and their years of experience working in the pediatric ED ranged from 2 to 22 years. The average length of the interviews was 25 minutes.

Five themes emerged for factors that influence physicians' decisions about whether to perform an LP: (1) the age of the infant, (2) the physician's clinical experience, (3) the physician's use of

TABLE 1 Interview Guide Questions for Physicians and Nurses

Participant	Questions	Related Prompts
Physicians	1. Tell me about the last time you cared for a febrile infant.	Describe the information you communicated to the parents and the sequence in which you provided that information.
	2. How did you communicate about LPs?	
	3. If the infant is well-appearing and has normal urine and blood tests, what is your current practice in obtaining an LP?	Up to what age do you routinely obtain an LP? Why this age? If you don't obtain an LP in certain infants, how do you explain to the parents the risks of going home without an LP?
	4. How do you feel about shared decision-making with parents in the ED?	
	5. Tell me how you feel about shared decision-making with febrile infants?	Are there certain scenarios for febrile infants in which you would be willing to engage parents in shared decision-making? Do you think parents of febrile infants would be receptive to shared decision-making?
	6. How would you feel about using shared decision-making with a parent on whether to perform an LP on his or her febrile infant?	Are there particular factors that would impact when you decide to use shared decision-making? Would you consider shared decision-making for a well-appearing febrile infant? What do you see as barriers or facilitators to using shared decision-making with parents of febrile infants?
	7. How have you handled the discussion when a parents' preferred decision contradicts your opinion? For example, if you want to obtain an LP but the parent does not?	
Nurses	1. Tell me about the last time you cared for a febrile infant.	
	2. How do you feel about shared decision-making with parents in the ED?	
	3. How prepared do you feel to support parents during a shared decision-making process in the ED?	
	4. What role should the parent play in making any decision about the care of their febrile infant?	What do you feel the role of the parent should be in making the decision of whether to perform an LP on a febrile infant? How would you feel about a physician using shared decision-making with a parent on whether to perform an LP on his or her febrile infant?

research findings, (4) the physician's values, and (5) the role of the primary care pediatrician (Table 2).

Factors that Influence Physicians' Decisions About Whether to Perform an LP

Age of the Infant

Nearly all physicians stated that they routinely obtain an LP on febrile infants ≤ 4 weeks old. A common reason cited for this age cutoff was the perception that there is consensus among physicians nationwide that performing an LP in this age group is always done (Table 2, 1a) and that the "rules" dictate this practice. For low-risk infants 4 to 8 weeks old, most physicians did not routinely perform an LP, although some did until infants were either 6 or 8 weeks old. Some found that the decision was more difficult in infants 4 to 6 weeks old because of the lack of consensus among physicians (Table 2, 1b).

Physicians' Clinical Experience

Physicians' years of clinical experience influenced their reported practice of

performing an LP on low-risk infants 4 to 8 weeks old. Some younger physicians reported that they were more risk averse (Table 2, 2a). Although 1 physician with more experience still worried about missing meningitis, he said that over time he was willing to forgo the LP as long as the decision-making process involved the parents (Table 2, 2b). Attending physicians with >10 years of experience varied in how experience affected their stated practice. Some of these experienced physicians said that their practice had evolved recently to not routinely perform the LP. However, 1 physician with >20 years of experience stated that his practice of always obtaining the LP had not changed because he had cared for many infants with bacterial meningitis and therefore had seen its consequences (Table 2, 2c). One general EM physician said that the infrequency of managing febrile infants resulted in some discomfort about the decision of whether to perform an LP (Table 2, 2d). Some younger physicians, including a senior fellow, identified that the

dominant practice patterns during their training influenced their current decisions about LP (Table 2, 2e).

Physicians' Use of Research Findings

For febrile infants ≤ 4 weeks old, physicians' practices of routinely obtaining an LP were informed by long-standing results of research in which both the higher risk of bacterial meningitis and the lack of reliability of clinical appearance had been documented as indicators of IBI in this age group. For infants 4 to 8 weeks old, many physicians had stopped routinely obtaining an LP because of newer management algorithms such as the Step-by-Step (or "stepwise") approach that allows infants in this age group to be classified as low risk without routine use of LP (Table 2, 3a). However, some physicians felt that there were insufficient data regarding the risk of meningitis in this older age group, which made the decision about LP difficult. The 2 general EM physicians felt it was challenging to stay informed about the

TABLE 2 Themes for Factors that Influence Physician's Decisions About Whether to Perform an LP

Theme	Representative Quotations
Age of the infant	
1a. Pediatric EM physician	"So I tell parents, if the patient is less than 4 weeks, it's very easy because there's a consensus. The consensus, [for] infants less than 4 weeks with a fever, is that they're very high risk for severe infections. They all get treated the same way nationwide. They get blood testing for infection, urine testing for infection, and an LP to make sure that the cause of fever isn't meningitis."
1b. Pediatric EM physician	"I know we're trying to stick to fever [in infants] under 2 months, so even a fever [in infants] under 2 months is very different if it's [in infants] under 4 weeks. And even, I think [for] 6–8 wk, I find that most physicians are pretty comfortable with screening labs and, you know, the LP decision in the well-appearing infant, based on those screening labs. And I think [infants] 5–6 weeks is less consensus and the hardest group to manage. . . ."
Physician's clinical experience	
2a. Pediatric EM physician in first year as an attending physician	"I am more risk averse than maybe some of my colleagues, probably due to my level of training and experience, just my volume and that sort of thing. Not wanting to miss as opposed to the other side of that coin."
2b. Pediatric EM physician with >7 y of experience as an attending physician	"But for something like the LP in a child who's 5 weeks old, who for the most part is well-appearing with a fever, that baby's probably not going to have meningitis. I think that we need to empower the doctors, the clinicians, and parents to think about making that decision together. But also realize that there is going to inevitably be a case where everything is perfect and even the labs are perfect, and the LP is not going to be performed, and a day later or 2 days later there's going to be a patient that has meningitis. I think that's just the sheer volume of numbers, that's something that's inevitable. So, I would feel terrible about being caught in that interaction because, you know, hindsight being 20/20, we could've probably ruled it out pretty easily with a fairly straightforward procedure. I felt like I would've spent a lot of energy discussing what do you want to do? Ten years ago, I would have just gone, 'uh, LP'; [I] would have known, but medicine is not easy. Parental input is super important."
2c. Pediatric EM physician with >20 y of experience as an attending physician	"I'm probably a little more conservative than some, maybe because I'm older and I grew up in an era where I've seen (not to practice defensive medicine), but I've seen more bad outcomes."
2d. General EM physician who estimated caring for 4–5 febrile infants as an attending physician	"I think if I was a pediatrics EM provider, I would feel differently. It's just what I do for a living, and there's just come clinical gestalt that I probably don't have as a general ED provider, you know? I mean, I can think of, for example, PE. In our adult world, a PE decision-making is like, super high, and there's clinical gestalt, and it's such a controversial thing. But I think it's because we all have seen enough PE people to be like, that doesn't feel good. But all febrile infants don't feel good to me. So my compass for where that clinical gestalt is different."
2e. Senior pediatric EM fellow who practices as an attending physician in a community ED	"I usually do up to 6 weeks. More so because that's what my attendings do right now. . . .The question of, do you cut it back to 4 weeks? Some people do; I mean, depending on where you train, you can go all the way up to 3 months."
Physician's use of research findings	
3a. Pediatric EM physician with 13 y of experience as an attending physician	"My practice has evolved over the last few months from performing LP on all children less than 56 days [old] who are febrile to doing what's called stepwise approach where we send bloodwork, and if there are no signs of an increase in inflammatory markers, we omit a step. . . so I think the short answer is that due to some recent evidence seeming to argue for the safety of omitting the LP in a subset of patients who appear well and have no signs of the increased inflammatory markers."
3b. General EM physician	"I would still say that even now, as a practicing ED attending, I still feel like I don't understand all the decisions behind how you ultimately decide to do the full gambit versus not. I think I understand there's some decision rules, and I understand there's some very clear black and white cases, but then there's a lot of gray in between, and I think that makes me very nervous."
Physician's values	
4a. Pediatric EM physician who routinely performs an LP up to 8 wk old	"You know, my practice over the years has not been to defer on the LP. Unless they're ill, in which case, I would then give antibiotics. So I understand that you and others are trying to figure out a kind of staged approach to the whole sequence of the testing. I just feel nervous about missing things. So much of what we do, whether it's a head injury or appendicitis, there's always a small, but finite, risk of missing something. And I hate to miss things. I think our job in pediatric emergency, or any EM setting, is to diagnose. And that can be difficult and time consuming and costly and hard for the parents, but I think it's our job to diagnose."
4b. Pediatric EM physician who does not routinely perform an LP in infants 4–8 wk old	"I think consensus, there's likely to be practice variability in the 6–8-week range fever workup by institution and probably more broadly by setting, by practice setting. So, it's very hard for me, ethically, to tell parents that we have to do this, we have to do an LP. Even though I may, in the back of my mind, wish that we could just do it."

TABLE 2 Continued

Theme	Representative Quotations
Role of the primary care physician	
5a. Pediatric EM physician	"I think, especially with some of the new literature coming out, that I've called pediatricians before to discuss whether we should do the LP or not. Most of the time, it has been that the pediatrician was trained this way and that is what they expect, and that's fine. It is; I don't think I've ever had a scenario where I've felt like they need to have an LP and the pediatrician said no. So I think it's always been that reverse situation. I think it's totally appropriate. That's what they're comfortable with, and we just don't have great data right now. So they definitely need to do it the other way."
5b. Pediatric EM physician	"I think if the family and the pediatrician seem to be a reasonable constellation of a medical home and understand what we're talking about. I think that's true for both the pediatrician and the family; so there's pediatric offices, in my experience, in New York where you can't really ensure follow-up because someone makes a phone call, and that could be some of those in Connecticut. Not as many. But really, that population of patients that maybe are traveling down I-95 and not going to see a pediatrician for the next day or 2. And then I think the population that also just are potentially not understanding the gravity of this when you're talking about meningitis and death and things, and they're on their cellphone and doing other things. So, I think that in that age group, my approach in a well-appearing febrile infant is to try to re-stratify in my mind, not necessarily the risk of disease, but the risk of not following up."

PE, pulmonary embolism.

algorithms used for managing febrile infants (Table 2, 3b).

Physicians' Values

Risk aversion was an important value for physicians in the decision about whether to perform an LP. For infants ≤ 4 weeks old, physicians felt the risk of meningitis was too high for them to not perform an LP. For physicians who routinely obtain an LP on infants 4 to 8 weeks old, risk aversion remained an important value (Table 2, 4a). Other physicians, however, valued the sense of being ethical in providing parents with the option of not performing an LP given the lack of consensus among physicians about infants in this age group (Table 2, quotation 4b).

Role of the Primary Care Pediatrician

For infants ≤ 4 weeks old, EM physicians reported that primary care pediatricians played an important role in setting expectations of parents, before the ED visit, about the need for an LP. In the ED, EM physicians reported that they sometimes collaborated with the primary care pediatrician to help parents feel comfortable with the decision to perform an LP. For infants 4 to 8 weeks old, EM physicians reported that, on occasion, their recommendation about the need for an LP differed from that of the primary care

pedsiatrician, which sometimes led to a discussion about the need for LP (Table 2, 5a). In deciding not to perform an LP on these infants, EM physicians stated that the ability to arrange close follow-up with the primary care pediatrician was very important (Table 2, 5b).

Shared Decision-Making With Parents of Febrile Infants About the Decision to Perform an LP

Although physicians and nurses reported the frequent use of shared decision-making in the ED for various other clinical situations, they had mixed feelings about shared decision-making with parents of febrile infants and identified both barriers to and facilitators of shared decision-making as described below.

Barriers

Barriers included factors related to parents, providers, and time constraints (Table 3). Among factors related to parents, perceived understanding of information was identified as an important barrier. Factors identified as influencing parents' understanding included language barriers and parents' cognitive abilities (Table 3, 1a). Physicians and nurses also commonly identified parents' emotions (such as stress and feeling overwhelmed) as barriers to effective communication and to shared decision-making. Providers felt that

parents often feared LP, which inhibited their ability to clearly think through the risks of not performing the LP and could result in medicolegal risks for the physician if the parents decided against LP and the infant was later diagnosed with meningitis (Table 3, 1b). Disagreements in decision-making between family members were also identified as barriers (Table 3, 1c). Parents' receipt of contradictory messages, from different health care providers, from other family members, or from the Internet, was cited as a barrier to shared decision-making given the multiple and often conflicting sources of information (Table 3, 1d).

If physicians believed there was only 1 reasonable management pathway, shared decision-making was not considered to be an option. For example, physicians uniformly stated that LP was the only option for infants ≤ 4 weeks old (Table 3, 2a). Some physicians and nurses also felt a sense of paternalism in making the decision to perform an LP, given physicians' level of knowledge about risks compared with that of parents (Table 3, 2b).

Time constraints that inhibit the ability of providers to effectively communicate and to engage parents in shared decision-making were also identified as barriers. Specific time barriers were related to the volume of patients in the ED that prohibited the

TABLE 3 Barriers and Facilitators to Shared Decision-Making With Parents of Febrile Infants

	Representative Quotation
Barriers	
Parent factors	
1a. Understanding of information	
Pediatric EM physician	"You know, a barrier, there's a bunch of barriers. There's certainly language barriers, and even with a really good interpreter, that barrier still persists. It's just mitigated somewhat. There are barriers around cognitive ability of the parents. So if the parents' cognitive ability is below average, that is a barrier, and it can be difficult to convey what we're doing and why. Parents, in that situation, at least in my experience, tend to be more likely to dig in and have some difficulty finding common ground and shared decision-making."
1b. Emotions	
Pediatric EM physician	"And so I worry in the case of a febrile infant that the parents want everything to just go away. They want to go back to the way it was before they took the kid's temperature. It's like, I don't want to hear about it. And so that kind of fear leads to potentially poor decision-making. I worry about the emotional aspect trumping logic, trumping good decisions for the baby. And so if you tell parents, and this is obviously not an absolute, but potentially, if you tell parents we're going to decide this together, and then they make the "wrong" decision, then I think the baby is at risk, and professionally, we are at risk. And the parents may be at risk down the road when they regret what they decided."
1c. Disagreements	
Pediatric EM physician	"I mean, I typically attempt to, sort of, marriage counseling type of stuff. The same way you're feeling while you're feeling that, sharing the opinions, I mean, I think you've probably seen the same thing. I think at the end of the day, sort of going back to that basic assumption of we all want what's best for your child, and there's no right or wrong decision. If we do what mom says, there could be regrets. If we do what dad says, there could be regrets. We just need to come to a decision and move forward. I think more often than not they're like, okay, you decide."
1d. Contradictory messages	
Pediatric EM physician	"So, on the flip side, I think a huge barrier is when parents are getting mixed messages, and that happens more often than not, unfortunately, and via a mixed message from within the same health care setting, 2 different health care settings. Dr. Google gives them some information, which doesn't jive with what you're trying to review. I think there's a lot of places along the line where another family member had this experience, you know, so I think there's a lot of places where you can trip up on different people doing things different ways."
Provider factors	
2a. One reasonable option	
Pediatric EM physician	"And typically if (so it's not really shared decision-making because it's), I think the pathway there is very narrow in terms of what we feel like is an acceptable plan, an acceptable care for a 3-wk old that can't advocate for him or herself. So it's like, you know, if a child presents with obvious symptoms of a cancer process, I think making shared decision-making to do something the next day or in a week is not acceptable to me."
2b. Paternalism	
Nurse	"But I guess at the end of the day, I feel like when we say this patient really needs this test, and then we change our mind based on the parents, I feel like that that sends kind of a bad message. I'm not sure we should, so maybe the secret there is maybe don't promise, don't commit at first to what tests you're going to do, and maybe ease into it more slowly, but I do feel like at the end of the day, it's not a great thing that we have really smart medical people who went to school for many, many years and have so much information inside of their heads and so much knowledge, and they know that the best thing, the safest thing for this baby is to have, for example, an LP, but the parents are squeamish, [so] I think (my opinion) my deep-seated inclination is if the doctor feels strongly about it, we probably should be doing the test and not really letting the parents decline."
Time constraints	
3a. ED volume	
Pediatric EM physician	"Yeah, some of these things had come up, but potentially things like the volume in the ED. If it's exceedingly busy, it's going to be harder to spend time with the family, who's potentially stable when you have other things going on."
3b. Nursing protocols	
Nurse	"I think one of the biggest hurdles for us is that you know the national sepsis initiative really keeps us on a fairly tight timeline, and we've developed a protocol for that and an algorithm that starts in triage, so in an effort to get everything done quickly, I think we oftentimes forget, yes, we have to meet those algorithmic goals, but we still have to have time to talk to the patient or to the parents. . . ."

TABLE 3 Continued

	Representative Quotation
Facilitators	
Parent factors	
4a. Understanding of risks	
Nurse	“And it should be up to them. It could go either way, but they should be able to say, this is how I feel about it. As long as they've had all the information explained to them and they actually get it. Because I think sometimes the lack of deciding to do the LP for a parent is because they don't quite understand, and they don't quite understand the severity of not doing it if something bad happens.”
4b. Acceptance of risk	
Pediatric EM physician	“...and we see this in our practice, a lot in PEM, where some parents really have a pretty, I would say, reasonable approach to risk, [such as] they not only understand numerical risks, but they actually kind of think of it as their internal locus of control like, I get this. My kid is a reasonable human. I'm a reasonable human. I'm hearing what you're saying. I'm going to go. I'm going to follow-up.”
Provider factors	
5a. Feeling of clinical equipoise	
General EM physician	“In the older group, I think it's a little bit more shared decision-making but still kind of guided a little bit more to the physician's side, saying hey. . .because you know, I feel like once you have shared decision-making, you tend not to go down the pathway, but there's still a pathway. I say, listen, if all of this is negative and the kid looks good, we're probably not going to do it. Now, if the parents really wanted to, I would explain to them why I don't think they have bacterial meningitis, but I would understand why they would want a complete evaluation. What I'd probably get to is, you know, if I thought that I was kind of waffling between yes and no, and the parent really wanted it, then I'd say okay, let's do it, understanding the risks and understanding that we might fail to get an LP.”
5b. Incorporation of new research findings	
Pediatric EM physician	“So there probably have been like a handful where I feel like I haven't done them even when I thought it was indicated based on shared decision-making. Another thing is new data comes out; probably that is going to be the way to go because it's not so clear that it is necessary in this age group.”
Primary care pediatrician	
6a. Setting expectations	
Pediatric EM physician	“So, I think a big facilitator is, in the context of parents getting referred to here by their pediatrician, is when their pediatrician says, expect this, this, and this to happen when you get there. When we receive the patient, we're on board with that same plan. So then I think you have information [from] health care professionals from 2 different settings that coincide.”
6b. Availability of follow-up	
Pediatric EM physician	“But yeah, I've certainly had discussions where I wouldn't say I've been talked out of it, but I've come to an agreement with the parents that if they have very close follow-up and if anything changes that they'll come right back, which it still could be meningitis and we just don't know.”

PEM, pediatric emergency medicine.

physician from adequately communicating with the parents (Table 3, 3a). Nurses identified protocols that dictated the need for timely evaluation and prompt administration of antibiotics for febrile infants as a barrier to effective communication (Table 3, 3b).

Facilitators

Facilitators of shared decision-making similarly included factors related to both parents and providers as well as to the primary care pediatrician (Table 3). Although parents' abilities to understand risks was cited as a barrier, it was also identified as a facilitator by both physicians

and nurses if providers were able to effectively communicate risks in a manner that parents understood (Table 3, 4a). Similarly, parents' acceptance of risk was felt to be a facilitator because parents would need to accept a small amount of risk whether an LP was performed or not (Table 3, 4b).

The physician's sense of clinical equipoise in deciding whether to perform an LP for an infant was viewed as a facilitator. In situations in which the physician felt there were 2 reasonable options, shared decision-making was viewed as a viable process to use with parents (Table 3, 5a). Some

physicians also felt that recent research that found that LP is not always necessary in infants 4 to 8 weeks old enabled them to incorporate shared decision-making into the decision about whether to perform an LP (Table 3, 5b).

Providers also felt that shared decision-making was facilitated if the pediatrician set expectations with parents that matched those of the EM physician (Table 3, 6a) as opposed to contradictory messages, which were a barrier. Additionally, the availability of follow-up with the primary care pediatrician was an important facilitator because it allowed EM physicians to feel

comfortable with not performing an LP if the parents preferred that option (Table 3, 6b).

DISCUSSION

Multiple factors influence pediatric and general EM physicians' decisions about whether to perform an LP on a low-risk febrile infant ≤ 8 weeks old. Although physicians uniformly stated that they routinely obtain an LP for infants' ≤ 4 weeks old, the decision to perform an LP on infants 4 to 8 weeks old varied on the basis of differences in the physician's values, use of research findings, and clinical experience. Although this variation indicates that use of shared decision-making with parents may be warranted for infants in this older age group, both physicians and nurses had mixed feelings about its use.

We identified several factors that influence decisions of individual physicians as to whether to perform an LP on infants 4 to 8 weeks old. Publication of new algorithms for risk stratification led some physicians to change their practice and not perform an LP in infants who are classified as low risk by the newer algorithms. However, other physicians have argued that LPs should be performed even if the risk of meningitis is extremely low because of its potentially devastating consequences.¹⁶ In weighing this decision, the value of risk aversion is likely an important factor for physicians. Newer attending physicians sometimes reported feeling more risk averse because of their lack of experience, but this risk aversion dissipated over time for some more-experienced physicians. However, similar to reports in which researchers assessed physicians' risk aversion in adults and children with other conditions,^{17,18} 1 physician with many years of experience felt risk averse because he had often seen the consequences of meningitis. In our findings, risk aversion is highlighted as an important value for decision-making that differs among individual physicians. Physicians uniformly felt that the risk of meningitis in infants ≤ 4 weeks old was too high to forgo LP. Risk aversion in this age group may be linked to the sense of consensus that infants ≤ 4 weeks old are high risk,

although the actual risk of meningitis is $\sim 1\%$.⁵ As newer risk stratification algorithms without age cutoffs become adopted into practice,¹⁹ it is possible that physicians become less risk averse in this younger age group.

The factors we identified likely contribute to the extensive variation among providers and across EDs in whether an LP is performed on low-risk febrile infants 4 to 8 weeks old.^{1,20} As rates of meningitis are similar across institutions,¹ this variation may be considered unwarranted.^{21,22} Variation in care is also unwarranted when it is not explained by differences in preferences of parents or patients.^{21,22} Incorporation of parents' preferences into decisions is best made through a shared decision-making process, in which the parents are informed about both the risks and the benefits of management options and are able, with the support of the physician, to arrive at a decision that fits with their values.¹² Similar to physicians, parents of febrile infants likely have differences in their values and preferences that can be explored through shared decision-making, and that in turn can reduce the current "unwarranted" variation in whether an LP is performed.

Use of shared decision-making in adults has been shown to reduce unwarranted variability.²³ Additionally, decisions regarding the management of well-appearing febrile infants have been identified as well suited for shared decision-making.²⁴ However, shared decision-making with parents of febrile infants has not been previously studied, and physicians and nurses identified several barriers. Barriers to parents' ability to understand medical data and risks were commonly cited, as was the impact of parents' emotions on their understanding. The decision to obtain an LP is likely to elicit a strong emotional response in parents.²⁵ These emotion-laden decisions have been labeled "affect rich" because parents' emotional responses can inhibit their attention to objective information on risks and, ultimately, negatively impact the decision-making process.^{26,27} However, despite these challenges, it is suggested in research that

parents do want to participate in affect-rich decisions, for example, in the decision of whether to resuscitate their extremely premature or high-risk newborn.²⁸ Communicating risks in a manner that parents can understand was identified as a facilitator of shared decision-making. For example, pictographs improve parents' understanding of risks by giving them a visual representation of the denominator.²⁹ Pictographs have been incorporated into visual aids to facilitate communication and shared decision-making in the ED, such as with parents of children with head trauma.³⁰ However, time constraints were identified as barriers to shared decision-making, and use of visual aids may increase the time providers need to spend with parents.²⁵ In future investigations, researchers should evaluate how to effectively implement shared decision-making for febrile infants in the time-limited ED setting, including the important role of the primary care pediatrician both before the ED visit and for follow-up.

There are several limitations to our study. First, because the study was conducted at a single academic medical center, the perspectives of the physicians and nurses may not be widely generalizable. However, we interviewed physicians and nurses who had worked at different institutions, thereby increasing the generalizability of our findings. Second, we interviewed only 2 general EM physicians and enrolled nurses and general EM physicians who responded to recruitment e-mails, which may have resulted in selection bias. Third, although we collected data from interviews of physicians and nurses, we did not observe their actual clinical practice, and the narratives may not match physicians' actual practices. Fourth, although physicians and nurses discussed their perceptions of factors related to parents that are barriers to and facilitators of shared decision-making, we did not interview parents. Learning parents' values and preferences in decisions regarding LPs will be critical for implementation of shared decision-making, and in future investigation, researchers should evaluate the actual perspectives of parents on shared decision-making for low-risk febrile infants.

CONCLUSIONS

Differences in physicians' values, use of research, and clinical experience likely contribute to the observed variation in decisions about performing an LP on febrile infants ≤ 8 weeks old. To reduce this unwarranted variation, incorporation of parents' values and preferences through shared decision-making may be indicated, although there are several barriers that would need to be overcome. In future studies, researchers should explore parents' perspectives on shared decision-making for low-risk febrile infants and learn how best to implement shared decision-making for these infants.

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