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EDITORIALS

ONLINE ONLY

The American Board of Pediatrics Response to the Pediatric Hospital Medicine Petition

David G Nichols, MD, MBA, Suzanne K Woods, MD

American Board of Pediatrics, Chapel Hill, North Carolina.

In August of 2014, the Pediatric Hospital Medicine (PHM) community petitioned the American Board of Pediatrics (ABP) for a subspecialty certificate in PHM. A lengthy vetting process ensued during which the ABP consulted with a wide array of stakeholders. The ABP Board of Directors approved the request from the PHM community for a subspecialty certificate in December 2015 and published the results of the vetting process.[1]

The ABP received a second petition posted on PHM listserv, which opened with the following statement:

> *"We submit this petition letter to register a formal complaint, demand immediate action, and request a formal response from the ABP regarding the practice pathway criteria and the application of these criteria for the Pediatric Hospital Medicine specialty exam. Recently there has been considerable discussion on the Pediatric Hospital Medicine ListServ suggesting that the ABP's implementation of the career pathway criteria has failed to respect and fairly assess the diverse career paths of numerous experienced pediatric hospitalists, which may impede their opportunities for professional advancement. Anecdotal reports on the ListServ also suggest that the use of the current practice pathway criteria to evaluate exam applicants disadvantages women, though sufficient data is not available at this time to evaluate this assertion objectively."*

The ABP response to the PHM community's concerns regarding the practice pathway for the first certifying exam in PHM is as follows.

THE ABP RESPONSE

ABP thanks the PHM community for the opportunity to respond to the attached petition. Our approach and response are grounded in our mission:

> *"Advancing child health by certifying pediatricians who meet standards of excellence and are committed to continuous learning and improvement."*

Transparency is one of the ABP's core values, which underpins this response. The ABP acknowledges that the petitioners did not find the guidance on the ABP website sufficiently transparent. We regret the distress this may have caused, will do our best to answer the questions forthrightly, and have revised the website language for greater clarity.

ALLEGATION OF GENDER BIAS

Some posts on the PHM listserv alleged gender (sex) bias against women in the ABP application process and outcomes. This allegation is not supported by the facts. A peer group of pediatric hospitalists constitutes the ABP PHM subboard which determined the eligibility criteria. The subboard thoughtfully developed these criteria and the American Board of Medical Specialties (ABMS) approved the broad eligibility criteria. The PHM subboard is composed of practicing pediatric hospitalists with a diversity of practice location, age, gender, and race. The majority of ABP PHM subboard members and medical editors are women.

Making unbiased decisions is also a core value of the ABP. Among the 1,627 applicants for the exam, the ABP has approved 1,515 (93%) as of August 15, 2019. Seventy percent of applications were from women, which mirrors the demographics of the pediatric workforce. There was no significant difference between the percentage of women (4.0%) and men (3.7%) who were denied admission to the exam (Table 1).

As of August 15, 2019, the credentials committee of the PHM subboard is still reviewing 48 applications, including 35 appeals, of which 60% (N = 21) were from women and 40% (N = 14) were from men. Thirteen (N = 13) remaining applications are under review but not in the appeals process.

PRACTICE PATHWAY CRITERIA USED IN THE APPLICATION PROCESS

PHM is the 15th pediatric subspecialty to begin the certification process with a practice pathway. In none of the prior cases was it possible to do a detailed implementation study to understand the myriad of ways in which individual pediatricians arrange their professional and personal time. This reality has led to the publication of only general, rather than specific practice pathway criteria at the start of the application process for PHM and every other pediatric subspecialty. Rather, in each case, a well-informed and diverse peer group of subspecialists (the subboard) has reviewed the applications to get a sense of the variations of practice and then decided on the criteria that a subspecialist must meet to be considered eligible to sit for the certifying exam. Clear-cut criteria were used consistently in adjudicating all applications. Although the ABP has not done this for other subspecialties, we agree that publishing the spe-

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TABLE 1. **Decision Status on N = 1,627 PHM Applications (Including Pending Decisions) as of August 15, 2019**

	Approval	Denial	Pending	Total
Females	1,070	46	30	1,146
	(93.4%)	(4.0%)	(2.6%)	
Males	445	18	18	481
	(92.5%)	(3.7%)	(3.7%)	
Total	1,515	64	48	1,627

P =.89 using two-tailed Fisher Exact Test showing no difference between approvals and denials by gender.

TABLE 2. **Eligibility Criteria Used to Evaluate N = 1,579 Applications for the 2019 PHM Exam as of August 15, 2019**

	Practice Characteristics	Criteria
1.	Standard "Look-back" Period	4 years
2.	Start Date	PHM practice started on or before July 2015 for the 2019 exam
3.	% Total FTE and Workhours for all PHM Professional Activities	All PHM professional activities (eg, patient care, education, research, and PHM administration) equal ≥50% FTE defined as ≥900-1,000 hours per year every year for the preceding 4 years
4.	% Clinical FTE and Patient Care Hours	*Direct* patient care of hospitalized children equals ≥25% FTE defined as ≥450-500 hours per year every year for the preceding 4 years
5.	Scope	Practice covers the full range of hospitalized children concerning age ranges, diagnoses, and complexity.
6.	Location	Practice experience and hours (see items #3 and #4 of the seven practice characteristics) were acquired in the United States or Canada.
7.	Practice Interruptions	Practice interruptions cannot exceed 3 months in the preceding 4 years or 6 months in the preceding 5 years.

Approval of an application required meeting all seven of the criteria above as attested to by the applicant's supervisor.
Abbreviations: FTE, full-time equivalent; PHM, pediatric hospital medicine.

cific criteria once they had been decided upon would have improved the process. We commit to doing so in the future.

The eligibility criteria were designed to be true to the mission of the ABP and seek parity with the requirements used by other subspecialties and by the PHM training pathway. The assumption is that competent PHM practice of sufficient duration and breadth, attested to by a supervisor, would allow the ABP to represent to the public that the candidate is qualified to sit for the exam. The eligibility criteria focused on seven practice characteristics (Table 2):

(1) The "look-back window" refers to the years of recent experience a pediatric hospitalist must demonstrate to be eligible for the exam. The minimum look-back window for PHM was set at four years.

(2) The July 2015 start date follows from the four-year look-back window for the November 2019 exam date.

(3) The minimum percentage full-time equivalent (%FTE) for all PHM professional activities (ie, clinical care, research, education, and PHM administration) was set at 50% FTE. Recognizing that an FTE may be defined differently at different institutions, the ABP defined the workweek as 40 hours and the 50% FTE as 900-1,000 hours per year.

(4) The minimum percentage FTE for PHM direct patient care (as described below) was set at 25% FTE and defined as 450-500 hours per year. Every candidate must satisfy both the minimum hours for all PHM professional activities and the minimum hours for the direct care of hospitalized children. Applicants must meet or exceed these minima if the ABP is to represent to the public that an applicant has the necessary experience to be called a subspecialist. Similarly, all other ABP subspecialties required at least 50% FTE commitment for the candidate to be considered a subspecialist.

(5) The scope of practice seeks to maintain parity with the training pathway by requiring care of the full spectrum of hospitalized children. This full spectrum is defined as children on general pediatric wards, ages birth to 21 years, and specifically in-

TABLE 3. **Clarified and Simplified Eligibility Criteria for the 2019 PHM Exam**

Practice Characteristics		Criteria
1.	Standard "Look-back" Period	4 years
2.	Start Date	PHM practice started on or before July 2015 for the 2019 exam
3.	Workhours for all PHM Professional Activities	All PHM professional activities (eg, patient care, education, research, and PHM administration) ≥900-1,000 hours per year every year for the preceding 4 years
4.	Patient Care Hours	*Direct* patient care of hospitalized children ≥450-500 hours per year every year for the preceding 4 years
5.	Scope	Practice covers the full range of hospitalized children concerning age ranges, diagnoses, and complexity.
6.	Location	Practice experience and hours (see items 3 and 4) were acquired in the United States or Canada.

Approval of an application required meeting all 6 of the criteria above as attested to by the applicant's supervisor.
Abbreviation: PHM, pediatric hospital medicine.

cludes children with complex chronic disease, surgical care and comanagement, sedation, palliative care, and common procedures. Care devoted exclusively to a narrow patient population ("niched care"), such as newborns in the nursery, does not meet the eligibility requirements.

(6) The location for patient care must have occurred in the United States or Canada.

(7) The possibility of practice interruption was included among the eligibility criteria. Attempting to strike a balance between an applicant demonstrating sufficient recent experience to be called a subspecialist versus the reality of some individuals needing to interrupt professional and clinical practice, the subboard stipulated that interruptions of PHM professional activities should not exceed three months during the preceding four years and six months during the preceding five years.

CLARIFICATION AND SIMPLIFICATION OF ELIGIBILITY CRITERIA

The ABP recognizes that the use of %FTE, work hours, and leave exceptions led to unintended confusion among applicants. The intent had been to acknowledge the many valid reasons for interruption of practice, including parental leave. This response to the petition clarifies that the critical question from the public's perspective is whether the candidate has accumulated enough hours of sustained practice to be considered competent in the field of PHM and specifically caring for hospitalized children (as defined above). Upon review, the ABP believes the workhours criteria (items 3 and 4) accomplish this critical goal and make the %FTE and practice interruption criteria largely redundant. Table 3 reflects the clarified and streamlined requirements. Re-examination of all the denied applications showed that using the criteria in Table 3 did not have a significant impact on the outcomes. One additional applicant's appeal was granted, and this applicant has been so notified.

APPEALS PROCESS

The right to appeal and the Appellate Review Procedure are included in a denial letter. The applicant is given a deadline of 14 days to notify the ABP of the intent to appeal. There is no appellate fee. Within one to three days, the ABP acknowledges receipt of the applicant's intent to appeal and sends the applicant a date by which additional supporting information should be provided.

The appeal material is shared with the subboard credentials committee and each member individually reviews and votes on the appeal. The application is approved if a majority votes in favor of the applicant's appeal. If there is no majority, the credentials committee discusses the case to reach a decision. The results of the appeal are final according to the ABP Appellate Review Procedure. We remain in the appeal process for several PHM applicants as of the date of this response.

Thank you for the opportunity to respond to the petition. The ABP is committed to dialogue, transparency, and continuously improving its processes.

Acknowledgment

The authors thank the ABP board of directors and the ABP PHM subboard for their review and thoughtful contributions.

Disclosures: Dr. Nichols reports other from The American Board of Pediatrics, during the conduct of the work. Dr. Woods has nothing to disclose.

Reference

1. Barrett DJ, McGuinness GA, Cunha CA, et al. Pediatric hospital medicine: A proposed new subspecialty. *Pediatrics*. 2017;139(3). https://doi.org/10.1542/peds.2016-1823.

Society of Hospital Medicine Position on the American Board of Pediatrics Response to the Pediatric Hospital Medicine Petition

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The first Pediatric Hospital Medicine (PHM) fellowships in the United States were established in 2003;[1] and since then, the field has expanded and matured dramatically. This growth, accompanied by greater definition of the role and recommended competencies of pediatric hospitalists,[2] culminated in the submission of a petition to the American Board of Pediatrics (ABP) in August 2014 to consider recognition of PHM as a new pediatric subspecialty.[3] After an 18-month iterative process requiring extensive input from the Joint Council of Pediatric Hospital Medicine, ABP subcommittees, the Association of Medical School Pediatric Department Chairs, the Association of Pediatric Program Directors, and other prominent pediatric professional societies, the ABP voted in December 2015 to recommend that the American Board of Medical Subspecialties (ABMS) recognize PHM as a new subspecialty.[3]

The ABP subsequently announced three pathways for board certification in PHM:

- Training pathway for those completing an Accreditation Council for Graduate Medical Education–accredited two-year PHM fellowship program;
- Practice pathway for those satisfying ABP criteria for clinical activity in PHM for four years prior to exam dates (in 2019, 2021, and 2023), initially described as "direct patient care of hospitalized children ≥25% full-time equivalent (FTE) defined as ≥450-500 hours per year every year for the preceding four years";[4]
- Combined pathway for those completing less than two years of fellowship, who would be required to complete two years of practice experience that satisfy the same criteria as each year of the practice pathway.[5]

While the training pathway met near-uniform acceptance, concerns were raised through the American Academy of Pediatrics Section of Hospital Medicine (AAP SOHM) Listserv regarding the practice pathway, and by extension, the combined pathway. Specifically, language describing the necessary characteristics of acceptable PHM practice was felt to be vague and not transparent. Listserv posts also raised concerns regarding the potential exclusion of "niche" practices such as subspecialty hospitalists and newborn hospitalists. As applicants in the practice pathway began to receive denials, opinions voiced in listserv posts were increasingly critical of the ABP's lack of transparency regarding the specific criteria adjudicating applications.

ORIGIN OF THE PHM PETITION

A group of hospitalists, led by Dr. David Skey, a pediatric hospitalist at Arnold Palmer Children's Hospital in Orlando, Florida, created a petition which was submitted to the ABP on August 6, 2019, and raised the following issues:

- "A perception of unfairness/bias in the practice pathway criteria and the way these criteria have been applied.
- Denials based on gaps in employment without reasonable consideration of mitigating factors.
- Lack of transparency, accountability, and responsiveness from the ABP."[6]

The petition, posted on the AAP SOHM listserv and signed by 1,479 individuals,[7] raised concerns of anecdotal evidence that the practice pathway criteria disproportionately disadvantaged women, although intentional bias was not suspected by the signers of the letter. The petition's signers submitted the following demands to the ABP:

- "Facilitate a timely analysis to determine if gender bias is present or perform this analysis internally and release the findings publicly.
- Revise the practice pathway criteria to be more inclusive of applicants with interrupted practice and varied clinical experience, to include clear-cut parameters rather than considering these applications on a closed-door 'case-by-case basis...at the discretion of the ABP'.
- Clarify the appeals process and improve responsiveness to appeals and inquiries regarding denials.
- Provide a formal response to this petition letter through the PHM ListServ and/or the ABP website within one week of receiving the signed petition."[6]

THE ABP RESPONSE TO THE PHM PETITION

A formal response to the petition was released on the AAP SOHM Listserv on August 29, 2019, to address the concerns raised and is published in this issue of the *Journal of Hospital Medicine*.[4] In response to the allegation of gender bias, the ABP maintained that the data did not support this, as the denial rate for females (4.0%) was not significantly different than

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that for males (3.7%). The response acknowledged that once clear-cut criteria were decided upon to augment the general practice pathway criteria published at the outset, these criteria should have been disseminated. The ABP maintained, however, that these criteria, once established, were used consistently in adjudicating all applications. To clarify and simplify the eligibility criteria, the percentage of the full-time equivalent and practice interruption criteria were removed, as the work-hours criteria (direct patient care of hospitalized children ≥450-500 hours per year every year for the preceding four years)[8] were deemed sufficient to ensure adequate clinical participation.

SHM'S POSITION REGARDING THE PHM PETITION AND ABP RESPONSE

The Society of Hospital Medicine (SHM), through pediatric hospitalists and pediatricians on its Board, committees, and the Executive Council of the Pediatric Special Interest Group, has followed with great interest the public debate surrounding the PHM certification process and the subsequent PHM petition to the ABP. The ABP responded swiftly and with full transparency to the petition, and SHM supports these efforts by the ABP to provide a timely, honest, data-driven response to the concerns raised by the PHM petition. SHM recognizes that the mission of the ABP is to provide the public with confidence that physicians with ABP board certifications meet appropriate "standards of excellence". While the revisions implemented by the ABP in its response still may not satisfy the concerns of all members of the PHM community, SHM recognizes that the revised requirements remain true to the mission of the ABP.

SHM applauds the authors and signatories of the PHM petition for bravely raising their concerns of gender bias and lack of transparency. The response of the ABP to this petition by further improving transparency serves as an example of continuous improvement in collaborative practice to all medical specialty boards.

While SHM supports the ABP response to the PHM petition, it is clear that excellent physicians caring for hospitalized children will be unable to achieve PHM board certification for a variety of reasons. For these physicians who are not PHM board certified as pediatric hospitalists by the ABP, SHM supports providing these physicians with recognition as hospitalists. These include "niche" hospitalists, such as newborn hospitalists, subacute hospitalists, and subspecialty hospitalists. SHM will also continue to support and recognize community-based hospitalists, family medicine-trained hospitalists, and Med-Peds hospitalists whose practice may not comply with criteria laid out by the ABP. For these physicians, receiving Fellow designation through SHM, a merit-based distinction requiring demonstration of clinical excellence and commitment to hospital medicine, is another route whereby physicians can achieve designation as a hospitalist.

FUTURE DIRECTIONS FOR PEDIATRIC HOSPITALISTS

SHM supports future efforts by the ABP to be vigilant for bias of any sort in the certification process. Other future considerations for the PHM community include the possibility of a focused practice pathway in hospital medicine (FPHM) for pediatrics as is currently jointly offered by the American Board of Internal Medicine (ABIM) and the American Board of Family Medicine (ABFM). This maintenance of certification program is a variation of internal medicine or family medicine recertification, not a subspecialty, but allows physicians practicing primarily in inpatient settings to focus continuing education efforts on skills and attitudes needed for inpatient practice.[9] While this possibility was discounted by the ABP in the past based on initially low numbers of physicians choosing this pathway, this pathway has grown from initially attracting 150 internal medicine applicants yearly to 265 in 2015.[10] The ABMS approved the ABIM/ABFM FPHM as its first approved designation in March 2017 after more than 2,500 physicians earned this designation.[11] Of the >2,800 pediatric residency graduates (not including combined programs) each year, 10% report planning on becoming pediatric hospitalists,[12] and currently only 72-74 fellows graduate from PHM fellowships yearly.[13] FPHM for pediatric hospital medicine would provide focused maintenance of certification and hospitalist designation for those who cannot match to fellowship programs.

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References

1. Freed GL, Dunham KM, Research Advisory Committee of the American Board of P. Characteristics of pediatric hospital medicine fellowships and training programs. *J Hosp Med.* 2009;4(3):157-163. https://doi.org/10.1002/jhm.409.
2. Stucky ER, Maniscalco J, Ottolini MC, et al. The Pediatric Hospital Medicine Core Competencies Supplement: a Framework for Curriculum Development by the Society of Hospital Medicine with acknowledgement to pediatric hospitalists from the American Academy of Pediatrics and the Academic Pediatric Association. *J Hosp Med.* 2010;5 Suppl 2:i-xv, 1-114. https://doi.org/10.1002/jhm.776.
3. Barrett DJ, McGuinness GA, Cunha CA, et al. Pediatric Hospital Medicine: A Proposed New Subspecialty. *Pediatrics.* 2017;139(3). https://doi.org/10.1542/peds.2016-1823.
4. Nichols DG WS. The American Board of Pediatrics response to the Pediatric Hospital Medicine petition. *J Hosp Med.* 2019;14(10):586-588. https://doi.org/10.12788/jhm.3322.
5. Pediatric hospital medicine certification. American Board of Pediatrics. https://www.abp.org/content/pediatric-hospital-medicine-certification#training. Accessed 3 September, 2019.
6. Skey D. Pediatric Hospitalists, It's time to take a stand on the PHM Boards Application Process! Five Dog Development, LLC. https://www.phmpetition.com/. Accessed 3 September, 2019.
7. Skey D. Petition Update. In: AAP SOHM Listserv: American Academy of Pediatrics; 2019.
8. The American Board of Pediatrics Response to the Pediatric Hospital Medicine Petition. The American Board of Pediatrics. https://www.abp.org/sites/abp/files/phm-petition-response.pdf. Published 2019. Accessed September 4, 2019.
9. Focused practice in hospital medicine. American Board of Internal Medicine. https://www.abim.org/maintenance-of-certification/moc-requirements/focused-practice-hospital-medicine.aspx. Published 2019 Accessed September 4, 2019.
10. Butterfield S. Following the focused practice pathway. American College of Physicians. Your career Web site. https://acphospitalist.org/archives/2016/09/focused-practice-hospital-medicine.htm. Published 2016. Accessed September 4, 2019.
11. American Board of Medical Specialties Announces New, Focused Practice Designation [press release]. American Board of Medical Specialties, 14 Mar 2017.
12. Leyenaar JK, Frintner MP. Graduating Pediatric Residents Entering the Hospital Medicine Workforce, 2006-2015. *Acad Pediatr.* 2018;18(2):200-207. https://doi.org/10.1016/j.acap.2017.05.001.
13. PHM Fellowship Programs. PHMFellows.org. http://phmfellows.org/phm-programs/. Published 2019. Accessed September 4, 2019.

Recommendations on the Use of Ultrasound Guidance for Adult Lumbar Puncture: A Position Statement of the Society of Hospital Medicine

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EXECUTIVE SUMMARY

1) When ultrasound equipment is available, along with providers who are appropriately trained to use it, we recommend that ultrasound guidance should be used for site selection of lumbar puncture to reduce the number of needle insertion attempts and needle redirections and increase the overall procedure success rates, especially in patients who are obese or have difficult-to-palpate landmarks.

2) We recommend that ultrasound should be used to more accurately identify the lumbar spine level than physical examination in both obese and nonobese patients.

3) We suggest using ultrasound for selecting and marking a needle insertion site just before performing lumbar puncture in either a lateral decubitus or sitting position. The patient should remain in the same position after marking the needle insertion site.

4) We recommend that a low-frequency transducer, preferably a curvilinear array transducer, should be used to evaluate the lumbar spine and mark a needle insertion site. A high-frequency linear array transducer may be used in nonobese patients.

5) We recommend that ultrasound should be used to map the lumbar spine, starting at the level of the sacrum and sliding the transducer cephalad, sequentially identifying the lumbar spine interspaces.

6) We recommend that ultrasound should be used in a transverse plane to mark the midline of the lumbar spine and in a longitudinal plane to mark the interspinous spaces. The intersection of these two lines marks the needle insertion site.

7) We recommend that ultrasound should be used during a preprocedural evaluation to measure the distance from the skin surface to the ligamentum flavum from a longitudinal paramedian view to estimate the needle insertion depth and ensure that a spinal needle of adequate length is used.

8) We recommend that novices should undergo simulation-based training, where available, before attempting ultrasound-guided lumbar puncture on actual patients.

9) We recommend that training in ultrasound-guided lumbar puncture should be adapted based on prior ultrasound experience, as learning curves will vary.

10) We recommend that novice providers should be supervised when performing ultrasound-guided lumbar puncture before performing the procedure independently on patients. *Journal of Hospital Medicine* 2019;14;591-601

Approximately 400,000 lumbar punctures (LPs) are performed in the United States annually for either diagnostic workup or therapeutic relief.[1] Lumbar punctures are increasingly being performed in the United States, with an estimated 97,000 LPs performed on Medicare fee-for-service beneficiaries in 2011 alone, which is an increase of approximately 4,000 LPs in the same population from 1991.[2] Approximately 273,612 LPs were performed on hospitalized patients in the United States in 2010,[1] and the inpatient hospital setting is the most common site for LPs.[2,3]

Many LPs are referred to radiologists who have access to imaging guidance to aid with needle insertion.[2] However, referrals to radiology delay performance of LPs, and delayed diagnosis of acute bacterial meningitis, the most common yet serious condition for which LPs are performed, is associ-

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TABLE 1. **Summary of Recommendations**

No.	Topic of Recommendation	Strength of Recommendation	Degree of Consensus
Clinical Outcomes			
1	Reduce the number of needle insertion attempts and needle redirections, and increase overall procedure success rates	Strong	Very good
	Reduce post-procedure back pain and improve patient satisfaction	N/A	N/A
	Reduce risk of a traumatic tap	N/A	N/A
Technique			
2	Identify the lumbar spine level more accurately than physical examination	Strong	Very Good
	Using a sitting position widens interspinous spaces	N/A	N/A
3	Perform ultrasound mapping in either a lateral decubitus or sitting position	Weak	Good
4	Use a low frequency transducer to evaluate lumbar spine and mark a needle insertion site	Strong	Very good
5	Start at level of sacrum and slide transducer cephalad to map lumbar spine	Strong	Very good
6	Use ultrasound in transverse plane to mark midline of lumbar spine and a longitudinal plane to mark interspinous spaces. Intersection of these lines marks the needle insertion site	Strong	Very good
7	During a preprocedural ultrasound evaluation, measure the distance from skin surface to ligamentum flavum from a longitudinal paramedian view to estimate needle insertion depth and ensure adequate length spinal needle is used	Strong	Very good
	Use of real-time ultrasound guidance from a paramedian approach may be performed by trained operators; however, this technically challenging approach may not confer any additional advantage over static guidance	N/A	N/A
	Use of novel needle tracking devices may facilitate real-time ultrasound guidance but have limited evidence	N/A	N/A
Training			
8	Practice with simulation models before performing on real patients	Strong	Very good
9	Learning curves for skill acquisition vary	Strong	Very good
10	Supervise novice providers use of ultrasound guidance for lumbar puncture before allowing independent performance on patients	Strong	Very good

Grayed out recommendations did not achieve consensus.
Abbreviations: N/A, Statements without recommendations due to lack of agreement/uncertainty

ated with increased morbidity and mortality.[4-8] Furthermore, although initiating empiric antibiotic treatment for suspected acute bacterial meningitis is recommended in some cases, doing so routinely can cause false-negative cerebrospinal fluid (CSF) culture results, complicating decisions about de-escalation and duration of antibiotics that could have been safely avoided by promptly performing an LP.[9]

Delaying the performance of LP has been associated with increased mortality.[10] Demonstration of proficiency in performance of lumbar puncture is considered a core competency for hospitalists,[11] and with the increasing availability of point-of-care ultrasound, hospitalists can use ultrasound to guide performance of LPs at the bedside.[12] However, 30% of patients requiring LP in emergency departments have difficult-to-palpate lumbar spine landmarks,[13] and lumbar puncture performed based on palpation of landmarks alone has been reported to fail or be traumatic in 28% of patients.[14] Use of ultrasound guidance for lumbar puncture has been shown in randomized controlled trials to improve procedural success rates, while reducing the time to successful LP, needle passes, patient pain scores, and risk of a traumatic LP.[15-17]

The purpose of this position statement is to review the literature and present consensus-based recommendations on the performance of ultrasound-guided LP in adult patients. This position statement does not mandate that hospitalists use ultrasound guidance for LP, nor does it establish ultrasound guidance as the standard of care for LP. Similar to previously published Society of Hospital Medicine (SHM) position statements,[12,18,19] this document presents recommendations with supporting evidence for the clinical outcomes, techniques, and training for using ultrasound guidance for LP. A manuscript describing the technique of ultrasound guidance for LPs has been previously published by some of the authors of this position statement.[20]

METHODS

Detailed methods are described in Appendix 1. The SHM Point-of-care Ultrasound (POCUS) Task Force was assembled to carry out this guideline development project under the direction of the SHM Board of Directors, Director of Education,

TABLE 2. **Degree of Consensus, Strength of Recommendation, and Wording**

Degree of Consensus	Strength of Recommendation	Wording [Based on Voting]
Perfect consensus	Strong	Recommend – must/to be/will
Very good consensus	Strong	Recommend – should be/can
Good consensus	Weak/Conditional	Suggest – to do
Some consensus	Weak/Conditional	Suggest – may do
No consensus Disagreement	NO	No recommendation was made regarding

and Education Committee. All expert panel members were physicians or advanced practice providers with expertise in POCUS. Expert panel members were divided into working group members, external peer reviewers, and a methodologist. All Task Force members were required to disclose any potential conflicts of interests (Appendix 2). The literature search was conducted in two independent phases. The first phase included literature searches conducted by the six working group members themselves. Key clinical questions and draft recommendations were then prepared. A systematic literature search was conducted by a medical librarian based on the findings of the initial literature search and draft recommendations. The Medline, Embase, CINAHL, and Cochrane medical databases were searched from 1975 to December 2015 initially. Google Scholar was also searched without limiters. Updated searches were conducted in November 2016, January 2018, and October 2018. The search strings are included in Appendix 3. All article abstracts were first screened for relevance by at least two members of the working group. Full-text versions of screened articles were reviewed, and articles on the use of ultrasound to guide LP were selected. In addition, the following article types were excluded: non-English language, nonhuman, age <18 years, meeting abstracts, meeting posters, narrative reviews, case reports, letters, and editorials. Moreover, studies focusing on the use of ultrasound guidance for spinal nerve root injections, regional anesthesia, and assessment of lumbar spine anatomy alone were excluded. All relevant systematic reviews, meta-analyses, randomized controlled trials, and observational studies of ultrasound-guided LP were screened and selected. Final article selection was based on working group consensus, and the selected literature was incorporated into the draft recommendations.

The Research and Development (RAND) Appropriateness Method that required panel judgment and consensus was used.[21] The 27 voting members of the SHM POCUS Task Force reviewed and voted on the draft recommendations considering the following five transforming factors: (1) Problem priority and importance, (2) Level of quality of evidence, (3) Benefit/harm balance, (4) Benefit/burden balance, and (5) Certainty/concerns about PEAF (Preferences/Equity/Acceptability/Feasibility). Panel members participated in two rounds of electronic voting using an internet-based electronic data collection tool (REDCap™) in February 2018 and April 2018 (Appendix 4). Voting on appropriateness was conducted using a 9-point Likert scale. The three zones of the 9-point Likert scale were inappropriate (1-3 points), uncertain (4-6 points), and appropriate (7-9 points). The degree of consensus was assessed using the RAND algorithm (Appendix 1 Figure, and Table 1). Establishing a recommendation required at least 70% agreement that a recommendation was "appropriate." A strong recommendation required 80% of the votes within one integer of the median, following the RAND rules. Disagreement was defined as >30% of panelists voting outside of the zone of the median.

Recommendations were classified as strong or weak/conditional based on preset rules defining the panel's level of consensus, which determined the wording of each recommendation (Table 2). The revised consensus-based recommendations underwent internal and external reviews by POCUS experts from different subspecialties. The final review of this position statement was performed by members of the SHM POCUS Task Force, SHM Education Committee, and SHM Executive Committee. The SHM Executive Committee endorsed this position statement in June 2018 before submission to the *Journal of Hospital Medicine*.

RESULTS

Literature Search

A total of 4,389 references were pooled from four different sources: a search by a certified medical librarian in December 2015 (3,212 citations) that was updated in November 2016 (380 citations), January 2018 (282 citations), and October 2018 (274 citations); working group members' personal bibliographies and searches (31 citations); and a search focusing on ultrasound-guided LP training (210 citations). A total of 232 full-text articles were reviewed, and the final selection included 77 articles that were abstracted into a data table and incorporated into the draft recommendations. Details of the literature search strategy are presented in Appendix 3.

RECOMMENDATIONS

Four domains (clinical outcomes, technique, training, and knowledge gaps) with 16 draft recommendations were generated based on a review of the literature. Selected references were abstracted and assigned to each draft recommendation. Rationales for each recommendation were drafted citing supporting evidence. After two rounds of panel voting, five recommenda-

tions did not achieve agreement based on the RAND rules, one recommendation was combined with another recommendation during peer review, and 10 statements received final approval. The degree of consensus based on the median score and the dispersion of voting around the median are shown in Appendix 5. Nine statements were approved as strong recommendations, and one was approved as a conditional recommendation. Therefore, the final recommendation count was 10. The strength of the recommendation and degree of consensus for each recommendation are summarized in Table 1.

Terminology

LP is a procedure in which a spinal needle is introduced into the subarachnoid space for the purpose of collecting CSF for diagnostic evaluation and/or therapeutic relief.

Throughout this document, the phrases "ultrasound-guided" and "ultrasound guidance" refer to the use of ultrasound to mark a needle insertion site immediately before performing the procedure. This is also known as static ultrasound guidance. Real-time or dynamic ultrasound guidance refers to direct visualization of the needle tip as it traverses through the skin and soft tissues to reach the ligamentum flavum. Any reference to real-time ultrasound guidance is explicitly stated.

Clinical outcomes

1) When ultrasound equipment is available, along with providers who are appropriately trained to use it, we recommend that ultrasound guidance should be used for site selection of LPs to reduce the number of needle insertion attempts and needle redirections and increase the overall procedure success rates, especially in patients who are obese or have difficult-to-palpate landmarks.

Rationale. LPs have historically been performed by selecting a needle insertion site based on palpation of anatomical landmarks. However, an estimated 30% of patients requiring LP in emergency departments have lumbar spine landmarks that are difficult to palpate, most commonly due to obesity.[13] Furthermore, lumbar puncture performed based on palpation of landmarks alone has been reported to fail in 28% of patients.[14]

Ultrasound can be used at the bedside to elucidate the lumbar spine anatomy to guide performance of LP or epidural catheterization. Since the early 2000s, randomized studies comparing the use of ultrasound guidance (ultrasound-guided) versus anatomical landmarks (landmark-guided) to map the lumbar spine for epidural catheterization have emerged. It is important to recognize that the exact same ultrasound technique is used for site marking of LP, epidural catheterization, and spinal anesthesia—the key difference is how deep the needle tip is inserted. Therefore, data from these three ultrasound-guided procedures are often pooled. Currently, at least 33 randomized controlled studies comparing ultrasound-guided vs landmark-guided site selection for LP, epidural catheterization, or spinal anesthesia have been published.[22-49] We present three meta-analyses below that pooled data primarily from randomized controlled studies comparing ultrasound-guided vs landmark-guided site selection for LP or spinal anesthesia.

In 2013, Shaikh et al. published the first meta-analysis with 14 randomized controlled studies comparing ultrasound-guided vs landmark-guided site selection for LP (n = 5) or epidural catheterization (n = 9). The pooled data showed that use of ultrasound guidance decreased the proportion of failed procedures (risk ratio 0.21, 95% CI 0.10-0.43) with an absolute risk reduction of 6.3% (95% CI 4.1%-8.4%) and a number needed to treat of 16 (95% CI 12-25) to prevent one failed procedure. In addition, the use of ultrasound reduced the mean number of attempts by 0.44 (95% CI 0.24-0.64) and reduced the mean number of needle redirections by 1.00 (95% CI 0.75-1.24). The reduction in risk of a failed procedure was similar for LPs (risk ratio 0.19 [95% CI 0.07-0.56]) and epidural catheterizations (risk ratio 0.23 [95% CI 0.09-0.60]).[16]

A similar meta-analysis published by Perlas et al. in 2016 included a total of 31 studies, both randomized controlled and cohort studies, evaluating the use of ultrasound guidance for LP, spinal anesthesia, and epidural catheterization.[50] The goal of this systematic review and meta-analysis was to establish clinical practice recommendations. The authors concluded (1) the data consistently suggest that ultrasound is more accurate than palpation for lumbar interspace identification, (2) ultrasound allows accurate measurement of the needle insertion depth to reach the epidural space with a mean difference of <3 mm compared with the actual needle insertion depth, and (3) ultrasound increases the efficacy of lumbar epidural or spinal anesthesia by decreasing the mean number of needle passes for success by 0.75 (95% CI 0.44-1.07) and reducing the risk of a failed procedure (risk ratio 0.51 [95% CI 0.32-0.80]), both in patients with normal surface anatomy and in those with technically difficult surface anatomy due to obesity, scoliosis, or previous spine surgery.

Compared to the two earlier meta-analyses that included studies of both LP and spinal anesthesia procedures, the meta-analysis conducted by Gottlieb et al. in 2018 pooled data from 12 randomized controlled studies of ultrasound guidance for LPs only. For the primary outcome, pooled data from both adult and pediatric studies demonstrated higher procedural success rates with ultrasound-guided vs landmark-guided LPs (90% vs 81%) with an odds ratio of 2.1 (95% CI 0.66-7.44) in favor of ultrasound; however, there were no statistically significant differences when the adult and pediatric subgroups were analyzed separately, probably due to underpowering. For the secondary outcomes, data from the adult subgroup showed that use of ultrasound guidance was associated with fewer traumatic LPs (OR 0.28, 95% CI 0.14-0.59), shorter time to procedural success (adjusted mean difference –3.03 minutes, 95% CI –3.54 to –2.52), fewer number of needle passes (adjusted mean difference –0.81 passes, 95% CI –1.57 to –0.05), and lower patient pain scores (adjusted mean difference –2.53, 95% CI –3.89 to –1.17).

At least 12 randomized controlled studies have been published comparing the use of ultrasound guidance vs landmarks for the performance of LP or spinal anesthesia in adult patients, which were not included in the abovementioned meta-analy-

ses. These individual studies demonstrated similar benefits of using ultrasound guidance: reduced needle insertion attempts, reduced needle redirections, and increased overall procedural success rates.[17,31,37,40,41,43-49]

It is important to recognize that four randomized controlled studies did not demonstrate any benefits of ultrasound guidance on the number of attempts or procedural success rates,[23,33,41,51] and three of these studies were included in the abovementioned meta-analyses.[23,33,51] Limitations of these negative studies include potential selection bias, inadequate sample sizes, and varying levels of operator skills in procedures, ultrasound guidance, or both. One study included emergency medicine residents as operators with varying degrees of ultrasound skills, and more importantly, patient enrollment occurred by convenience sampling, which may have introduced selection bias. Furthermore, most of the patients were not obese (median BMI of 27 kg/m^2), and it is unclear why 10 years lapsed from data collection until publication.[33] Another study with three experienced anesthesiologists as operators performing spinal anesthesia enrolled only patients who were not obese (mean BMI of 29 kg/m^2) and had easily palpable bony landmarks—two patient characteristics associated with the least benefit of using ultrasound guidance in other studies.[23] Another negative study had one experienced anesthesiologist marking obstetric patients with ultrasound, but junior residents performing the actual procedure in the absence of the anesthesiologist who had marked the patient.[41]

In general, the greatest benefit of using ultrasound guidance for LP has been demonstrated in obese patients.[24,32,34,35,52,53] Benefits have been shown in specific obese patient populations, including obstetric,[31,54,55] orthopedic,[24,56,57] and emergency department patients.[30]

By increasing the procedural success rates with the use of ultrasound at the bedside, fewer patients may be referred to interventional radiology for fluoroscopic-guided LP, decreasing the patient exposure to ionizing radiation. A randomized study (n = 112) that compared site marking with ultrasound guidance versus fluoroscopic guidance for epidural steroid injections found the two techniques to be equivalent with respect to mean procedure time, number of needle insertion attempts, or needle passes.[58] Another randomized study found that the performance time of ultrasound guidance was two minutes shorter ($P < .05$) than fluoroscopic guidance.[59]

Techniques

2) We recommend that ultrasound should be used to more accurately identify the lumbar spine level than physical examination in both obese and nonobese patients.

Rationale. Traditionally, an imaginary line connecting the iliac crests (intercristal line, Tuffier's line, or Jacoby's line) was considered to identify the L4 vertebra or the L4-L5 interspinous space in the midline; however, studies have revealed this traditional landmark to be much less accurate than previously thought. In general, palpating the iliac crests to mark the intercristal line identifies an interspinous space that is one space cephalad (ie, the L2-L3 interspinous space) but can range from L1-L2 to L4-L5.[46,60-64] If an LP is inadvertently performed in the L1-L2 interspinous space, the risk of spinal cord injury is higher than that when performed in a more distal interspinous space.

A study by Margarido et al. with 45 patients with a mean BMI of 30 kg/m^2 found that the intercristal line was located above the L4-L5 interspinous space in 100% of patients. More importantly, the intercristal line was above L2-L3 in 36% of patients and above L1-L2 in 4% of patients. It is important to note that patients with scoliosis or previous spine surgery were excluded from this study, and all examinations were performed by two experienced anesthesiologists with patients in a sitting position—all factors that would favor accurate palpation and marking of the iliac crests.[60]

In a study of nonobese patients (mean BMI 28 kg/m^2) undergoing spinal anesthesia, Duniec et al. compared the lumbar level identified by palpation versus ultrasound and found discordance between the two techniques in 36% of patients; 18% were one space too cephalad, 16% were one space too caudal, and 2% were off by two interspinous spaces.[61] Another study found discordance in 64% of patients (mean BMI 28 kg/m^2) when comparing the interspinous level where spinal anesthesia had been performed by palpation versus a post-procedural ultrasound examination. This study revealed that the interspinous space was more cephalad in 50% of patients with 6% of punctures performed in the L1-L2 interspace.[62] A similar study compared the accuracy of palpation vs ultrasound to identify the L3-L4 interspinous space in obese (mean BMI 34 kg/m^2) versus nonobese (mean BMI 27 kg/m^2) patients. This study found marking a space above L3-L4 in 51% of obese and 40% of nonobese patients and marking of the L1-L2 interspace in 7% of obese and 4% of nonobese patients.[64]

A study comparing palpation vs ultrasound found that 68% of obese patients with a BMI of >30 kg/m^2 had difficult-to-palpate lumbar spine landmarks, but with the use of ultrasound, landmarks were identified in 76% of all patients, including obese and nonobese, with difficult-to-palpate landmarks.[65]

3) We suggest using ultrasound for selecting and marking a needle insertion site just before performing LPs in either a lateral decubitus or sitting position. The patient should remain in the same position after marking the needle insertion site.

Rationale. Ultrasound mapping of the lumbar spine can be performed in either a lateral decubitus or sitting position. Selecting and marking a needle insertion site should be performed at the bedside just before performing the procedure. The patient must remain in the same position in the interim between marking and inserting the needle, as a slight change in position can alter the needle trajectory, lowering the LP success rate. Although performing LPs in a lateral decubitus position has the advantage of accurately measuring the opening pressure, misalignment of the shoulder and pelvic girdles and bowing of the bed in a lateral decubitus position may lower LP success rates.

One randomized study comparing ultrasound-guided spinal anesthesia in a lateral decubitus versus sitting position found no difference in the number of needle insertion attempts or measurement of the skin-dura distance; however, the needle insertion depth was 0.73 cm greater in a lateral decubitus vs sitting position ($P = .002$).[66] Procedural success rates of LP with ultrasound guidance have not been directly compared in a sitting versus lateral decubitus position, although the overall procedural success rates were higher in one study that allowed the operator to choose either sitting or lateral decubitus position when ultrasound was used.[32]

4) We recommend that a low-frequency transducer, preferably a curvilinear array transducer, should be used to evaluate the lumbar spine and mark a needle insertion site in most patients. A high-frequency linear array transducer may be used in nonobese patients.

Rationale. Low-frequency transducers emit sound waves that penetrate deep tissues, allowing visualization of bones and ligaments of the lumbar spine. A high-frequency linear transducer offers better resolution but shallower penetration to approximately 6-9 cm, limiting its use for site marking in overweight and obese patients. In obese patients, the ligamentum flavum is often deeper than 6 cm, which requires a low-frequency transducer to be visualized.

Most of the randomized controlled studies demonstrating benefits of using ultrasound guidance compared with landmark guidance for performance of LP, epidural anesthesia, or spinal anesthesia have used a low-frequency, curvilinear transducer.[22,24,26-28,31,34-36,39,43-45,67] Two randomized controlled trials used a high-frequency linear transducer for site marking of lumbar procedures.[30,32,37] Using a high-frequency linear transducer has been described in real-time, ultrasound-guided LPs, the advantage being better needle visualization with a linear transducer.[29] Detection of blood vessels by color flow Doppler may be another advantage of using a high-frequency linear transducer, although a study by Grau et al. showed that use of color flow Doppler with a low-frequency curvilinear transducer permitted visualization of interspinous vessels as small as 0.5 mm in size.[68]

5) We recommend that ultrasound should be used to map the lumbar spine, starting at the level of the sacrum and sliding the transducer cephalad, sequentially identifying the lumbar spine interspaces.

Rationale. Although no studies have directly compared different ultrasound scanning protocols to map the lumbar spine, starting at the level of the sacrum and sliding the transducer cephalad to sequentially identify the lumbar interspinous spaces is the most commonly described technique in studies demonstrating improved clinical outcomes with the use of ultrasound.[24,31,34,37,39,40,45,56,57,67] Because the sacrum can be easily recognized, identifying it first is most beneficial in patients with few or no palpable landmarks.

All five lumbar spinous processes and interspinous spaces can be mapped from the sacrum using either a midline or a paramedian approach, and the widest interspinous space can be selected. In a midline approach, either a transverse or a longitudinal view is obtained. The transducer is centered on the sacrum and slid cephalad from L5 to L1 to identify each spinous process and interspinous space. In a paramedian approach, longitudinal paramedian views are obtained from the L5–sacrum interspace to the L1–L2 interspace, and each interspinous space is identified as the transducer is slid cephalad. Both these approaches are effective for mapping the lumbar spine. Whether the entire lumbar spine is mapped, and whether a midline or a paramedian approach is utilized, will depend on the operator's preference.

6) We recommend that ultrasound should be used in a transverse plane to mark the midline of the lumbar spine and a longitudinal plane to mark the interspinous spaces. The intersection of these two lines marks the needle insertion site.

Rationale. The most common technique described in comparative studies of ultrasound vs landmarks includes visualization of the lumbar spine in two planes, a transverse plane to identify the midline and a longitudinal plane to identify the interspinous spaces. The majority of randomized controlled studies that demonstrated a reduction in the number of needle insertion attempts and an increase in the procedural success rates have used this technique (see Clinical Outcomes).[22,24,28,32,35-37,43,44] Marking the midline and interspinous space(s) for LP may be performed in any order, starting with either the transverse or longitudinal plane first.

The midline of the spine is marked by placing the transducer in a transverse plane over the lumbar spine, centering over the spinous processes that have a distinct hyperechoic tip and a prominent acoustic shadow deep to the bone, and drawing a line perpendicular to the center of the transducer delineating the midline. The midline should be marked over a minimum of two or three spinous processes.

To identify the interspinous spaces, the transducer is aligned longitudinally over the midline. The transducer is slid along the midline to identify the widest interspinous space. Once the transducer is centered over the widest interspinous space, a line perpendicular to the center of the transducer is drawn to mark the interspinous space. The intersection of the lines marking the spinal midline and the selected interspinous space identifies the needle entry point.

To visualize the ligamentum flavum from a paramedian view, the transducer is oriented longitudinally over the midline, slid approximately 1 cm laterally, and tilted approximately 15 degrees aiming the ultrasound beam toward the midline. The skin–ligamentum flavum distance is most reliably measured from a paramedian view. Alternatively, in some patients, the ligamentum flavum may be visualized in the midline and the depth can be measured.

7) We recommend that ultrasound should be used during a preprocedural evaluation to measure the distance from the

skin surface to the ligamentum flavum from a longitudinal paramedian view to estimate the needle insertion depth and ensure that a spinal needle of adequate length is used.

Rationale. The distance from the skin to the ligamentum flavum can be measured using ultrasound during preprocedural planning. Knowing the depth to the ligamentum flavum preprocedurally allows the operator to procure a spinal needle of adequate length, anticipate the insertion depth before CSF can be obtained, determine the depth to which a local anesthetic will need to be injected, and decide whether the anticipated difficulty of the procedure warrants referral to or consultation with another specialist.

The skin–ligamentum flavum distance can be measured from a transverse midline view or a longitudinal paramedian view. A longitudinal paramedian view provides an unobstructed view of the ligamentum flavum due to less shadowing from bony structures compared with a midline view. Several studies have demonstrated a strong correlation between the skin–ligamentum flavum distance measured by ultrasound and the actual needle insertion depth in both midline and paramedian views.[28,34,36,53,54,57,69,70]

A meta-analysis that included 13 comparative studies evaluating the correlation between ultrasound-measured depth and actual needle insertion depth to reach the epidural or intrathecal space consistently demonstrated a strong correlation between the measured and actual depth.[50] A few studies have reported near-perfect Pearson correlation coefficients of 0.98.[55,71,72] The pooled correlation was 0.91 (95% CI 0.87-0.94). All studies measured the depth from the skin to the ventral side of the ligamentum flavum or the intrathecal space from either a longitudinal paramedian view (n = 4) or a transverse midline view (n = 9). Eight of the more recent studies evaluated the accuracy of the ultrasound measurements and found the depth measurements by ultrasound to be accurate within 1-13 mm of the actual needle insertion depth, with seven of the eight studies reporting a mean difference of ≤3 mm.[50]

Measurement of the distance between the skin and the ligamentum flavum generally underestimates the needle insertion depth. One study reported that measurement of the skin–ligamentum flavum distance underestimates the needle insertion depth by 7.6 mm to obtain CSF, whereas measurement of the skin–posterior longitudinal ligament distance overestimates the needle insertion depth by 2.5 mm.[57] A well-accepted contributor to underestimation of the depth measurements using ultrasound is compression of the skin and soft tissues by the transducer, and therefore, pressure on the skin must be released before freezing an image and measuring the depth to the subarachnoid space.

Training

8) We recommend that novices should undergo simulation-based training, where available, before attempting ultrasound-guided LPs on actual patients.

Rationale. Similar to training for other bedside procedures, dedicated training sessions, including didactics, supervised practice on patients, and simulation-based practice, should be considered when teaching novices to perform ultrasound-guided LP. Simulation-based training facilitates acquisition of knowledge and skills to perform invasive bedside procedures, including LP.[73] Simulation-based training has been commonly incorporated into procedure training for trainees using an immersive experience, such as a "boot camp,"[74-77] or a standardized curriculum,[78,79] and has demonstrated improvements in post-course procedural knowledge, technical skills, and operator confidence. Two of these studies included training in the use of ultrasound guidance for LP. These studies showed that simulation-based practice improved skill acquisition and confidence.[80,81] Simulation using novel computer software may improve skill acquisition in the use of ultrasound guidance for LP.[82]

9) We recommend that training in ultrasound-guided LPs should be adapted based on prior ultrasound experience, as learning curves will vary.

Rationale. The learning curve to achieve competency in the use of ultrasound guidance for LP has not been well studied. The rate of attaining competency in identifying lumbar spine structures using ultrasound will vary by provider based on prior skills in ultrasound-guided procedures.[83] Thus, providers with prior ultrasound experience may require less training than those without such experience to achieve competency. However, extensive experience in performing landmark-guided LPs does not necessarily translate into rapid acquisition of skills to perform the procedure with ultrasound guidance. A study of practicing anesthesiologists with no prior ultrasound experience demonstrated that 20 supervised trials of ultrasound-guided spinal anesthesia were insufficient to achieve competency.[84] Although minimums may be a necessary step to gain competence, using them as a sole means to define competence does not account for variable learning curves.[12] Based on a national survey of 21 hospitalist procedure experts, the mean current vs suggested minimums for initial and ongoing hospital privileging for LPs were 1.8 vs 6.9 and 2.2 vs 4.6 annually in one report.[85]

A fundamental question that needs to be answered is how to define competency in the use of ultrasound guidance for LP, including the specific skills and knowledge that must be mastered. At a minimum, providers must be able to identify lumbar spinous processes and distinguish them from the sacrum, identify the lumbar interspinous spaces and their corresponding levels, and estimate the depth from the skin to the ligamentum flavum from the midline and paramedian planes. Novice operators may benefit from practicing lumbar spine mapping of nonobese patients using a high-frequency linear transducer that generates high-resolution images and facilitates recognition of lumbar spine structures.

10) We recommend that novice providers should be supervised when performing ultrasound-guided LPs before performing the procedure independently on patients.

Rationale: Demonstration of competency in the use of ultrasound to identify lumbar spine anatomy should be achieved before routinely performing the procedure independently on patients.[18] All providers will require a variable period of supervised practice to demonstrate the appropriate technique, followed by a period of unsupervised practice before competency is achieved. Supervised practice with guidance and feedback has been shown to significantly improve providers' ability to delineate lumbar spine anatomy.[86]

KNOWLEDGE GAPS

The process of producing these guidelines revealed areas of uncertainty and important gaps in the literature regarding the use of ultrasound guidance for LP.

First, it is unclear whether the use of ultrasound guidance for LP reduces postprocedural back pain and whether it improves patient satisfaction. Several studies have evaluated postprocedural back pain[28,30,32,33,52] and patient satisfaction[28,29,33,51] with the use of ultrasound guidance, but these studies have found inconsistent results. Some of these results were probably due to insufficient statistical power or confounding variables. Furthermore, benefits have been demonstrated in certain subgroups, such as overweight patients or those with anatomical abnormalities, as was found in two studies.[52,87] Use of ultrasound guidance for spinal anesthesia has been shown to reduce postprocedural headache[28] and improve patient satisfaction[51], although similar benefit has not been demonstrated in patients undergoing LP.

Second, the effect of using ultrasound guidance on the frequency of traumatic LPs is an area of uncertainty. A "traumatic tap" is defined as an inadvertent puncture of an epidural vein during passage of the spinal needle through the dura. It remains difficult to discern in these studies whether red blood cells detected in the CSF resulted from puncture of an epidural vein or from needle trauma of the skin and soft tissues. Despite this uncertainty, at least seven randomized controlled studies have assessed the effect of ultrasound guidance on traumatic LPs. The meta-analysis by Shaikh et al. included five randomized controlled studies that assessed the effect of ultrasound guidance on the reporting of traumatic taps. The study found a reduced risk of traumatic taps (risk ratio 0.27 [95% CI 0.11-0.67]), an absolute risk reduction of 5.9% (95% CI 2.3%-9.5%), and a number needed to treat of 17 (95% CI 11-44) to prevent one traumatic tap.[16] Similarly, the meta-analysis by Gottlieb et al. showed a lower risk of traumatic taps among adults undergoing LP with ultrasound guidance in five randomized controlled studies with an odds ratio of 0.28 (95% CI 0.14-0.59). The meta-analysis by Gottlieb et al. included two adult studies that were not included by Shaikh et al.

Third, several important questions about the technique of ultrasound-guided LP remain unanswered. In addition to the static technique, a dynamic technique with real-time needle tracking has been described to perform ultrasound-guided LP, epidural catheterization, and spinal anesthesia. A pilot study by Grau et al. found that ultrasound used either statically or dynamically had fewer insertion attempts and needle redirections than use of landmarks alone.[29] Three other pilot studies showed successful spinal anesthesia in almost all patients[88-90] and one large study demonstrated successful spinal anesthesia with real-time ultrasound guidance in 97 of 100 patients with a median of three needle passes.[91] Furthermore, a few industry-sponsored studies with small numbers of patients have described the use of novel needle tracking systems that facilitate needle visualization during real-time ultrasound-guided LP.[92,93] However, to our knowledge, no comparative studies of static versus dynamic guidance using novel needle tracking systems in human subjects have been published, and any potential role for these novel needle tracking systems has not yet been defined.

Finally, the effects of using ultrasound guidance on clinical decision-making, timeliness, and cost-effectiveness of LP have not yet been explored but could have important clinical practice implications.

CONCLUSION

Randomized controlled trials have demonstrated that using ultrasound guidance for LPs can reduce the number of needle insertion attempts and needle redirections and increase the overall procedural success rates. Ultrasound can more accurately identify the lumbar spine level than physical examination in both obese and nonobese patients, although the greatest benefit of using ultrasound guidance for LPs has been shown in obese patients.

Ultrasound permits assessment of the interspinous space width and measurement of the ligamentum flavum depth to select an optimal needle insertion site and adequate length spinal needle. Although the use of real-time ultrasound guidance has been described, the use of static ultrasound guidance for LP site marking remains the standard technique.

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References

1. Wolfe KS, Kress JP. Risk of procedural hemorrhage. *Chest.* 2016;150(1):237-246. https://doi.org/10.1016/j.chest.2016.01.023.
2. Kroll H, Duszak R, Jr, Nsiah E, et al. Trends in lumbar puncture over 2 decades: a dramatic shift to radiology. *AJR Am J Roentgenol.* 2015;204(1):15-19. https://doi.org/10.2214/AJR.14.12622.
3. Vickers A, Donnelly JP, Moore JX, Wang HE. 263EMF epidemiology of lumbar punctures in hospitalized patients in United States. *Ann Emerg Med.* 2017;70(4):S104. https://doi.org/10.1016/j.annemergmed.2017.07.241.
4. Køster-Rasmussen R, Korshin A, Meyer CN. Antibiotic treatment delay and outcome in acute bacterial meningitis. *J Infect.* 2008;57(6):449-454. https://doi.org/10.1016/j.jinf.2008.09.033.
5. Aronin SI, Peduzzi P, Quagliarello VJ. Community-acquired bacterial meningitis: risk stratification for adverse clinical outcome and effect of antibiotic timing. *Ann Intern Med.* 1998;129(11):862-869. https://doi.org/10.7326/0003-4819-129-11_Part_1-199812010-00004.
6. Lepur D, Barsić B. Community-acquired bacterial meningitis in adults: antibiotic timing in disease course and outcome. *Infection.* 2007;35(4):225-231. https://doi.org/10.1007/s15010-007-6202-0.
7. Proulx N, Fréchette D, Toye B, Chan J, Kravcik S. Delays in the administration of antibiotics are associated with mortality from adult acute bacterial meningitis. *QJM.* 2005;98(4):291-298. https://doi.org/10.1093/qjmed/hci047.
8. Auburtin M, Wolff M, Charpentier J, et al. Detrimental role of delayed antibiotic administration and penicillin-nonsusceptible strains in adult intensive care unit patients with pneumococcal meningitis: the PNEUMOREA prospective multicenter study. *Crit Care Med.* 2006;34(11):2758-2765. https://doi.org/10.1097/01.CCM.0000239434.26669.65.
9. Michael B, Menezes BF, Cunniffe J, et al. Effect of delayed lumbar punctures on the diagnosis of acute bacterial meningitis in adults. *Emerg Med J.* 2010;27(6):433-438. https://doi.org/10.1136/emj.2009.075598.
10. Glimåker M, Johansson B, Grindborg Ö, et al. Adult bacterial meningitis: earlier treatment and improved outcome following guideline revision promoting prompt lumbar puncture. *Clin Infect Dis.* 2015;60(8):1162-1169. https://doi.org/10.1093/cid/civ011.
11. Nichani S, Crocker J, Fitterman N, Lukela M. Updating the core competencies in hospital medicine--2017 Revision: introduction and methodology. *J Hosp Med.* 2017;12(4):283-287. https://doi.org/10.12788/jhm.2715.
12. Soni NJ, Schnobrich D, Matthews BK, et al. Point-of-care ultrasound for hospitalists: a position statement of the Society of Hospital Medicine. *J Hosp Med.* 2019;14:E1-E6. https://doi.org/10.12788/jhm.3079.
13. Shah KH, McGillicuddy D, Spear J, Edlow JA. Predicting difficult and traumatic lumbar punctures. *Am J Emerg Med.* 2007;25(6):608-611. https://doi.org/10.1016/j.ajem.2006.11.025.
14. Williams P, Tait G, Wijeratne T. Success rate of elective lumbar puncture at a major Melbourne neurology unit. *Surg Neurol Int.* 2018;9:12. https://doi.org/10.4103/sni.sni_426_17.
15. Gottlieb M, Holladay D, Peksa GD. Ultrasound-assisted lumbar punctures: a systematic review and meta-analysis. *Acad Emerg Med.* 2018;26(1). https://doi.org/10.1111/acem.13558.
16. Shaikh F, Brzezinski J, Alexander S, et al. Ultrasound imaging for lumbar punctures and epidural catheterisations: systematic review and meta-analysis. *BMJ.* 2013;346:f1720. https://doi.org/10.1136/bmj.f1720.
17. Perlas A, Chaparro LE, Chin KJ. Lumbar neuraxial ultrasound for spinal and epidural anesthesia: a systematic review and meta-analysis. *Reg Anesth Pain Med.* 2016;41(2):251-260. https://doi.org/10.1097/AAP.0000000000000184.
18. Lucas BP, Tierney DM, Jensen TP, et al. Credentialing of hospitalists in ultrasound-guided bedside procedures: a position statement of the Society of Hospital Medicine. *J Hosp Med.* 2018;13(2):117-125. https://doi.org/10.12788/jhm.2917.
19. Dancel R, Schnobrich D, Puri N, et al. Recommendations on the use of ultrasound guidance for adult thoracentesis: a position statement of the Society of Hospital Medicine. *J Hosp Med.* 2018;13(2):126-135. https://doi.org/10.12788/jhm.2940.
20. Soni NJ, Franco-Sadud R, Schnobrich D, et al. Ultrasound guidance for lumbar puncture. *Neurol Clin Pract.* 2016;6(4):358-368. https://doi.org/10.1212/CPJ.0000000000000265.
21. Fitch K, Bernstein SJ, Aguilar MD, Burnand B, LaCalle JR. *The Rand/UCLA Appropriateness Method User's Manual.* Santa Monica, CA: Rand Corp; 2001.
22. Abdelhamid SA, Mansour MA. Ultrasound-guided intrathecal anesthesia: does scanning help? *Egypt J Anaesth.* 2013;29(4):389-394. https://doi.org/10.1016/j.egja.2013.06.003.
23. Ansari T, Yousef A, El Gamassy A, Fayez M. Ultrasound-guided spinal anaesthesia in obstetrics: is there an advantage over the landmark technique in patients with easily palpable spines? *Int J Obstet Anesth.* 2014;23(3):213-216. https://doi.org/10.1016/j.ijoa.2014.03.001.
24. Chin KJ, Perlas A, Chan V, et al. Ultrasound imaging facilitates spinal anesthesia in adults with difficult surface anatomic landmarks. *Anesthesiology.* 2011;115(1):94-101. https://doi.org/10.1097/ALN.0b013e31821a8ad4.
25. Cho YC, Koo DH, Oh SK, et al. Comparison of ultrasound-assisted lumbar puncture with lumbar puncture using palpation of landmarks in aged patients in an emergency center. *J Korean Soc Emerg Med.* 2009;20(3):304.
26. Grau T, Leipold RW, Conradi R, Martin E. Ultrasound control for presumed difficult epidural puncture. *Acta Anaesthesiol Scand.* 2001;45(6):766-771. https://doi.org/10.1034/j.1399-6576.2001.045006766.x.
27. Grau T, Leipold RW, Conradi R, Martin E, Motsch J. Ultrasound imaging facilitates localization of the epidural space during combined spinal and epidural anesthesia. *Reg Anesth Pain Med.* 2001;26(1):64-67. https://doi.org/10.1053/rapm.2001.19633.
28. Grau T, Leipold RW, Conradi R, Martin E, Motsch J. Efficacy of ultrasound imaging in obstetric epidural anesthesia. *J Clin Anesth.* 2002;14(3):169-175. https://doi.org/10.1016/S0952-8180(01)00378-6.
29. Grau T, Leipold RW, Fatehi S, Martin E, Motsch J. Real-time ultrasonic observation of combined spinal-epidural anaesthesia. *Eur J Anaesthesiol.* 2004;21(1):25-31. https://doi.org/10.1017/S026502150400105X.
30. Mofidi M, Mohammadi M, Saidi H, et al. Ultrasound guided lumbar puncture in emergency department: time saving and less complications. *J Res Med Sci.* 2013;18(4):303-307.
31. Nassar M, Abdelazim IA. Pre-puncture ultrasound guided epidural insertion before vaginal delivery. *J Clin Monit Comput.* 2015;29(5):573-577. https://doi.org/10.1007/s10877-014-9634-y.
32. Nomura JT, Leech SJ, Shenbagamurthi S, et al. A randomized controlled trial of ultrasound-assisted lumbar puncture. *J Ultrasound Med.* 2007;26(10):1341-1348. https://doi.org/10.7863/jum.2007.26.10.1341.
33. Peterson MA, Pisupati D, Heyming TW, Abele JA, Lewis RJ. Ultrasound for routine lumbar puncture. *Acad Emerg Med.* 2014;21(2):130-136. https://doi.org/10.1111/acem.12305.
34. Sahin T, Balaban O, Sahin L, Solak M, Toker K. A randomized controlled trial of preinsertion ultrasound guidance for spinal anaesthesia in pregnancy: outcomes among obese and lean parturients: ultrasound for spinal anesthesia in pregnancy. *J Anesth.* 2014;28(3):413-419. https://doi.org/10.1007/s00540-013-1726-1.
35. Wang Q, Yin C, Wang TL. Ultrasound facilitates identification of combined spinal-epidural puncture in obese parturients. *Chin Med J (Engl).* 2012;125(21):3840-3843.
36. Vallejo MC, Phelps AL, Singh S, Orebaugh SL, Sah N. Ultrasound decreases the failed labor epidural rate in resident trainees. *Int J Obstet Anesth.*

2010;19(4):373-378. https://doi.org/10.1016/j.ijoa.2010.04.002.
37. Darrieutort-Laffite C, Bart G, Planche L, et al. Usefulness of a pre-procedure ultrasound scanning of the lumbar spine before epidural injection in patients with a presumed difficult puncture: a randomized controlled trial. *Joint Bone Spine*. 2015;82(5):356-361. https://doi.org/10.1016/j.jbspin.2015.02.001.
38. Vosko MR, Brunner C, Schreiber S. Lumbar puncture with ultrasound study (lupus study)-international prospective randomized multicentre trial. *Int J Stroke*. 2017;12(1):22. https://doi.org/10.1055/s-0037-1606991.
39. Urfalioğlu A, Bilal B, Öksüz G, et al. Comparison of the landmark and ultrasound methods in cesarean sections performed under spinal anesthesia on obese pregnants. *J Matern Fetal Neonatal Med*. 2017;30(9):1051-1056. https://doi.org/10.1080/14767058.2016.1199677.
40. Tawfik MM, Atallah MM, Elkharboutly WS, Allakkany NS, Abdelkhalek M. Does preprocedural ultrasound increase the first-pass success rate of epidural catheterization before cesarean delivery? A randomized controlled trial. *Anesth Analg*. 2017;124(3):851-856. https://doi.org/10.1213/ANE.0000000000001325.
41. Turkstra TP, Marmai KL, Armstrong KP, Kumar K, Singh SI. Preprocedural ultrasound assessment does not improve trainee performance of spinal anesthesia for obstetrical patients: a randomized controlled trial. *J Clin Anesth*. 2017;37:21-24. https://doi.org/10.1016/j.jclinane.2016.10.034.
42. Chong SE, Mohd Nikman A, Saedah A, et al. Real-time ultrasound-guided paramedian spinal anaesthesia: evaluation of the efficacy and the success rate of single needle pass. *Br J Anaesth*. 2017;118(5):799-801. https://doi.org/10.1093/bja/aex108.
43. Creaney M, Mullane D, Casby C, Tan T. Ultrasound to identify the lumbar space in women with impalpable bony landmarks presenting for elective caesarean delivery under spinal anaesthesia: a randomised trial. *Int J Obstet Anesth*. 2016;28:12-16. https://doi.org/10.1016/j.ijoa.2016.07.007.
44. Ekinci M, Alici HA, Ahiskalioglu A, et al. The use of ultrasound in planned cesarean delivery under spinal anesthesia for patients having nonprominent anatomic landmarks. *J Clin Anesth*. 2017;37:82-85. https://doi.org/10.1016/j.jclinane.2016.10.014.
45. Perna P, Gioia A, Ragazzi R, Volta CA, Innamorato M. Can pre-procedure neuroaxial ultrasound improve the identification of the potential epidural space when compared with anatomical landmarks? A prospective randomized study. *Minerva Anestesiol*. 2017;83(1):41-49. https://doi.org/10.23736/S0375-9393.16.11399-9.
46. Chin A, Crooke B, Heywood L, et al. A randomised controlled trial comparing needle movements during combined spinal-epidural anaesthesia with and without ultrasound assistance. *Anaesthesia*. 2018;73(4):466-473. https://doi.org/10.1111/anae.14206.
47. Dhanger S, Vinayagam S, Vaidhyanathan B, Rajesh IJ, Tripathy DK. Comparison of landmark versus pre-procedural ultrasonography-assisted midline approach for identification of subarachnoid space in elective caesarean section: a randomised controlled trial. *Indian J Anaesth*. 2018;62(4):280-284. https://doi.org/10.4103/ija.IJA_488_17.
48. Evans DP, Tozer J, Joyce M, Vitto MJ. Comparison of ultrasound-guided and landmark-based lumbar punctures in inexperienced resident physicians. *J Ultrasound Med*. 2019;38(3):613-620. https://doi.org/10.1002/jum.14728.
49. Srinivasan KK, Leo AM, Iohom G, Loughnane F, Lee PJ. Pre-procedure ultrasound-guided paramedian spinal anaesthesia at L5-S1: is this better than landmark-guided midline approach? A randomised controlled trial. *Indian J Anaesth*. 2018;62(1):53-60. https://doi.org/10.4103/ija.IJA_448_17.
50. Perlas A, Chaparro LE, Chin KJ. Lumbar neuraxial ultrasound for spinal and epidural anesthesia: a systematic review and meta-analysis. *Reg Anesth Pain Med*. 2016;41(2):251-260. https://doi.org/10.1097/AAP.0000000000000184.
51. Lim YC, Choo CY, Tan KT. A randomised controlled trial of ultrasound-assisted spinal anaesthesia. *Anaesth Intensive Care*. 2014;42(2):191-198. https://doi.org/10.1177/0310057X1404200205.
52. Honarbakhsh S, Osman C, Teo JTH, Gabriel C. Ultrasound-guided lumbar puncture as a diagnostic aid to reduce number of attempts and complication rates. *Ultrasound*. 2013;21(4):170-175. https://doi.org/10.1177/1742271X13504332.
53. Sahota JS, Carvalho JC, Balki M, Fanning N, Arzola C. Ultrasound estimates for midline epidural punctures in the obese parturient: paramedian sagittal oblique is comparable to transverse median plane. *Anesth Analg*. 2013;116(4):829-835. https://doi.org/10.1213/ANE.0b013e31827f55f0.
54. Balki M, Lee Y, Halpern S, Carvalho JC. Ultrasound imaging of the lumbar spine in the transverse plane: the correlation between estimated and actual depth to the epidural space in obese parturients. *Anesth Analg*. 2009;108(6):1876-1881. https://doi.org/10.1213/ane.0b013e3181a323f6.
55. Wallace DH, Currie JM, Gilstrap LC, Santos R. Indirect sonographic guidance for epidural anesthesia in obese pregnant patients. *Reg Anesth*. 1992;17(4):233-236.
56. Srinivasan KK, Iohom G, Loughnane F, Lee PJ. Conventional landmark-guided midline versus preprocedure ultrasound-guided paramedian techniques in spinal anesthesia. *Anesth Analg*. 2015;21(4):1089-1096. https://doi.org/10.1213/ANE.0000000000000911.
57. Chin KJ, Perlas A, Singh M, et al. An ultrasound-assisted approach facilitates spinal anesthesia for total joint arthroplasty. *Can J Anaesth*. 2009;56(9):643-650. https://doi.org/10.1007/s12630-009-9132-8.
58. Evansa I, Logina I, Vanags I, Borgeat A. Ultrasound versus fluoroscopic-guided epidural steroid injections in patients with degenerative spinal diseases: a randomised study. *Eur J Anaesthesiol*. 2015;32(4):262-268. https://doi.org/10.1097/EJA.0000000000000103.
59. Park Y, Lee JH, Park KD, et al. Ultrasound-guided vs fluoroscopy-guided caudal epidural steroid injection for the treatment of unilateral lower lumbar radicular pain: a prospective, randomized, single-blind clinical study. *Am J Phys Med Rehabil*. 2013;92(7):575-586. https://doi.org/10.1097/PHM.0b013e318292356b.
60. Margarido CB, Mikhael R, Arzola C, Balki M, Carvalho JC. The intercristal line determined by palpation is not a reliable anatomical landmark for neuraxial anesthesia. *Can J Anaesth*. 2011;58(3):262-266. https://doi.org/10.1007/s12630-010-9432-z.
61. Duniec L, Nowakowski P, Kosson D, Łazowski T. Anatomical landmarks based assessment of intravertebral space level for lumbar puncture is misleading in more than 30%. *Anaesthesiol Intensive Ther*. 2013;45(1):1-6. https://doi.org/10.5603/AIT.2013.0001.
62. Schlotterbeck H, Schaeffer R, Dow WA, et al. Ultrasonographic control of the puncture level for lumbar neuraxial block in obstetric anaesthesia. *Br J Anaesth*. 2008;100(2):230-234. https://doi.org/10.1093/bja/aem371.
63. Whitty R, Moore M, Macarthur A. Identification of the lumbar interspinous spaces: palpation versus ultrasound. *Anesth Analg*. 2008;106(2):538-540, table of contents. https://doi.org/10.1213/ane.0b013e31816069d9.
64. Locks Gde F, Almeida MC, Pereira AA. Use of the ultrasound to determine the level of lumbar puncture in pregnant women. *Rev Bras Anestesiol*. 2010;60(1):13-19. https://doi.org/10.1016/S0034-7094(10)70002-7.
65. Stiffler KA, Jwayyed S, Wilber ST, Robinson A. The use of ultrasound to identify pertinent landmarks for lumbar puncture. *Am J Emerg Med*. 2007;25(3):331-334. https://doi.org/10.1016/j.ajem.2006.07.010.
66. Gulay U, Meltem T, Nadir SS, Aysin A. Ultrasound-guided evaluation of the lumbar subarachnoid space in lateral and sitting positions in pregnant patients to receive elective cesarean operation. *Pak J Med Sci*. 2015;31(1):76-81. https://doi.org/10.12669/pjms.311.5647.
67. Kawaguchi R, Yamauchi M, Sugino S, Yamakage M. Ultrasound-aided ipsilateral-dominant epidural block for total hip arthroplasty: a randomised controlled single-blind study. *Eur J Anaesthesiol*. 2011;28(2):137-140. https://doi.org/10.1097/EJA.0b013e3283423457.
68. Grau T, Leipold RW, Horter J, Martin E, Motsch J. Colour Doppler imaging of the interspinous and epidural space. *Eur J Anaesthesiol*. 2001;18(11):706-712. https://doi.org/10.1097/00003643-200111000-00002.
69. Arzola C, Davies S, Rofaeel A, Carvalho JC. Ultrasound using the transverse approach to the lumbar spine provides reliable landmarks for labor epidurals. *Anesth Analg*. 2007;104(5):1188-92, tables of contents. https://doi.org/10.1213/01.ane.0000250912.66057.41.
70. Chauhan AK, Bhatia R, Agrawal S. Lumbar epidural depth using transverse ultrasound scan and its correlation with loss of resistance technique: a prospective observational study in Indian population. *Saudi J Anaesth*. 2018;12(2):279-282. https://doi.org/10.4103/sja.SJA_679_17.
71. Gnaho A, Nguyen V, Villevielle T, et al. Assessing the depth of the subarachnoid space by ultrasound. *Rev Bras Anestesiol*. 2012;62(4):520-530. https://doi.org/10.1016/S0034-7094(12)70150-2.
72. Cork RC, Kryc JJ, Vaughan RW. Ultrasonic localization of the lumbar epidural space. *Anesthesiology*. 1980;52(6):513-516. https://doi.org/10.1097/00000542-198006000-00013.
73. Barsuk JH, Cohen ER, Caprio T, et al. Simulation-based education with mastery learning improves residents' lumbar puncture skills. *Neurology*. 2012;79(2):132-137. https://doi.org/10.1212/WNL.0b013e31825dd39d.
74. Lenchus J, Issenberg SB, Murphy D, et al. A blended approach to invasive bedside procedural instruction. *Med Teach*. 2011;33(2):116-123. https://doi.org/10.3109/0142159X.2010.509412.
75. Wayne DB, Cohen ER, Singer BD, et al. Progress toward improving medical school graduates' skills via a "boot camp" curriculum. *Simul Healthc*. 2014;9(1):33-39. https://doi.org/10.1097/SIH.0000000000000001.
76. Cohen ER, Barsuk JH, Moazed F, et al. Making July safer: simulation-based mastery learning during intern boot camp. *Acad Med*. 2013;88(2):233-239. https://doi.org/10.1097/ACM.0b013e31827bfc0a.

77. Martin R, Gannon D, Riggle J, et al. A comprehensive workshop using simulation to train internal medicine residents in bedside procedures performed by internists. *Chest*. 2012;142(4):545A. https://doi.org/10.1378/chest.1390093.
78. Lenchus JD. End of the "see one, do one, teach one" era: the next generation of invasive bedside procedural instruction. *J Am Osteopath Assoc*. 2010;110(6):340-346.
79. Mourad M, Ranji S, Sliwka D. A randomized controlled trial of the impact of a teaching procedure service on the training of internal medicine residents. *J Grad Med Educ*. 2012;4(2):170-175. https://doi.org/10.4300/JGME-D-11-00136.1.
80. Restrepo CG, Baker MD, Pruitt CM, Gullett JP, Pigott DC. Ability of pediatric emergency medicine physicians to identify anatomic landmarks with the assistance of ultrasound prior to lumbar puncture in a simulated obese model. *Pediatr Emerg Care*. 2015;31(1):15-19. https://doi.org/10.1097/PEC.0000000000000330.
81. VanderWielen BA, Harris R, Galgon RE, VanderWielen LM, Schroeder KM. Teaching sonoanatomy to anesthesia faculty and residents: utility of hands-on gel phantom and instructional video training models. *J Clin Anesth*. 2015;27(3):188-194. https://doi.org/10.1016/j.jclinane.2014.07.007.
82. Keri Z, Sydor D, Ungi T, et al. Computerized training system for ultrasound-guided lumbar puncture on abnormal spine models: a randomized controlled trial. *Can J Anaesth*. 2015;62(7):777-784. https://doi.org/10.1007/s12630-015-0367-2.
83. Deacon AJ, Melhuishi NS, Terblanche NC. CUSUM method for construction of trainee spinal ultrasound learning curves following standardised teaching. *Anaesth Intensive Care*. 2014;42(4):480-486. https://doi.org/10.1177/0310057X1404200409.
84. Margarido CB, Arzola C, Balki M, Carvalho JC. Anesthesiologists' learning curves for ultrasound assessment of the lumbar spine. *Can J Anaesth*. 2010;57(2):120-126. https://doi.org/10.1007/s12630-009-9219-2.
85. Jensen TP, Soni NJ, Tierney DM, Lucas BP. Hospital privileging practices for bedside procedures: a survey of hospitalist experts. *J Hosp Med*. 2017;12(10):836-839. https://doi.org/10.12788/jhm.2837.
86. Terblanche NC, Arzola C, Wills KE, et al. Standardised training program in spinal ultrasound for epidural insertion: protocol driven versus non-protocol driven teaching approach. *Anaesth Intensive Care*. 2014;42(4):460-466. https://doi.org/10.1177/0310057X1404200406.
87. Mofidi M, Mohammadi M, Saidi H, et al. Ultrasound guided lumbar puncture in emergency department: time saving and less complications. *J Res Med Sci*. 2013;18(4):303-307.
88. Karmakar MK, Li X, Ho AM, Kwok WH, Chui PT. Real-time ultrasound-guided paramedian epidural access: evaluation of a novel in-plane technique. *Br J Anaesth*. 2009;102(6):845-854. https://doi.org/10.1093/bja/aep079.
89. Tran D, Kamani AA, Al-Attas E, et al. Single-operator real-time ultrasound-guidance to aim and insert a lumbar epidural needle. *Can J Anaesth*. 2010;57(4):313-321. https://doi.org/10.1007/s12630-009-9252-1.
90. Liu Y, Qian W, Ke XJ, Mei W. Real-time ultrasound-guided spinal anesthesia using a new paramedian transverse approach. *Curr Med Sci*. 2018;38(5):910-913. https://doi.org/10.1007/s11596-018-1961-7.
91. Conroy PH, Luyet C, McCartney CJ, McHardy PG. Real-time ultrasound-guided spinal anaesthesia: a prospective observational study of a new approach. *Anesthesiol Res Pract*. 2013;2013:525818. https://doi.org/10.1155/2013/525818.
92. Brinkmann S, Tang R, Sawka A, Vaghadia H. Single-operator real-time ultrasound-guided spinal injection using SonixGPS™: a case series. *Can J Anaesth*. 2013;60(9):896-901. https://doi.org/10.1007/s12630-013-9984-9.
93. Niazi AU, Chin KJ, Jin R, Chan VW. Real-time ultrasound-guided spinal anesthesia using the SonixGPS ultrasound guidance system: a feasibility study. *Acta Anaesthesiol Scand*. 2014;58(7):875-881. https://doi.org/10.1111/aas.12353.

Nurse Responses to Physiologic Monitor Alarms on a General Pediatric Unit

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BACKGROUND: Hospitalized children generate up to 152 alarms per patient per day outside of the intensive care unit. In that setting, as few as 1% of alarms are clinically important. How nurses make decisions about responding to alarms, given an alarm's low specificity for detecting clinical deterioration, remains unclear.

OBJECTIVE: Our objective was to describe how bedside nurses think about and act upon monitor alarms for hospitalized children.

DESIGN, SETTING, PARTICIPANTS: This was a qualitative study that involved the direct observation of nurses working on a general pediatric unit at a large children's hospital.

MEASUREMENTS: We used a structured tool that included predetermined categories to assess nurse responses to monitor alarms. Data on alarm frequency and type were pulled from bedside monitors.

RESULTS: We conducted 61.3 patient-hours of observation with nine nurses, in which we documented 207 nurse responses to patient alarms. For 67% of alarms heard outside of the room, the nurse decided not to respond without further assessment. Nurses most commonly cited reassuring clinical context (eg, medical team in room), as the rationale for alarm nonresponse. The nurse deemed clinical intervention necessary in only 14 (7%) of the observed responses.

CONCLUSION: Nurses rely on clinical and contextual details to determine how to respond to alarms. Few of the alarm responses in our study resulted in a clinical intervention. These findings suggest that multiple system-level and educational interventions may be necessary to improve the efficacy and safety of continuous monitoring. *Journal of Hospital Medicine* 2019;14:602-606. © 2019 Society of Hospital Medicine

Alarms from bedside continuous physiologic monitors (CPMs) occur frequently in children's hospitals and can lead to harm. Recent studies conducted in children's hospitals have identified alarm rates of up to 152 alarms per patient per day outside of the intensive care unit,[1-3] with as few as 1% of alarms being considered clinically important.[4] Excessive alarms have been linked to alarm fatigue, when providers become desensitized to and may miss alarms indicating impending patient deterioration. Alarm fatigue has been identified by national patient safety organizations as a patient safety concern given the risk of patient harm.[5-7] Despite these concerns, CPMs are routinely used: up to 48% of pediatric patients in nonintensive care units at children's hospitals are monitored.[2]

Although the low number of alarms that receive responses has been well-described,[8,9] the reasons why clinicians do or do not respond to alarms are unclear. A study conducted in an adult perioperative unit noted prolonged nurse response times for patients with high alarm rates.[10] A second study conducted in the pediatric inpatient setting demonstrated a dose-response effect and noted progressively prolonged nurse response times with increased rates of nonactionable alarms.[4,11] Findings from another study suggested that underlying factors are highly complex and may be a result of excessive alarms, clinician characteristics, and working conditions (eg, workload and unit noise level).[12] Evidence also suggests that humans have difficulty distinguishing the importance of alarms in situations where multiple alarm tones are used, a common scenario in hospitals.[13,14] Understanding the factors that contribute to clinicians responding or not responding to CPM alarms will be crucial for addressing this serious patient safety issue.

An enhanced understanding of why nurses respond to alarms in daily practice will inform intervention development and improvement work. In the long term, this information could help improve systems for monitoring pediatric inpatients that are less prone to issues with alarm fatigue. The objective of this qualitative study, which employed structured observation, was to describe how bedside nurses think about and act upon bedside monitor alarms in a general pediatric inpatient unit.

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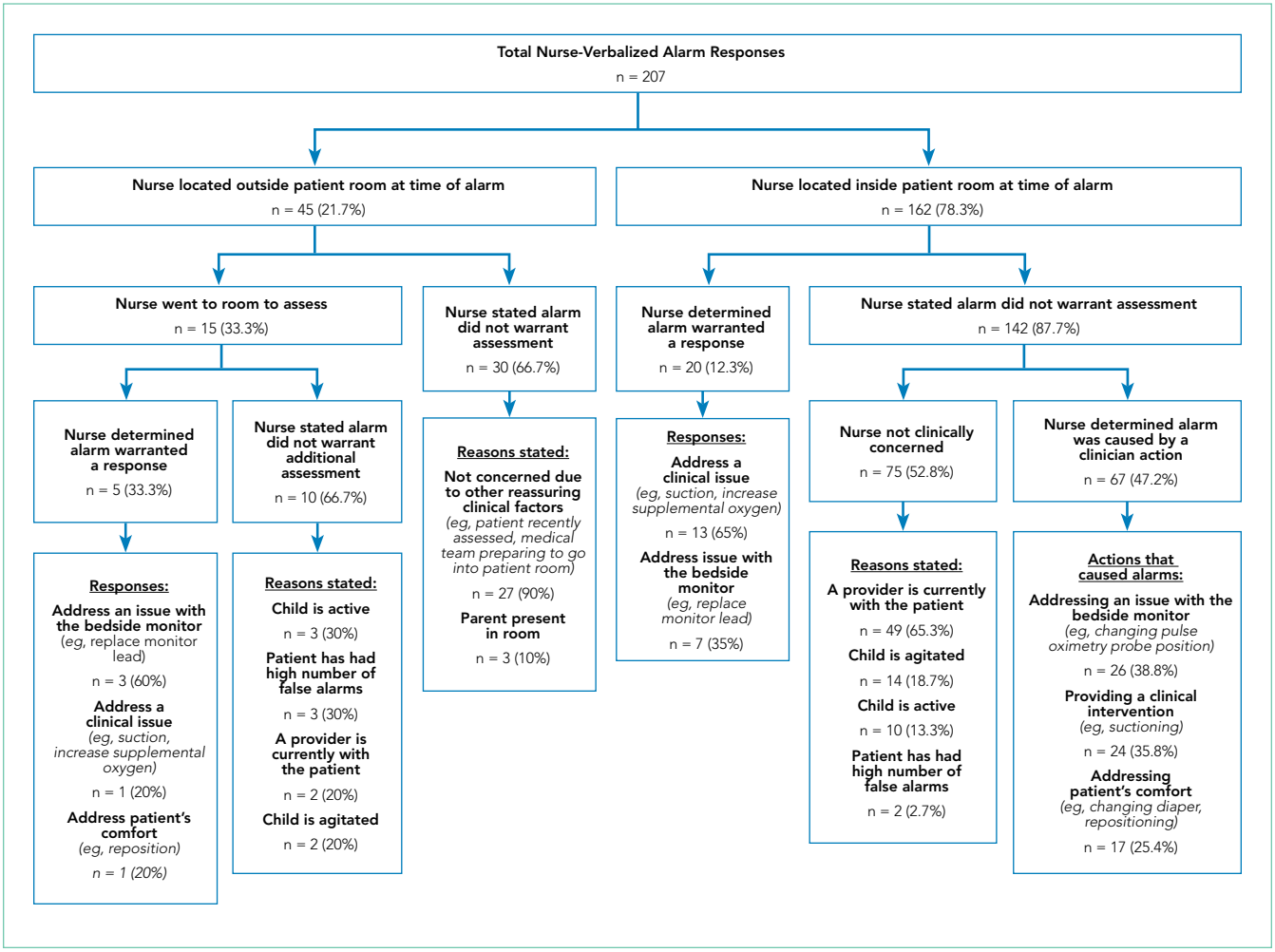

FIG. Nurse-Verbalized Responses to Alarms.

METHODS

Study Design and Setting

This prospective observational study took place on a 48-bed hospital medicine unit at a large, freestanding children's hospital with >650 beds and >19,000 annual admissions. General Electric (Little Chalfont, United Kingdom) physiologic monitors (models Dash 3000, 4000, and 5000) were used at the time of the study, and nurses could be notified of monitor alarms in four ways: First, an in-room auditory alarm sounds. Second, a light positioned above the door outside of each patient room blinks for alarms that are at a "warning" or "critical level" (eg ventricular tachycardia or low oxygen saturation). Third, audible alarms occur at the unit's central monitoring station. Lastly, another staff member can notify the patient's nurse via in-person conversion or secure smart phone communication. On the study unit, CPMs are initiated and discontinued through a physician order.

This study was reviewed and approved by the hospital's institutional review board.

Study Population

We used a purposive recruitment strategy to enroll bedside nurses working on general hospital medicine units, stratified to ensure varying levels of experience and primary shifts (eg, day vs night). We planned to conduct approximately two observations with each participating nurse and to continue collecting data until we could no longer identify new insights in terms of responses to alarms (ie, thematic saturation[15]). Observations were targeted to cover times of day that coincided with increased rates of distraction. These times included just prior to and after the morning and evening change of shifts (7:00 AM and 7:00 PM), during morning rounds (8:00 AM-12:00 PM), and heavy admission times (12:00 PM-10:00 PM). After written informed consent, a nurse was eligible for observation during his/her shift if he/she was caring for at least one monitored patient. Enrolled nurses were made aware of the general study topic but were blinded to the study team's hypotheses.

Data Sources

Prior to data collection, the research team, which consisted of physicians, bedside nurses, research coordinators, and a human factors expert, created a system for categorizing alarm responses. Categories for observed responses were based on the location and corresponding action taken. Initial categories

were developed a priori from existing literature and expanded through input from the multidisciplinary study team, then vetted with bedside staff, and finally pilot tested through >4 hours of observations, thus producing the final categories. These categories were entered into a work-sampling program (WorkStudy by Quetech Ltd., Waterloo, Ontario, Canada) to facilitate quick data recording during observations.

The hospital uses a central alarm collection software (BedMasterEx by Anandic Medical Systems, Feuerthalen, Switzerland), which permitted the collection of date, time, trigger (eg, high heart rate), and level (eg, crisis, warning) of the generated CPM alarms. Alarms collected are based on thresholds preset at the bedside monitor. The central collection software does not differentiate between accurate (eg, correctly representing the physiologic state of the patient) and inaccurate alarms.

Observation Procedure

At the time of observation, nurse demographic information (eg, primary shift worked and years working as a nurse) was obtained. A brief preobservation questionnaire was administered to collect patient information (eg, age and diagnosis) and the nurses' perspectives on the necessity of monitors for each monitored patient in his/her care.

The observer shadowed the nurse for a two-hour block of his/her shift. During this time, nurses were instructed to "think aloud" as they responded to alarms (eg, "I notice the oxygen saturation monitor alarming off, but the probe has fallen off"). A trained observer (AML or KMT) recorded responses verbalized by the nurse and his/her reaction by selecting the appropriate category using the work-sampling software. Data were also collected on the vital sign associated with the alarm (eg, heart rate). Moreover, the observer kept written notes to provide context for electronically recorded data. Alarms that were not verbalized by the nurse were not counted. Similarly, alarms that were noted outside of the room by the nurse were not classified by vital sign unless the nurse confirmed with the bedside monitor. Observers did not adjudicate the accuracy of the alarms. The session was stopped if monitors were discontinued during the observation period. Alarm data generated by the bedside monitor were pulled for each patient room after observations were completed.

Analysis

Descriptive statistics were used to assess the percentage of each nurse response category and each alarm type (eg, heart rate and respiratory rate). The observed alarm rate was calculated by taking the total number of observed alarms (ie, alarms noted by the nurse) divided by the total number of patient-hours observed. The monitor-generated alarm rate was calculated by taking the total number of alarms from the bedside-alarm generated data divided by the number of patient-hours observed.

Electronically recorded observations using the work-sampling program were cross-referenced with hand-written field notes to assess for any discrepancies or identify relevant events not captured by the program. Three study team members (AML, KMT, and ACS) reviewed each observation independently and compared field notes to ensure accurate categorization. Discrepancies were referred to the larger study group in cases of uncertainty.

TABLE. **Patient Characteristics**

Characteristics	(n = 35)
Age[a], n (%)	
Under 2 years	13 (38.2)
2 years to 6 years	10 (29.4)
Greater than 7 years	11 (32.4)
Female, n (%)	17 (48.6)
Diagnosis category, n (%)	
Asthma	2 (5.7)
Bronchiolitis	4 (11.4)
BRUE	3 (8.6)
High risk therapy	2 (5.7)
Ingestion	1 (2.9)
Other	4 (11.4)
Other infectious	2 (5.7)
Other respiratory	9 (25.7)
Pneumonia	6 (17.1)
Postoperative	1 (2.9)
Sepsis	1 (2.9)
Family present in room, n (%)	25 (71.4)
RN perspective on need for monitors, n (%)	29 (82.9)

[a]n = 34

Abbreviations: BRUE, brief resolved unexplained event; RN, registered nurse.

RESULTS

Nine nurses had monitored patients during the available observations and participated in 19 observation sessions, which included 35 monitored patients for a total of 61.3 patient-hours of observation. Nurses were observed for a median of two times each (range 1-4). The median number of monitored patients during a single observation session was two (range 1-3). Observed nurses were female with a median of eight years of experience (range 0.5-26 years). Patients represented a broad range of age categories and were hospitalized with a variety of diagnoses (Table). Nurses, when queried at the start of the observation, felt that monitors were necessary for 29 (82.9%) of the observed patients given either patient condition or unit policy.

A total of 207 observed nurse responses to alarms occurred during the study period for a rate of 3.4 responses per patient per hour. Of the total number of responses, 45 (21.7%) were noted outside of a patient room, and in 15 (33.3%) the nurse chose to go to the room. The other 162 were recorded when the nurse was present in the room when the alarm activated. Of the 177 in-person nurse responses, 50 were related to a pulse oximetry alarm, 66 were related to a heart rate alarm, and 61 were related to a respiratory rate alarm. The most common

observed in-person response to an alarm involved the nurse judging that no intervention was necessary (n = 152, 73.1%). Only 14 (7% of total responses) observed in-person responses involved a clinical intervention, such as suctioning or titrating supplemental oxygen. Findings are summarized in the Figure and describe nurse-verbalized reasons to further assess (or not) and then whether the nurse chose to take action (or not) after an alarm.

Alarm data were available for 17 of the 19 observation periods during the study. Technical issues with the central alarm collection software precluded alarm data collection for two of the observation sessions. A total of 483 alarms were recorded on bedside monitors during those 17 observation periods or 8.8 alarms per patient per hour, which was equivalent to 211.2 alarms per patient-day. A total of 175 observed responses were collected during these 17 observation periods. This number of responses was 36% of the number we would have expected on the basis of the alarm count from the central alarm software.

There were no patients transferred to the intensive care unit during the observation period. Nurses who chose not to respond to alarms outside the room most often cited the brevity of the alarm or other reassuring contextual details, such as that a family member was in the room to notify them if anything was truly wrong, that another member of the medical team was with the patient, or that they had recently assessed the patient and thought likely the alarm did not require any action. During three observations, the observed nurse cited the presence of family in the patient's room in their decision not to conduct further assessment in response to the alarm, noting that the parent would be able to notify the nurse if something required attention. On two occasions in which a nurse had multiple monitored patients, the observed nurse noted that if the other monitored patients were alarming and she happened to be in another patient's room, she would not be able to hear them. Four nurses cited policy as the reason a patient was on monitors (eg, patient was on respiratory support at night for obstructive sleep apnea).

DISCUSSION

We characterized responses to physiologic monitor alarms by a group of nurses with a range of experience levels. We found that most nurse responses to alarms in continuously monitored general pediatric patients involved no intervention, and further assessment was often not conducted for alarms that occurred outside of the room if the nurse noted otherwise reassuring clinical context. Observed responses occurred for 36% of alarms during the study period when compared with bedside monitor-alarm generated data. Overall, only 14 clinical interventions were noted among the observed responses. Nurses noted that they felt the monitors were necessary for 82.9% of monitored patients because of the clinical context or because of unit policy.

Our study findings highlight some potential contradictions in the current widespread use of CPMs in general pediatric units and how clinicians respond to them in practice.[2] First, while nurses reported that monitors were necessary for most of their patients, participating nurses deemed few alarms clinically actionable and often chose not to further assess when they noted alarms outside of the room. This is in line with findings from prior studies suggesting that clinicians overvalue the contribution of monitoring systems to patient safety.[16,17] Second, while this finding occurred in a minority of the observations, the presence of family members at the patient's bedside was cited by nurses as a rationale for whether they responded to alarms. While family members are capable of identifying safety issues,[18] formal systems to engage them in patient safety and physiologic monitoring are lacking. Finally, clinical interventions or responses to the alerts of deteriorating patients, which best represented the original intent of CPMs, were rare and accounted for just 7% of the responses. Further work elucidating why physicians and nurses choose to use CPMs may be helpful to identify interventions to reduce inappropriate monitor use and highlight gaps in frontline staff knowledge about the benefits and risks of CPM use.

Our findings provide a novel understanding of previously observed phenomena, such as long response times or nonresponses in settings with high alarm rates.[4,10] Similar to that in a prior study conducted in the pediatric setting,[11] alarms with an observed response constituted a minority of the total alarms that occurred in our study. This finding has previously been attributed to mental fatigue, caregiver apathy, and desensitization.[8] However, even though a minority of observed responses in our study included an intervention, the nurse had a rationale for why the alarm did or did not need a response. This behavior and the verbalized rationale indicate that in his/her opinion, not responding to the alarm was clinically appropriate. Study participants also reflected on the difficulties of responding to alarms given the monitor system setup, in which they may not always be capable of hearing alarms for their patients. Without data from nurses regarding the alarms that had no observed response, we can only speculate; however, based on our findings, each of these factors could contribute to nonresponse. Finally, while high numbers of false alarms have been posited as an underlying cause of alarm fatigue, we noted that a majority of nonresponse was reported to be related to other clinical factors. This relationship suggests that from the nurse's perspective, a more applicable framework for understanding alarms would be based on clinical actionability[4] over physiologic accuracy.

In total, our findings suggest that a multifaceted approach will be necessary to improve alarm response rates. These interventions should include adjusting parameters such that alarms are highly likely to indicate a need for intervention coupled with educational interventions addressing clinician knowledge of the alarm system and bias about the actionability of alarms may improve response rates. Changes in the monitoring system setup such that nurses can easily be notified when alarms occur may also be indicated, in addition to formally engaging patients and families around response to alarms. Although secondary notification systems (eg, alarms transmitted to individual clinician's devices) are one solution,

the utilization of these systems needs to be balanced with the risks of contributing to existing alarm fatigue and the need to appropriately tailor monitoring thresholds and strategies to patients.

Our study has several limitations. First, nurses may have responded in a way they perceive to be socially desirable, and studies using in-person observers are also prone to a Hawthorne-like effect,[19-21] where the nurse may have tried to respond more frequently to alarms than usual during observations. However, given that the majority of bedside alarms did not receive a response and a substantial number of responses involved no action, these effects were likely weak. Second, we were unable to assess which alarms were accurately reflecting the patient's physiologic status and which were not; we were also unable to link observed alarm response to monitor-recorded alarms. Third, despite the use of silent observers and an actual, rather than a simulated, clinical setting, by virtue of the data collection method we likely captured a more deliberate thought process (so-called System 2 thinking)[22] rather than the subconscious processes that may predominate when nurses respond to alarms in the course of clinical care (System 1 thinking).[22] Despite this limitation, our study findings, which reflect a nurse's in-the-moment thinking, remain relevant to guiding the improvement of monitoring systems, and the development of nurse-facing interventions and education. Finally, we studied a small, purposive sample of nurses at a single hospital. Our study sample impacts the generalizability of our results and precluded a detailed analysis of the effect of nurse- and patient-level variables.

CONCLUSION

We found that nurses often deemed that no response was necessary for CPM alarms. Nurses cited contextual factors, including the duration of alarms and the presence of other providers or parents in their decision-making. Few (7%) of the alarm responses in our study included a clinical intervention. The number of observed alarm responses constituted roughly a third of the alarms recorded by bedside CPMs during the study. This result supports concerns about the nurse's capacity to hear and process all CPM alarms given system limitations and a heavy clinical workload. Subsequent steps should include staff education, reducing overall alarm rates with appropriate monitor use and actionable alarm thresholds, and ensuring that patient alarms are easily recognizable for frontline staff.

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References

1. Schondelmeyer AC, Bonafide CP, Goel VV, et al. The frequency of physiologic monitor alarms in a children's hospital. *J Hosp Med*. 2016;11(11):796-798. https://doi.org/10.1002/jhm.2612.
2. Schondelmeyer AC, Brady PW, Goel VV, et al. Physiologic monitor alarm rates at 5 children's hospitals. *J Hosp Med*. 2018;13(6):396-398. https://doi.org/10.12788/jhm.2918.
3. Schondelmeyer AC, Brady PW, Sucharew H, et al. The impact of reduced pulse oximetry use on alarm frequency. *Hosp Pediatr*. In press.
4. Bonafide CP, Lin R, Zander M, et al. Association between exposure to nonactionable physiologic monitor alarms and response time in a children's hospital. *J Hosp Med*. 2015;10(6):345-351. https://doi.org/10.1002/jhm.2331.
5. Siebig S, Kuhls S, Imhoff M, et al. Intensive care unit alarms--how many do we need? Crit Care Med. 2010;38(2):451-456. https://doi.org/10.1097/CCM.0b013e3181cb0888.
6. Sendelbach S, Funk M. Alarm fatigue: a patient safety concern. *AACN* Adv Crit Care. 2013;24(4):378-386. https://doi.org/10.1097/NCI.0b013e3182a903f9.
7. Sendelbach S. Alarm fatigue. Nurs Clin *North* Am. 2012;47(3):375-382. https://doi.org/10.1016/j.cnur.2012.05.009.
8. Cvach M. Monitor alarm fatigue: an integrative review. *Biomed Instrum Technol*. 2012;46(4):268-277. https://doi.org/10.2345/0899-8205-46.4.268.
9. Paine CW, Goel VV, Ely E, et al. Systematic review of physiologic monitor alarm characteristics and pragmatic interventions to reduce alarm frequency. *J Hosp Med*. 2016;11(2):136-144. https://doi.org/10.1002/jhm.2520.
10. Voepel-Lewis T, Parker ML, Burke CN, et al. Pulse oximetry desaturation alarms on a general postoperative adult unit: a prospective observational study of nurse response time. *Int J Nurs Stud*. 2013;50(10):1351-1358. https://doi.org/10.1016/j.ijnurstu.2013.02.006.
11. Bonafide CP, Localio AR, Holmes JH, et al. Video analysis of factors associated With response time to physiologic monitor alarms in a children's hospital. *JAMA Pediatr*. 2017;171(6):524-531. https://doi.org/10.1001/jamapediatrics.2016.5123.
12. Deb S, Claudio D. Alarm fatigue and its influence on staff performance. IIE Trans Healthc Syst Eng. 2015;5(3):183-196. https://doi.org/10.1080/19488300.2015.1062065.
13. Mondor TA, Hurlburt J, Thorne L. Categorizing sounds by pitch: effects of stimulus similarity and response repetition. *Percept Psychophys*. 2003;65(1):107-114. https://doi.org/10.3758/BF03194787.
14. Mondor TA, Finley GA. The perceived urgency of auditory warning alarms used in the hospital operating room is inappropriate. *Can J Anaesth*. 2003;50(3):221-228. https://doi.org/10.1007/BF03017788.
15. Fusch PI, Ness LR. Are we there yet? Data saturation in qualitative research. Qual Rep; 20(9), 2015:1408-1416.
16. Najafi N, Auerbach A. Use and outcomes of telemetry monitoring on a medicine service. *Arch Intern Med*. 2012;172(17):1349-1350. https://doi.org/10.1001/archinternmed.2012.3163.
17. Estrada CA, Rosman HS, Prasad NK, et al. Role of telemetry monitoring in the non-intensive care unit. *Am J Cardiol*. 1995;76(12):960-965. https://doi.org/10.1016/S0002-9149(99)80270-7.
18. Khan A, Furtak SL, Melvin P et al. Parent-reported errors and adverse events in hospitalized children. *JAMA Pediatr*. 2016;170(4):e154608. https://doi.org/10.1001/jamapediatrics.2015.4608.
19. Adair JG. The Hawthorne effect: a reconsideration of the methodological artifact. *J Appl Psychol*. 1984;69(2):334-345. https://doi.org/10.1037/0021-9010.69.2.334.
20. Kovacs-Litman A, Wong K, Shojania KG, et al. Do physicians clean their hands? Insights from a covert observational study. *J Hosp Med*. 2016;11(12):862-864. https://doi.org/10.1002/jhm.2632.
21. Wolfe F, Michaud K. The Hawthorne effect, sponsored trials, and the overestimation of treatment effectiveness. *J Rheumatol*. 2010;37(11):2216-2220. https://doi.org/10.3899/jrheum.100497.
22. Kahneman D. *Thinking,* Fast *and* Slow. 1st Pbk. ed. New York: Farrar, Straus and Giroux; 2013.

Inpatient Communication Barriers and Drivers When Caring for Limited English Proficiency Children

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BACKGROUND: Achieving effective communication between medical providers and families with limited English proficiency (LEP) in the hospital is difficult.

OBJECTIVE: Our objective was to identify barriers to and drivers of effective interpreter service use when caring for hospitalized LEP children from the perspectives of pediatric medical providers and interpreters.

DESIGN/ PARTICIPANTS/ SETTING: We used Group Level Assessment (GLA), a structured qualitative participatory method that allows participants to directly produce and analyze data in an interactive group session. Participants from a single academic children's hospital generated individual responses to prompts and identified themes and relevant action items. Themes were further consolidated by our research team and verified by stakeholder groups.

RESULTS: Four GLA sessions were conducted including 64 participants: hospital medicine physicians and pediatric residents (56%), inpatient nursing staff (16%), and interpreter services staff (28%). Barriers identified included: (1) difficulties accessing interpreter services; (2) uncertainty in communication with LEP families; (3) unclear and inconsistent expectations and roles of team members; and (4) unmet family engagement expectations. Drivers of effective communication were: (1) utilizing a team-based approach between medical providers and interpreters; (2) understanding the role of cultural context in providing culturally effective care; (3) practicing empathy for patients and families; and (4) using effective family-centered communication strategies.

CONCLUSIONS: Participants identified unique barriers and drivers that impact communication with LEP patients and their families during hospitalization. Future directions include exploring the perspective of LEP families and utilizing team-based and family-centered communication strategies to standardize and improve communication practices. *Journal of Hospital Medicine* 2019;14:607-613.

Immigrant children make up the fastest growing segment of the population in the United States.[1] While most immigrant children are fluent in English, approximately 40% live with a parent who has limited English proficiency (LEP; ie, speaks English less than "very well").[2,3] In pediatrics, LEP status has been associated with longer hospitalizations,[4] higher hospitalization costs,[5] increased risk for serious adverse medical events,[4,6] and more frequent emergency department reutilization.[7] In the inpatient setting, multiple aspects of care present a variety of communication challenges,[8] which are amplified by shift work and workflow complexity that result in patients and families interacting with numerous providers over the course of an inpatient stay.

Increasing access to trained professional interpreters when caring for LEP patients improves communication, patient satisfaction, adherence, and mortality.[9-12] However, even when access to interpreter services is established, effective use is not guaranteed.[13] Up to 57% of pediatricians report relying on family members to communicate with LEP patients and their caregivers;[9] 23% of pediatric residents categorized LEP encounters as frustrating while 78% perceived care of LEP patients to be "misdirected" (eg, delay in diagnosis or discharge) because of associated language barriers.[14]

Understanding experiences of frontline inpatient medical providers and interpreters is crucial in identifying challenges and ways to optimize communication for hospitalized LEP patients and families. However, there is a paucity of literature exploring the perspectives of medical providers and interpreters as it relates to communication with hospitalized LEP children and families. In this study, we sought to identify barriers and drivers of effective communication with pediatric patients and families with LEP in the inpatient setting from the perspective of frontline medical providers and interpreters.

METHODS

Study Design

This qualitative study used Group Level Assessment (GLA), a structured participatory methodology that allows diverse

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TABLE 1. **Participant Demographics Based on Participant Role**

	Physicians[a]	Nursing and Ancillary staff	Interpreters	Total
Total participants (n, %)	36 (56%)	10 (16%)	18 (28%)	64[b]
Duration in current position (years)	3.8 ± 3.7	12.6 ± 10.3	4.8 ± 3.8	5.4 ± 6.0
Non-Hispanic white (n, %)	23 (62%)	9 (24%)	5 (14%)	37 (58%)
Speaks multiple languages (n, %)	29 (59%)	0	18 (37%)	49 (77%)
Speaks multiple languages well (n, %)[c]	9 (31%)	0	18 (62%)	29 (45%)

[a]Two GLA sessions involved physicians, which included attending physicians (n = 16) and pediatric residents (n = 20)

[b]Ten to 21 participants were present for each GLA session

[c]Self-reported to be "native/ functionally native" or "advanced" in their proficiency and accuracy in conversing and understanding including communication of health concepts as defined in AAMC residency ERAS® 2018 application[20]

Abbreviations: AAMC, Association of American Medical Colleges; ERAS®, Electronic Residency Application Service; GLA, group level assessment.

groups of stakeholders to generate and evaluate data in interactive sessions.[15-18] GLA structure promotes active participation, group problem-solving, and development of actionable plans, distinguishing it from focus groups and in-depth semi-structured interviews.[15,19] This study received a human subject research exemption by the institutional review board.

Study Setting

Cincinnati Children's Hospital Medical Center (CCHMC) is a large quaternary care center with ~200 patient encounters each day who require the use of interpreter services. Interpreters (in-person, video, and phone) are utilized during admission, formal family-centered rounds, hospital discharge, and other encounters with physicians, nurses, and other healthcare professionals. In-person interpreters are available in-house for Spanish and Arabic, with 18 additional languages available through regional vendors. Despite available resources, there is no standard way in which medical providers and interpreters work with one another.

Study Participants and Recruitment

Medical providers who care for hospitalized general pediatric patients were eligible to participate, including attending physicians, resident physicians, bedside nurses, and inpatient ancillary staff (eg, respiratory therapists, physical therapists). Interpreters employed by CCHMC with experience in the inpatient setting were also eligible. Individuals were recruited based on published recommendations to optimize discussion and group-thinking.[15] Each participant was asked to take part in one GLA session. Participants were assigned to specific sessions based on roles (ie, physicians, nurses, and interpreters) to maximize engagement and minimize the impact of hierarchy.

Study Procedure

GLA involves a seven-step structured process (Appendix 1): climate setting, generating, appreciating, reflecting, understanding, selecting, and action.[15,18] Qualitative data were generated individually and anonymously by participants on flip charts in response to prompts such as: "I worry that LEP families___," "The biggest challenge when using interpreter services is___," and "I find___ works well in providing care for LEP families." Prompts were developed by study investigators, modified based on input from nursing and interpreter services leadership, and finalized by GLA facilitators. Fifty-one unique prompts were utilized (Appendix 2); the number of prompts used (ranging from 15 to 32 prompts) per session was based on published recommendations.[15] During sessions, study investigators took detailed notes, including verbatim transcription of participant quotes. Upon conclusion of the session, each participant completed a demographic survey, including years of experience, languages spoken and perceived fluency,[20] and ethnicity.

Data Analysis

Within each session, under the guidance of trained and experienced GLA facilitators (WB, HV), participants distilled and summarized qualitative data into themes, discussed and prioritized themes, and generated action items. Following completion of all sessions, analyzed data was compiled by the research team to determine similarities and differences across groups based on participant roles, consolidate themes into barriers and drivers of communication with LEP families, and determine any overlap of priorities for action. Findings were shared back with each group to ensure accuracy and relevance.

RESULTS

Participants

A total of 64 individuals participated (Table 1): hospital medicine physicians and residents (56%), inpatient nurses and ancillary staff (16%), and interpreters (28%). While 81% of physicians spoke multiple languages, only 25% reported speaking them well; two physicians were certified to communicate medical information without an interpreter present.

Themes Resulting from GLA Sessions

A total of four barriers (Table 2) and four drivers (Table 3) of effective communication with pediatric LEP patients and their families in the inpatient setting were identified by participants.

TABLE 2. **Barriers to Effective Communication with LEP Patients and Families**

Subthemes	Quotes
Barrier 1: Difficulties accessing interpreter services	
Process of scheduling interpreters	• "My biggest challenge when using interpreter services is not understanding the scheduling process or availability"…"More transparency around how in-person interpreters are scheduled would help teams troubleshoot better." (physicians) • "Providers schedule appointment [with interpreters] without confirming with family… [at] the last minute… [and] interpreters are not used when time requested," … "[and] requests from providers [do not have] a realistic and accurate estimate of the time and need for an in-person interpreter." (interpreters)
Knowledge about system and limitations	• "My biggest challenges when using interpreter services are lack of predictability in when we have rapid access… or need." (physicians) • "I wish [medical providers] understood the difficulties of obtaining resources for rare languages"… "[and are] more familiar with alternative interpreting platforms and be willing and open to use them." (interpreters)
Using technology	• "Communicating with LEP families goes poorly when technology doesn't work … poor connection [and] the video/audio goes in and out " (nursing staff) • "If I could change anything about using phone interpreters, it would be improved directions in how to use… [and] improvement in the wait time… [I] have waited 10 minutes for an interpreter [on the phone]." (physicians)
Barrier 2: Uncertainty in communication with LEP families	
What to share and how to prioritize information during encounters with LEP families	• "There is a danger in [treating] all the data as equal. By the time we get to the end, which is really important stuff, an interpreter [may need] to run to another appointment… [We] need to make sure [we] get to priorities first." (physicians) • "Communicating with LEP families goes poorly when providers use… numbers and data with patients the same way they share them with fellow doctors." (interpreters)
What is actually being communicated during interpretation	• "Communicating with LEP families goes poorly when I am unsure if information is being delivered correctly [by the interpreter]" … "The most difficult part of taking care of LEP families is feeling frustrated when [information] gets lost in the interpreter conversation." (physicians) • "When caring for LEP families, physicians need to speak slowly so all [information] can be interpreted … [and] give time for interpreter to interpret." (interpreters)
What families understand	• "The most difficult part about taking care of LEP families is really knowing they are understanding and receiving info the way I think they are." (physicians) • "Communication with LEP families goes poorly when everyone speaks for a long time [using] very complicated terminology or sentences that are incoherent…" (interpreters) • "When taking care of LEP families, I feel they don't understand the importance of what [we are] telling them." (nursing staff) vs "When taking care of LEP families, I [am] worried they don't fully understand the plan or have unaddressed concerns." (physicians) vs "I wish LEP families knew … how to express their needs." (interpreters)
Barrier 3: Unclear and inconsistent expectations and roles of team members	
Communication regarding expectations from multiple stakeholders	• "It [is] difficult to convey info in a very large group, especially [with] intern [or] new learner [who] are trying first hand at the expense of the family. Communicating goes poorly when multiple medical professionals or family members try to talk at once." (physicians) • "The way we take care of LEP families would completely change if [medical] providers [communicated] level of seriousness of encounter." (interpreters) vs "I wish interpreters would [communicate] their style [with the team] prior to going [into] a room… [Some] have different preferences on how much info is too much." (physicians) vs "Families [don't know] how rounds go [or what they should expect from rounds]." (interpreters)
Roles and scope of practice for each team member	• "I wish interpreters felt empowered to ask us to slow down or clarify… We had an untrained student who was presenting during rounds, but I was astonished that interpreter didn't stop him to say that it wasn't working." (physicians) vs "Interpreters [must] stick to their role … [and] remain within the code of ethics." (interpreters) • "Both family and interpreter defer authority to physician; if you educate that one person, it will change the entire encounter." (interpreters) • "I wish interpreters would interpret everything that is said … verbatim… even when providers are discussing among themselves … even if it doesn't seem as important." (physicians) vs "[Interpreting in verbatim is difficult] when everyone speaks for a long time [using] very complicated terminology or sentences that are incoherent [or] contradictory … [and] when [there are] distractions during session." (interpreters)
Barrier 4: Unmet family engagement expectations	
Provider engagement with the family	• "When providing interpreter services during rounds, I feel [as if] rounding team does not have enough patience to answer families' questions." (interpreters) • "When busy, I find it most difficult to provide brief updates that would occur if they were English speaking… if interpreter is not scheduled, [I] shy away from doing what is right." (physicians) • "When interacting with LEP families, I wish physicians would use a [professional] interpreter and not guess what the family are trying to say." (interpreters) • "LEP families do not have much contact with their care teams… [and] get as many updates on their child [such as] labs, studies, and assessment as English-proficient families" … "[It feels] like I do them a disservice sometimes due to challenges and time needed to arrange appropriate interpretation." (physicians)
Family engagement with the providers	• "When taking care of LEP families, I feel bad for the family because most of the time they do not ask questions and may not know what I am doing … I feel like work happens around the patient and family instead of with … especially when medical staff is rushed or no interpreter is available." (nursing staff) • "When taking care of LEP families I feel inefficient … [and] less connected." (nursing staff) • "I wish LEP families knew their medical rights … and knew how to speak directly to healthcare providers [and didn't] shy away from asking questions or ask for clarifications." (interpreters)

Abbreviation: LEP, limited English proficiency.

Table 3. Drivers of Effective Communication with LEP Patients and Families

Subthemes	Quotes
Driver 1: Utilizing a team-based approach between medical providers and interpreters	
Mutual understanding to optimize current resources	• "[Medical staff need to] request the interpreter in advance, without waiting until the last minute, [and provide] a realistic and accurate estimate of the time and need for a live interpreter" … "I wish [medical staff] knew how hard it is to coordinate interpreter resources… [and that] we are not machines but human beings…We are not a burden but a tool to get job done." (interpreters) • "In-person [interpretation] is fantastic but [has] logistic challenge[s]. When an iPad/phone [is] ready in the room… and available immediately, [it] saves time [and] reduces hassle." (physicians)
Shared expectations for a patient encounter via presession	• "Communicating with LEP families goes [well when] interpreter services [communicate] back to [medical staff] that one is not available or time has changed." (nursing staff) • "Communicating with LEP families goes well when a presession was conducted and all parties know what to expect from the interpreter" … "[and] medical staff receive[d] training on how to work with interpreters" … "[It helps] when the nature of the bedside interaction is considered … [and] physicians … inform the interpreter of needed info by the sessions begin." (interpreters)
Driver 2: Understanding the role of cultural context in providing culturally effective care	
Provider perception of the family's culture	• "When caring for LEP families, [medical providers] need to… increase their cultural competency…stop making cultural judgments, [and] avoid practicing their "language knowledge" with the families… [while] interpreters need to be transparent, accurate, culturally sensitive." (interpreters) • "Communicating with LEP families goes well when there is some understanding of cultural differences in communication" … "[and] cultural context [that would inform us on] how best to convey information and interact with families". (physicians)
LEP family's knowledge about the culture and healthcare system in the US	• "I wish LEP families knew to speak directly to healthcare providers [and] the hospital… [and learn about] their medical rights, the meaning of HIPAA, [and] the new culture in the US different than their own." (interpreters) • "When providing interpreter services to LEP families, I believe that the most important source of time loss in each encounter is too many jokes … [or] idioms that don't translate to other languages." (interpreters)
Provider insight into one's own preconceived ideas about LEP families	• "If I could change one thing about working with medical staff when providing interpreter services, [it is] medical staff assumptions that family members are capable to interpret for patient/ family." (interpreters) • "When providing interpreter services at discharge, I [worry] assumptions of providers that LEP patients are familiar with US life style; [physicians] need to avoid promising help that can't be provided or sustained by the health system." (interpreters)
Driver 3: Practicing empathy for patients and families	
Respect for diversity	• "The best part about taking care of LEP families is appreciating other cultures, getting to know other people with different backgrounds, feeling like you are impacting someone's life and their views of the US [by] helping them feel welcome and [that their] voice [is] heard." (nursing staff) • "The best part about taking care of LEP families is having diversity in patient care [and] learning about different cultural perspectives; [There is a] different sense of fulfillment [that comes from] attempting to fill in holes in their medical knowledge that other providers may not have done." (physicians) • "The best part of providing interpreter services in the hospital is… seeing people connect despite language barrier." (interpreters)
Display of humanism and compassion toward LEP families	• "The way we take care of LEP families would completely change if we took [the] time to learn about their struggles to come to this country and [in] everyday life" … "[Medical providers] need to be more friendly [and] patient with LEP families… It takes longer, but it's for a reason" (interpreters) • "When caring for LEP families, physicians need to… leave their egos at the door" … "I wish the physicians would actually … [and] really listen… [and] avoid side conversations" (interpreters)
Driver 4: Using effective family-centered communication strategies	
Verbal communication	• "Communicating with LEP families goes well when everyone pauses frequently for the sake of accuracy… takes turns talking … [avoids] repetitive questions" … "[and] uses simple and clear instructions." (interpreters) • "Communicating with LEP families goes well when there are short, concrete phrases used… [with] moderately frequent intervals of interpreting [and the] team understands importance of avoiding jargon … giv[ing] time for interpreter to interpret." (physicians)
Nonverbal communication	• "Using interpreter services goes well during rounds when the team, family, and interpreter are all on time and present" … "and awake" (nursing staff) • "I wish physicians would look at [and] address the families directly when using an interpreter." (physicians) vs [Medical providers] need to talk to the families (mother and father) if they are present, because sometimes they only speak to the patient. [Furthermore] providers [tend to] speak to English-speaking parent only, ignoring the other parent with LEP. [Most] of the time, the mother has LEP, [which] is a problem since mom is the one taking care of the child." (interpreters)
Assessment of family understanding and engagement	• "Communicating with LEP families goes well when families are actively invited for feedback and questions … [and] when we remember to do teach-back and better gauge understanding; [it is] a clear confirmation that communication was clear and successful." (physicians)

Abbreviations: LEP, limited English proficiency; US, United States.

Participants across all groups, despite enthusiasm around improving communication, were concerned about quality of care LEP families received, noting that the system is "designed to deliver less-good care" and that "we really haven't figured out how to care for [LEP patients and families] in a [high-]quality and reliable way." Variation in theme discussion was noted between groups based on participant role: physicians voiced concern about rapport with LEP families, nurses emphasized actionable tasks, and interpreters focused on heightened challenges in times of stress.

Barrier 1: Difficulties Accessing Interpreter Services

Medical providers (physicians and nurses) identified the "opaque process to access [interpreter] services" as one of their biggest challenges when communicating with LEP families. In particular, the process of scheduling interpreters was described as a "black box," with physicians and nurses expressing difficulty determining if and when in-person interpreters were scheduled and uncertainty about when to use modalities other than in-person interpretation. Participants across groups highlighted the lack of systems knowledge from medical providers and limitations within the system that make predictable, timely, and reliable access to interpreters challenging, especially for uncommon languages. Medical providers desired more in-person interpreters who can "stay as long as clinically indicated," citing frustration associated with using phone- and video-interpretation (eg, challenges locating technology, unfamiliarity with use, unreliable functionality of equipment). Interpreters voiced wanting to take time to finish each encounter fully without "being in a hurry because the next appointment is coming soon" or "rushing… in [to the next] session sweating."

Barrier 2: Uncertainty in Communication with LEP Families

Participants across all groups described three areas of uncertainty as detailed in Table 2: (1) what to share and how to prioritize information during encounters with LEP patients and families, (2) what is communicated during interpretation, and (3) what LEP patients and families understand.

Barrier 3: Unclear and Inconsistent Expectations and Roles of Team Members

Given the complexity involved in communication between medical providers, interpreters, and families, participants across all groups reported feeling ill-prepared when navigating hospital encounters with LEP patients and families. Interpreters reported having little to no clinical context, medical providers reported having no knowledge of the assigned interpreter's style, and both interpreters and medical providers reported that families have little idea of what to expect or how to engage. All groups voiced frustration about the lack of clarity regarding specific roles and scope of practice for each team member during an encounter, where multiple people end up "talking [or] using the interpreter at once." Interpreters shared their expectations of medical providers to set the pace and lead conversations with LEP families. On the other hand, medical providers expressed a desire for interpreters to provide cultural context to the team without prompting and to interrupt during encounters when necessary to voice concerns or redirect conversations.

Barrier 4: Unmet Family Engagement Expectations

Participants across all groups articulated challenges with establishing rapport with LEP patients and families, sharing concerns that "inadequate communication" due to "cultural or language barriers" ultimately impacts quality of care. Participants reported decreased bidirectional engagement with and from LEP families. Medical providers not only noted difficulty in connecting with LEP families "on a more personal level" and providing frequent medical updates, but also felt that LEP families do not ask questions even when uncertain. Interpreters expressed concerns about medical providers "not [having] enough patience to answer families' questions" while LEP families "shy away from asking questions."

Driver 1: Utilizing a Team-Based Approach between Medical Providers and Interpreters

Participants from all groups emphasized that a mutual understanding of roles and shared expectations regarding communication and interpretation style, clinical context, and time constraints would establish a foundation for respect between medical providers and interpreters. They reported that a team-based approach to LEP patient and family encounters were crucial to achieving effective communication.

Driver 2: Understanding the Role of Cultural Context in Providing Culturally Effective Care.

Participants across all groups highlighted three different aspects of cultural context that drive effective communication: (1) medical providers' perception of the family's culture; (2) LEP families' knowledge about the culture and healthcare system in the US, and (3) medical providers insight into their own preconceived ideas about LEP families.

Driver 3: Practicing Empathy for Patients and Families

All participants reported that respect for diversity and consideration of the backgrounds and perspectives of LEP patients and families are necessary. Furthermore, both medical providers and interpreters articulated a need to remain patient and mindful when interacting with LEP families despite challenges, especially since, as noted by interpreters, encounters may "take longer, but it's for a reason."

Driver 4: Using Effective Family-Centered Communication Strategies

Participants identified the use of effective family-centered communication principles as a driver to optimal communication. Many of the principles identified by medical providers and interpreters are generally applicable to all hospitalized patients and families regardless of English proficiency: optimizing verbal communication (eg, using shorter sentences, pausing to allow for interpretation), optimizing nonverbal communication (eg, setting, position, and body language), and assessment of family understanding and engagement (eg, use of teach back).

DISCUSSION

Frontline medical providers and interpreters identified barriers and drivers that impact communication with LEP patients and families during hospitalization. To our knowledge, this is the first study that uses a participatory method to explore the perspectives of medical providers and interpreters who care for LEP children and families in the inpatient setting. Despite existing difficulties and concerns regarding language barriers and its impact on quality of care for hospitalized LEP patients and families, participants were enthusiastic about how iden-

tified barriers and drivers may inform future improvement efforts. Notable action steps for future improvement discussed by our participants included: increased use and functionality of technology for timely and predictable access to interpreters, deliberate training for providers focused on delivery of culturally-effective care, consistent use of family-centered communication strategies including teach-back, and implementing interdisciplinary expectation setting through "presessions" before encounters with LEP families.

Participants elaborated on several barriers previously described in the literature including time constraints and technical problems.[14,21,22] Such barriers may serve as deterrents to consistent and appropriate use of interpreters in healthcare settings.[9] A heavy reliance on off-site interpreters (including phone- or video-interpreters) and lack of knowledge regarding resource availability likely amplified frustration for medical providers. Communication with LEP families can be daunting, especially when medical providers do not care for LEP families or work with interpreters on a regular basis.[14] Standardizing the education of medical providers regarding available resources, as well as the logistics, process, and parameters for scheduling interpreters and using technology, was an action step identified by our GLA participants. Targeted education about the logistics of accessing interpreter services and having standardized ways to make technology use easier (ie, one-touch dialing in hospital rooms) has been associated with increased interpreter use and decreased interpreter-related delays in care.[23]

Our frontline medical providers expressed added concern about not spending as much time with LEP families. In fact, LEP families in the literature have perceived medical providers to spend less time with their children compared to their English-proficient counterparts.[24] Language and cultural barriers, both perceived and real, may limit medical provider rapport with LEP patients and families[14] and likely contribute to medical providers relying on their preconceived assumptions instead.[25] Cultural competency education for medical providers, as highlighted by our GLA participants as an action item, can be used to provide more comprehensive and effective care.[26,27]

In addition to enhancing cultural humility through education, our participants emphasized the use of family-centered communication strategies as a driver of optimal family engagement and understanding. Actively inviting questions from families and utilizing teach-back, an established evidence-based strategy[28-30] discussed by our participants, can be particularly powerful in assessing family understanding and engagement. While information should be presented in plain language for families in all encounters,[31] these evidence-based practices are of particular importance when communicating with LEP families. They promote effective communication, empower families to share concerns in a structured manner, and allow medical providers to address matters in real-time with interpreters present.

Finally, our participants highlighted the need for partnerships between providers and interpreter services, noting unclear roles and expectations among interpreters and medical providers as a major barrier. Specifically, physicians noted confusion regarding the scope of an interpreter's practice. Participants from GLA sessions discussed the importance of a team-based approach and suggested implementing a "presession" prior to encounters with LEP patients and families. Presessions—a concept well accepted among interpreters and recommended by consensus-based practice guidelines—enable medical providers and interpreters to establish shared expectations about scope of practice, communication, interpretation style, time constraints, and medical context prior to patient encounters.[32,33]

There are several limitations to our study. First, individuals who chose to participate were likely highly motivated by their clinical experiences with LEP patients and invested in improving communication with LEP families. Second, the study is limited in generalizability, as it was conducted at a single academic institution in a Midwestern city. Despite regional variations in available resources as well as patient and workforce demographics, our findings regarding major themes are in agreement with previously published literature and further add to our understanding of ways to improve communication with this vulnerable population across the care spectrum. Lastly, we were logistically limited in our ability to elicit the perspectives of LEP families due to the participatory nature of GLA; the need for multiple interpreters to simultaneously interact with LEP individuals would have not only hindered active LEP family participation but may have also biased the data generated by patients and families, as the services interpreters provide during their inpatient stay was the focus of our study. Engaging LEP families in their preferred language using participatory methods should be considered for future studies.

In conclusion, frontline providers of medical and language services identified barriers and drivers impacting the effective use of interpreter services when communicating with LEP families during hospitalization. Our enhanced understanding of barriers and drivers, as well as identified actionable interventions, will inform future improvement of communication and interactions with LEP families that contributes to effective and efficient family centered care. A framework for the development and implementation of organizational strategies aimed at improving communication with LEP families must include a thorough assessment of impact, feasibility, stakeholder involvement, and sustainability of specific interventions. While there is no simple formula to improve language services, health systems should establish and adopt language access policies, standardize communication practices, and develop processes to optimize the use of language services in the hospital. Furthermore, engagement with LEP families to better understand their perceptions and experiences with the healthcare system is crucial to improve communication between medical providers and LEP families in the inpatient setting and should be the subject of future studies.

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References

1. The American Academy of Pediatrics Council on Community Pediatrics. Providing care for immigrant, migrant, and border children. *Pediatrics.* 2013;131(6):e2028-e2034.
2. Meneses C, Chilton L, Duffee J, et al. Council on Community Pediatrics Immigrant Health Tool Kit. The American Academy of Pediatrics. https://www.aap.org/en-us/Documents/cocp_toolkit_full.pdf. Accessed May 13, 2019.
3. Office for Civil Rights. Guidance to Federal Financial Assistance Recipients Regarding Title VI and the Prohibition Against National Origin Discrimination Affecting Limited English Proficient Persons. https://www.hhs.gov/civil-rights/for-individuals/special-topics/limited-english-proficiency/guidance-federal-financial-assistance-recipients-title-vi/index.html. Accessed May 13, 2019.
4. Lion KC, Rafton SA, Shafii J, et al. Association between language, serious adverse events, and length of stay Among hospitalized children. *Hosp Pediatr.* 2013;3(3):219-225. https://doi.org/10.1542/hpeds.2012-0091.
5. Lion KC, Wright DR, Desai AD, Mangione-Smith R. Costs of care for hospitalized children associated With preferred language and insurance type. *Hosp Pediatr.* 2017;7(2):70-78. https://doi.org/10.1542/hpeds.2016-0051.
6. Cohen AL, Rivara F, Marcuse EK, McPhillips H, Davis R. Are language barriers associated with serious medical events in hospitalized pediatric patients? *Pediatrics.* 2005;116(3):575-579. https://doi.org/10.1542/peds.2005-0521.
7. Samuels-Kalow ME, Stack AM, Amico K, Porter SC. Parental language and return visits to the Emergency Department After discharge. *Pediatr Emerg Care.* 2017;33(6):402-404. https://doi.org/10.1097/PEC.0000000000000592.
8. Unaka NI, Statile AM, Choe A, Shonna Yin H. Addressing health literacy in the inpatient setting. *Curr Treat Options Pediatr.* 2018;4(2):283-299. https://doi.org/10.1007/s40746-018-0122-3.
9. DeCamp LR, Kuo DZ, Flores G, O'Connor K, Minkovitz CS. Changes in language services use by US pediatricians. *Pediatrics.* 2013;132(2):e396-e406. https://doi.org/10.1542/peds.2012-2909.
10. Flores G. The impact of medical interpreter services on the quality of health care: A systematic review. *Med Care Res Rev.* 2005;62(3):255-299. https://doi.org/10.1177/1077558705275416.
11. Flores G, Abreu M, Barone CP, Bachur R, Lin H. Errors of medical interpretation and their potential clinical consequences: A comparison of professional versus hoc versus no interpreters. *Ann Emerg Med.* 2012;60(5):545-553. https://doi.org/10.1016/j.annemergmed.2012.01.025.
12. Anand KJ, Sepanski RJ, Giles K, Shah SH, Juarez PD. Pediatric intensive care unit mortality among Latino children before and after a multilevel health care delivery intervention. *JAMA Pediatr.* 2015;169(4):383-390. https://doi.org/10.1001/jamapediatrics.2014.3789.
13. The Joint Commission. *Advancing Effective Communication, Cultural Competence, and Patient- and Family-Centered Care: A Roadmap for Hospitals.* Oakbrook Terrace, IL: The Joint Commission; 2010.
14. Hernandez RG, Cowden JD, Moon M *et al.* Predictors of resident satisfaction in caring for limited English proficient families: a multisite study. *Acad Pediatr.* 2014;14(2):173-180. https://doi.org/10.1016/j.acap.2013.12.002.
15. Vaughn LM, Lohmueller M. Calling all stakeholders: group-level assessment (GLA)-a qualitative and participatory method for large groups. *Eval Rev.* 2014;38(4):336-355. https://doi.org/10.1177/0193841X14544903.
16. Vaughn LM, Jacquez F, Zhao J, Lang M. Partnering with students to explore the health needs of an ethnically diverse, low-resource school: an innovative large group assessment approach. *Fam Commun Health.* 2011;34(1):72-84. https://doi.org/10.1097/FCH.0b013e3181fded12.
17. Gosdin CH, Vaughn L. Perceptions of physician bedside handoff with nurse and family involvement. *Hosp Pediatr.* 2012;2(1):34-38. https://doi.org/10.1542/hpeds.2011-0008-2.
18. Graham KE, Schellinger AR, Vaughn LM. Developing strategies for positive change: transitioning foster youth to adulthood. *Child Youth Serv Rev.* 2015;54:71-79. https://doi.org/10.1016/j.childyouth.2015.04.014.
19. Vaughn LM. Group level assessment: A Large Group Method for Identifying Primary Issues and Needs within a community. London2014. http://methods.sagepub.com/case/group-level-assessment-large-group-primary-issues-needs-community. Accessed 2017/07/26.
20. *Association of American Medical Colleges Electronic Residency Application Service. ERAS 2018 MyERAS Application Worksheet: Language Fluency.* Washington, DC:: Association of American Medical Colleges; 2018:5.
21. Brisset C, Leanza Y, Laforest K. Working with interpreters in health care: A systematic review and meta-ethnography of qualitative studies. *Patient Educ Couns.* 2013;91(2):131-140. https://doi.org/10.1016/j.pec.2012.11.008.
22. Wiking E, Saleh-Stattin N, Johansson SE, Sundquist J. A description of some aspects of the triangular meeting between immigrant patients, their interpreters and GPs in primary health care in Stockholm, Sweden. *Fam Pract.* 2009;26(5):377-383. https://doi.org/10.1093/fampra/cmp052.
23. Lion KC, Ebel BE, Rafton S et al. Evaluation of a quality improvement intervention to increase use of telephonic interpretation. *Pediatrics.* 2015;135(3):e709-e716. https://doi.org/10.1542/peds.2014-2024.
24. Zurca AD, Fisher KR, Flor RJ, et al. Communication with limited English-proficient families in the PICU. *Hosp Pediatr.* 2017;7(1):9-15. https://doi.org/10.1542/hpeds.2016-0071.
25. Kodjo C. Cultural competence in clinician communication. *Pediatr Rev.* 2009;30(2):57-64. https://doi.org/10.1542/pir.30-2-57.
26. Britton CV, American Academy of Pediatrics Committee on Pediatric Workforce. Ensuring culturally effective pediatric care: implications for education and health policy. *Pediatrics.* 2004;114(6):1677-1685. https://doi.org/10.1542/peds.2004-2091.
27. The American Academy of Pediatrics. *Culturally Effective Care Toolkit: Providing Cuturally Effective Pediatric Care*; 2018. https://www.aap.org/en-us/professional-resources/practice-transformation/managing-patients/Pages/effective-care.aspx. Accessed May 13, 2019.
28. Starmer AJ, Spector ND, Srivastava R, et al. Changes in medical errors after implementation of a handoff program. *N Engl J Med.* 2014;371(19):1803-1812. https://doi.org/10.1056/NEJMsa1405556.
29. Jager AJ, Wynia MK. Who gets a teach-back? Patient-reported incidence of experiencing a teach-back. *J Health Commun.* 2012;17 Supplement 3:294-302. https://doi.org/10.1080/10810730.2012.712624.
30. Kornburger C, Gibson C, Sadowski S, Maletta K, Klingbeil C. Using "teach-back" to promote a safe transition from hospital to home: an evidence-based approach to improving the discharge process. *J Pediatr Nurs.* 2013;28(3):282-291. https://doi.org/10.1016/j.pedn.2012.10.007.
31. Abrams MA, Klass P, Dreyer BP. Health literacy and children: recommendations for action. *Pediatrics.* 2009;124 Supplement 3:S327-S331. https://doi.org/10.1542/peds.2009-1162I.
32. Betancourt JR, Renfrew MR, Green AR, Lopez L, Wasserman M. *Improving Patient Safety Systems for Patients with Limited English Proficiency: a Guide for Hospitals. Agency for Healthcare Research and Quality;* 2012.
33. The National Council on Interpreting in Health Care. *Best Practices for Communicating Through an Interpreter* . https://refugeehealthta.org/access-to-care/language-access/best-practices-communicating-through-an-interpreter/. Accessed May 19, 2019.

An On-Treatment Analysis of the MARQUIS Study: Interventions to Improve Inpatient Medication Reconciliation

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It is unclear which medication reconciliation interventions are most effective at reducing inpatient medication discrepancies. Five United States hospitals' interdisciplinary quality improvement (QI) teams were virtually mentored by QI-trained physicians. Sites implemented one to seven evidence-based interventions in 791 patients during the 25-month implementation period. Three interventions were associated with significant decreases in potentially harmful discrepancy rates: (1) defining clinical roles and responsibilities, (2) training, and (3) hiring staff to perform discharge medication reconciliation. Two interventions were associated with significant increases in potentially harmful discrepancy rates: training staff to take medication histories and implementing a new electronic health record (EHR). Hospitals should focus first on hiring and training pharmacy staff to assist with medication reconciliation at discharge and delineating roles and responsibilities of clinical staff. We caution hospitals implementing a large vendor EHR, as medication discrepancies may increase. Finally, the effect of medication history training on discrepancies needs further study. *Journal of Hospital Medicine* 2019;14:614-617. © 2019 Society of Hospital Medicine

Unintentional medication discrepancies in the hospital setting are common and contribute to adverse drug events, resulting in patient harm.[1] Discrepancies can be resolved by implementing high-quality medication reconciliation, but there are insufficient data to guide hospitals as to which interventions are most effective at improving medication reconciliation processes and reducing harm.[2] We recently reported that implementation of a best practices toolkit reduced total medication discrepancies in the Multi-Center Medication Reconciliation Quality Improvement Study (MARQUIS).[3] This report describes the effect of individual toolkit components on rates of medication discrepancies with the potential for patient harm.

METHODS

Detailed descriptions of the intervention toolkit and study design of MARQUIS are published.[4,5] Briefly, MARQUIS was a pragmatic, mentored, quality improvement (QI) study in which five hospitals in the United States implemented interventions from a best practices toolkit to improve medication reconciliation on noncritical care medical and surgical units from September 2011 to July 2014. We used a mentored implementation approach, in which each site identified the leaders of their local quality improvement team (ie, mentees) who received mentorship from a trained physician with QI and medication safety experience.[6] Mentors conducted monthly calls with their mentees and two site visits. Sites adapted and implemented one or more components from the MARQUIS toolkit, a compilation of evidence-based best practices in medication reconciliation.[5,7]

The primary outcome was unintentional medication discrepancies in admission and discharge orders with the potential for causing harm, as previously described.[4] Trained study pharmacists at each site took "gold standard" medication histories on a random sample of up to 22 patients per month. These medications were then compared with admission and discharge medication orders, and all unintentional discrepancies were identified. The discrepancies were then adjudicated by physicians blinded to the treatment arm, who confirmed whether discrepancies were unintentional and carried the potential for patient harm.

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TABLE 1. **Implementation of Components by Site**

	Site				
Intervention Component	**1**	**2**	**3**	**4**	**5**
Best Possible Medication History-Taking					
Trained existing staff to take best possible medication histories		X	X	X	X
Hired additional staff to take best possible medication histories		X	X	X	
Discharge Medication Reconciliation and Counseling					
Trained existing staff to perform discharge medication reconciliation and patient counseling			X	X	X
Hired additional staff to perform discharge medication reconciliation and patient counseling			X		X
Roles and Responsibilities					
Clearly defined roles and responsibilities and communicated this with clinical staff				X	
Risk Stratification					
Performed high-intensity interventions on high-risk patients			X	X	
Health Information Technology					
Implemented a new electronic medical record	X			X	
Made improvements to existing medication reconciliation health information technology		X			X
Access to Medication Sources					
Improved access to preadmission medication sources		X		X	

We employed a modification of a stepped wedge methodology to measure the incremental effect of implementing nine different intervention components, introduced at different sites over the course of the study, on the number of potentially harmful discrepancies per patient. These analyses were restricted to the postimplementation period on hospital units that implemented at least one intervention. All interventions conducted at each site were categorized by component, including dates of implementation. Each intervention component could be applied more than once per site (eg, when involving a new group of providers) or implemented on a new hospital unit or service, in which case, all dates were included in the analysis. We conducted a multivariable Poisson regression (with time divided into months) adjusted for patient factors, season, and site, with the number of potentially harmful discrepancies as the dependent variable, and the total number of gold standard medications as a model offset. The model was designed to analyze changes in the y-intercept each time an intervention component was either implemented or spread and assumed the change in the y-intercept was the same for each of these events for any given component. The model also assumes that combinations of interventions had independent additive effects.

RESULTS

Across the five participating sites, 1,648 patients were enrolled from September 2011 to July 2014. This number included 613 patients during the preimplementation period and 1,035 patients during the postimplementation period, of which 791 were on intervention units and comprised the study population. Table 1 displays the intervention components implemented by site. Sites implemented between one and seven components. The most frequently implemented intervention component was training existing staff to take the best possible medication histories (BPMHs), implemented at four sites. The regression results are displayed in Table 2. Three interventions were associated with significant decreases in potentially harmful discrepancy rates: (1) clearly defining roles and responsibilities and communicating this with clinical staff (hazard ratio [HR] 0.53, 95% CI: 0.32–0.87); (2) training existing staff to perform discharge medication reconciliation and patient counseling (HR 0.64, 95% CI: 0.46–0.89); and (3) hiring additional staff to perform discharge medication reconciliation and patient counseling (HR 0.48, 95% CI: 0.31–0.77). Two interventions were associated with significant increases in potentially harmful discrepancy rates: training existing staff to take BPMHs (HR 1.38, 95% CI: 1.21–1.57) and implementing a new electronic health record (EHR; HR 2.21, 95% CI: 1.64–2.97).

DISCUSSION

We noted that three intervention components were associated with decreased rates of unintentional medication discrepancies with potential for harm, whereas two were associated with increased rates. The components with a beneficial effect were not surprising. A prior qualitative study demonstrated the confusion related to clinicians' roles and responsibilities during medication reconciliation; therefore, clear delineations should reduce rework and improve the medication reconciliation process.[8] Other studies have shown the benefits of pharmacist involvement in the inpatient setting, particularly in reducing errors at discharge.[9] However, we did not anticipate that training staff to take BPMHs would be detrimental. Possible reasons for this finding that are based on direct observations by mentors at site visits or noted during monthly calls include (1) training personnel on this task without certification of competency may

TABLE 2. **Relationship between Potentially Harmful Medication Discrepancies Per Patient and Intervention Components by Site**

Intervention Component	Adjusted Incidence Rate Ratio[a] (95% CI[b])	*P* Value
Trained existing staff to take best possible medication histories	1.38 (1.21 to 1.57)	<.001
Hired additional staff to take best possible medication histories	0.98 (0.58 to 1.65)	.94
Trained existing staff to perform discharge medication reconciliation and patient counseling	0.64 (0.46 to 0.89)	.007
Hired additional staff to perform discharge medication reconciliation and patient counseling	0.48 (0.31 to 0.77)	.002
Clearly defined roles and responsibilities and communicating this with clinical staff	0.53 (0.32 to 0.87)	.01
Performed high-intensity interventions on high-risk patients	1.28 (0.89 to 1.85)	.18
Implemented a new electronic medical record	2.21 (1.64 to 2.97)	<.001
Made improvements to existing medication reconciliation health information technology	0.82 (0.51 to 1.30)	.40
Improved access to pre-admission medication sources	1.42 (0.46 to 4.38)	.54

[a]Adjusted for patient age, service, insurance, marital status, number of prior admissions, number of high-risk medications, Elixhauser comorbidity score, diagnosis-related group (DRG) weight, median income by zip code, season, and study site

[b]95% confidence interval

not sufficiently improve their skills, leading instead to diffusion of responsibility; (2) training personnel without sufficient time to perform the task well (eg, frontline nurses with many other responsibilities) may be counterproductive compared with training a few personnel with time dedicated to this task; and (3) training existing personnel in history-taking may have been used to delay the necessary hiring of more staff to take BPMHs. Future studies could address several of these shortcomings in both the design and implementation of medication history-training intervention components.

Several reasons may explain the association we found between implementing a new EHR and increased rates of discrepancies. Based on mentors' experiences, we suspect it is because sitewide EHR implementation requires significant resources, time, and effort. Therefore, sitewide EHR implementation pulls attention away from a focus on medication safety. Most large vendor EHRs have design flaws in their medication reconciliation modules, with the overarching problem being that their systems are not designed for an interdisciplinary team approach to medication reconciliation (unpublished material). In addition, problems may also exist with the local implementation of these modules and the way they are used by clinicians (eg, bypassing critical steps in the medication reconciliation process that lead to new medication errors). We have updated the MARQUIS toolkit to include pros and cons of EHR software and ideal features and functions of medication reconciliation information technology. We should note that this finding contrasts with previous studies that showed beneficial effects of dedicated medication reconciliation applications, which used proprietary technology, often combined with process redesign, in a focused QI effort.[10-13] These findings suggest the need for improvements in the design, local customization, and use of medication reconciliation modules in vendor EHRs.

Our study has several limitations. We conducted an on-treatment analysis, which may be confounded by characteristics of sites that chose to implement different intervention components; however, we adjusted for sites in the analysis. Some results are based on a limited number of sites implementing an intervention component (eg, defining roles and responsibilities). Although this was a longitudinal study, and we adjusted for seasonal effects, it is possible that temporal trends and cointerventions confounded our results. The adjudication of discrepancies for the potential for harm was somewhat subjective, although we used a rigorous process to ensure the reliability of adjudication, as in prior studies.[3,14] As in the main analysis of the MARQUIS study, this analysis did not measure intervention fidelity.

Based on these analyses and the literature base, we recommend that hospitals focus first on hiring and training dedicated staff (usually pharmacists) to assist with medication reconciliation at discharge.[7] Hospitals should also be aware of potential increases in medication discrepancies when implementing a large vendor EHR across their institution. Further work is needed on the best ways to mitigate these adverse effects, at both the design and local site levels. Finally, the effect of medication history training on discrepancies warrants further study.

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References

1. Cornish PL, Knowles SR, Marchesano R, et al. Unintended medication discrepancies at the time of hospital admission. *Arch Intern Med*. 2005;165(4):424-429. https://doi.org/10.1001/archinte.165.4.424.
2. Kaboli PJ, Fernandes O. Medication reconciliation: moving forward. *Arch Intern Med*. 2012;172(14):1069-1070. https://doi.org/10.1001/archinternmed.2012.2667.
3. Schnipper JL, Mixon A, Stein J, et al. Effects of a multifaceted medication reconciliation quality improvement intervention on patient safety: final results of the MARQUIS study. *BMJ Qual Saf*. 2018;27(12):954-964. https://doi.org/10.1136/bmjqs-2018-008233.
4. Salanitro AH, Kripalani S, Resnic J, et al. Rational and design of the Multicenter Medication Reconciliation Quality Improvement Study (MARQUIS). *BMC Health Serv Res*. 2013;13:230. https://doi.org/10.1186/1472-6963-13-230.
5. Mueller SK, Kripalani S, Stein J, et al. Development of a toolkit to disseminate best practices in inpatient medication reconciliation. *Jt Comm J Qual Patient Saf*. 2013;39(8):371-382. https://doi.org/ 10.1016/S1553-7250(13)39051-5.
6. Maynard GA, Budnitz TL, Nickel WK, et al. 2011 John M. Eisenberg patient safety and quality awards. Mentored implementation: building leaders and achieving results through a collaborative improvement model. Innovation in patient safety and quality at the national level. *Jt Comm J Qual Patient Saf*. 2012;38(7):301-310. https://doi.org/10.1016/S1553-7250(12)38040-9.
7. Mueller SK, Sponsler KC, Kripalani S, Schnipper JL. Hospital-based medication reconciliation practices: a systematic review. *Arch Intern Med*. 2012;172(14):1057-1069. https://doi.org/10.1001/archinternmed.2012.2246.
8. Vogelsmeier A, Pepper GA, Oderda L, Weir C. Medication reconciliation: a qualitative analysis of clinicians' perceptions. *Res Social Adm Pharm*. 2013;9(4):419-430. https://doi.org/10.1016/j.sapharm.2012.08.002.
9. Kaboli PJ, Hoth AB, McClimon BJ, Schnipper JL. Clinical pharmacists and inpatient medical care: a systematic review. *Arch Intern Med*. 2006;166(9):955-964. https://doi.org/10.1001/archinte.166.9.955.
10. Plaisant C, Wu J, Hettinger AZ, Powsner S, Shneiderman B. Novel user interface design for medication reconciliation: an evaluation of Twinlist. *J Am Med Inform Assoc*. 2015;22(2):340-349. https://doi.org/10.1093/jamia/ocu021.
11. Bassi J, Lau F, Bardal S. Use of information technology in medication reconciliation: a scoping review. *Ann Pharmacother*. 2010;44(5):885-897. https://doi.org/10.1345/aph.1M699.
12. Marien S, Krug B, Spinewine A. Electronic tools to support medication reconciliation: a systematic review. *J Am Med Inform Assoc*. 2017;24(1):227-240. https://doi.org/10.1093/jamia/ocw068.
13. Agrawal A. Medication errors: prevention using information technology systems. *Br J Clin Pharmacol*. 2009;67(6):681-686. https://doi.org/10.1111/j.1365-2125.2009.03427.x.
14. Pippins JR, Gandhi TK, Hamann C, et al. Classifying and predicting errors of inpatient medication reconciliation. *J Gen Intern Med*. 2008;23(9):1414-1422. https://doi.org/10.1007/s11606-008-0687-9.

Progress (?) Toward Reducing Pediatric Readmissions

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Many children's hospitals are actively working to reduce readmissions to improve care and avoid financial penalties. We sought to determine if pediatric readmission rates have changed over time. We used data from 66 hospitals in the Inpatient Essentials Database including index hospitalizations from January, 2010 through June, 2016. Seven-day all cause (AC) and potentially preventable readmission (PPR) rates were calculated using 3M PPR software. Total and condition-specific quarterly AC and PPR rates were generated for each hospital and in aggregate. We included 4.52 million hospitalizations across all study years. Readmission rates did not vary over the study period. The median seven-day PPR rate across all quarters was 2.5% (range 2.1%-2.5%); the median seven-day AC rate across all quarters was 5.1% (range 4.3%-5.3%). Readmission rates for individual conditions fluctuated. Despite significant national efforts to reduce pediatric readmissions, both AC and PPR readmission rates have remained unchanged over six years. *Journal of Hospital Medicine* 2019;14:618-621. © 2019 Society of Hospital Medicine

Readmission rates have been used by payers to administer financial incentives or penalties to hospitals as a measure of quality. The Centers for Medicare and Medicaid Services (CMS) reduces payments to hospitals with excess readmissions for adult Medicare patients.[1] Although the Medicare readmission penalties do not apply to children, several state Medicaid agencies have adopted policies to reduce reimbursement for hospitals with higher than expected readmission rates. These Medicaid programs often use potentially preventable readmission (PPR) rates calculated with proprietary software.[2] As a result of these incentives and with a goal of improving care, many children's hospitals have focused on reducing readmissions through participation in local, regional, and national collaboratives.[3]

Rates of unplanned readmissions in children are lower than in older adults, with all-cause 30-day pediatric readmission rates around 13%.[4-7] Even so, as many as 30% of pediatric readmissions may be potentially preventable, with the most common transition failure involving a hospital factor, such as failure to recognize worsening clinical status prior to discharge.[8] While readmission metrics are often judged across peer institutions, little is known about national trends over time. Therefore, we sought to examine readmission rates at children's hospitals over a six-year timeframe to determine if progress has been made toward reducing readmissions.

METHODS

We utilized data from the Children's Hospital Association Inpatient Essentials Database and included index hospitalizations from January 1, 2010 through June 30, 2016. This database contains demographic information, diagnosis and procedure codes, and All-Patient Refined Diagnosis-Related Groups (APR-DRGs; 3M Health Information Systems) to describe the principal reason for each hospitalization.[9] We included 66 hospitals from 31 states plus the District of Columbia with complete data during the study period.

Seven-day all-cause (AC) readmission and PPR rates were calculated using the output from 3M potentially preventable readmission software (version 32). The PPR software utilizes a proprietary algorithm to designate potentially preventable read-

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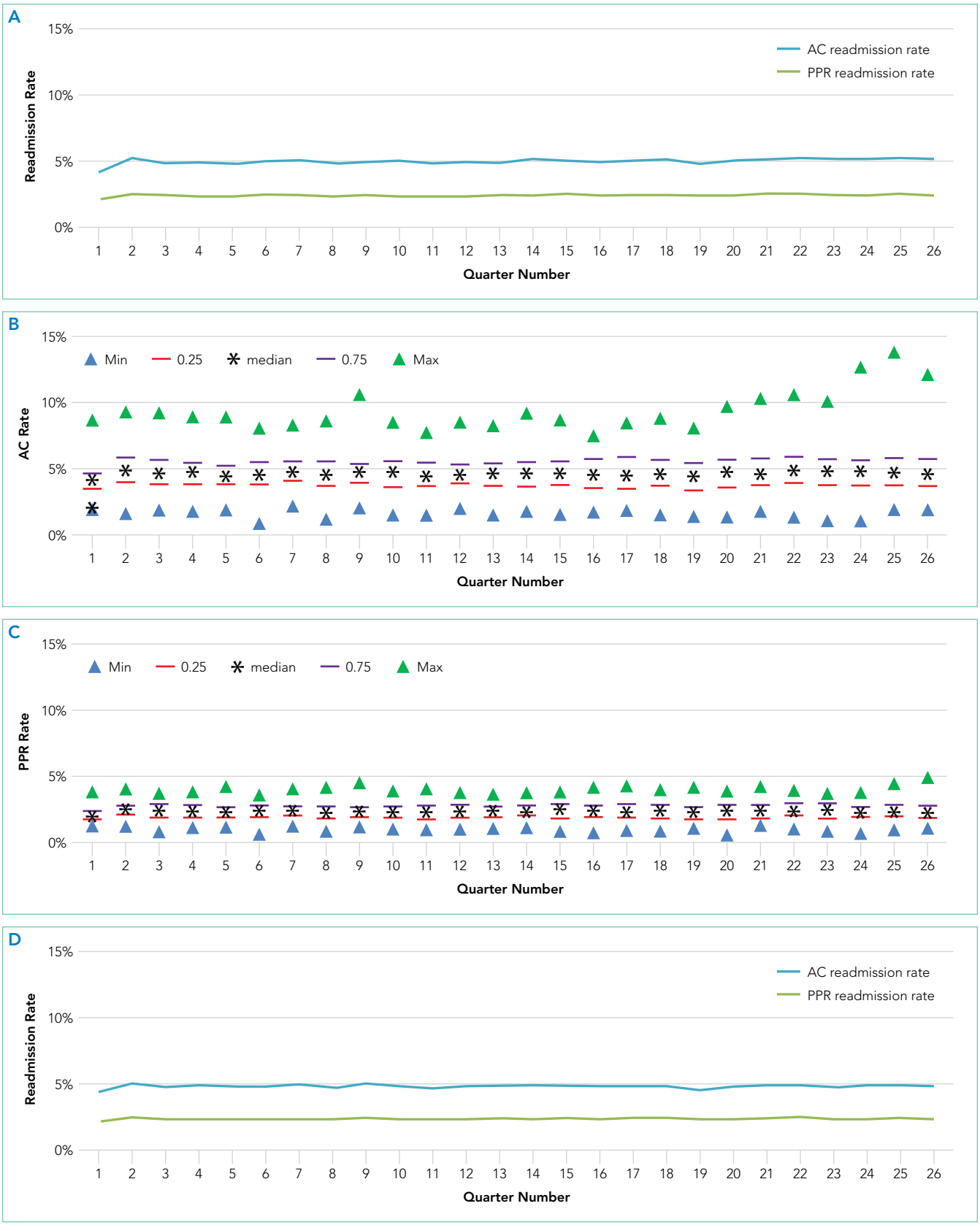

FIG. Seven-day All-Cause and Potentially Preventable Readmissions from 2010 to 2016. (A) Aggregate potentially preventable readmissions and all-cause rates over time. (B) Hospital all-cause rates over time. (C) Hospital potentially preventable readmission rates over time. (D) Aggregate risk-adjusted potentially preventable readmissions and all-cause rates over time.

Abbreviations: AC, all cause; PPR, potentially preventable readmission.

missions based on diagnosis codes and the severity of illness (as measured by the APR-DRG severity of illness classification). We chose seven-day readmissions, as opposed to a longer window, as readmissions soon after discharge are more likely to be preventable[8] and thus theoretically more amenable to prevention efforts. Quarterly rates were generated for each hospital and in aggregate across the population. We chose quarterly rates *a priori* to assess changes in rates without focusing on minor monthly fluctuations due to seasonal differences. We performed generalized linear mixed regression models with cluster adjustments at the hospital level to assess changes in readmission rates over time adjusted for case mix index, as admissions to children's hospitals have increased in complexity over time.[10,11] We operationalized the case mix index as an average of pediatric admissions' relative weights at each hospital for the quarter.[12] We assessed AC and PPR models separately. The average case mix index was a covariate in both regression models.

Finally, to determine if readmission reduction may be specific to particular conditions, we generated readmission rates for a select number of APR-DRGs. We focused on conditions with a very high percentage of AC readmissions classified as PPR (appendectomy, connective tissue disorders, ventricular shunt procedures, bronchiolitis, asthma, and sickle cell crisis) as well as those with a very low percentage of AC readmissions classified as PPR (gastrointestinal infections, hematologic disease, and bone marrow transplant [BMT]).[5]

RESULTS

We included 4.52 million admissions to the 66 included hospitals. Most hospitals (62%) were freestanding acute-care children's hospitals. The hospitals were geographically diverse. Two-thirds had magnet status (Appendix Table 1). Appendix Table 2 displays patient/admission characteristics over time. Approximately 49% of children were non-Hispanic white, 19% were non-Hispanic black, and 19% were Hispanic. Half of the children were insured by Medicaid. These characteristics were stable over time, except case mix index, which increased during the study period ($P = .04$).

Across Diagnosis All-Cause and Potentially Preventable Readmission Rates

Over the study period, there were 227,378 AC seven-day readmissions (5.1% readmission rate), and 91,467 readmissions (40% of AC readmissions) were considered PPRs. Readmission rates did not vary over the study period (Figure, Panel A). The median AC seven-day readmission rate across all quarters was 5.1%, ranging from 4.3% to 5.3% (Figure, Panels A and B). The median seven-day PPR rate across all quarters was 2.5% and ranged from 2.1% to 2.5% (Figure, Panels A and C). When adjusted for case mix index, the AC rate increased slightly (on average 0.006% increase per quarter, $P = .01$) and PPR rates were unchanged over time (PPR model $P = .14$; Figure, Panel D).

Condition-Specific Readmission Rates

Of the condition-specific readmission rates, only the AC rate for BMT changed significantly, with a decrease of 0.1% per quarter, $P = .048$. None of the conditions had significant trends in increasing or decreasing readmission in PPR rates. Some conditions, including sickle cell and cerebrospinal fluid ventricular shunt procedures, had fluctuating readmission rates throughout the study period (Appendix Figure, Panels A-G).

DISCUSSION

Despite substantial national efforts to reduce pediatric readmissions,[3] seven-day readmission rates at children's hospitals have not decreased over six years. When individual conditions are examined, there are minor fluctuations of readmission rates over time but no clear trend of decreased readmission events.

Our results are contrary to findings in the Medicare population, where 30-day readmission rates have decreased over time.[13,14] In these analyses, we focused on seven-day readmission, as earlier pediatric readmissions are more likely to be preventable. Importantly, the majority of our included hospitals (88%) participate in the Solutions for Patient Safety collaborative, which focuses on reducing seven-day readmissions. Thus, we are confident that a concerted effort to decrease readmission has been ongoing. Further, our findings are contrary to recent analyses indicating an increase in pediatric readmission rates using the pediatric all-condition readmission rate in the National Readmission Database.[15] Our analyses are distinctly different in that they allow a focus on hospital-level performance in children's hospitals. Although in our analyses the all-cause adjusted readmission rate did increase significantly over time (0.006% a quarter or 0.024% per year), this small increase is unlikely to be clinically relevant.

There are several potential reasons for the lack of change in pediatric readmission rates despite concerted efforts to decrease readmissions. First, pediatric readmissions across all conditions are relatively infrequent compared with adult readmission rates. Extrapolating from the largest pediatric study on readmission preventability,[8] it is estimated that only two in 100 pediatric hospitalizations results in a PPR.[16] Given the lack of robust pediatric readmission prediction tools, the ability to prospectively identify children at high risk for readmission and target interventions is challenging. Second, as we have previously described, children are readmitted after hospitalization for a wide variety of conditions.[5] Medicare readmission penalties are leveraged on specific conditions; yet, Medicaid policies include all conditions. In pediatrics, successful interventions to reduce readmissions have focused on hospitalizations for specific conditions.[17] In the only two large pediatric readmission reduction trials across multiple conditions, postdischarge homecare nursing contact did not reduce reutilization.[18,19] It is challenging to decrease readmissions in *heterogenous* populations without a robust set of evidence-based interventions. Third, there are multiple ways to measure pediatric readmissions, and different institutions may focus on different methods. Given the proprietary nature and the reliance on retrospective administrative data, PPR rates cannot be assessed during admission and thus are not feasible as a real-time quality improvement outcome. Fourth, in contrast to other hospital quality metrics such as central line-associated bloodstream infections or catheter-associat-

ed urinary tract infection, the locus of control for readmission is not entirely within the purview of the hospital.

It is unclear what readmission rate in children is appropriate—or safe—and whether that level has already been met. National readmission prevention efforts may have collateral benefits such as improved communication, medication errors or adherence, and other important aspects of care during transitions. In this scenario, lower readmission rates may not reflect improved quality. Future research should focus on determining if and how readmission reduction efforts are helping to ease the transition to home. Alternatively, research should determine if there are better interventions to assist with transition challenges which should receive resources divested from failing readmission reduction efforts.

Using administrative data, we are limited in delineating truly preventable readmissions from nonpreventable readmissions. Nevertheless, we chose to focus on the PPR and AC metrics, as these are the most policy-relevant metrics. Additionally, we examined aggregate rates of readmission across a cohort of hospitals and did not assess for within-hospital changes in readmission rates. Thus, it is possible (and likely) that some hospitals saw improvements and others saw increases in readmission rates during the study period. We are unable to examine readmission rates at hospitals based on investment in readmission reduction efforts or individual state Medicaid reimbursement policies. Finally, we are unable to assess readmissions to other institutions; however, it is unlikely that readmissions to other hospitals have decreased significantly when readmissions to the discharging hospital have not changed.

Pediatric readmissions at children's hospitals have not decreased in the past six years, despite widespread readmission reduction efforts. Readmission rates for individual conditions have fluctuated but have not decreased.

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References

1. Centers for Medicare & Medicaid Services. Readmissions Reduction Program (HRRP). https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html. Accessed January 19, 2018.
2. 3M Health Information Systems. Potentially Preventable Readmissions Classification System: Methodology Overview. http://multimedia.3m.com/mws/media/1042610O/resources-and-references-his-2015.pdf. Accessed April 5, 2019.
3. Children's Hospitals' Solutions for Patient Safety. SPS prevention bundles: readmission. http://www.solutionsforpatientsafety.org/wp-content/uploads/SPS-Prevention-Bundles.pdf. Accessed January 11, 2017.
4. Berry JG, Toomey SL, Zaslavsky AM, et al. Pediatric readmission prevalence and variability across hospitals. *JAMA*. 2013;309(4):372-380. https://doi.org/10.1001/jama.2012.188351.
5. Gay JC, Agrawal R, Auger KA, et al. Rates and impact of potentially preventable readmissions at children's hospitals. *J Pediatr*. 2015;166(3):613-619. https://doi.org/10.1016/j.jpeds.2014.10.052.
6. Auger KA, Teufel RJ, Harris JM, et al. Children's hospital characteristics and readmission metrics. *Pediatrics*. 2017;139(2):e20161720. https://doi.org/10.1542/peds.2016-1720.
7. Joynt KE, Orav EJ, Jha AK. Thirty-day readmission rates for medicare beneficiaries by race and site of care. *JAMA*. 2011;305(7):675-681. https://doi.org/10.1001/jama.2011.123.
8. Toomey SL, Peltz A, Loren S, et al. Potentially preventable 30-day hospital readmissions at a children's hospital. *Pediatrics*. 2016;138(2):e20154182. https://doi.org/10.1542/peds.2015-4182.
9. Children's Hospital Association. Pediatric analytic solutions. https://www.childrenshospitals.org/Programs-and-Services/Data-Analytics-and-Research/Pediatric-Analytic-Solutions. Accessed June 2, 2018.
10. Simon TD, Berry J, Feudtner C, et al. Children with complex chronic conditions in inpatient hospital settings in the United States. *Pediatrics*. 2010;126(4):647-655. https://doi.org/10.1542/peds.2009-3266.
11. Berry JG, Hall M, Hall DE, et al. Inpatient growth and resource use in 28 children's hospitals: a longitudinal, multi-institutional study. *JAMA Pediatr*. 2013;167(2):170-177. https://doi.org/10.1001/jamapediatrics.2013.432.
12. Richardson T, Rodean J, Harris M, et al. Development of hospitalization resource intensity scores for kids (H-RISK) and comparison across pediatric populations. *J Hosp Med*. 2018;13(9):602-608. https://doi.org/10.12788/jhm.2948.
13. Zuckerman RB, Sheingold SH, Orav EJ, Ruhter J, Epstein AM. Readmissions, observation, and the hospital readmissions reduction program. *N Engl J Med*. 2016;374(16):1543-1551. https://doi.org/10.1056/NEJMsa1513024.
14. Desai NR, Ross JS, Kwon JY, et al. Association between hospital penalty status under the hospital readmission reduction program and readmission rates for target and nontarget conditions. *JAMA*. 2016;316(24):2647-2656. https://doi.org/10.1001/jama.2016.18533.
15. Bucholz EM, Toomey SL, Schuster MA. Trends in pediatric hospitalizations and readmissions: 2010-2016. *Pediatrics*. 2019;143(2):e20181958. https://doi.org/10.1542/peds.2018-1958.
16. Brittan M, Shah SS, Auger KA. Preventing pediatric readmissions: how does the hospital fit in? *Pediatrics*. 2016;138(2):e20161643. https://doi.org/10.1542/peds.2016-1643.
17. Auger KA, Kenyon CC, Feudtner C, Davis MM. Pediatric hospital discharge interventions to reduce subsequent utilization: a systematic review. *J Hosp Med*. 2014;9(4):251-260. https://doi.org/10.1002/jhm.2134.
18. Auger KA, Simmons JM, Tubbs-Cooley H, et al. Hospital to home outcomes (H2O) randomized trial of a post-discharge nurse home visit. *Pediatrics*. In press.
19. Auger KA, Shah SS, Tubbs-Cooley HL, et al. Effects of a 1-time nurse-led telephone call after pediatric discharge: the H2O II randomized clinical trial. *JAMA Pediatr*. 2018;172(9):e181482. https://doi.org/10.1001/jamapediatrics.2018.1482.

Improving Resident Feedback on Diagnostic Reasoning after Handovers: The LOOP Project

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Appropriate calibration of clinical reasoning is critical to becoming a competent physician. Lack of follow-up after transitions of care can present a barrier to calibration. This study aimed to implement structured feedback about clinical reasoning for residents performing overnight admissions, measure the frequency of diagnostic changes, and determine how feedback impacts learners' self-efficacy. Trainees shared feedback via a structured form within their electronic health record's secure messaging system. Forms were analyzed for diagnostic changes. Surveys evaluated comfort with sharing feedback, self-efficacy in identifying and mitigating cognitive biases' negative effects, and perceived educational value of night admissions—all of which improved after implementation. Analysis of 544 forms revealed a 43.7% diagnostic change rate spanning the transition from night-shift to day-shift providers; of the changes made, 29% (12.7% of cases overall) were major changes. This study suggests that structured feedback on clinical reasoning for overnight admissions is a promising approach to improve residents' diagnostic calibration, particularly given how often diagnostic changes occur. *Journal of Hospital Medicine* 2019;14:622-625. © 2019 Society of Hospital Medicine

One of the most promising methods for improving medical decision-making is learning from the outcomes of one's decisions and either maintaining or modifying future decision-making based on those outcomes.[1-3] This process of iterative improvement over time based on feedback is called calibration and is one of the most important drivers of lifelong learning and improvement.[1]

Despite the importance of knowing the outcomes of one's decisions, this seldom occurs in modern medical education.[4] Learners do not often obtain specific feedback about the decisions they make within a short enough time frame to intentionally reflect upon and modify that decision-making process.[3,5] In addition, almost every patient admitted to a teaching hospital will be cared for by multiple physicians over the course of a hospitalization. These care transitions may be seen as barriers to high-quality care and education, but we suggest a different paradigm: transitions of care present opportunities for trainees to be teammates in each other's calibration. Peers can provide specific feedback about the diagnostic process and inform one another about patient outcomes. Transitions of care allow for built-in "second opinions," and trainees can intentionally learn by comparing the clinical reasoning involved at different points in a patient's course. The diagnostic process is dynamic and complex; it is fundamental that trainees have the opportunity to reflect on the process to identify how and why the diagnostic process evolved throughout a patient's hospitalization. Most inpatient diagnoses are "working diagnoses" that are likely to change. Thus, identifying the twists and turns in a patient's diagnostic journey provides invaluable learning for future practice.

Herein, we describe the implementation and impact of a multisite initiative to engage residents in delivering feedback to their peers about medical decisions around transitions of care.

METHODS

The LOOP Project is a prospective clinical educational study that aimed to engage resident physicians to deliver feedback and updates about their colleagues' diagnostic decision-making around care transitions. This study was deemed exempt from review by the University of Minnesota Institutional Review Board and either approved or deemed exempt by the corresponding Institutional Review Boards at all participating institutions. The study was conducted by seven programs at six institutions and included Internal Medicine, Pediatrics, and Internal Medicine–Pediatrics (PGY 1-4) residents from February 2017 to June 2017. Residents rotating through participating clinical services during the study period were invited to partic-

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Date of Initial Encounter: ***
Patient Initials: ***

Diagnosis Comparison
(Primary diagnosis OR, if diagnosis not known, what are the top 3 items in the differential diagnosis?)
- **From previous provider's note: *****
- **From my/our team's discussion after the transition of care: *****

Diagnostic/Management Evolution:
If the diagnosis changed, why? ***

Helpful Pearls: (select one or more of the following)
Examples:
- If you're concerned about ***, consider ***
- If a patient has ***, consider ***
- Something doesn't fit: ***
- ***

FIG. Structured LOOP feedback form, usually sent as a secure in-basket message in the Electronic Health Record.

ipate and given further information by site leads via informational presentations, written handouts, and/or emails.

The intervention entailed residents delivering structured feedback to their colleagues regarding their patients' diagnoses after transitions of care. The predominant setting was the inpatient hospital medicine day-shift team providing feedback to the night-shift team regarding overnight admissions. Feedback about patients (usually chosen by the day-shift team) was delivered through completion of a standard templated form (Figure) usually sent within 24 hours after hospital admission through secure messaging (ie, EPIC In-Basket message utilizing a Smartphrase of the LOOP feedback form). A 24-hour time period was chosen to allow for rapid cycling of feedback focusing on initial diagnostic assessment. Site leads and resident champions promoted the project through presentations, informal discussions, and prizes for high completion rates of forms and surveys (ie, coffee cards and pizza).

Feedback forms were collected by site leads. A categorization rubric was developed during a pilot phase. Diagnoses before and after the transition of care were categorized as no change, diagnostic refinement (ie, the initial diagnosis was modified to be more specific), disease evolution (ie, the patient's physiology or disease course changed), or major diagnostic change (ie, the initial and subsequent diagnoses differed substantially). Site leads acted as single-coders and conference calls were held to discuss coding and build consensus regarding the taxonomy. Diagnoses were not labeled as "right" or "wrong"; instead, categorization focused on differences between diagnoses before and after transitions of care.

Residents were invited to complete surveys before and after the rotation during which they had the opportunity to give or receive feedback. A unique identifier was entered by each participant to allow pairing of pre- and postsurveys. The survey (Appendix 1) was developed and refined during the initial pilot phase at the University of Minnesota. Surveys were collected using RedCap and analyzed using SAS version 9.3 (SAS Institute Inc., Cary, North Carolina). Differences between pre- and postsurveys were calculated using paired *t*-tests for continuous variables, and descriptive statistics were used for demographic and other items. Only surveys completed by individuals who completed both pre- and postsurveys were included in the analysis.

RESULTS

Overall, there were 716 current residents in the training programs that participated in this study; one site planned on participating but did not complete any forms. A total of 405 residents were eligible to participate during the study period. Overall, 221 (54.5%) presurveys and 90 postsurveys were completed (22.2%); 54 residents (13.3%) completed both pre- and postsurveys and were included in the analysis. Of the 54 survey respondents, 26 (48.15%) were female.

Survey results (Table) indicated significantly improved self-efficacy in identifying cognitive errors in residents' own practice, identifying why those errors occurred, and identifying strategies to decrease future diagnostic errors. Participants noted increased frequency of discussions within teams regarding differential diagnoses, diagnostic errors, and why diagnoses changed over time. The feedback process was viewed positively by participants, who were also generally satisfied with the overall quality, frequency, and value of the feedback received. After the intervention, participants reported an increase in the amount of feedback received for night admissions and an overall increase in the perception that nighttime admissions were as "educational" as daytime admissions.

Of 544 collected forms, 238 (43.7%) showed some diagnostic change. These changes were further categorized into disease evolution (60 forms, 11.0%), diagnostic refinement (109 forms, 20.0%), and major diagnostic change (69 forms, 12.7%).

CONCLUSION

This study suggests that an intervention to operationalize standardized, structured feedback about diagnostic decision-making around transitions of care is a promising approach to improve residents' understanding of changes in, and evolution of, the diagnostic process, as well as improve the perceived educational value of overnight admissions. In our results, over 40% of the patients admitted by residents had some change in their diagnoses after a transition of care during their early hospitalization. This finding highlights the importance of ensuring that trainees have the opportunity to know the outcomes of their decisions. Indeed, residents should be encouraged to follow-up on their own patients without prompting; however, studies show that this practice is uncommon and interventions beyond admonition are necessary.[4]

The diagnostic change rate observed in this study confirms that diagnosis is an iterative process and that the concept of a *working diagnosis* is key—a diagnosis made at admission will very likely be modified by time, the natural history of the disease, and new clinical information. When diagnoses are viewed

TABLE. **LOOP Study Project Survey Results: Diagnostic Error Identification and Mitigation, Differential Building, Educational Value, Feedback Value**

How confident are you in your ability to:[a]	**Pre (mean)**	**Post (mean)**	***P* Value**
Determine why differential diagnoses change from admission to 1 day later?	3.8	3.8	.6871
Identify why different providers' differential diagnoses vary?	3.4	3.6	.0795
Understand a patient's disease progression over the first 24-36 hours of admission?	3.7	3.8	.0733
Identify cognitive errors in your own practice?	3.2	3.6	.0006
Identify diagnostic errors or near misses in your own practice?	3.2	3.6	.0006
Identify why these errors or near misses occurred?	3.2	3.7	<.0001
Identify strategies to decrease diagnostic errors in your own practice?	3.1	3.6	<.0001
In your experience, how often do your teams discuss:[b]	**Pre (mean)**	**Post (mean)**	***P* Value**
Clinical reasoning and differential diagnosis building for patients admitted by someone else?	3.2	3.7	.0016
Clinical reasoning and differential diagnosis building for patients you admit?	3.7	4.1	.0307
Diagnostic errors and/or near misses in patients admitted by someone else?	2.8	3.2	.0003
Diagnostic errors and/or near misses in patients you admit?	3.0	3.4	.0067
Why a given diagnosis changed for a patient admitted by someone else?	3.1	3.5	.0036
Why a given diagnosis changed for a patient you admitted?	3.3	3.7	.0111
Feedback Perceptions:[c]	**Pre (mean)**	**Post (mean)**	***P* Value**
I get the same amount of feedback about my decision-making for patients I admit at night as for those I admit during the day.	1.9	2.4	.0022
Nighttime admissions are as educational as daytime admissions.	3.2	3.5	.0119
Considering all methods of clinical reasoning feedback you receive, you are satisfied with the feedback:[c]	**Pre (mean)**	**Post (mean)**	***P* Value**
Quality	3.4	3.5	.6898
Frequency	2.8	2.9	.6264
Overall value	3.3	3.6	.0571

[a]On a 1-5 Likert scale, (1) Very unconfident, (2) Somewhat unconfident, (3) Neutral, (4) Somewhat confident, (5) Very confident
[b]On a 1-5 Likert scale, (1) Never, (2) Rarely, (3) Sometimes, (4) Usually, (5) Always
[c]On a 1-5 Likert scale, (1) Strongly disagree, (2) Disagree, (3) Neutral, (4) Agree, (5) Strongly agree

as working diagnoses, trainees may be empowered to better understand the diagnostic process. As learners and teachers adopt this perspective, training programs are more likely to be successful in helping learners calibrate toward expertise.

Previous studies have questioned whether resident physicians view overnight admissions as valuable.[6] After our intervention, we found an increase in both the amount of feedback received and the proportion of participants who agreed that night and day admissions were equally educational, suggesting that targeted diagnostic reasoning feedback can bolster educational value of nighttime admissions.

This study presents a number of limitations. First, the survey response rate was low, which could potentially lead to biased results. We excluded those respondents who did not respond to both the pre- and postsurveys from the analysis. Second, we did not measure actual change in diagnostic performance. While learners did report learning and saw feedback as valuable, self-identified learning points may not always translate to improved patient care. Additionally, residents chose the patients for whom feedback was provided, and the diagnostic change rate described may be overestimated. We did not track the total number of admissions for which feedback could have been delivered during the study. We did not include a control group, and the intervention may not be responsible for changing learners' perceptions. However, the included programs were not implementing other new protocols focused on diagnostic reasoning during the study period. In addition, we addressed diagnostic changes early in a hospital course; a comprehensive program should address more feedback loops (eg, discharging team to admitting team).

This work is a pilot study; for future interventions focused on improving calibration to be sustainable, they should be

congruent with existing clinical workflows and avoid adding to the stress and/or cognitive load of an already-busy clinical experience. The most optimal strategies for delivering feedback about clinical reasoning remain unclear.

In summary, a program to deliver structured feedback among resident physicians about diagnostic reasoning across care transitions for selected hospitalized patients is viewed positively by trainees, is feasible, and leads to changes in resident perception and self-efficacy. Future studies and interventions should aim to provide feedback more systematically, rather than just for selected patients, and objectively track diagnostic changes over time in hospitalized patients. While truly objective diagnostic information is challenging to obtain, comparing admission and other inpatient diagnoses to discharge diagnoses or diagnoses from primary care follow-up visits may be helpful. In addition, studies should aim to track trainees' clinical decision-making over time and determine the effectiveness of feedback at improving diagnostic performance through calibration.

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References

1. Croskerry P. The feedback sanction. *Acad Emerg Med*. 2000;7(11):1232-1238. https://doi.org/10.1111/j.1553-2712.2000.tb00468.x.
2. Trowbridge RL, Dhaliwal G, Cosby KS. Educational agenda for diagnostic error reduction. *BMJ Qual Saf*. 2013;22(Suppl 2):ii28-ii32. https://doi.org/10.1136/bmjqs-2012-001622.
3. Dhaliwal G. Clinical excellence: make it a habit. *Acad Med*. 2012;87(11):1473. https://doi.org/10.1097/ACM.0b013e31826d68d9.
4. Shenvi EC, Feupe SF, Yang H, El-Kareh R. Closing the loop: a mixed-methods study about resident learning from outcome feedback after patient handoffs. *Diagnosis*. 2018;5(4):235-242. https://doi.org/10.1515/dx-2018-0013.
5. Rencic J. Twelve tips for teaching expertise in clinical reasoning. *Med Teach*. 2011;33(11):887-892. https://doi.org/10.3109/0142159X.2011.558142.
6. Bump GM, Zimmer SM, McNeil MA, Elnicki DM. Hold-over admissions: are they educational for residents? *J Gen Intern Med*. 2014;29(3):463-467. https://doi.org/10.1007/s11606-013-2667-y.

Empowering Educators

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"Better than a thousand days of diligent study is one day with a great teacher."

—Japanese proverb

My chairman of medicine in medical school was a looming, intimidating, diagnostic genius—and one of the best teachers I have ever had. As a sub-intern it seemed I learned more in one month with him than in my prior six months of medical school. After the rotation, I asked him how he became such an effective teacher. "Simple," he said, "I invest significant time and effort."

But time is limited and you have to be smart with how you invest it. Here are three pearls that are a wise investment—they *will* make you a better teacher.

PREPARE

Those who *seem* to teach effortlessly do so after substantial behind-the-scenes effort. Read on your patients before rounds. Identify key teaching points and useful literature. Get some questions ready to define knowledge gaps and create "Teaching Scripts."

Teaching Scripts are preplanned summaries of specific topics that can be used on rounds or longer talks and are "triggered" by common scenarios (eg, hypoxia). Great teaching scripts use a "hook" to engage the learner (commonly a thought-provoking question or story), two to five teaching points, and purposeful questions, mnemonics, and visual representations.

You should aim to develop at least five teaching scripts on commonly encountered topics. Eventually, you should have twenty scripts you can easily reference.

USE TECHNOLOGY

Technology significantly enhances the efficiency and impact of your teaching. For example, on rounds use your cell phone to display and teach anatomy, radiographic images, and EKGs. Use an iPad as a mobile whiteboard. Use email to collate and disseminate teaching points or send links to valuable learning resources like procedural videos. At its best, you can develop new programs and recruit team members to create resources, like I did with an online series focused on teaching to teach using graphically-enhanced TED-style talks[1] and animated whiteboard videos.[2]

LEARN FROM OTHER DISCIPLINES

Do you easily remember the content from your medical school lectures? Likely not. But you likely remember moments from your favorite comedian or TED talk. Unlike the many PowerPoint lectures you've sat through, I'll bet you stay engaged in films and documentaries. Why the difference? In short—medical educators often don't make content engaging, readily understood, or memorable. To be most effective in teaching, learn from experts in other fields. Think how storytelling, film, theater, and graphic design contribute to learning. Don't be afraid to be different.

All of these disciplines recognize the power of storytelling to make their points more impactful and memorable. Leverage this by mixing lessons with stories to create teaching points that stick. Lessons of character and morals can be highlighted through stories of personal struggles, prior patients, or people you admire. Clinical tips can be reinforced through sharing a "clinical story"—concise retellings of high-yield patient cases with diagnosis or management tips.

These disciplines also recognize the importance of "setting the stage" to create an optimal experience. We too can learn from this by setting the stage for our learners. Build a learning environment that is positive, collaborative, and fun by being open, curious, and enthusiastic. Treat your team to coffee rounds or lunch and get to know each learner as you walk between patients. As Teddy Roosevelt said, "people don't care how much you know, until they know how much you care."

My chairman taught me that exceptional teaching is not a talent of the gifted, it is a skill of the diligent. If you invest in your teaching, you can make a tremendous impact in the lives of your learners. Are you ready to be empowered?

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References

1. Kabeer R, Salari S, Cronin D. MENTOR Video Series: The Golden Secret. [Video]. 2019. Available at: http://mentorseries.org/FeedbackGS.
2. Kabeer R, Salari S, Cronin D. MENTOR Video Series: Effective Feedback Summary - The 5Ps. [Video]. 2019. Available at: http://mentorseries.org/Feedback5Ps.

Methodological Progress Note: Group Level Assessment

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Group Level Assessment (GLA) is a qualitative research methodology designed to enable groups of stakeholders to generate and evaluate data in participatory sessions.[1] It has been used in diverse health-related settings for multiple research purposes, including needs/resource assessment, program evaluation, quality improvement, intervention development, feasibility/acceptability testing, knowledge generation, and prioritization.[2-6] Unlike traditional qualitative research methods in which participants provide data and researchers analyze it, GLA uses a seven-step structured process (Table) that actively involves a large group of stakeholders in the generation, interpretation, and synthesis of data and allows salient themes to be identified from stakeholders' perspectives.[7] GLA deliverables include a set of action items that are relevant to the target issue and representative of the collective view of stakeholders. In this issue of the *Journal of Hospital Medicine*, Choe and colleagues used GLA methodology to identify the perspectives of pediatric medical providers and interpreters with regard to the use of interpreter services for hospitalized children having limited English proficiency (LEP).[8]

Each individual GLA session is intended for a group of 15-60 stakeholders. Ideally, a GLA session is scheduled for approximately three hours with a skilled facilitator guiding the group through the steps of the session.[1] Depending on the study scope and research questions, modifications to GLA can be made when engaging fewer stakeholders, conducting the GLA across several shorter sessions with the same group, or conducting multiple sessions with different stakeholder groups wherein results are integrated across the groups.[1]

APPLICATION OF GLA

Stakeholder Recruitment

GLAs are designed to bring diverse groups together to be able to generate and evaluate ideas collectively, which in turn helps to reduce potential power differentials between or among participants. Depending on the research question(s), relevant stakeholders may include local community residents, patients, caregivers, community leaders, practitioners, providers, community-based organizations, and even CEOs. The use of purposeful sampling techniques can obtain a diverse group of stakeholders, thus helping ensure a wide range of ideas and perspectives. Choe and colleagues used flyers and announcements at staff meetings to recruit physicians, nursing staff, and interpreters who were subsequently assigned to GLA sessions to ensure engagement from a range of stakeholder roles at each session.[8]

Session Logistics

Strategies to create an open, equitable atmosphere in GLA sessions include role-based assigning of individuals to specific groups, avoiding introductions that emphasize status, pre-education for any leaders and supervisors about the participatory and equitable nature of GLA, and minimizing cliques and overly dominant voices throughout the session. Stakeholders who take part in activities in a GLA session typically receive an incentive for participating. Additional supports such as food and childcare may be considered. GLA sessions involving children may require providing the young participants assistance in writing their responses and/or the use of additional facilitators to keep the small groups on track.[5] Interpreters and facilitators can be incorporated into GLA sessions to assist stakeholders who may need assistance with understanding and responding to prompts, such as language interpretation and translation services.

Prompt Development

Similar to the development of questions for interview and focus group guides, creating effective prompts is a critical component of data collection in GLA. Prompts are statements worded as incomplete or fill-in-the-blank sentences that should be open ended to allow participants to respond with their own thoughts and experiences. Prompts that resemble the beginning of a sentence (eg, "The biggest challenge we face is…") encourage honest reflection rather than questions that can make participants feel like they are being evaluated. We recommend varying the number of prompts based on the group size: approximately one chart and prompt per person attending, with a maximum of 35 prompts at one session.[1] This allows for sufficient variability in the responses generated without being overwhelming or too time-consuming. For example, Choe et al. developed a pool of 51 unique prompts addressing their research questions and then used 15-32 prompts in each GLA session, depending on the number of participants.[8] Prompts should be written with some purposeful redundancy, targeting the research question from several angles. The emphasis should be on the content's alignment with the research questions rather than the actual wording of the prompts as a way of

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TABLE. **GLA Steps**

Step 1: Climate Setting
Overview of session; introductions; icebreaker/warm-up
Step 2: Generating
Participants respond to prompts on wall charts with words or pictures
Step 3: Appreciating
Participants mill around and look at data on wall charts
Step 4: Reflecting
Participants spend time alone thinking about what stands out in the data
Step 5: Understanding
Small groups discuss and distill data into themes; report out
Step 6: Selecting
Participants further discuss and prioritize themes
Step 7: Action
Participants consider the next steps to take based on priorities

Abbreviation: GLA, group level assessment.

ensuring that the generated data is both valid and useful.

Prompts should also vary in format, style (eg, different color markers, pictures, fonts, etc.), and placement on each flip chart page. An individual flip chart can include multiple related prompts: for example, "split-halves" in two columns or rows (ie, the best part/worst part). Taken as a whole, the flip charts and accompanying prompts create different lenses for gathering participant perspectives on the research questions. See Appendix Table for suggested prompt characteristics and examples from a hypothetical study related to pediatric healthcare.

GLA prompt development will ideally occur in collaboration with an advisory team comprised of representative members from each of the stakeholder groups. Using a participatory research approach in the research design and preparation phases ensures that GLA prompts are understandable and relevant to participants and are able to appropriately capture the underlying purpose of the study.

Description of the Seven Steps in GLA

In step one, climate setting, the facilitator provides an overview of the session, including a description of the GLA rationale and process. Typically, an icebreaker or brief introduction activity is conducted. Step two, generating, is a hallmark step of GLA in which participants walk around and respond to prompts prewritten on flip charts hung on walls in a large room. Participants use markers and respond to each prompt by either providing a unique comment and/or corroborating an existing comment by adding a checkmark or star. During this step, organizers typically play music and encourage participants to enjoy food, chat with fellow participants, and leisurely move from prompt to prompt in any order. Step three, appreciating, is a brief interim step where participants take a "gallery walk" and view responses written on the charts.

In step four, reflecting, participants reflect on the data and briefly write down their thoughts about the responses generated in the session. In step five, understanding, smaller groups synthesize responses across a subset of charts and report their findings to the larger group. Depending on the size and composition of the larger group, small groups of four to seven people are formed or assigned. Each small group is assigned a subset of approximately four to six charts. Using thematic analysis, participants look for relationships among the responses on their assigned charts, referring to individual responses as evidence for the main findings. Groups will take notes on the charts, circle key phrases, or draw arrows to show relationships in the data and thereafter develop themes. As each small group reports their findings, the facilitator will keep a running list of generated themes, ideally in the participants' own words. Step six, selecting, involves participants discussing, further synthesizing, and prioritizing data. Step six can occur as a facilitated large group discussion or in a form in which participants can remain in the same small groups from step five and work together to complete this further step. Themes across all of the small groups are consolidated and developed into overarching themes. Step seven, action, includes planning the next steps to address priorities.

Data Analysis

Analyzing the data generated through a GLA is an iterative process incorporated into steps three to seven as described above and often continues after the GLA session is complete. Step seven can be scheduled as a separate action-planning session depending on time constraints and the study goals. This final step moves the group toward interpretation and dissemination as themes are prioritized and used to drive action steps toward a programmatic, policy, or community change. In some studies, themes will be aggregated across multiple GLAs to integrate the findings from several sessions. This step is sometimes completed with a smaller group of stakeholders, an advisory board, or the research team.

Complementary Data and Synthesis

Research teams often collect additional sources of data that are later used to analyze and interpret the initial stakeholder-developed findings (ie, demographic surveys) and to identify priority areas. Field notes, photographs of completed charts, and recorded participant quotes can also be incorporated into the thematic analysis. Small and large group discussions could be audio recorded and transcribed to capture participants' individual comments and interpretations. In Choe et al. the team recorded detailed notes, including quotations from participants, and collected a demographic survey. After each GLA session, Choe and colleagues compiled all of the stakeholder-driven findings to develop an overarching set of themes related to communication with LEP families and priority areas that could inform subsequent action. Similar to the qualitative

validation strategy of member checking, the authors shared and revised this overarching set of themes in discussion with stakeholders to ensure that participant ideas were adequately and accurately represented.[8]

STRENGTHS OF GLA

Compared to traditional qualitative methods such as one-on-one interviews and focus groups, GLA is designed for large groups and is used to promote active engagement of diverse stakeholders in the participatory process. Unlike many other qualitative methods, GLA provides a stakeholder-driven, structured format to elicit diverse stakeholder viewpoints in the moment and build consensus in a participatory manner about priorities and subsequent actions. The progression of the GLA process is collaborative, with stakeholders generating, analyzing, and prioritizing data from their own perspectives. In a focus group or one-on-one interviews, researchers would conduct the analysis after the audio recordings were transcribed. In GLA, stakeholders conduct a thematic analysis in real time, an aspect that adds the stakeholder perspective to analysis of the findings, interpretation, and implications. GLA offers a fun and interactive experience that can build a sense of community among participants (eg, walking around, impromptu conversation, working in small groups, sharing perspectives on the same issue from different vantage points, etc.). GLA is a versatile, flexible methodology that can be used to address different research objectives, be modified for use with various size groups, and be adapted based on the needs and characteristics of stakeholders (eg, children, people with disabilities, etc.).[1] When used in recruitment, GLA is designed to include stakeholders representing different roles and levels of a system. GLA can be particularly useful when engaging underserved communities in research because the process is nonthreatening and promotive of shared perspectives and decision-making. Importantly, the final step of GLA provides interested stakeholders with a way to stay involved in the research through prioritization and action.

LIMITATIONS OF GLA

Like other self-report research methods, GLA relies on stakeholder comfort and willingness to share "public data".[1] Thus, controversial or sensitive issues may not be brought forth. Since the final themes of GLA are consensus based in terms of what the group of stakeholders finds to be most important, nuances and outlier data can be missed. Successfully conducting a GLA requires a skilled, flexible facilitator who can manage group dynamics while also balancing the structure of the seven-step process, promoting an open and equitable environment, and ensuring the research process remains rigorous. Large groups can be more difficult for facilitators to manage especially when there are power differentials, conflict, and hidden agendas among stakeholders. The large group design, multiple steps of GLA, and participatory atmosphere with music and food can be off-putting for some stakeholders who find the process too noisy, overwhelming, or unstructured. In addition, large groups can be challenging to schedule at times and to find locations that are convenient for stakeholders.

WHY DID THE AUTHORS USE GLA?

Compared to researcher-driven qualitative methods that can be resource-intensive and are limited by researcher perspective, GLA emphasizes the contextual, "lived" expertise of stakeholders and relies on them in real time to identify and prioritize matters relevant to the participants. The participatory process of GLA promotes stakeholder buy-in and builds on the collective wisdom of the stakeholder group. This is ideally seen in Choe et al.'s study where GLA offered the researchers a structured qualitative methodology that engaged a large number of medical providers and interpreters to identify effective practices that should ultimately enhance communication with families of hospitalized LEP children.

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References

1. Vaughn LM, Lohmueller M. Calling all stakeholders: group-level assessment (GLA)—a qualitative and participatory method for large groups. *Eval Rev.* 2014;38(4):336-355. https://doi.org/10.1177/0193841X14544903.
2. Gosdin CH, Vaughn L. Perceptions of physician bedside handoff with nurse and family involvement. *Hosp Pediatr.* 2012;2(1):34-38. https://doi.org/10.1542/hpeds.2011-0008-2
3. Graham KE, Schellinger AR, Vaughn LM. Developing strategies for positive change: transitioning foster youth to adulthood. *Child Youth Serv Rev.* 2015;54:71-79. https://doi.org/10.1016/j.childyouth.2015.04.014
4. Schondelmeyer AC, Jenkins AM, Allison B, et al. Factors influencing use of continuous physiologic monitors for hospitalized pediatric patients. *Hosp Pediatr.* 2019;9(6):423-428. https://doi.org/10.1542/hpeds.2019-0007
5. Vaughn LM, Jacquez F, Zhao J, Lang M. Partnering with students to explore the health needs of an ethnically diverse, low-resource school: an innovative large group assessment approach. *Fam Community Health.* 2011;34(1):72-84. https://doi.org/10.1097/FCH.0b013e3181fded12
6. Vaughn LM. Group level assessment: a large group method for identifying primary issues and needs within a community. *Sage Journals.* 2014;38:336-355. https://doi.org/10.4135/9781446273050145626
7. Vaughn LM. *Psychology and culture: thinking, feeling and behaving in a global context.* 2nd ed. New York, NY: Taylor & Francis; 2019.
8. Choe A, Unaka N, Schondelmeyer AC, Bignall, RW, Vilvens H, Thomson J. Inpatient communication barriers and drivers when caring for children with limited English proficiency *J Hosp Med. 2019;14(10)607-613.* https://doi.org/10.12788/jhm.3240.

Collective Action and Effective Dialogue to Address Gender Bias in Medicine

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In 2016, Pediatric Hospital Medicine (PHM) was recognized as a subspecialty under the American Board of Pediatrics (ABP), one of 24 certifying boards of the American Board of Medical Specialties. As with all new ABP subspecialty certification processes, a "practice pathway" with specific eligibility criteria allows individuals with expertise and sufficient practice experience within the discipline to take the certification examination. For PHM, certification via the practice pathway is permissible for the 2019, 2021, and 2023 certifying examinations.[1] In this perspective, we provide an illustration of ABP leadership and the PHM community partnering to mitigate unintentional gender bias that surfaced after the practice pathway eligibility criteria were implemented. We also provide recommendations to revise these criteria to eliminate future gender bias and promote equity in medicine.

In July 2019, individuals within the PHM community began to share stories of being denied eligibility to sit for the 2019 exam.[2] Some of the reported denials were due to an eligibility criterion related to "practice interruptions", which stated that practice interruptions cannot exceed three months in the preceding four years or six months in the preceding five years. Notably, some women reported that their applications were denied because of practice interruptions due to maternity leave. These stories raised significant concerns of gender bias in the board certification process and sparked collective action to revise the board certification eligibility criteria. A petition was circulated within the PHM community and received 1,479 signatures in two weeks.

Given the magnitude of concern, leaders within the PHM community, with support from the American Academy of Pediatrics, collaboratively engaged with the ABP and members of the ABP PHM subboard to improve the transparency and equity of the eligibility process. As a result of this activism and effective dialogue, the ABP revised the PHM board certification eligibility criteria and removed the practice interruption criterion.[1] Through this unique experience of advocacy and partnership in medicine, the PHM community and ABP were able to work together to mitigate unintentional gender bias in the board certification process. However, this collaboration must continue as we believe the revised criteria remain unintentionally biased against women.

Gender bias is defined as the unfair difference in the way men and women are treated.[3] Maternal bias is further characterized as bias experienced by mothers related to motherhood, often involving discrimination based on pregnancy, maternity leave, or breastfeeding. Both are common in medicine. Two-thirds of physician mothers report experiencing gender bias and more than a third experience maternal bias.[4] This bias may be explicit, or intentional, but often the bias is unintentional. This bias can occur even with equal representation of women and men on committees determining eligibility, and even when the committee believes it is not biased.[5] Furthermore, gender or maternal bias negatively affects individuals in medicine in regards to future employment, career advancement, and compensation.[6-11]

Given these implications, we celebrate the removal of the practice interruptions criterion as it was unintentionally biased against women. Eligibility criteria that considered practice interruptions would have disproportionately affected women due to leaves related to pregnancy and due to discrepancies in the length of parental leave for mothers versus fathers. Though the ABP's initial review of cases of denial did not demonstrate a significant difference in the proportion of men and women who were denied, these data may be misleading. Potential reasons why the ABP did not find significant differences in denial rates between women and men include: (1) some women who had recent maternity leaves chose not to apply because of concerns they may be denied; or (2) some women did not disclose maternity leaves on their application because they did not interpret maternity leave to be a practice interruption. This "self-censoring" may have resulted in incomplete data, making it difficult to fully understand the differential impact of this criterion on women versus men. Therefore, it is essential that we as a profession continue to identify any areas where gender bias exists in determining eligibility for certification, employment, or career advancement within medicine and eliminate it.

Despite the improvements made in the revised criteria, further revision is necessary to remove the criterion related to the "start date", which will differentially affect women. This criterion states that an individual must have started their PHM practice on or before July of the first year of a four-year look-back period (eg, July 2015 for the 2019 cycle). We present three the-

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TABLE. **Theoretical Cases to Illustrate Gender Bias in the Pediatric Hospital Medicine Board Certification Eligibility Criteria**

Applicant	Context	Applicant-Reported Hours	Eligibility Determination
1	Full-time in PHM practice for 4 years from July 1, 2015 to June 30, 2019. This individual had a 6-month practice interruption from January 1, 2015 to June 30, 2015.	Spent 1,000 work hours in the direct care of hospitalized children in the first year and 2,000 work hours in each of the subsequent three years, resulting in 7,000 direct patient care hours.	Would be eligible under the revised practice pathway criteria.
2	Full-time in PHM practice for almost 4 years from October 1, 2015 to June 30, 2019. This individual started her PHM practice 12 weeks into the "look-back" period due to the birth of her child in July 2015.	Spent 1,500 work hours in the direct care of hospitalized children in the first year and 2,000 work hours in each of the subsequent three years, resulting in 7,500 direct patient care hours.	Would be ineligible in 2019 under the revised practice pathway criteria (solely based on the start date criterion[a]), but may be eligible in 2021.
3	Plans to practice full-time in PHM practice for almost 4 years from August 1, 2019 to June 30, 2023. This individual delayed the start of her PHM practice by 4 weeks due to a maternity leave during residency that delayed her residency graduation date.	Will spend 1,833 work hours in the direct care of hospitalized children in the first year and 2,000 work hours in each of the subsequent three years, resulting in 7,833 direct patient care hours.	Will be ineligible for the 2023 exam and the practice pathway (solely based on the July start-date criterion[a]), as 2023 is the final year the exam will be offered under the practice pathway.

[a] This criterion states that an individual must have started their PHM practice on or before July of the first year of the four-year look-back period (eg, July 2019 for the 2023 cycle).
Abbreviation: PHM, pediatric hospital medicine.

oretical cases to illustrate gender bias with respect to this criterion (Table). Even though Applicants #2 and #3 accrue far more than the minimum number of hours in their first year—and more hours overall than Applicant #1—both of these women will remain ineligible under the revised criteria. While Applicant #2 could be eligible for the 2021 or 2023 cycle, Applicant #3, who is new to PHM practice in 2019 as a residency graduate, will not be eligible at all under the practice pathway due to delayed graduation from residency.

Parental leave during residency following birth of a child may result in the need to make up the time missed.[12] This means that more women than men will experience delayed entry into the workforce due to late graduation from residency.[13] Women who experience a gap in employment at the start of their PHM practice due to pregnancy or childbirth will also be differentially affected by this criterion. If this same type of gap were to occur later in the year, it would no longer impact a woman's eligibility under the revised criteria. Therefore, we implore the ABP to reevaluate this criterion which results in a hidden "practice interruption" penalty. Removing eligibility criteria related to practice interruptions, wherever they may occur, will not only eliminate systematic bias against women, but may also encourage men to take paternity leave, for which the benefits to both men and women are well described.[14,15]

We support the ABP's mission to maintain the public's trust by ensuring PHM board certification is an indicator that individuals have met a high standard. We acknowledge that the ABP and PHM subboard had to draw a line to create minimum standards. The start date and four-year look-back criteria were informed by prior certification processes, and the PHM community was given the opportunity to comment on these criteria prior to final ABP approval. However, now that we have become aware of how the start date criteria can differentially impact women and men, we must reevaluate this line to ensure that women and men are treated equally. Similar to the removal of the practice interruptions criterion, we do not believe that removal of the start date criterion will in any way compromise these standards. A four-year look-back period will still be in place and individuals will still be required to accrue the minimum number of hours in the first year and each subsequent year of the four-year period.

Despite any change in the criteria, there will be individuals who remain ineligible for PHM board certification. We will need to rely on institutions and the societies that lead PHM to remember that not all individuals had the opportunity to certify as a pediatric hospitalist, and for some, this was due to maternity leave. No woman should have to worry about her future employment when considering motherhood.

We hope the lessons learned from this experience will be informative for other specialties considering a new certification. Committees designing new criteria should have proportional representation of women and men, inclusion of underrepresented minorities, and members with a range of ages, orientations, identities, and abilities. Criteria should be closely scrutinized to evaluate if a single group of people is more likely to be excluded. All application reviewers should undergo training in identifying implicit bias.[16] Once eligibility criteria are determined, they should be transparent to all applicants, consistently applied, and decisions to applicants should clearly state which criteria were or were not met. Regular audits should be conducted to identify any bias. Finally, transparent and respectful dialogue between the certifying board and the physician community is paramount to ensuring continuous quality improvement in the process.

The PHM experience with this new board certification process highlights the positive impact that the PHM community had engaging with the ABP leadership, who listened to the concerns and revised the eligibility criteria. We are optimistic that this productive relationship will continue to eliminate any gender bias in the board certification process. In turn, PHM and the ABP can be leaders in ending gender inequity in medicine.

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References

1. Nichols DG, Woods SK. The American Board of Pediatrics response to the Pediatric Hospital Medicine petition. J Hosp Med. 2019;14(10):586-588. https://doi.org/10.12788/jhm.3322
2. Don't make me choose between motherhood and my career. https://www.kevinmd.com/blog/2019/08/dont-make-me-choose-between-motherhood-and-my-career.html. Accessed September 16, 2019.
3. GENDER BIAS | definition in the Cambridge English Dictionary. April 2019. https://dictionary.cambridge.org/us/dictionary/english/gender-bias.
4. Adesoye T, Mangurian C, Choo EK, Girgis C, Sabry-Elnaggar H, Linos E. Perceived discrimination experienced by physician mothers and desired workplace changes: A cross-sectional survey. *JAMA Intern Med*. 2017;177(7):1033-1036. https://doi.org/10.1001/jamainternmed.2017.1394
5. Régner I, Thinus-Blanc C, Netter A, Schmader T, Huguet P. Committees with implicit biases promote fewer women when they do not believe gender bias exists. *Nat Hum Behav*. 2019. https://doi.org/10.1038/s41562-019-0686-3
6. Trix F, Psenka C. Exploring the color of glass: Letters of recommendation for female and male medical faculty. *Discourse Soc*. 2003;14(2):191-220. https://doi.org/10.1177/0957926503014002277
7. Correll SJ, Benard S, Paik I. Getting a job: Is there a motherhood penalty? *Am J Sociol*. 2007;112(5):1297-1339. https://doi.org/10.1086/511799
8. Aamc. Analysis in Brief - August 2009: Unconscious Bias in Faculty and Leadership Recruitment: A Literature Review; 2009. https://implicit.harvard.edu/. Accessed September 10, 2019.
9. Wright AL, Schwindt LA, Bassford TL, et al. Gender differences in academic advancement: patterns, causes, and potential solutions in one US College of Medicine. *Acad Med*. 2003;78(5):500-508. https://doi.org/10.1097/00001888-200305000-00015
10. Weaver AC, Wetterneck TB, Whelan CT, Hinami K. A matter of priorities? Exploring the persistent gender pay gap in hospital medicine. *J Hosp Med*. 2015;10(8):486-490. https://doi.org/10.1002/jhm.2400
11. Frintner MP, Sisk B, Byrne BJ, Freed GL, Starmer AJ, Olson LM. Gender differences in earnings of early- and midcareer pediatricians. *Pediatrics*. September 2019:e20183955. https://doi.org/10.1542/peds.2018-3955
12. Section on Medical Students, Residents and Fellowship Trainees, Committee on Early Childhood. Parental leave for residents and pediatric training programs. *Pediatrics*. 2013;131(2):387-390. https://doi.org/10.1542/peds.2012-3542
13. Jagsi R, Tarbell NJ, Weinstein DF. Becoming a doctor, starting a family — leaves of absence from graduate medical education. *N Engl J Med*. 2007;357(19):1889-1891. https://doi.org/10.1056/NEJMp078163
14. Nepomnyaschy L, Waldfogel J. Paternity leave and fathers' involvement with their young children. *Community Work Fam*. 2007;10(4):427-453. https://doi.org/10.1080/13668800701575077
15. Andersen SH. Paternity leave and the motherhood penalty: New causal evidence. *J Marriage Fam*. 2018;80(5):1125-1143. https://doi.org/10.1111/jomf.12507.
16. Girod S, Fassiotto M, Grewal D, et al. Reducing Implicit Gender Leadership Bias in Academic Medicine With an Educational Intervention. *Acad Med*. 2016;91(8):1143-1150. https://doi.org/10.1097/ACM.0000000000001099

Things We Do for No Reason™: Discontinuing Buprenorphine When Treating Acute Pain

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Inspired by the ABIM Foundation's Choosing Wisely® campaign, the "Things We Do for No Reason™" (TWDFNR™) series reviews practices that have become common parts of hospital care but may provide little value to our patients. Practices reviewed in the TWDFNR™ series do not represent "black and white" conclusions or clinical practice standards but are meant as a starting place for research and active discussions among hospitalists and patients. We invite you to be part of that discussion.

CLINICAL SCENARIO

A 40-year-old woman with a history of opioid use disorder (OUD) on buprenorphine-naloxone treatment is admitted to medicine following incision and drainage of a large forearm abscess with surrounding cellulitis. The patient reports severe pain following the procedure, which is not relieved by ibuprofen. The admitting hospitalist orders a pain regimen for the patient, which includes oral and intravenous hydromorphone and discontinues the patient's buprenorphine-naloxone so that the short-acting opioids can take effect.

BACKGROUND

Medications to treat OUD include methadone, buprenorphine, and extended-release naltrexone. Buprenorphine is a Schedule III medication under the United States Food and Drug Administration that reduces opioid cravings, subsequently decreasing drug use[1] and opioid-related overdose deaths.[2] It has a favorable safety profile and can be prescribed for OUD in an office-based, outpatient setting since the Drug Addiction Treatment Act of 2000 (DATA 2000). Due to extensive first-pass metabolism, buprenorphine for OUD is typically administered sublingually, either alone or in a fixed combination with naloxone.

WHY YOU MIGHT THINK YOU SHOULD HOLD BUPRENORPHINE WHEN TREATING ACUTE PAIN

Buprenorphine is a partial opioid agonist with a long half-life and high affinity for the mu opioid receptor. Given these properties, prior recommendations assumed that buprenorphine blocked the effectiveness of additional opioid agonists.[3,4] In 2004, guidelines by the Department of Health and Human Service Center for Substance Abuse Treatment recommended discontinuing buprenorphine in patients taking opioid pain medications.[5] These suggestions were based on limited case reports describing difficulty controlling pain in patients with OUD with a high opioid tolerance who were receiving buprenorphine.[6]

Providers may hold buprenorphine when treating acute pain out of concern it could precipitate withdrawal by displacing full opioid agonists from the mu receptor. Providers may also believe that the naloxone component in the most commonly prescribed formulation, buprenorphine-naloxone, blocks the effects of opioid analgesics. Evolving understanding of buprenorphine pharmacology and the absence of high-quality evidence has resulted in providers holding buprenorphine in the setting of acute pain.

Finally, providers without dedicated training may feel they lack the necessary qualifications to prescribe buprenorphine in the inpatient setting. DATA 2000 requires mandatory X waiver training for physicians, nurse practitioners, and physician assistants to prescribe outpatient buprenorphine for OUD treatment outside of specialized opioid treatment programs.

WHY DISCONTINUING BUPRENORPHINE WHEN TREATING ACUTE PAIN IS NOT NECESSARY

Despite buprenorphine's high affinity at the mu receptor, additional receptors remain available for full opioid agonists to bind and activate,[6] providing effective pain relief even in patients using buprenorphine. In contrast to the 2004 Department of Health and Human Service guidelines, subsequent clinical studies have demonstrated that concurrent use of opioid analgesics is effective for patients maintained on buprenorphine, similar to patients on other forms of OUD treatment such as methadone.[7,8]

Precipitated withdrawal only occurs when buprenorphine is newly introduced to patients with already circulating opioids. Patients receiving buprenorphine-naloxone can also be exposed to opioids without precipitated withdrawal from the naloxone component, as naloxone is not absorbed via sublingual or buccal administration, but only present in the formulation to dissuade intravenous administration of the medication.

Even in the perioperative period, there is insufficient evidence to support the discontinuation of buprenorphine.[9] Stud-

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ies in this patient population have found that patients receiving buprenorphine may require higher doses of short-acting opioids to achieve adequate analgesia, but they experience similar pain control, lengths of stay, and functional outcomes to controls.[10] Despite variable perioperative management of buprenorphine,[11] protocols at major medical centers now recommend continuing or dose adjusting buprenorphine in the perioperative period rather than discontinuing.[12-14]

Patients physically dependent on opioid agonists, including buprenorphine, must be maintained on a daily equivalent opioid dose to avoid experiencing withdrawal. This maintenance requirement must be met before any analgesic effect for acute pain is obtained with additional opioids. Temporarily discontinuing buprenorphine introduces unnecessary complexity to a hospitalization, places the patient at risk of exacerbation of pain, opioid withdrawal, and predisposes the patient to return to use and overdose if not resumed before hospital discharge.[5]

Finally, clinicians do not require additional training or an X waiver to administer buprenorphine to hospitalized patients. These requirements are limited to providers managing buprenorphine in the outpatient setting or those prescribing buprenorphine to patients to take postdischarge. Hospitalists frequently prescribe opioid medications in the inpatient setting with similar or greater safety risk profiles to buprenorphine.

WHEN YOU SHOULD CONSIDER HOLDING BUPRENORPHINE

Providers may consider holding buprenorphine if a patient with OUD has not been taking buprenorphine before hospitalization and has severe acute pain needs. This history can be confirmed with the patient and the state's online prescription drug monitoring program. If further clarification is needed, this can be accomplished with a pharmacist and urine testing or by verifying with the patient's opioid treatment program, as some programs provide directly administered buprenorphine.

In cases where a patient may have stopped buprenorphine before admission but wants to restart it in the hospital, it is essential to ascertain when the patient last used an opioid. The buprenorphine reinduction should be timed to a sufficient number of hours since last opioid use and/or to when the patient shows signs of active withdrawal. The re-induction can take place before, during, or after an acute pain episode, depending on the individual circumstances.

Patient preference is extremely important in the management of both pain and OUD. After shared decision-making, some patients may ultimately opt to hold buprenorphine in certain situations or switch to an alternative treatment, such as methadone, during their hospitalization. Such adjustments should be made in conjunction with the patient, primary care provider, and pain or addiction medicine specialty consultation.

WHAT YOU SHOULD DO INSTEAD

For patients on buprenorphine admitted to the hospital with anticipated or unanticipated acute pain needs, hospitalists should continue buprenorphine. Continuation of buprenorphine meets a patient's baseline opioid requirement while still allowing the use of additional short-acting opioid agonists as needed for pain.[15]

As with all pain, multimodal pain management should be provided with adjunctive medications such as acetaminophen, nonsteroidal anti-inflammatory drugs, neuropathic agents, topical analgesics, and regional anesthesia.[8]

Acute pain can be addressed by taking advantage of buprenorphine's analgesic effects and adding additional short-acting opioids if needed.[15] Several options are available, including:

1. Continuing daily buprenorphine and prescribing short-acting opioid agonists, preferably those with high intrinsic activity at the mu receptor (such as morphine, fentanyl, or hydromorphone). Full opioid agonist doses to achieve analgesia for patients on buprenorphine will be higher than in opioid naïve patients due to tolerance.[16]
2. Dividing the total daily buprenorphine dose into three or four times per day dosing, since buprenorphine provides an analgesic effect lasting six to eight hours. Short-acting opioid agonists can still be prescribed on an as-needed basis for additional pain needs.
3. Temporarily increasing the total daily buprenorphine dose and dividing into three or four times per day dosing, as above. Short-acting opioid agonists can still be prescribed on an as-needed basis for additional pain needs.

It is essential to make a clear plan with the patient for initiation and discontinuation of short-acting opioid agonists or buprenorphine changes. Patients on buprenorphine should be managed collaboratively with the primary care provider or addiction specialist to coordinate prescribing and follow-up after discharge.

RECOMMENDATIONS

- Continue outpatient buprenorphine treatment for patients admitted with acute pain.
- Use adjunctive nonopioid pain medications and nonpharmacologic modalities to address acute pain.
- Adjust buprenorphine to address acute pain by dividing the total daily amount into three or four times a day dosing, and/or up-titrate the buprenorphine dose (federal prescribing regulations recommend a maximum of 24 mg daily, but state regulations may vary).
- Add short-acting opioid agonists on an as-needed basis in conjunction with a defined plan to discontinue short-acting opioid agonists to avoid a return to use.
- Make plans collaboratively with the patient and outpatient provider, and communicate medication changes and plan at discharge.

CONCLUSION

Concerning our case, the hospitalist can continue the patient's buprenorphine-naloxone, even with her acute pain needs. The patient has a baseline opioid requirement, fulfilled by continuing buprenorphine. Additional short-acting opioid agonists, such as hydromorphone, will provide analgesia for the patient, though the clinician should be aware that higher doses might

be required. The practice of holding buprenorphine during episodes of acute pain is not supported by current evidence and may predispose to inadequate analgesia, opioid withdrawal, and risk of return to use and death.[2]

Do you think this is a low-value practice? Is this truly a "Thing We Do for No Reason™"? Share what you do in your practice and join in the conversation online by retweeting it on Twitter (#TWDFNR) and liking it on Facebook. We invite you to propose ideas for other "Things We Do for No Reason™" topics by emailing TWDFNR@hospitalmedicine.org.

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References

1. Mattick RP, Breen C, Kimber J, Davoli M. Buprenorphine maintenance versus placebo or methadone maintenance for opioid dependence. *Cochrane Database Syst Rev*. 2014;(3):CD002207. https://doi.org/10.1002/14651858.CD002207.
2. Sordo L, Barrio G, Bravo M, et al. Morality risk during and after opioid substitution treatment: systemic review and meta-analysis of cohort studies. *BMJ*. 2017;357:1550. https://doi.org/10.1136/bmj.j1550.
3. Johnson RE, Fudula PJ, Payne R. Buprenorphine: considerations for pain management. *J Pain Symptom Manage*. 2005;29(3):297-326. https://doi.org/10.1016/j.jpainsymman.2004.07.005.
4. Marcelina JS, Rubinstein A. Continuous perioperative sublingual buprenorphine. *J Pain Palliat Care Pharmacother*. 2016;30(4):289-293. https://doi.org/10.1080/15360288.2016.1231734.
5. Greenwald MK, Johanson CE, Moody DE, et al. Effects of buprenorphine maintenance dose on mu-opioid receptor binding potential, plasma concentration and antagonist blockade in heroin-dependent volunteers. *Neuropsychopharmacology*. 2003;28(11):2000-2009. https://doi.org/10.1038/sj.npp.1300251.
6. Lembke A, Ottestad E, Schmiesing C. Patients maintained on buprenorphine for opioid use disorder should continue buprenorphine through the perioperative period. *Pain Med*. 2019;20(3):425-428. https://doi.org/10.1093/pm/pny019.
7. Kornfeld H, Manfredi L. Effectiveness of full agonist opioids in patients stabilized on buprenorphine undergoing major surgery: A case series. *Am J Ther*. 2010;17(5):523-528. https://doi.org/10.1097/MJT.0b013e3181be0804.
8. Harrison TK, Kornfeld H, Aggarwal AK, Lembke A. Perioperative considerations for the patient with opioid use disorder on buprenorphine, methadone, or naltrexone maintenance therapy. *Anesthesiol Clin*. 2018;36(3):345-359. https://doi.org/10.1016/j.anclin.2018.04.002.
9. Goel A, Azargive S, Lamba W, et al. The perioperative patient on buprenorphine: a systematic review of perioperative management strategies and patient outcomes. *Can J Anesth*. 2019; 66(2):201-217. https://doi.org/10.1007/s12630-018-1255-3.
10. Hansen LE, Stone GL, Matson CA, Tybor DJ, Pevear ME, Smith EL. Total joint arthroplasty in patients taking methadone or buprenorphine/naloxone preoperatively for prior heroin addiction: a prospective matched cohort study. *J Arthroplasty*. 2016;31(8):1698-1701. https://doi.org/10.1016/j.arth.2016.01.032.
11. Jonan AB, Kaye AD, Urman RD. Buprenorphine formulations: clinical best practice strategies recommendations for perioperative management of patients undergoing surgical or interventional pain procedures. *Pain Physician*. 2018;21(1):E1-12.
12. Quaye AN, Zhang Y. Perioperative management of buprenorphine: solving the conundrum. *Pain Med*. 2018. https://doi.org/10.1093/pm/pny217.
13. Silva MJ, Rubinstein A. Continuous perioperative sublingual buprenorphine. *J Pain Palliative Care Pharmacother*. 2016;30(4):289-293. https://doi.org/10.1080/15360288.2016.1231734.
14. Kampman K, Jarvis M. ASAM National practice guidelines for the use of medications in the treatment of addiction involving opioid use. *J Addict Med*. 2015;9(5):358-367. https://doi.org/10.1097/ADM.0000000000000166.
15. Childers JW, Arnold RM. Treatment of pain in patients taking buprenorphine for opioid addiction. *J Palliat Med*. 2012;15(5):613-614. https://doi.org/10.1089/jpm.2012.9591.
16. Alford DP, Compton P, Samet JH. Acute pain management for patients receiving maintenance methadone or buprenorphine therapy. *Ann Intern Med*. 2006;144(2):127-134. https://doi.org/10.7326/0003-4819-144-2-200601170-00010

Ultrasound Guidance for Lumbar Puncture: A Consideration, Not an Obligation

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Recognizing the increasingly important role of point-of-care ultrasound (POCUS) in advancing clinical care, the Society of Hospital Medicine (SHM) has published a valuable series of position statements to guide hospitalists and administrators on the safe and effective use of POCUS.[1] In this issue of the *Journal of Hospital Medicine*, Soni et al. present a series of consensus-based recommendations on ultrasound guidance for lumbar puncture (LP).[2] Among these are the recommendations that ultrasound "should be used" to map the lumbar spine and to select an appropriate puncture site to reduce insertion attempts, reduce needle redirections, and increase overall procedural success.

At first glance, the recommendations appear definitive. However, not immediately obvious is the authors' clarification that "This position statement does not mandate that hospitalists use ultrasound guidance for LP, nor does it establish ultrasound guidance as the standard of care for LP." Even with the authors' caveat, this nuance may not be readily apparent to the readers who review only the executive summary of the guidelines or who omit the context provided in the background of the position statement.

The directive language of this position statement may be a result of an unmerited amplification. The SHM POCUS Task Force employed the Research and Development Appropriateness Method to quantify the degree of consensus and the strength of the recommendation assigned,[3] reaching "very good" consensus for each of the recommendations espoused in its position statement. Procedurally, this implies that ≥80% of the 27 voting members rated each published recommendation statement as "appropriate". Using wording assigned a priori by the committee to each level of consensus, appropriateness became magnified to the declaration "should be used". In this manner, the strength of the recommendations in this position statement is not necessarily based on the experts' convictions related to ultrasound-guided LP, nor the strength of the supporting evidence.

In the case of ultrasound-guided LP, we might choose different descriptors than "appropriate" or "should be used". The evidence base for ultrasound guidance for LP, though growing, may be insufficient as a foundation to a position statement and is certainly insufficient to create a new standard of care for hospitalists. Although the SHM POCUS Task Force completed a thoughtful literature review, no systematic approach (eg, GRADE methodology[4]) was used to rate the quality of evidence. Furthermore, the literature reviewed was drawn predominantly from anesthesia and emergency medicine sources—not readily generalizable to the hospitalist. Notably, these studies examined all neuraxial procedures (most commonly epidural and spinal anesthesia), which employ different techniques and tools than LP and are performed by clinicians with vastly different procedural training backgrounds than most hospitalists. Altogether, this creates the potential for a gap between true evidence quality and the strength of recommendation.

At a high level, although the technique for ultrasound mapping of the lumbar spine may be similar, the use of ultrasound has been less well studied specifically for LP. When considering LP alone, the available literature is inadequate to recommend uniform ultrasound guidance. A 2018 meta-analysis by Gottlieb et al. included 12 studies focusing only on LP, totaling N = 957 patients.[5] This showed some favorability of ultrasound guidance, with a success rate of 90% using ultrasound, 81.4% with a landmark-based approach, and an odds ratio of 2.22 favoring ultrasound guidance (95% CI: 1.03-4.77). Unfortunately, when focusing only on adult patients, the advantage of POCUS diminished, with 91.4% success in the ultrasound group, 87.7% success in the landmark group, and a nonsignificant odds ratio of 2.10 (95% CI: 0.66-7.44).

Unequivocally, POCUS has established itself as a transformative technology for the guidance of invasive bedside procedures, bringing increased procedural success, improved safety, and decreased complication rates.[6] For some procedures, particularly central venous catheterization, ultrasound guidance is a clear standard of care.[7,8] For LP, the greatest benefit has been observed in patients with anticipated procedural challenges, most commonly obese patients in whom landmarks are not easily palpable.[9] Moreover, the harms ultrasound seeks to prevent are substantially different. The primary risk of deferring ultrasound guidance for LP is most often a failed procedure, whereas for other common ultrasound-guided procedures, the harms may include significant vascular injury, pneumothorax, or bowel perforation. Differences in the relative harms make risk-benefit assessments harder to quantify and studies harder to carry out.

Sonographic guidance for LP has a role in clinical practice and should always be considered. However, at present, there exist no guidelines in any other specialty regarding the routine use of ultrasound-guided LP, including anesthesia, emergency medicine, neurology, or interventional radiology.[10-15] As a re-

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sult, a conservative interpretation of the POCUS Task Force's findings would be to consider the use of ultrasound guidance for LP in patients where landmark identification is particularly challenging, but not to consider it a standard requirement for accreditation, training, or practice as of yet. Saying "more studies are required" can be a cop-out in some cases, but in this situation, the old adage does seem to apply.

We have great respect for the work of the SHM POCUS Task Force in advancing the use of POCUS in hospital medicine. Though ultrasound is not currently mandated as a care standard for the performance of LP, we all can agree that POCUS does confer advantages for this procedure, particularly in a well-selected patient population. To continue to provide care of the highest quality, hospitalists must be encouraged to elevate their practice with POCUS and be supported with the equipment, training, credentialing, and quality assurance structures necessary to integrate bedside ultrasound safely and effectively into their diagnostic and procedural practice.

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References

1. Soni NJ, Schnobrich D, Matthews BK, et al. Point-of-care ultrasound for hospitalists: a position statement of the society of hospital medicine. *J Hosp Med.* 2019;14(10):591-601. https://doi.org/10.12788/jhm.3079.
2. Soni NJ, Franco-Sadud R, Dobaidze K, et al. Recommendations on the use of ultrasound guidance for adult lumbar puncture: a position statement of the society of hospital medicine. *J Hosp Med.* 2018;13(2):126-135. https://doi.org/10.12788/jhm.2940.
3. Fitch, K, Bernstein SJ, Aguilar MD et al. The RAND/UCLA appropriateness method user's manual. Santa Monica, CA: RAND Corporation, 2001.
4. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: An emerging consensus on rating quality of evidence and strength of recommendations. *BMJ.* 2008;334(7650):924-926.
5. Gottlieb M, Holladay D, Peksa GD. Ultrasound-assisted lumbar punctures: a systematic review and meta-analysis. *Acad Emerg Med.* 2019;26(1):85-96. https://doi.org/10.1111/acem.13558.
6. Moore CL, Copel JA. Point of care ultrasonography. *N Engl J Med.* 2011;364(8):749-757. https://doi.org/10.1056/NEJMra0909487.
7. Shojania K, Duncan B, McDonald K, Wachter RM. Making health care safer: a critical analysis of patient safety practices. Rockville, MD: Agency for Healthcare Research and Quality, 2001. Evidence Report/Technology Assessment No. 43; AHRQ publication 01-E058.
8. Brass P, Hellmich M, Kolodziej L, Schick G, Smith AF. Ultrasound guidance versus anatomical landmarks for internal jugular vein catherization. *Cochrane Database Syst Rev.* 2015;Art. No.: 1:CD006962. https://doi.org/10.1002/14651858.CD006962.pub2.
9. Peterson MA, Pisupati D, Heyming TW, Abele JA, Lewis RJ. Ultrasound for routine lumbar puncture. *Acad Emerg Med.* 2014;21(2):130-136. https://doi.org/10.1111/acem.12305.
10. American College of Emergency Physicians. Ultrasound guidelines: emergency, point-of-care, and clinical ultrasound guidelines in medicine. *Ann Emerg Med.* 2017;69(5):e27-e54. https://doi.org/10.1016/j.annemergmed.2016.08.457.
11. Neal JM, Brull R, Horn JL, et al. The Second American Society of Regional Anesthesia and Pain Medicine Evidence-Based Medicine Assessment of Ultrasound-Guided Regional Anesthesia: executive summary. *Reg Anesth Pain Med.* 2016;41(2):181-194. https://doi.org/10.1097/AAP.0000000000000331.
12. Practice guidelines for obstetric anesthesia: an updated report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia and the Society for Obstetric Anesthesia and Perinatology. *Anesthesiology.* 2016;124(2):270-300. https://doi.org/10.1097/ALN.0000000000000935.
13. Engelborghs S, Sebastiaan E, Struyfs H, et al. Consensus guidelines for lumbar puncture in patients with neurological diseases. *Alzheimers Dement.* 2017;8:111-126. https://doi.org/10.1016/j.dadm.2017.04.007.
14. American College of Radiology. ACR-SPR-SRU Practice Parameter for the Performing and Interpreting Diagnostic Ultrasound Examinations. 2017; Available at https://www.acr.org/-/media/ACR/Files/Practice-Parameters/us-perf-interpret.pdf. Accessed April 15, 2019.
15. American College of Radiology. ACR-AIUM-SPR-SRU Practice Parameter for the Performance of an Ultrasound Examination of the Neonatal and Infant Spine. 2016/ Available at https://www.acr.org/-/media/ACR/Files/Practice-Parameters/US-NeonatalSpine.pdf. Accessed April 15, 2019.

Thinking Aloud: How Nurses Rationalize Responses to Monitor Alarms

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In the past five years, it has become increasingly apparent that hospital physiologic monitoring systems are not functioning optimally for children. On pediatric wards, 26%-48% of children are continuously monitored, and these children generate between 42 and 155 alarms per day.[1] Just 1% or fewer are considered actionable or informative, slowing nurses' response times and placing patients at risk of delayed recognition of life-threatening events.[2,3] While some factors associated with alarm response times have been elucidated,[3] in order to design safe and effective monitoring systems, further work is needed to understand the complex decision-making process that nurses face when encountering alarms outside a patient's room. It is in this area that Schondelmeyer and colleagues strive to enhance our understanding in this issue of the *Journal of Hospital Medicine*.[4]

Schondelmeyer et al. conducted a single-center, observational study using mixed methods in a general pediatric unit. Trained observers shadowed nine nurses one to four times each, during which nurses were asked to "think aloud" as they managed physiologic monitor alarms, rationalizing their decisions about how and why they might respond for the observer to document. Observers accumulated 61 patient-hours of observation before investigators halted data collection because new insights about alarm responses were no longer emerging from the data (thematic saturation).

Nurses thought aloud about 207 alarms during the study, which the investigators estimated comprised about one third of the alarms that occurred during observation periods. Most of the 207 occurred while the nurse was already in the patient's room, where a response decision is uncomplicated. More interesting were the 45 alarms heard while outside the patient's room, where nurses face the complex decision of whether to interrupt their current tasks and respond or delay their response and assume the associated risk of nonresponse to a potentially deteriorating patient. Of the 45 alarms, nurses went into the room to evaluate the patient 15 times and, after doing so, reported that five of the 15 warranted in-person responses to address technical issues with the monitor, clinical issues, or patients' comfort. Reassuring clinical contexts—such as presence of the medical team or family in the room and recent patient assessments—were the reasons most commonly provided to explain alarm nonresponse.

This study has two key limitations. First, the authors designed the study to observe nurses' responses until thematic saturation was achieved. However, the small sample size (nine nurses, 45 out-of-room alarms) could raise questions about whether sufficient data were captured to make broadly generalizable conclusions, given the diverse range of patients, families, and clinical scenarios nurses encounter on an inpatient unit. Second, by instructing nurse participants to verbalize their rationale for response or nonresponse, investigators essentially asked nurses to override the "Type 1", heuristic-based reasoning[5] that research suggests regulates nursing responses to alarms when adapting to circumstances requiring high cognitive demand or a heavy workload.[3] While innovative, it is possible that this approach prevented the investigators from fully achieving their stated objective of describing how bedside nurses think about and act upon alarms.

Nonetheless, the findings by Schondelmeyer and colleagues extend our emerging understanding of why alarm responses are disconcertingly slow. Nursing staff's dismissal of monitor alarms that are discordant with a reassuring patient evaluation underscores the imperative to reduce nuisance alarms. Furthermore, the explicit statements justifying alarm nonresponse because of the presence of family members build upon prior findings of longer response times when family members are at the bedside[3] and invite a provocative question: how would family members feel if they knew that they were being entrusted as a foundational component of safety monitoring in the hospital? In their recently published study conducted at the same hospital,[6] Schondelmeyer's team elicited perceptions that families are deeply concerned about staff nonresponse to alarms—as one nurse stated, parents "wonder what's going on when no one comes in." While there is a valuable role for integrating families into efforts to overcome threats to patient safety, as has been achieved with family error reporting[7] and communication on family-centered rounds,[8] this must occur in a structured, explicit, and deliberate manner, with families engaged as key stakeholders.

In summary, while Schondelmeyer and colleagues may not have exposed the depth of implicit thinking that governs nurses' responses to alarms, they have highlighted the high-stakes decisions that nurses confront on a daily basis in an environment with exceedingly high alarm rates and low alarm actionability. The authors cite staff education among potential solutions to improve the safety of continuous monitoring, but such an inter-

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vention cannot be effective in a system that places impossible burdens on nurses. An openly family centered and multidisciplinary approach to reengineering the system for monitoring hospitalized children is needed to enable nurses to respond quickly and accurately to patients at risk of clinical deterioration.

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References

1. Schondelmeyer AC, Brady PW, Goel VV, et al. Physiologic monitor alarm rates at 5 children's hospitals. *J Hosp Med.* 2018;13(6):396-398. https://doi.org/10.12788/jhm.2918.
2. Bonafide CP, Lin R, Zander M, et al. Association between exposure to nonactionable physiologic monitor alarms and response time in a children's hospital. *J Hosp Med.* 2015;10(6):345-351. https://doi.org/10.1002/jhm.2331.
3. Bonafide CP, Localio AR, Holmes JH, et al. Video analysis of factors associated with response time to physiologic monitor alarms in a children's hospital. *JAMA Pediatr.* 2017;171(6):524-531. https://doi.org/10.1001/jamapediatrics.2016.5123.
4. Schondelmeyer A, Daraiseh NM, Allison B, et al. Nurse responses to physiologic monitor alarms on a general pediatric unit. *J Hosp Med.* 2019;14(10):602-606. https://doi.org/10.12788/jhm.3234.
5. Croskerry P. A universal model of diagnostic reasoning. *Acad Med.* 2009;84(8):1022-1028. https://doi.org/10.1097/ACM.0b013e3181ace703.
6. Schondelmeyer AC, Jenkins AM, Allison B, et al. Factors influencing use of continuous physiologic monitors for hospitalized pediatric patients. *Hosp Pediatr.* 2019;9(6):423-428. https://doi.org/10.1542/hpeds.2019-0007.
7. Khan A, Coffey M, Litterer KP, et al. Families as partners in hospital error and adverse event surveillance. *JAMA Pediatr.* 2017;171(4):372-381. https://doi.org/10.1001/jamapediatrics.2016.4812.
8. Khan A, Spector ND, Baird JD, et al. Patient safety after implementation of a coproduced family centered communication programme: multicenter before and after intervention study. *BMJ.* 2018;363:k4764. https://doi.org/10.1136/bmj.k4764.

Inpatient Language Barriers: An Old Problem in Need of Novel Solutions

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The 25 million people in the United States with limited English proficiency (LEP), which is defined as speaking English less than "very well", are at increased risk for healthcare disparities that result in preventable harm and poor patient experiences compared with English-proficient patients.[1,2] The use of trained professional interpreters is associated with improved communication, healthcare outcomes, safety, and experiences for LEP patients.[3] However, underuse of professional interpreters remains common.[4] Healthcare staff frequently use family members, friends, or minor children as interpreters or try to "get by" with the patient's limited English skills or staff's limited non-English skills.[5] These practices regularly compromise patient safety and quality for LEP patients and their families.

In the article "Inpatient Communication Barriers and Drivers when Caring for Limited English Proficiency Children," Dr. Choe and colleagues approach the problem of interpreter underuse by studying the barriers and facilitators that exist at their children's hospital.[6] The group conducted four sessions using Group Level Assessment, a structured, interactive approach to understanding a problem and identifying potential solutions. Sixty-four pediatric hospitalists and residents, bedside nurses, and staff interpreters participated. Participants identified four primary barriers to communicating effectively with LEP families: difficulty accessing interpreter services, uncertainty in communicating with LEP families, unclear roles and expectations of different team members, and unmet expectations related to family engagement. They also identified four drivers of effective communication: collaborative problem-solving between providers and interpreters, greater attention to cultural context, practicing empathy for patients and families, and using family centered communication strategies.

This study reinforces that myriad challenges remain in accessing and using an interpreter. The barriers identified fall into two major categories: systems for accessing interpretation and communication involving an interpreter. Both ultimately must be addressed to achieve equitable communication for LEP patients/families. As interpreter use is contingent upon access, optimizing delivery systems is an essential foundation. At this study site, key barriers were the opaque scheduling processes and inconsistent access to and unfamiliarity with interpreter-related technology (eg, for telephone or video interpretation). These barriers are likely generalizable to many other hospitals. Priority should be given to developing transparent, consistent, and reliable processes for interpreter access. Interventions to improve interpreter access, such as one-touch interpreter telephones at every hospital bedside, have been more successful in improving interpreter use than provider education or regulatory mandates.[4]

The challenges identified around communicating with LEP families via interpreter are also likely generalizable. In the current study, participants described a clear tension around the interpreters' optimal role, in which the care team might want the interpreter to intervene or participate in the discussion more, while interpreter standards require that they remain a neutral conduit for information. This neutral-party approach, when taken to the extreme, can limit the bidirectional communication between clinical teams and interpreters necessary to address communication challenges. Fostering collaborative problem-solving between interpreters and clinicians, in both formal and informal settings, is critically needed to improve the quality of communication during encounters. In addition to the proposed presession meeting between the clinician and interpreter, incorporating a debriefing after an interpreter-mediated encounter could offer an opportunity for bidirectional feedback. Unfortunately, interpreter scheduling constraints, fueled by the lack of reimbursement for interpretation in most states, frequently limit the feasibility of such proposals.

Participating providers also reported decreased engagement with LEP families and that they spent less time with them. These observations also merit attention if we are to achieve equitable outcomes for LEP patients. A conversation via interpreter requires more time for the same content, given the time needed to interpret the message. The fact that participants reported spending less time with LEP families means that less communication occurs with those families, compared with others. There are well-established links between good communication and improved clinical outcomes, including everything from decreased glycosylated hemoglobin levels to lower inpatient narcotic use.[7] Thus, it is not surprising that patients with fewer opportunities to communicate fully have worse clinical outcomes.[8] Addressing this will require changing hospital culture and provider expectations. Healthcare systems could support this effort with interventions such as decreased nursing assignments, longer allocated rounding times, longer outpatient

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clinic visits, and additional "points" in resident patient caps, if they exist, for LEP patients. Such steps would be an important investment in improving outcomes and decreasing costs for these vulnerable patients.

For all the barriers identified by Choe and colleagues, solutions are needed. Some may be generalizable, some may be location-specific, and most will be somewhere in between, requiring context-specific tailoring. We recommend a quality improvement (QI) approach, as the evidence-based best practice for communicating with LEP patients and families is well-known, but the gap is in delivering care that meets that standard. Leveraging the growing QI expertise at many institutions to devise approaches that go beyond provider education to change the systems and culture around communicating with LEP patients holds our best promise for improving the safety and effectiveness of care for this population.

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References

1. Divi C, Koss RG, Schmaltz SP, Loeb JM. Language proficiency and adverse events in US hospitals: A pilot study. *Int J Qual Heal Care*. 2007;19(2):60-67. https://doi.org/10.1093/intqhc/mzl069.
2. Yeheskel A, Rawal S. Exploring the "patient experience" of individuals with limited English proficiency: A scoping review. *J Immigr Minor Heal*. 2018. https://doi.org/10.1007/s10903-018-0816-4.
3. Karliner LS, Jacobs EA, Chen AH, Mutha S. Do professional interpreters improve clinical care for patients with limited English proficiency? A systematic review of the literature. *Heal Serv Res*. 2007;42(2):727-754. https://doi.org/10.1111/j.1475-6773.2006.00629.x.
4. Taira BR, Kim K, Mody N. Hospital and health system-level interventions to improve care for limited English proficiency patients: A systematic review. *Jt Comm J Qual Patient Saf*. 2019. https://doi.org/10.1016/j.jcjq.2019.02.005.
5. Diamond LC, Schenker Y, Curry L, Bradley EH, Fernandez A. Getting by: Underuse of interpreters by resident physicians. *J Gen Intern Med*. 2009;24(2):256-262. https://doi.org/10.1007/s11606-008-0875-7.
6. Choe A, Unaka N, Schondelmeyer A, Raglin Bignall W, Vilvens H, Thomson J. Inpatient communication barriers and drivers when caring for limited English proficiency children. *J Hosp Med*. 2019;14(10):607-613. https://doi.org/10.12788/jhm.3240.
7. Stewart MA. Effective physician-patient communication and health outcomes: A review. *CMAJ*. 1995;152(9):1423-1433.
8. Pérez-Stable EJ, El-Toukhy S. Communicating with diverse patients: How patient and clinician factors affect disparities. *Patient Educ Couns*. 2018;101(12):2186-2194. https://doi.org/10.1016/j.pec.2018.08.021.

The Best Laid Plans—Medication Reconciliation Optimization in Theory and Practice

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Of all the errors that occur in modern healthcare, medication errors are among the most ubiquitous and consequential. Adverse drug events (ADEs) account for approximately 700,000 emergency department visits, 100,000 hospitalizations, and 1.3 million people are injured by medication errors annually.[1] Among the most frequent causes of preventable ADEs are errors on the medication lists when patients are admitted to hospitals.[2] Therefore, preventing discrepancies between medications the patient is prescribed (and actually taking) inside and outside the hospital—the so-called "medication reconciliation"—is an intense, ongoing area of focus for health systems, pharmacies, and numerous quality and safety organizations seeking to reduce ADEs.

Past studies of medication reconciliation interventions have suggested benefit from restricting medication reconciliation to admission or discharge, pharmacist or pharmacy technician-led medication reconciliation, and pharmacy-led interventions (ie, telephone follow-up/home visit, patient counseling) for ensuring an accurate medication list.[3-5] Recent evidence suggests that pharmacist discharge medication reconciliation is associated with decreased readmission rates, decreased medication discrepancies, and adverse events associated with drug therapy issues.[4] The successful interventions were promising, but disseminating such interventions can often be very complex.[6]

In this issue of the *Journal of Hospital Medicine*, Mixon et al. report the results of a subanalysis of the MARQUIS trial,[7] wherein they individually examined the on-protocol effects of the interventions that MARQUIS recommended, comparing hospitals to their own running baseline data at the implementation of each intervention to data following the implementation. The authors found that only three of the nine interventions were associated with reducing potentially harmful discrepancies in the medication list—training existing staff to perform discharge medication reconciliation, hiring additional staff for this purpose, and defining roles and responsibilities and roles clearly—and that two were actually associated with harm—training existing staff to take best possible medication histories (BPMHs) and implementing a new Electronic Medical Record (EMR). MARQUIS is unique in not just attempting but in reporting "best case" real-world implementation using available literature to design mentored, practical approaches to those same interventions at sites not involved in their initial setup and validation.

EMR implementation should in theory improve accuracy (or at least legibility), but it can also contribute to new types of inaccuracy or, as the authors propose, deprioritize quality and safety as organizational goals during the rigors of digitization. Similarly, training staff to take a BPMH might create false confidence in the results or interact with medication reconciliation in other complex ways. Opting to add more work instead of hiring additional staff may have increased the burden of medication review and thus contributed to its inaccuracy.

On the contrary, certain interventions, such as having clear accountability for the medication list, hiring additional staff to construct that list, and clearly defining the roles of those involved in the reconciliation process, were associated with improved medication reconciliation. All these strategies require resource allocation, but at least the current study provides evidence that such resource allocation can be effective in new settings as they were in their original ones.

The study has important acknowledged limitations. The on-protocol analysis limited the authors to reporting associations rather than causality. Moreover, the original trial ran from 2011 to 2014, which was a time of rapid EMR implementation and new recognition of the problems posed by the same; several organizations are in a far more mature EMR context today. Conversely, newer technologies such as patient-facing medication reconciliation applications, cross-organization medication lists available from some EMR vendors, and health platforms that collect data from multiple EMRs were not evaluated because they did not exist at the time of the original trial. Another important trend in healthcare, the rise of Accountable Care Organizations and their focus on integration and defragmentation, may have an important part to play in medication list accuracy. All the above-mentioned aspects will be important avenues for ongoing research in real-world medication reconciliation.

Mixon's findings come at a time when medication reconciliation is again a national health informatics priority, a key component of the Medicare Access and CHIP reauthorization Act of 2015 and Merit-based Incentive Payments System[8] since 2019, with hospitals reporting medication reconciliation rates for financial in addition to quality and safety reasons. Hopefully, this study and others, in combination with the abovementioned incentives, will stimulate further research into impactful strate-

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gies for medication reconciliation and ideal ways to implement them. With luck, the end result will be more generalizable interventions, with a track record of success, that would help ensure that patients are prescribed, are reporting, are taking, and are noted to be taking the medications that they and their providers intended, both on presentation to the hospital and on discharge home.

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References

1. Center for Drug Evaluation and Research. Medication Errors-Medication Error Reports. https://www.fda.gov/Drugs/DrugSafety/MedicationErrors/ucm080629.htm.Accessed June 14, 2019.
2. Cornish PL, Knowles SR, Marchesano R, et al. Unintended medication discrepancies at the time of hospital admission. *Arch Intern Med.* 2005;165(4):424-429. https://doi.org/ 10.1001/archinte.165.4.424.
3. Mekonnen AB, McLachlan AJ, Brien JE. Pharmacy-led medication reconciliation programmes at hospital transitions: a systematic review and meta-analysis. *J Clin Pharm Ther.* 2016;41(2):128-144. https://doi.org/ 10.1111/jcpt.12364.
4. Kilcup M, Schultz D, Carlson J, et al. Postdischarge pharmacist medication reconciliation: impact on readmission rates and financial savings. *J Am Pharm Assoc.* 2013;53(1):78-84. https://doi.org/ 10.1331/JAPhA.2013.11250.
5. Cater SW, Luzum M, Serra AE, et al. A prospective cohort study of medication reconciliation using pharmacy technicians in the emergency department to reduce medication errors among patients. *J Emerg Med.* 2015;48(2):230-238. https://doi.org/ 10.1016/j.jemermed.2014.09.065.
6. Horton TJ, Illingworth JH, Warburton WHP. Overcoming challenges in codifying and replicating complex health care interventions. *Health Aff.* 2018;37(2):191-197. https://doi.org/ 10.1377/hlthaff.2017.1161.
7. Mixon A, Kripalani S, Stein J, et al. An on-treatment analysis of the MARQUIS study: interventions to improve inpatient medication reconciliation. *J Hosp Med.* 2019;(10):614-617. https://doi.org/ 10.12788/jhm.3258
8. Centers for Medicare & Medicaid Services. https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/Value-Based-Programs/MACRA-MIPS-and-APMs/MACRA-MIPS-and-APMs.html.Accessed June 25, 2019.

Are Pediatric Readmission Reduction Efforts Falling Flat?

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In an effort to improve healthcare for Americans by linking hospital payments to quality of care, Medicare's Hospital Readmission Reduction Program (HRRP) began penalizing hospitals with "excess" readmission rates in 2012. The decision sparked widespread debate about the definition of a preventable readmission and whether a patient's socioeconomic status should be considered for risk adjustment. Although coming back to the hospital after an admission is an undesirable outcome for any patient, the suitability of readmission as a quality measure remains a hot and debated topic. Research on the subject skyrocketed; over 12000 articles about hospital readmissions have been indexed in PubMed since 2000, and the number of publications has steadily increased since 2010 (Figure).

Although the HRRP is a Medicare initiative, there has been a substantial focus on readmissions in pediatrics as well. The National Quality Forum has endorsed three quality measures specific to readmission in children: (1) the rate of unplanned readmissions to the pediatric intensive care unit within 24 hours after discharge or transfer, (2) the pediatric lower respiratory infection readmission measure, defined as the percentage of admissions followed by one or more readmissions within 30 days of hospitalization for lower respiratory infection, and (3) the pediatric all-cause readmission measure, defined as the percentage of admissions followed by one or more readmissions within 30 days. These endorsements were preceded by studies showing that pediatric readmission rates varied substantially across hospitals and clinical conditions, and that children with chronic illnesses were at the highest risk.

Readmission is an attractive pediatric quality measure for a number of reasons. This measure is easy to apply to data at the hospital, health system, and payor levels at relatively low cost. Relatedly, the all-condition measure can be applied to all pediatric hospitalizations, overcoming the very real challenge in pediatric quality measurement of inadequate sample sizes to discern differences in healthcare quality at the hospital level for many disease-specific measures.[1] In addition, this measure moves beyond process measurement to quantify an outcome relevant to families as well as healthcare systems. Finally, the measure is founded on a compelling conceptual framework (albeit one that remains challenging to prove) that efforts to improve a patient's hospital-to-home transition and discharge readiness will reduce their likelihood of readmission.

In this issue of the *Journal of Hospital Medicine*, Katherine Auger and colleagues present their analysis of pediatric readmission rates from 2010 to 2016 across 66 children's hospitals.[2] They found that the median seven-day all-cause pediatric readmission rate was 5.1%, with no change in rates over the seven-year study period. Applying proprietary software to identify potentially preventable readmissions (PPR), they reported that approximately 40% of these readmissions may be preventable, a proportion that was also unchanged over time. Interestingly, 88% of the hospitals represented in their data were participating in the Solutions for Patient Safety national learning collaborative during the study period, making efforts to reduce seven-day readmission rates. Despite this, the figures presented in this paper of all-condition and potentially preventable readmission rates over time are very, very flat.

This work by Auger et al. contributes to our understanding about the preventability, or lack thereof, of pediatric all-condition readmissions. If 40% of these readmissions are indeed preventable, then why did Auger et al. not observe a declining proportion of PPR over time as a result of hospital participation in a national collaborative? Past quantitative and qualitative studies provide important context. First, the 40% rate of readmission preventability is twofold higher than that reported in past studies that relied on physician judgement to determine readmission preventability;[3,4] the authors' use of proprietary software to categorize the preventability of a readmission limits our ability to explain the differences in these rates. However, in these past studies, the rates of initial agreement between physician reviewers about readmission preventability were poor, highlighting the challenges associated with determining readmission preventability. Moreover, qualitative studies suggest that physicians and families lack a shared understanding of the preventability of readmissions.[5] Finally, a systematic review of pediatric hospital discharge interventions did not identify any one intervention that was consistently effective in reducing hospital readmission rates.[6] The following important questions remain: Were hospitals' efforts to reduce PPR targeting the wrong patients? Were the interventions insufficient or ineffective? Or are readmission measures insufficiently sensitive to improved processes of care?

Recognizing that the majority of research on readmission as well as HRRP penalties focuses on adult populations, perhaps we can apply some lessons learned from the HRRP to

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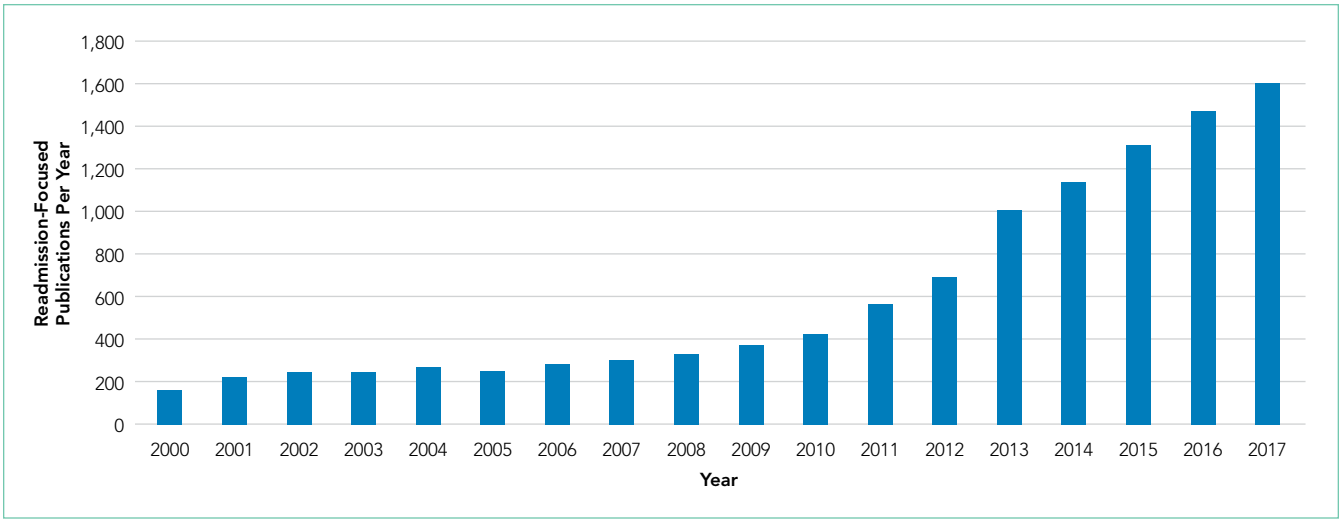

FIG. Readmission-Focused Publications Indexed in PubMed by Using a Medical Subject Heading of "Hospital Readmission" since 2000.

pediatrics. Recent analyses by Medicare Payment Advisory Commission (MedPAC) suggest that raw and risk-adjusted readmission rates have declined for conditions covered by the HRRP, with readmission rates for HRRP target conditions declining more quickly than that for nontarget conditions.[7] Just as the HRRP has focused on target conditions with relatively high readmission rates, analogous efforts to focus pediatric readmission reduction on children at greatest risk may enable measurement of change over time. For example, although children with complex chronic medical conditions represent a small proportion of the pediatric population, they account for 60% of all pediatric readmissions in the United States. However, similar to the above-described meta-analysis of readmission reduction efforts in children, at least one meta-analysis has demonstrated that there is no one intervention or even bundle of interventions that has consistently reduced readmissions in adults.[8] Although the readmission rates for HRRP target conditions have decreased, the results of clinical trials evaluating readmission reduction efforts are difficult to translate into practice given substantial heterogeneity in study designs, interventions, and patient populations.

Does this study by Auger et al. suggest that pediatric readmission reduction efforts are misguided or futile? No. But it does provide compelling data that efforts to reduce all-cause readmissions for all children may not yield measureable changes using the current measures. A narrowed focus on children with chronic illnesses, who account for approximately half of all pediatric admissions, may be warranted. A number of studies have summarized families' preferences regarding their hospital-to-home transitions; the results indicate that families of children with chronic illness have unique desires and needs.[9,10] Perhaps it is time to take a step back from pediatric readmission reduction efforts, largely inspired by the HRRP, and redirect our resources to implement and evaluate processes and outcomes most valued by children and their families.

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References

1. Berry JG, Zaslavsky AM, Toomey SL, et al. Recognizing differences in hospital quality performance for pediatric inpatient care. *Pediatrics*. 2015;136(2):251-262. https://doi.org/10.1542/peds.2014-3131.
2. Auger K, Harris M, Gay J, et al. Progress (?) towards reducing pediatric readmissions. *J Hosp Med*. 2019;14(10):618-621. https://doi.org/10.12788/jhm.3210
3. Hain PD, Gay JC, Berutti TW, Whitney GM, Wang W, Saville BR. Preventability of early readmissions at a children's hospital. *Pediatrics*. 2013;131(1):e171-e181. https://doi.org/10.1542/peds.2012-0820.
4. Wallace SS, Keller SL, Falco CN, et al. An examination of physician-, caregiver-, and disease-related factors associated with readmission from a pediatric hospital medicine service. *Hosp Pediatr*. 2015;5(11):566-573. https://doi.org/10.1542/hpeds.2015-0015.
5. Brittan M, Albright K, Cifuentes M, Jimenez-Zambrano A, Kempe A. Parent and provider perspectives on pediatric readmissions: what can we learn about readiness for discharge?. *Hosp Pediatr*. 2015;5(11):559-565. https://doi.org/10.1542/hpeds.2015-0034.
6. Auger K, Kenyon CC, Feudtner C, Davis MM. Pediatric hospital discharge interventions to reduce subsequent utilization: a systematic review. *J Hosp Med*. 2014;9(4):251-260. https://doi.org/10.1002/jhm.2134.
7. NEJM Catalyst. Hospital Readmissions Reduction Program (HRRP). Available at: https://catalyst.nejm.org/hospital-readmissions-reduction-program-hrrp/. Accessed May 21, 2019.
8. Hansen L, Young R, Hinami K, Leung A, Williams M. Interventions to reduce 30-day rehospitalization: a systematic review. *Ann Intern Med*. 2011;155(8):520-528. https://doi.org/10.7326/0003-4819-155-8-201110180-00008.
9. Leyenaar J, O'Brien E, Leslie L, Lindenauer P, Mangione-Smith R. Families' priorities regarding hospital-to-home transitions for children with medical complexity. *Pediatrics*. 2017;139(1): e20161581. https://doi.org/10.1542/peds.2016-1581.
10. Desai AD, Durkin LK, Jacob-Files EA, Mangione-Smith R. Caregiver perceptions of hospital to home transitions according to medical complexity: a qualitative study. *Acad Pediatr*. 2016;16(2):136-144. https://doi.org/10.1016/j.acap.2015.08.003.