Characteristics of High Versus Low-Performing Hospitals for Very Preterm Infant Morbidity and Mortality

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Objective To ascertain organizational attributes, policies, and practices that differentiate hospitals with high versus low risk-adjusted rates of very preterm neonatal morbidity and mortality (NMM).

Methods Using a positive deviance research framework, we conducted qualitative interviews of hospital leadership and frontline clinicians from September-October 2018 in 4 high-performing and 4 low-performing hospitals in New York City, based on NMM measured in previous research. Key interview topics included NICU physician and nurse staffing, professional development, standardization of care, quality measurement and improvement, and efforts to measure and report on racial/ethnic disparities in care and outcomes for very preterm infants. Interviews were audiotaped, professionally transcribed, and coded using NVivo software. In qualitative content analysis, researchers blinded to hospital performance identified emergent themes, highlighted illustrative quotes, and drew qualitative comparisons between hospital clusters.

Results The following features distinguished high-performing facilities: 1) stronger commitment from hospital leadership to diversity, quality, and equity; 2) better access to specialist physicians and experienced nursing staff; 3) inclusion of nurses in developing clinical policies and protocols, and 4) acknowledgement of the influence of racism and bias in healthcare on racial-ethnic disparities. In both clusters, areas for improvement included comprehensive family engagement strategies, care standardization, and reporting of quality data by patient sociodemographic characteristics.

Conclusions and relevance Our findings suggest specific organizational and cultural characteristics, from hospital leadership and clinician perspectives, that may yield better patient outcomes, and demonstrate the utility of a positive deviance framework to center equity in quality initiatives for high-risk infant care. *(J Pediatr 2023;10:100094)*.

Very preterm births (VPTB), or births at less than 32 weeks gestation, represent roughly one percent of live births in the United States (US), but account for more than half of infant deaths.[1] VPTB is also associated with long-term health and neurodevelopmental difficulties, especially for infants who experience morbidity in the neonatal intensive care unit (NICU).[2] VPTB contributes substantially to health inequity, with Black infants twice as likely to be born preterm than are white infants and over 4 times as likely to be born very preterm.[3,4] These disparities are rooted in structural racism and the social determinants that shape differential exposure and vulnerability to maternal health risks and in-utero exposures.[5-12] Our previous research suggests that structural racism also manifests in health care quality. We identified wide variation in hospital rates of VTPB newborn morbidity and mortality (NMM) that was not fully explained by individual patient characteristics, and that Black and Latinx infants were born disproportionately in hospitals with the highest risk-adjusted rates. Roughly 40% of the Black-white and 30% of the Latinx-white VPTB morbidity and mortality gap could be attributed to variation in hospital quality[13] establishing the need for further research into modifiable hospital-level factors for disparity reduction.

A robust literature has explored hospital structural and organizational factors that influence newborn health.[14-20] Characteristics such as NICU level and volume show limited utility in discriminating hospital performance for very preterm infant outcomes.[21] Measures of hospital safety climate, teamwork, and

CMO	Chief Medical Officer
L&D	labor and delivery
NICU	neonatal intensive care unit
NMM	neonatal morbidity and mortality
NYC	New York City
PBP	potentially better practice
VPTB	very preterm birth

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Box 1: Methodology for Measuring and Ranking Hospital-Level Very Preterm Neonatal Morbidity and Mortality Rate

We previously[5] measured VPTB neonatal morbidity and mortality (NMM) in New York City hospitals using vital statistics birth records linked to state-wide hospital discharge data containing International Classification of Diseases, Ninth Revision (ICD-9-CM) diagnosis and procedure codes for the delivery hospitalization. We used a combined measure of neonatal mortality and severe morbidity (NMM). Neonatal mortality was defined as death up to but not including 28 days, or within 1 year if continuously hospitalized. Severe neonatal morbidity was defined by the presence in the infant hospital record of the ICD-9-CM code for any of the following diagnoses or procedures: bronchopulmonary dysplasia, necrotizing enterocolitis (unspecified, stage 2 or 3, laparotomy), retinopathy of prematurity (stage 3, 4, or 5), and intraventricular hemorrhage (grade 3 or 4). We risk-adjusted hospital-level NMM for maternal sociodemographic characteristics (eg, age, self-identified race and ethnicity, parity, education, insurance coverage), clinical and obstetric factors (eg, multiple pregnancy, history of previous cesarean delivery, body mass index, diabetes, hypertension, premature rupture of membranes, disorders of placentation), and infant factors present before delivery (eg, sex, birthweight). We used mixed-effects logistic regression with a random hospital-specific intercept to generate risk-standardized NMM rates for each hospital and ranked hospitals from lowest to highest risk-standardized NMM. We evaluated Black–White and Latinx–White disparities in hospital use by comparing the cumulative distribution of births between racial and ethnic groups across hospitals ranked by risk-standardized morbidity. Additional detail on this methodology is provided elsewhere.[5]

nurse staffing have been correlated with NICU-level variation in some outcomes (eg, hospital-acquired infection, length of stay) but associations have not been observed consistently across clinical quality indicators.[16,17,19,20] Furthermore, few studies have identified specific practices and quality improvement initiatives from hospital leadership and clinician perspectives that may impact process- and outcome-level disparities. Positive deviance provides a research framework for quality improvement, wherein researchers examine quantitative variation among entities (eg, hospitals) in performance on an attribute (eg, health outcome) and then use qualitative inquiry to understand characteristics distinguishing high from low performers.[22,23] Positive deviance has proven fruitful in examining salient quality factors in other health care settings[24-27] and by our team to explain hospital variations in severe maternal morbidity,[28] but has not previously been used to address neonatal care and disparities. Our objective was to apply positive deviance to ascertain organizational attributes, policies, and practices that differentiate high from low-performing hospitals for VPTB mortality and morbidity in New York City (NYC). We aimed to identify, through consultation with hospital leadership and frontline staff, characteristics of high performers that may provide lessons for quality improvement to achieve better outcomes and reduce health disparities among these high-risk newborns.

Methods

Study Design and Sample

We used a qualitative positive deviance approach[22-24] to identify hospital features that may influence variation in neonatal morbidity and mortality (NMM). Based on prior research (Box 1),[13] we divided 39 NYC hospitals into 3 tertiles by their risk-adjusted VPTB NMM rates. We purposively sampled 4 hospitals in the first tertile (low-NMM/"high-performing") and 4 in the third tertile (high-NMM/"low-performing"). We aimed to have a similar mix of hospitals in each cluster in terms of size, percentage of Black and Latinx patients, percentage of patients with Medicaid coverage, and NICU level (levels 3 and 4 only). Given our focus on disparities, we proactively included hospitals with high proportions of Black or Latinx patients.

Data Collection

We conducted semi-structured interviews between September 2017 through October 2018 with a group of 3 to 7 senior, mid-level, and frontline clinicians and administrators in each of the 8 study hospitals. Respondents included Chief Medical Officers (CMO); NICU medical directors; physicians responsible for quality (NICU, Pediatrics, or hospital overall); NICU nurse managers; frontline NICU nurses; and respiratory therapists. Each site visit included 2 to 3 researchers. Interviews were conducted in person at the hospital and lasted 30 to 90 minutes. The study team obtained informed consent and basic demographic characteristics (without identifiers) for each respondent. Interviews were taped and transcribed; names of hospitals, systems, and individuals were redacted prior to analysis. The Icahn School of Medicine at Mount Sinai Program for the Protection of Human Subjects approved this study.

The interview protocol (online only) followed a published conceptual framework[29] and addressed structures and processes that may influence hospital quality, including 6 major topics: 1) respondent's professional background; 2) NICU physician and nurse staffing; 3) professional development; 4) standardization of care; 5) quality measurement and improvement; and 6) efforts to measure and report on racial/ethnic disparities in VPTB care and outcomes.

Data Analysis

We used qualitative content analysis, a systematic process of coding and identifying themes and patterns in codes, to analyze qualitative interviews.[30,31] Two independent qualitative

analysts coded the interviews using NVivo 12 software. Data analysts did not participate in interviews and were blinded to hospital names and cluster assignment (high vs low performing). Analysts generated a start list of initial deductive codes based on the research questions and interview protocols and iteratively edited and added inductive codes from close reading of the transcripts. Transcription analysis was piloted to ensure consistent interpretation and application of codes. The qualitative team summarized key findings by topic and hospital and developed tabular data displays. After completion of coding, analysts developed memos identifying emergent interview themes and patterns and highlighting illustrative quotes. Analysts then examined similarities and differences between the 2 blinded hospital clusters and drew qualitative comparisons across clusters for each key theme. Memos summarized results from individual hospital interviews, for the two hospital clusters with different (but unrevealed) performance levels, and for all hospitals together.

Results

The 8 study hospitals varied in NICU level, teaching status, size, geographic location, and socioeconomic status of patients (Table I). Table II lists characteristics of the 44 interviewees. Most participants were >45 years of age and 61% in practice for >20 years. Roughly 20% of interviewees identified as Black, 5% as Hispanic/Latino, 40% Asian, and 36% white. Eight main themes emerged from analysis, as presented in Table III with illustrative quotations.

Leadership Commitment to Mission & Quality

Interviewees in both clusters discussed commitment to mission and strong sense of purpose as motivators for quality improvement. Top-down commitment was emphasized in high-performing facilities, with respondents describing how hospital and departmental leadership fostered shared mission to improve patients' lives (Table III, A3-A5). All CMOs in the high-performing cluster and one in the low-performing emphasized dedication to quality among senior management. For example, a high-performing hospital CMO described how close partnership between himself and a Quality Officer amplified effectiveness in maintaining quality standards (Table III, A2).

Table I. Characteristics of study hospitals (n = 8)

Characteristic	Value
Teaching hospital, n (% of hospitals)	8 (100.0)
Level 4 nursery, n (% of hospitals)	8 (100.0)
Delivery volume	
Mean volume	3426
<2500 deliveries, n (% of hospitals)	4 (50.0)
≥2500, n (% of hospitals)	4 (50.0)
Medicaid coverage	
Mean percent Medicaid births	57.4
<50% births, n (% of hospitals)	3 (37.5)
≥50% births, n (% of hospitals)	5 (62.5)
Race/ethnicity of obstetric population	
Percent Black, mean	36.9
Percent Latinx, mean	27.3

Data are n (%) or mean. Data use agreements with the New York State Department of Health and the New York City Department of Health and Mental Hygiene do not allow presentation of individual hospital characteristics.

Table II. Demographic characteristics of clinicians and administrators (n = 44) interviewed at 8 New York City hospitals

Characteristic	N (%)
Age	
≤45	11 (25)
>45	33 (75)
Gender	
Male	18 (41)
Female	26 (59)
Race/Ethnicity	
Black	8 (18)
Asian	17 (39)
White	16 (36)
Hispanic/Latino	2 (5)
Other	1 (2)
>20 Years in Practice	27 (61)
>10 Years at Current Institution	25 (57)
Position[a]	
NICU Director	8 (18.1)
Quality and Safety Lead for NICU	8 (18.1)
Nurse Manager for NICU	8 (18.1)
Front Line NICU Nurse	6 (13.6)
Respiratory Therapist	7 (15.9)
Chief Medical Officer	6 (13.6)
Other[b]	3 (6.8)

NICU, neonatal intensive care unit.
[a]One respondent was both NICU Director and Quality/Safety Lead.
[b]Director of Pediatrics, Associate Director of Quality Management, Chief Patient Safety & Quality Officer/Executive Vice President.

Clinician Staffing and Professional Development

Respondents in all hospitals noted the importance of full-time attending neonatologist coverage to ensure high quality, safe patient care. NICU staffing challenges were apparent across both clusters, but the frequency and intensity of discussion suggested challenges were greater in low-performing facilities. High-performing hospitals generally reported better access to specialty physicians and sufficient staffing of NICU clinical leadership (Table III, Section B). Nurse staffing challenges (Section C) in low-performing hospitals included hiring freezes, scrambling to secure coverage, and the need to transfer infants externally for NICU care. One low-performing hospital used multiple strategies to maintain decent staffing ratios, such as hiring temporary nurses, encouraging staff to use overtime hours, and asking nurses to limit time off. While low-performing hospitals reported worse nurse to patient staffing ratios, high-performing hospitals also described pressure to increase nursing workload and the potential for staff shortages to negatively impact patient safety and quality, parent satisfaction, and smooth transition from labor and delivery (L&D) to the NICU setting.

Professional development for physicians (ie, participating in journal clubs, teaching residents, attending external

Table III. Quotations from participants by theme

Theme	Quote	Participant role	Hospital (high vs Low NMM)
A. Leadership Commitment to Mission and Quality	**A1.** [The CEO] feels personally invested in the hospital as an extension of almost his own practice…He wants his family to come here…his friends…trustees.	NICU Medical Director	High (H1)
	A2. We're both pretty senior people and it works very well, it's actually probably 'one plus one equals three' because we're on the same page and people won't bypass one of us to get something from the other.	CMO	High (H2)
	A3. Our board? Absolutely. We have a really involved quality commitment at the board of trustees that I've been working with for a long time. It's also become closer with them because it's also a subset of that quality committee is the privileging and credentialing committee of the board.	CMO	High (H3)
	A4. We don't have to be here, you can make more money outside. But, it's the commitment that we make to serve the underprivileged.	Neonatologist	High (H4)
	A5. [The CEO works on] making sure that we provide the same level of care to every patient, to our diverse employee and physician groups.	CMO	High (H3)
	A6. It's a tabula rasa and we're building it from the ground up…and [for] young people who want a certain level of responsibility and who are very motivated, I offer them the ability to come in and run a department and build the department that they want…They all have a vision…of how healthcare should be provided.	CMO	Low (L1)
B. Physician Staffing	**B1.** For the physicians themselves, you would have to ask them how they feel their coverage is, but they're readily available to us whenever we need. And we could easily, if we don't feel comfortable with something that's being done, we could always call somebody and let them know our feelings or our thoughts on it.	NICU RN	High (H3)
	B2. Sometimes it's adequate, sometimes not.	NICU RN	Low (L1)
	B3. I think in terms of the trainees, and kind of the front-line providers, we are not adequately staffed.	NICU Director of Quality	Low (L2)
C. Nurse Staffing	**C1.** We ran the NICU, and that's not the case anymore. It's run by the hospital…that ties your hand.	NICU Medical Director	High (H3)
	C2. There are no new grads on our unit. We have seasoned nurses. I mean probably the youngest one is maybe four or 5 years, so we don't have any new grads that needs constant attention.	NICU RN	High (H4)
	C3. We don't have enough nurses. I know that the head nurses are always scrambling to get good coverage.	NICU MD Director	Low (L1)
	C4. So I was in scrubs every day, I was coming in on weekends to work with an assignment. And so were my, you know, manager colleges, because it, it was scary.	NICU RN Manager	Low (L2)
D. Professional Development	**D1.** It's hard to interface with nurses, so basically what you do is it's all done teaching rounds. So, when I go through these 23 patients bedside to bedside, the nurse who is taking care of the patient has got to be there and basically to take part in it because I feel like I need her input. And then we can talk about, you try to integrate physiology with what you're seeing, what's actually happening with this baby. You just have to put things into some kind of contet. In terms of formal [simulation/professional development] session[s], no. It's very hard to get formal sessions with all these [people].	NICU Quality Director/ Physician	High (H3)
	D2. [NICU nurses] get the same basic annual competency [as L&D nurses]: making sure they know how to document the events and calculate the meds and those things; as far as emphasizing them being certified and emphasizing them going to conferences, that wasn't something coming from me.	L&D Nurse Manager	Low (L4)

(*continued*)

Table III. Continued

Theme	Quote	Participant role	Hospital (high vs Low NMM)
	D3. There have been attempts, by various people, both physicians and nurse coordinators, to do monthly code simulations, during the days and during the nights. Those initiatives have always been – within the last several years – are always somewhat short-lived because of other time constraints on those individuals. It is, you know, very hard to be the only individual leading something, without having additional cohorts to make it a consistent process.	Respiratory Therapist	Low (L2)
E. Standardization of care	**E1.** One is, you know, we go to conferences just to make sure we are, you know, we're updated. And at the same time, I, we also have, you know, nurses, new nurses who brings new ideas... And they, so, they tell us, this is what they do in their hospital. So, we check that out and see how, you know, how it can be applied to our, policies and procedures and practices.	NICU RN	High (H1)
	E2. There's a lot of opportunities for us to work collaboratively when we generate policies. So I think as far as policies are concerned we work across disciplines, but of course there is some things that, not really conflicting, but working in tandem. So we're talking about the same thing. There's an opportunity there. But as far as policies we usually, most of our policies are done collaboratively and interdisciplinary.	Respiratory Care Manager	High (H3)
	E3. And it's really like – it's what we call shared governance, that it's the clinical nurses making the policies. It's not just the upper management.	NICU RN Manager	High (H3)
	E4. The first thing is our division... We go for unanimity. Everything that's revised or written or whatever is reviewed by everybody within my division. We were meeting regularly with nursing.	NICU MD Director	High (H4)
	E5. SS: How do you think these policies get created? NICU RN: I think a lot of it is from research. I think that some of it is, we've had attendings coming in from different hospitals, and what they used to do at their old hospitals, they brought over here. Otherwise, I don't really— SS: Otherwise you're not really sure where it comes from? NICU RN: I'm not really sure, yeah.	NICU RN	Low (L2)
	E6. They're not communicating very well. Everything is informal. There is very little formal communication. I'll give you an example. Newborn screen. The state has very clear guidelines…There's a whole algorithm for it…The way I found out about it, in the morning we are rounding, and the head nurse comes and says, 'By the way…'"	NICU Director of Quality	High (H4)
F. L&D and NICU Collaboration	**F1.** "I love the flow of this NICU, which is you have L&D on one side…And then you have NICU and then you have postpartum, so, it's just a beautiful flow. And we can transition through that."	Respiratory Therapist	High (H1)
G. Quality Measurement and Improvement	**G1.** …probably at least once a week we're debriefing on something, and not because we have such bad outcomes, but because I think we have a very heightened awareness of when something unexpected happens, do we understand what happened and why. Do we really understand?	Neonatologist	High (H1)
	G2. …I don't know numbers as far as outcomes, that's not something I'm provided with…but I know anecdotally the culture change and perception change, I think there is an improvement [in attention to quality] because parents, neonatologists, nurses are…having conversations that they were never having before.	NICU Nurse manager	Low (L4)
	G3. The data that you get doesn't really mean anything unless you can apply it….and so it doesn't really, the volume statistics…it doesn't really mean much, but what matters is what did we do for them?...So we're taking the data and we're looking for useful metrics, we're looking for ways that we can have an impact…	CMO	Low (L1)

(*continued*)

Table III. Continued

Theme	Quote	Participant role	Hospital (high vs Low NMM)
	G4. Instead of just looking at the nurse that made the mistake, we look at what was the patient load, was she tired, how many hours has she been working, was it time for her to get a break, and we look at all the factors that could…cause her to make the mistake.	Nurse Manager	High (H4)
	G5. They see the copies of the reports. They get the report and then it's risk-management, quality improvement. They're all mixed together here in this hospital. They look at them too. [Name redacted] is about to really change everything. Her areas of interest and expertise are really QI so she arrived here and wanted to do that. I was so grateful because I am so overwhelmed with everything else that I have to do. She is going to take us to a new level. In fact, she is now become the PI person for my entire department. She [NICU RN Manager] is ruthless in what she demands from people in a way that no one has ever demanded.	NICU Director of Quality	High (H4)
H. Family Engagement	**H1.** You certainly see that where parents are fighting time just to get here to see their kids where they may have 2 other children at home, nobody to watch, or they have to go to work, and it's tough to get them here. The nursing would probably know better than me about that.	Respiratory Therapist	High (H4)
	H2. …both to advocate and be there for them, especially participate in the care, because it's one thing if you can't be there, we understand that of course, but you're calling regularly and checking up on the babe, making sure you know you are up to date with the baby, that's fine. So we know they're calling if they can't come in, they know what's going on with the baby, we are updating them.	NICU RN	Low (L1)
	H3. You still need that primary care nurse to do everything, and that is what we do…Our parents come, but they come at different times. Some of them literally live at the bedside of the baby, but that's just one small set. You have some that don't show up at all, and it's a fight to get them to come in, or they come in when the baby's very critical, but as the baby starts to become stable, you see less visits, and that's a time you really need them because you want to teach because you're preparing them for discharge. So, parents, they have – when they come in it's more work for us because we have to cater to their needs. It's like that's a tug of war that we wrestle with.	NICU Nurse Manager/ Front Line NICU Nurse	High (H4)
	H4. Well, you see different levels of parental involvement and you see different motivations for parental involvement. Some parents watch the kids like a hawk because they are convinced that the nurses aren't competent or are going to make some error, their just terrified. They're living in this constant state of terror. They can be pretty tough to deal with because they fixate on any little thing that they perceive as a deviation in the plan or what was supposed to happen. They can't let go of that ever. So you wind up spending a lot of time with people like that, trying to overcome, if you can, that sort of thing. Sometimes you never do.	NICU Director of Quality	High (H3)
	H5. They do get referred with good follow ups and resources out there whether they go or not…we try to make all of their appointments before they go home, but, in the event that the clinic that they have to go to is closed or whatever, they get a number and we check up on them the next day just to make sure that they are making those phone calls and they have their appointments. We have a designated social worker and she's very good. Nobody goes out of here without all of their services in place unless there's a plan b.	NICU RN Manager	High (H2)
	H6. We have a good relationship with the social work team. One of the things that we do here, which is I think kind of novel is that we've gotten our social worker for	NICU Medical Director	Low (L1)

(*continued*)

Table III. Continued

Theme	Quote	Participant role	Hospital (high vs Low NMM)
	the babies to come with us to our neonatal high-risk clinic as well. And I thought this was a good way because the social worker has a real relationship with a lot of these parents…And so it's kind of a way to transition them to outpatient care, but they still have that connection. And the social worker knows why they're living in a shelter, or is this going on. And, again, it's nice to have them follow them to the clinic.		
	H7. We love our discharge nurse. Families love our discharge nurse. Physicians love it. It makes everything feel smoother, and more coordinated, and better care, and patients are happier, and everybody's happier.	NICU Medical Director	Low (L2)
	H8. The layout is not modern. It is an old-fashioned NICU with incubators and beds side by side. I wish we have more space to have parent-centered—patient-centered care…	NICU Medical Director	High (H2)
	H9. I really want to see a better place for a baby to- and the mother and the father to be together in one room…we have no landing room where the baby's really approaching time to go home…I think the parents should have a place for them to stay so that they will be more comfortable with the child and respond, like, you know, if the baby stop breathing…they will see the real thing, not just 24 hours before they go home.	NICU Nurse Manager	Low (L3)
	H10. When Mom comes to visit, we are really struggling to figure out how to get like a chair there…there is nowhere for her to be. There is no space. It's a tiny area, so when you're really busy you kind of have to juggle visiting which is just an odd thing when you're pushing for moms and babies to be together at all times. There is no space for them to do that.	L&D Nurse Manager	Low (L4)
I. Disparities and Discrimination	**I1.** First of all, regardless of your ethnicity, we treat everybody straightforward. You come, we introduce ourselves, we check your ID, we tell you to wash your hands, and after that, if you say I can't speak English, then okay, we tell them we'll get help. We'll use–somebody pick the phone right up. We'll get help. Something like that. And then if there are–get special request from them regarding their religion we accommodate them.	NICU RN Manager	Low (L3)
	I2. I think there's an assumption that we're treating everyone the same way. Obviously that's not valid, that's probably (an assumption) held by both the clinical staff and the hospital leadership.	CMO	High (H1)
	I3. I think it's racism…something about being a black person in this country is toxic.	NICU Director of Quality	High (H3)
	I4. Yeah, maybe if they're not getting a good prenatal or they have a lack of information, how to take care of themselves when they are pregnant.	NICU RN	Low (L3)
	I5. From the little that I have followed, I feel that it starts with the mother, the education and the access to medical care. And not just the access, but actually the delivery of the quality medical care to the mothers and the high-risk mothers is not the same based on race, based on socioeconomic status. It's not the same. And when you have high-risk mothers, you have high-risk babies...the hypertension. Already, the black mothers are at high risk for hypertension, all these other co-morbidities, all these metabolic disorders, and that affects the babies a lot. They are already at risk for all of these morbidities, and they are also, from what I've read, are at higher risk for maternal mortality as well.	NICU Director of Quality	High (H4)
	I6. Neonatologist: To tell you the truth, I never feel like the treatment that the parents receive and the treatment that my patients receive is different. SS: I see, interesting, and you don't think that the nurses treat different parents differently?	Neonatologist	Low (L4)

(*continued*)

Table III. Continued

Theme	Quote	Participant role	Hospital (high vs Low NMM)
	Neonatologist: I don't think so. SS: You haven't observed that? Okay. Neonatologist: At least, I tell you the truth, the mentality of this prejudicial treatment is that I don't feel it there.		
	I10. I think having a diverse staff itself solves a little bit of that [making sure people understand cultural differences] problem….we've not done any kind of cultural sensitivity formal teaching or training that I know.	Neonatologist/NICU Quality	Low (L3)
	I11. …maybe it [cultural competency] should be more of a part of it [NICU care], but oftentimes, when the kid's very, very sick and you're doing everything, the cultural part doesn't really come into it as much. I think maybe it should.	Front Line NICU Nurse	Low (L2)

conferences) was generally robust and consistent across clusters, though some weaknesses were reported included lack of interdisciplinary training (Table III, D1). We heard few formal hospital-based professional development opportunities for nurses (D2). Simulation centers were rarely utilized by NICU staff in either cluster (D3).

Standardization of Care

Standardization was not a major focus of discussion in either cluster. Conversations focused on clinician inclusion in policy development, with more involvement of nurses in high-performing than low-performing hospitals (Table III, E1-E5). Resistance to new standards and policies was reported in some facilities, and hospitals in both clusters had weak or inconsistent systems for documenting and communicating new policies (E6).

L&D and NICU Collaboration

Respondents described multiple mechanisms for L&D-NICU collaboration, including regular joint meetings, notification from L&D of scheduled high-risk deliveries, and NICU staff attendance at L&D huddles. Most facilities reported smooth, albeit varied, internal transfer procedures. High-performing facilities reported more formal daily L&D-NICU communication than in the low-performing cluster. Both clusters addressed the influence of the hospital's physical layout on collaboration (Table III, F1), with proximity lauded as "fantastic" and fostering "smooth transitions" and distance (eg, units on different floors) hindering quality care.

Measuring and Sharing Quality Data

Some hospitals collected and shared performance data for participation in collaborative quality initiatives (eg, Vermont Oxford Network, Leapfrog Group) or for "baby-friendly" hospital or Regional Perinatal Center designation. While attention to quality improvement was emphasized more often in high-performing hospitals (Table III, G1), we found that frontline staff (especially nurses) in both clusters were rarely shown quality data (G2). When asked about data feedback, nurses spoke about operational (eg, number and acuity of NICU infants) as opposed to quality measures. Some evidence suggested high-performing hospitals had more data sharing and debriefing mechanisms in place for nurses (eg, adverse event huddles) than the low-performing cluster (G4-G5). However, no study hospitals reported monitoring outcome data by race or ethnicity or having mechanisms such as disparities dashboards to track stratified data.

Family Engagement

There was considerable variation across hospitals in how clinicians approached family engagement. Respondents in both clusters spoke extensively about parent presence in the NICU; some had negative perceptions of parental absence from the bedside, while others acknowledged external factors inhibiting daily presence (eg, other children, transportation, employment) (Table III, H1-H4). Hospitals in both clusters included parents on bedside rounds. Both clusters had formal mechanisms for family engagement such as patient/family advisory councils, support groups, "Welcome to the NICU" classes, and use of social workers and discharge procedures to facilitate transition home (H5-H7). Having sufficient physical space to accommodate parents was discussed across clusters, specifically regarding its impact on breastfeeding, family bonding, and the ability for parents to learn and prepare to care for their infants after discharge (H7-H9).

Awareness of Disparities and Discrimination

Respondents had a range of responses to the presence of bias and discrimination in hospital care (Table III, Section I): assurance that clinicians provide the same high-quality care regardless of personal characteristics; explanation that the intention is to provide equal care but that it is not always achieved in practice; and the naming of racism and its contribution to disparate medical care as a cause of poor health outcomes. Notably, the term racism was used by respondents in high-performing hospitals while racism and bias were not explicitly mentioned in the low-performing cluster. In multiple cases, participants acknowledged infant

health disparities but attributed them to factors outside of the hospital setting (eg, socioeconomic status, individual health behaviors/knowledge, genetics, cultural practices) as opposed to differences in medical care received during the delivery hospitalization and NICU stay. While clinician leaders from high-performing hospitals were open about the existence of racism and implicit bias and impact on quality, they did not describe steps to address such bias. Cultural competency training was rarely utilized (I10-I11); one high-performing facility had mandatory in-person training and a low-performing hospital described ad hoc training efforts. Some high-performing hospitals without cultural competency training were trying to institute such programming.

Discussion

We interviewed NICU leadership and clinical staff in 8 NYC hospitals to explore attributes of organizational culture, policy, and practice that may improve performance on high-risk newborn outcomes. We identified shared characteristics among facilities with high and low NMM rates, including strengths (eg, commitment to mission) and challenges (eg, lack of data feedback to frontline clinicians). However, despite considerable overlap in emergent themes from staff in high- and low-performing clusters, we observed salient differences in the intensity of the challenges described. Overall, high-performing hospitals were differentiated by the following features: 1) a stronger commitment from hospital leadership to diversity, quality, and equity; 2) better access to specialist physicians and experienced nursing staff 3) inclusion of nurses in developing clinical policies and protocols, and 4) acknowledgement of the influence of racism and bias in health care on racial and ethnic disparities. Comprehensive family engagement strategies, standardization, and reporting of disaggregated quality data were areas for improvement in both high- and low-performing hospitals.

One of the most prominent themes was the importance of strong leadership in setting the tone for success. Staff in high-performing facilities felt hospital administrators and governing bodies (ie, board of trustees) were invested in quality improvement, and prioritized staff diversity and maintaining equity in health care delivery. Senior management support for quality improvement has been identified as a driver of high performance in positive deviance research in other fields of medicine[24-27] and a previous study from our team on maternal healthcare.[28] Hospital and NICU leadership have a critical influence on improving the safety culture by establishing a direction for change, aligning stakeholder interests, and inspiring and motivating staff toward shared safety goals.[15] Interventions such as Executive WalkRounds™ - wherein senior leaders visit front line providers in patient care areas to discuss and address potential safety threats– are recommended to signal and fortify organizational commitment to safety.[15]

While both clusters faced staff turnover and shortages, particularly among nursing staff, the problem appeared less severe in high-performing facilities. High-performing hospitals generally had better access to experienced specialist physicians and neonatal nurses, while low-performing cluster staffing issues sometimes necessitated infant transfer, use of temporary nursing staff, and reducing time off to maintain sufficient coverage. Temporary nursing, higher nurse-to-patient staffing ratios, and poorer nurse working environments have been associated with racial disparities and poorer outcomes in neonatal care.[32-34] Improving standardization and training to address deficiencies in skilled nursing coverage may be particularly consequential for quality improvement, given nurses' role as frontline providers with the most time directly caring for and monitoring infants in the NICU. In previous studies, NICU parents and caregivers described excellent nurses as pivotal to their child's care, and particularly cited the continuity and reassurance of having a primary nurse assigned to their infant as defining to their NICU experience.[35] Furthermore, high-performing hospitals included nurses in policy development, which may improve knowledge of and commitment to standardization and reduce unwarranted practice variation among NICU nurses and the care team.

In previous positive deviance research, we identified that awareness of racial and ethnic health inequity and the influence of racism and bias in health care differentiated the organizational culture of hospitals with improved maternal health outcomes.[28] This theme similarly emerged in our discussions with NICU clinicians and administrators, with staff in high-performing facilities explicitly discussing racism in the hospital setting and a commitment to diversity and equity from hospital leadership. Results suggest that generating awareness and buy-in across hospital stakeholders (senior administrators, physicians, nurses, and other staff) is a critical step in "creating a culture of equity", the first in a set of Potentially Better Practices" (PBPs) for neonatal care developed by the Vermont Oxford Network.[36] While high-performing hospitals were farther along on this path, we identified that a lack of monitoring and sharing performance data stratified by race and ethnicity was a gap in quality efforts among all study sites. Tools such as disparities dashboards that track disaggregated perinatal quality metrics can help foster accountability to quality and safety goals, and identify areas where interventions to standardize care, provide additional training and supervision, and identify and redress clinician biases may increase equity in patient experience and outcomes.

Finally, family engagement is a growing focus of NICU quality improvement efforts. Infants born preterm are less likely than full-term infants to have family-centered medical homes and to receive prescribed postnatal services.[37] Models of care that explicitly involve families are considered NICU best practice and may help to bridge these gaps. However, many fall short of addressing the multilevel factors that shape health during and beyond the newborn stay and perpetuate

health disparities. While interviewees described hospital-based family engagement mechanisms, we noted limited discussion of policies addressing social determinants of health or extending beyond NICU hospitalization. Furthermore, we heard accounts in both high- and low-performing hospitals of clinician judgment toward family members who were not present at the infant's bedside, even when clinicians recognized the barriers to regular and sustained parent/caregiver presence. In previous qualitative research, family members perceived similar judgment about time spent in the NICU and lack of appreciation for the circumstances dictating their ability to be at the bedside.[35,38] Sigurdson et al. described these challenges as part of NICU families' "unmet needs for partnership in care or support", which are disproportionately felt by parents of color or low socioeconomic status.[35] The VON PBPs are directed toward improving "follow-through" – a comprehensive, partnership-based approach to meeting the immediate and long-term social and medical needs of infants and families. Specific PBPs include interventions such as universal screening for social determinants of health, mobile applications that link families to neighborhood resources after discharge, and nurse home visiting programs, and are intended to be adapted and tested in local contexts.[36]

This study has several limitations. Hospital performance was modeled using administrative data, with potential for misclassification bias.[5] We did not observe NICU activities or interactions between staff and patients. Study findings may not generalize to other geographic regions or hospital settings, especially areas with less racial segregation, population diversity, and fewer NICU facilities. Our methods should be replicated in other contexts to assess whether salient concepts differ. We did not interview family members in the NICU and cannot comment on parent or caregiver perspectives from high and low-performing facilities, but have explored parent perspectives on quality of care for infants in the NICU in previous focus group research.[39] Social desirability bias may have influenced participants' reporting of hospital culture or practices. However, respondents were not aware of their hospital's performance ranking and qualitative analysts were blinded to hospital performance. Data were collected at a single point in time and may not reflect most current practice. We were not able to consider financial resources in risk-adjusted hospital NMM rates.

Conclusions

We demonstrate the utility of a positive deviance framework to center equity in quality initiatives for the care of high-risk infants, and suggest that strong leadership commitment to quality, robust staffing, standardization, and data feedback to frontline clinicians may yield better patient outcomes. We identified a lack of quality reporting by patient sociodemographic characteristics and recommend that hospitals stratify metrics by race/ethnicity to monitor and inform quality improvement efforts. Finally, we urge development of comprehensive family engagement policies, including follow-through on social determinants and linkage to support beyond the immediate postnatal period, for long-term improvement in child health outcomes. ■

CRediT Authorship Contribution Statement

Shoshanna Sofaer: Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing. **Kimberly B. Glazer:** Formal analysis, Writing – original draft, Writing – review & editing. **Amy Balbierz:** Funding acquisition, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Anna Kheyfets:** Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Jennifer Zeitlin:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Elizabeth A. Howell:** Conceptualization, Methodology, Investigation, Supervision, Funding acquisition, Formal analysis, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

All listed authors meet all 4 of the International Committee of Medical Journal Editors' (ICMJE) criteria for authorship. The authors have no conflicts of interests to disclose.

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