



# Virtual Visitation in a Neonatal Intensive Care Unit

## *Insights From 5 Years Using a PDSA Model to Improve Family-Centered Care*

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### ABSTRACT

This 5-year study evaluated a virtual visitation implementation initiative in a neonatal intensive care unit. Our objectives were to (1) use the Plan-Do-Study-Act methodological framework to implement a virtual visitation program, (2) investigate whether implementation of virtual visitation could be done with no patient harm and minimal workflow disruption, (3) foster a top-down participatory structure for decision making, and (4) evaluate

parent use and satisfaction. The study involved a qualitative and quantitative description of cycles and results. Routine collection of outcome data allowed problems that arose as a result of changing practices to be quickly and efficiently addressed. The study results suggested that the virtual visitation implementation initiative in a neonatal intensive care unit using Plan-Do-Study-Act cycles helped create an environment of trust and provided benefits. A steady increase in the use of virtual visitation by parents and their extended families indicated utilization. During the COVID-19 pandemic, virtual visitation helped families feel connected with each other and their neonate, despite being in separate locations.

**Key Words:** neonates, Plan-Do-Study-Act cycles, visitation

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More than 7% of all live births in the United States are admitted to the neonatal intensive care unit (NICU).<sup>1,2</sup> Parents of these sick and preterm infants must begin their relationships with their infants in the unfamiliar, stressful, and “sterile” technological NICU environment.<sup>3</sup> These infants are physically, psychologically, and emotionally separated from their parents during a crucial time in infant-family dyad development.<sup>4</sup> This separation from the infant, the inability to parent while the infant is in a hospital, the appearance of the infant with multiple lines and tubes, and the infant's lack of responsiveness negatively affect parent-infant attachment, decrease parental self-confidence, and foster feelings of being a “surrogate parent.”<sup>5</sup>

Under these extreme conditions, family involvement is vital to optimize attachment between families and infants and to enhance infants' physical, cognitive, and

socioemotional development.<sup>6,7</sup> Several studies have demonstrated the importance of prolonged parental presence and skin-to-skin contact with their children as a powerful facilitator of better long-term outcomes for infants<sup>8,9</sup> and parents. The benefits are mutually reciprocal because the positive effects of skin-to-skin contact between the children and their parents while in NICU also mitigate problems parents may experience during these difficult times.<sup>10</sup>

Given these factors, it seems paradoxical to consider the potential benefits of an initiative to implement a virtual visitation (VV) NICU program that potentially allows parents and other family members to visit the neonate remotely. Virtual visiting as an alternative to in-person visits can support parents in a number of ways. Potential benefits include providing opportunities to involve all family members in the newborn's life, helping parents cope with feelings of separation when they have to work or attend other needs, and fostering attachment by allowing the parent to be with the infant when they are away. However, new ideas introduced without sufficient testing in the healthcare setting often have significant negative consequences that can outweigh or overshadow the benefits.<sup>11</sup> These ideas can involve structural shifts resulting in new processes, technology, organizational design, and governance structures.<sup>12,13</sup> Staff must be open to change and align their mental models and work patterns to amplify and sustain program benefits.<sup>14</sup>

To implement the VV program successfully, an approach was needed to allow interaction of all NICU staff, especially the nurses. It needed to be flexible enough to effectively translate ideas into actions and allow for rapid pilot testing and evaluation of the various changes, providing feedback on their potential effects.

We used the Plan-Do-Study-Act (PDSA) model in this article, we summarize 5 years of experience, and include qualitative and quantitative descriptions of PDSA cycles and outcomes and how problems were addressed on the basis of results of routine outcome data collection. We also include insights about program usage.

## LITERATURE REVIEW

### NICUs and FCC

Family-centered care has been endorsed by the American Academy of Pediatrics and many other health organizations. Family-centered care is an approach to medical care acknowledging that optimal health outcomes are achieved when family members have active roles in providing emotional, social, and developmental support.<sup>15</sup>

Use of family centered care (FCC) in the NICU has been shown to decrease length of stay, improve maternal well-being, enhance infant-parent attachment, and improve long-term outcomes for the baby.<sup>16-18</sup> Factors contributing to the success of FCC include the physical NICU design, parent education, breastfeeding support, kangaroo care, sibling support, photography, staff training, and policies generally supporting parent involvement in care.<sup>18-24</sup>

Technology can have a role in FCC and can be especially helpful when families are distant from the NICU.<sup>25</sup> Telephones, mobile phones, and Web-based conferencing software have been used as a component of FCC to allow admitted patients to frequently and conveniently connect with their families, and vice versa.<sup>26-31</sup>

This approach has been shown to be especially effective when families are separated by distance, whether this be through geographical location, military deployment, or personal and family responsibilities. More recently, during the COVID-19 pandemic, visitation restrictions in the NICU have further exacerbated the risk of family-infant estrangement and demonstrated the importance of continued logistical and technological innovation in the realm of patient-family communication.<sup>32</sup>

Technology has been used as a means of facilitating parent-infant attachment through photographs, video-phones, and web cameras (VV).<sup>33-36</sup> Virtual visitation goes beyond communication. It allows for the parent and other family members to establish a dynamic relationship through ongoing access that accounts for the maturation, individual differences, and responses of their baby over time, enhancing parent-infant interaction and bonding. However, use of technology is not meant as a replacement for in-person visitation but as a supplement.

The PDSA model aims to achieve continuous program improvement.<sup>37</sup> It provides a framework for developing, testing, and implementing changes. It is based on scientific methods and moderates the impulse to take immediate action to address perceived program deficits and is safer and less disruptive for patients and staff.<sup>38</sup> The PDSA cycles enable small-scale testing of changes before wholesale implementation.

Although some studies have analyzed the role of webcams in NICU units,<sup>39</sup> most are cross-sectional studies addressing use; only 1 (to our knowledge) addresses workflow issues.<sup>14</sup> Our study is unique because it uses the PDSA model to successfully address the challenges to acceptance of this new technology in the NICU over time. In addition, usage data from our VV program are shared and compared during the pandemic.

## MATERIALS/SUBJECTS AND METHODS

### General description

This project was undertaken as a Quality Improvement (QI) Initiative. The QI activity was approved by the NICU administrative team, which included the nurse manager, performance improvement nurse, and NICU medical director. It used an adaptive, iterative design requiring participation of the bedside nurses as a component of care, with no increased risk to the patient and no sharing of identifiable patient data.

Our aim was to implement a new technology in the NICU to facilitate FCC with no patient harm and minimal workflow disruption. Specifically, our objectives were to (1) use the PDSA methodological framework to implement a VV program; (2) investigate whether implementation of VV could be done with no patient harm and minimal workflow disruption; (3) foster a top-down participatory structure for decision making, and (4) evaluate parent usage of and satisfaction with VV.

### PDSA cycles

Initially, several cycles were planned, including (1) phase 1 before implementation, (2) phase 2 at 6 weeks, (3) phase 3 at 1 year, and (4) phase 4 at 5 years. Data collection during/after these cycles included use of surveys applied between phases, and VV program uses data and snapshot surveys to detect problems during extraordinary situations, such as the COVID-19 pandemic. During the pandemic, hospital visitation was severely curtailed for public health reasons. Therefore, it was important to collect information to monitor how the VV program helped family members feel close to each other and their neonate.

### Project management team

The management team consisted of a unit-based multidisciplinary team (nurses, physician champion, and social work). This team was actively involved in following the collaboration process, solving immediate problems, communicating decisions to the rest of the staff, developing new PDSA cycles, and preparing evaluations from results of surveys and informal feedback. Between cycles, due to the need for staff-approved changes ensuring broad participation could be facilitated, decisions from meetings held every week during the first 3 months and once a month after this period were implemented. During the last 3 years, meetings occurred every quarter.

### SETTING

The project was implemented at El Paso Children's Hospital (EPCH) El Paso, Texas, which is uniquely

situated as the only Children's hospital in West Texas (serves a 250-mile radius of Texas and New Mexico). It is located at the US-Mexico border and serves Fort Bliss, one of the largest military bases in our county. Parents and extended family members of patients in the EPCH NICU may live far away or be otherwise unable to visit the hospital. Many military parents are deployed overseas and some families are unable to cross the US-Mexico border.<sup>40</sup>

## LOGISTICS

### Phase 1: PDSA preplanning cycle

Planning involved establishing a unit-based multidisciplinary team that researched the technology required for the VV program (eg, individual web cameras for each bed space, with no audio function, permitting real-time infant observation and encrypted privacy, hosted on servers separate from hospital information), obtaining executive leadership and bedside staff buy-in, information technology support, and funding. Once these components were obtained, the program was launched.

It was agreed that decision making before or in-between cycles would take place in meetings held by the NICU administrative team chosen to study the process, measure effects, and to institute and monitor changes. Actions implemented from changes made were then tested using auditing, tracking, and measuring trends to ensure resolution or to determine changes needed for subsequent PDSA cycles.

### PDSA cycle: 6 weeks after implementation

Following implementation of the virtual system and based on feedback from the nursing staff, the project management team decided that the virtual system could be available for 24 hours instead of the initially scheduled hours, except when procedures or examinations were being performed on patients. Initially, only parents were granted viewing access. But, after 6 weeks of the program, nursing attitudes toward viewing access had changed, and parents were given control to allow family and friends to view their infants. The initial survey was also scheduled to be repeated a second time.

### PDSA cycles: 1 year after implementation

#### *Decision meetings between cycles*

The project management team continued to meet weekly for the first 3 months and once a month thereafter, until the 1-year mark. They then decided to meet every quarter to resolve issues raised by the nursing staff

regarding the virtual system. After 1 year, the initial survey was scheduled to be repeated, as well as at 5 years.

### Sample

During the 5-year study period, the average daily census in the NICU was 38 (range: 32-50). Approximately 20% of the NICU babies were from military families and 80% of the patients' families identified as Hispanic. The average population of NICU nurses was 60 during the 5 years. Before and during implementation, most personnel actively participated in the project and gave input directly to the project management team or via the surveys.

### Confidentiality

Participants received information about the program and about the QI activity associated with it. They were surveyed anonymously as part of the QI activity, and the findings were shared with them and used to improve the VV program. The risks to the bedside nurses were those typically associated with the work and did not include any risks to economic security.

**Measures.** Quantitative data were collected in the NICU using similar surveys at different times. Surveys were conducted before implementing the VV program (before survey;  $N = 42$ ), then at 6 weeks ( $N = 29$ ), 1

year ( $N = 42$ ), and 5 years after implementation (after surveys).

**Survey description.** The surveys included demographic data (eg, age group, gender, profession, years of practice). Additional questions included specific opinions about the program implementation process, anticipated benefits and problems, and access allowed to parents and other family members (see Table 1 for question descriptors). Responses were tabulated from 1 to 5 using a Likert scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree). An open-ended question section was included for comments. Additional tabulation of the mean rating classification was elaborated following the conceptual framework proposed by De Jesus and Blladia.<sup>41</sup> The following values were assigned to each response: 1 to 1.8, Strongly Disagree; 1.81 to 2.6, Disagree; 2.61 to 3.40, Neither; 3.41 to 4.20, Agree; and 4.21 to 5.0, Strongly Agree.

During the pandemic, a nursing attitude toward VV during the COVID-19 pandemic survey was randomly given to nurses ( $N = 24$ ). The survey included comments, demographic information, and 3 questions related to VV visitation. Questions included how VV helped facilitate FCC, increased workflow of bedside staff, and helped families stay connected to their babies due to the hospital's changes in visitation policy.

**Table 1. Examples of questions included in surveys before and after implementation**

Questions
<p>What do you think about the implementation process?</p> <ul style="list-style-type: none"> <li>• NIC view cameras will take place at set viewing hours (8:30-10:30 AM and 20:30-22:30 PM) coordinated with patient care and daily patient activities.</li> <li>• <b>Change from initial survey to subsequent surveys:</b></li> <li>• <b>NIC view cameras will take place 24 h a day with the exception of during procedures and examinations of patients</b></li> <li>• Licensed nurse or nurse aid will associate camera with infant, ensure that infant is in position for maximum viewing, activate camera, and document camera viewing status in electronic medical records.</li> </ul> <p>Do you anticipate benefits from:</p> <ul style="list-style-type: none"> <li>• Improved bonding between parents and infant</li> <li>• Better communication between parents and staff</li> <li>• Improved patient care</li> <li>• Facilitated family-centered care</li> <li>• Improved parents' sense of control during the NICU experience</li> </ul> <p>Do you anticipate problems from:</p> <ul style="list-style-type: none"> <li>• Distrust of healthcare providers among patient's families</li> <li>• Worsening of communication between parents and healthcare staff</li> <li>• Detrimental to being able to perform patient care</li> </ul> <p>Who do you think should be given virtual visitation access, with parental agreement?</p> <ul style="list-style-type: none"> <li>• Parents only</li> <li>• Parents and grandparents</li> <li>• Parents, grandparents, and other close relatives and/or friends</li> <li>• Anyone who the parent(s) designates</li> </ul>

Abbreviations: NIC, neonatal intensive care; NICU, neonatal intensive care unit.

Qualitative data were collected from nurses in the form of written comments from surveys during and after the implementation of the system and during cycles. The comments from nurses were categorized into 3 thematic areas: trust, communication, and patient care.

The company implementing the system provided usage data. These data included the location, time, and duration of camera access.

## RESULTS

Table 2 presents the demographic information from the survey responses in the PDSA cycles. The results for years of experience in the NICU reported by nurses indicated that about 50% had more than 10 years of experience. The median age was about 45 years and most respondents were female.

Before implementing the program, all nurses wanted a restricted viewing period. Thus, initial viewing times were 2 hours only and access was granted only to parents. Six weeks into the program, nursing attitudes regarding viewing access had changed. Viewing times were extended, and parents were allowed to control viewing access to their babies by sharing login access with family and friends. Ongoing auditing of this almost 24-hour viewing access did reveal some disruptions to nursing handoffs during shift changes. Therefore, a 1-hour blackout period was instituted during shift changes 2 years into the program. Because of these

decisions, viewing times were different between the before implementation and after implementation surveys and were reported on a different line in Table 3.

Table 3 presents the results obtained from the survey responses during the PDSA cycles. The red color indicates rating ranking changes from one period to another. *Before implementation*: there was medium agreement on questions regarding implementation and benefits (better communication and improved patient care). There was also medium agreement on all of the predicted problems listed and that access should be given only to parents. *Six weeks after implementation*: there were some changes in the rating ranking values on the benefits of the VV program (agreement on better communication between parents and staff, and improved patient care). At the same time, the results for the problem category rankings indicated that there was an increase in concern about communication problems between parents and healthcare staff. *One and 5 years after implementation*: 1 year after implementation, there was a positive change toward the implementation process, which was maintained 5 years later. Both the benefits and problems of the VV program seemed to neutralize after 1 year. These changes were probably related to the changes implemented during the cycles reported in Table 4.

The results for nursing problems/concerns reported verbally or in surveys and summarized into the 3 thematic areas of trust, communication, and patient care are

**Table 2. Demographic characteristics of survey participants during cycles**

	Before implementation <i>N</i> = 42(%)	6 wk after implementation <i>N</i> = 27(%)	1 y later <i>N</i> = 42(%)	5 y later <i>N</i> = 37(%)
Profession				
Nurses	32 (76.20)	23 (79.30)	32 (76.19)	24 (64.86)
MD	2 (4.80)	4 (13.80)	3 (7.14)	3 (8.11)
Other	8 (19.00)	2 (0.07)	7 (16.67)	10 (27.03)
Gender				
Male	2 (4.80)	4 (13.80)	5 (12.00)	3 (8.10)
Female	40 (95.20)	25 (86.20)	36 (88.00)	34 (91.90)
Age group, y				
19-29	10 (24.40)	8 (31.00)	3 (7.14)	3 (8.11)
30-39	10 (24.40)	5 (17.20)	12 (28.57)	8 (21.62)
40-49	14 (34.10)	10 (34.50)	18 (42.86)	10 (27.03)
50-59	5 (12.20)	3 (10.30)	7 (16.67)	14 (37.84)
>60	3 (4.90)	3 (8.90)	2 (4.76)	2 (5.41)
Years in practice				
<1	1 (2.40)	3 (10.30)	0 (0.00)	2 (5.41)
1-3	10 (23.80)	8 (27.60)	8 (19.05)	4 (10.81)
4-10	8 (19.00)	5 (17.20)	6 (14.29)	4 (10.81)
11-15	5 (11.90)	4 (13.80)	4 (9.52)	4 (10.81)
16-20	7 (16.70)	4 (13.80)	4 (14.29)	5 (13.51)
21-25	6 (14.30)	1 (3.40)	11 (26.19)	11 (29.73)
>25	5 (11.90)	4 (13.80)	7 (16.67)	7 (18.92)

Table 3. Rating average Likert responses to virtual visitation program<sup>a</sup>

	Before N = 42	6 wk N = 27	1 y N = 42	5 y N = 37
Implementation process agreement	3.33 Neither	3.30 Neither	<b>3.64</b> <b>Agree</b>	3.76 Agree
Benefits		Average rating and classification		
To parents	3.83 Agree	4.11 Agree	3.79 Agree	3.73 Agree
Improved bonding between parents and infant	3.45 Agree	3.63 Agree	3.93 Agree	3.84 Agree
Better communication between parent and staff	3.10 Neither	<b>3.44</b> <b>Agree</b>	3.43 Agree	<b>3.22</b> <b>Neither</b>
Improved patient care	2.98 Neither	<b>3.41</b> <b>Agree</b>	3.50 Agree	<b>3.22</b> <b>Neither</b>
Facilitated family-centered care	3.79 Agree	3.85 Agree	3.88 Agree	3.84 Agree
Improved parents' sense of control during the NICU course	3.48 Agree	3.96 Agree	3.76 Agree	3.75 Agree
Do you anticipate problems?				
Distrust of healthcare providers among patient's families	3.21 Neither	3.31 Neither	2.88 Neither	3.00 Neither
Worsening of communication between parents and healthcare staff	2.98 Neither	<b>3.44</b> <b>Agree</b>	<b>2.45</b> <b>Disagree</b>	2.70 Disagree
Detrimental to being able to perform patient care	2.73 Neither	3.26 Neither	2.73 Neither	3.10 Neither
Access times				
Agreement on time 8:30-10:30 AM and PM	3.45 Agree			
Agreement on 24 h with exceptions		3.89 Agree	3.64 Agree	3.95 Agree
Access to virtual visitation program				
Parents only	3.64 Agree	3.56 Agree	3.74 Agree	3.41 Agree
Parents and grandparents	2.33 Disagree	<b>3.63</b> <b>Agree</b>	4.07 Agree	3.78 Agree
Parents, grandparents, and other close relatives and/or friends	2.12 Disagree	<b>3.15</b> <b>Neither</b>	<b>2.52</b> <b>Disagree</b>	<b>3.03</b> <b>Neither</b>
Anyone who the parent designated	2.17 Disagree	<b>3.78</b> <b>Agree</b>	3.57 Agree	3.42 Agree

Abbreviation: NICU, neonatal intensive care unit.

<sup>a</sup>Rating Classification: 1.00 to 1.80, Strongly Disagree; 1.81 to 2.60, Disagree; 2.61 to 3.40, Neither; 3.41 to 4.20 Agree; 4.21 to 5, Strongly Agree. Bold text indicates changes in rating classification from one survey period to another.

presented in Table 4. Specific actions were implemented for each of the major concerns/problems reported.

Nursing attitudes toward VV during the COVID-19 pandemic survey ( $N = 19$ ) results indicated that with regard to how the VV helped facilitate FCC there was an 87% agreement, increment in RN workflow indicated by adding neutral and disagree responses a 67% agreement, and how the system helped families stay connected to their babies due to hospital changes in visitation policy adding neutral and in agreement, 86%. Numbers of calls increased during COVID-19 (see Figure 1). Nurses' comments during this time indicated that there were excess calls from parents, friends, and relatives. This change was addressed using previously

established actions (see Table 4). Some cameras were removed from use and a couple of cameras were not working well. These results suggested that cameras should be replaced after 5 years of continuous use.

## DISCUSSION

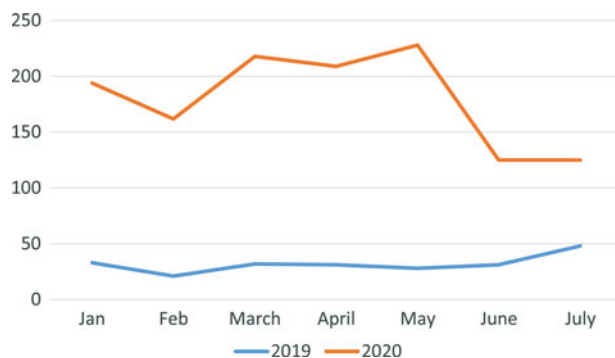
The overall long-term goal of this study was to determine the feasibility, use, benefits, and problems associated with implementing a VV program to supplement FCC in a NICU, without negatively affecting patient care and nursing workflow. Learning if an intervention works in a particular setting and making adjustments accordingly increase the chances of delivering



**Table 4. Summary of main concerns before and after program implementation, and strategies applied to resolve the identified problems**

Concerns	Actions
<p>Trust/communication</p> <p>Parent-child bonding/FCC: Nurses felt that the system would result in lack of bonding between parents and baby and give parents an excuse not to visit their baby.</p>	<ul style="list-style-type: none"> <li>• The VV program was presented to parents as a service to enable them to share their babies with their families and supplement bonding.</li> <li>• In-person visitation, whenever possible, was still encouraged.</li> <li>• Chart audits of social service and physician notes showed that much of this concern was not valid.</li> <li>• Parental visitation was included in a standardized shift report with each change of shift.</li> <li>• Instituting discussion of real lack of visitation in the daily multidisciplinary care progression huddles and weekly discharge planning meetings.</li> <li>• Daily family-centered rounds and separate rounds with the nurse manager were used to address these concerns.</li> </ul>
<p>Misinterpretation of nurse actions visualized on camera as a source of complaints from parents.</p> <p>Parents' inability to connect to the system.</p>	<ul style="list-style-type: none"> <li>• Empowering nurses to use these as opportunities for direct "teachable" moments.</li> <li>• Parents were given written information on how to use the camera with additional information on contacting the company supplying and hosting the cameras to troubleshoot use of the camera and provide technical support.</li> </ul>
<p>Patient care</p> <p><i>Quality of care:</i> Reduction in time dedicated to care of the patient due to attention to the system and users.</p>	<ul style="list-style-type: none"> <li>• General plan included increasing information to parents regarding the purpose of VV use and the role of nurses to address nonrelated clinical care problems with the equipment and restricting calls regarding problems with the VV to parents only.</li> <li>• Several meetings took place with nurses to address the scope of their obligations in regard to the VV program.</li> </ul>
<p><i>Time management:</i> Management of the system will take nursing time away from bedside care resulting in a reduction in the amount and quality of patient care and increased work for the nurses.</p>	<ul style="list-style-type: none"> <li>• Using unit clerks and other nonbedside staff (charge nurses, unit supervisors) to manage some of this workflow disruption.</li> </ul>
<p>Excess calls from parents due to inability to see the baby, baby crying, or any other nonpressing questions (eg, about camera position)</p>	<ul style="list-style-type: none"> <li>• Addressed by educating the families that clinical care takes priority over VV.</li> <li>• The NICU instituted a blackout characteristic on the cameras where they went offline during shift change (6:30-7:30 AM and PM).</li> <li>• Calls regarding the cameras were screened by the unit clerk who would adjust the cameras first before going to the bedside nurses.</li> </ul>
<p><i>Safety:</i> Cameras can hurt the baby if not attached properly.</p>	<ul style="list-style-type: none"> <li>• Cameras were checked by management and engineering to review problems.</li> <li>• Cameras initially were attached to IV poles with other equipment. Separate steel poles were purchased for camera attachment</li> </ul>
<p>HIPAA violation when child is discharged but camera is not dissociated from the bed, which may be occupied by a new patient</p>	<ul style="list-style-type: none"> <li>• Unit clerks ensured that cameras were dissociated from baby once baby had been discharged from the hospital or changed bed location. The unit supervisor or designee would periodically audit to ensure compliance.</li> </ul>

Abbreviations: FCC, family centered care; HIPAA, Health Insurance Portability and Accountability Act; NICU, neonatal intensive care unit; VV, virtual visitation.



**Figure 1.** Comparative number of views during the months of January to July 2019-2020. This figure is available in color online ([www.jpnnjournal.com](http://www.jpnnjournal.com)).

and sustaining the desired improvement.<sup>42</sup> Major key learning points resulted from the implementation years of this VV NICU project. The main lessons learned from this project were related to the human and technical aspects and to the balance of authority needed to sustain a project of this complexity. Regarding the human aspect, we found that nurse participation was central. Their voice, their experience, and their professional ability to recognize their own ability to make correct and incorrect judgments based on previous experiences when faced with a project never undertaken before were critical. Institutional support and commitment to implementing the project and giving freedom and fostering an environment of creativity and growth undoubtedly contributed to its success. The project management team, with its ability and speed to modify, eliminate, and create new strategies when necessary and becoming the voice of the majority, created the environment of trust necessary to achieve implementation of the project in a relatively short time. Having the support required to solve problems related to new technologies, with enough flexibility to respond to previously unforeseen problems, was crucial to the ability to ensure an early response to technical problems.

Problems arising during this program have been previously reported and are commonly encountered in NICU settings; therefore, they are not specific to the VV program. From the beginning to 6 weeks into the program, it was apparent that trust and communication between healthcare providers, and between bedside nurse and parents, were major issues. The NICU environment may hinder emergence of a trusting parent-provider relationship.<sup>43,44</sup> Therefore, exposure to 24-hour surveillance due to the use of the VV system created a positive environment to nurture confidence. Nurses felt that intermittent disconnection/connection of cameras could nurture suspicions in the viewer, but if cameras were on almost all the time, parents might misconstrue cer-

tain routine nursing functions and complain. By offering 24-hour viewing with disconnections when procedures or patient examinations were being performed, space was created to provide the best care for patients.

The VV system created a field to test the foundation of FCC. The FCC requires creation of a partnership between families and healthcare providers in which open and objective communication and information sharing must be present to build trust.<sup>45</sup> Most of our nurses are advocates for FCC, and by adopting and actively participating in the VV system, they indirectly positively supplemented FCC. By allowing parents almost continuous viewing access to their babies, they engendered trust and promoted good communication.

Maternal-infant attachment was another issue of concern expressed by nurses, who felt that the VV program could reduce the numbers of visits from parents. Maternal-infant attachment attenuates maternal anxiety and stress symptoms.<sup>46</sup> Mothers of patients in NICUs are at a high risk for short- and long-term symptoms of depression, anxiety, and stress.<sup>47</sup> These symptoms have a long duration, even after the babies are discharged. More studies are needed to determine the potential effects of VV on maternal-infant attachment. This study revealed that the system did not contribute to detachment, but whether VV promotes attachment requires further study.

The VV system created a closer examination of parent visitation. Bedside nurses were mistakenly under the impression that parents were not visiting when, in fact, they would visit during the “other shift.” Bedside nurses were also frequently unaware when parents had visitation constraints (eg, health of the parent, responsibilities for other children, and other family situations) when social workers and physicians were aware of the constraints and were in direct telephone communication with the families.

In addition, parents calling about what nursing staff considered unimportant, such as difficulty seeing the baby due to the presence of high incubator humidity or bilirubin lights, led to important teachable moments. These teachable moments can be hypothesized to improve families’ understanding of their babies’ conditions and needs, thus facilitating trust and bonding. However, the quantity of parent calls eventually led us to institute a “blackout” time during nursing shift changes to ensure that handoffs proceeded with minimal interruption. Regular use of PDSA cycles helped address many of these trust and communication issues. It allowed actions to be created, evaluated, and eventually adopted as “best practices,” such as daily huddles and standardized handoffs and shift reports.

When our VV program was conceived, it was primarily as a nurse-dependent technology that did not



account for the typical challenges already faced by nurses, including infant care demands, providing parents with adequate information regarding their baby's health status, relaying information from doctors and other healthcare professionals, and teaching parents how to care for their premature infant.<sup>48</sup> By following the PDSA cycles for design, redesign, and improvement and anonymously surveying the bedside nurses, unanticipated outcomes of the implementation were noted and corrected. For example, some of the workflow was changed to include unit clerks managing family expectations about the cameras, the safety aspects of the method initially used to attach the cameras, and potential Health Insurance Portability and Accountability Act (HIPAA) issues.

Virtual visitation is useful when parents and other family members are unable to be at the bedside. New parents who are unable to visit their baby for medical, geographic, and social reasons are able to view them 24/7 except for two 1-hour blackout periods each day during nursing shift changes. To improve milk production, the lactation consultant advised mothers to view the camera while expressing their milk at home. As most NICUs move toward an exclusive human milk diet for very low-birth-weight babies, this approach is a potentially powerful tool to increase the rates of use of mothers' milk for patients. Family members in other parts of the country and parents deployed overseas have been able to "meet" their newest family member, which can strengthen social connections. During the COVID-19 pandemic, when visitation was severely restricted or nonexistent for COVID-19-positive mothers, this program was considered "crucial" by staff and parents. Data from the company hosting the cameras also revealed a marked increase in views, compared with a similar period the previous year. The success of the project attracted a donor who provided funding for a major web camera upgrade.

Although NICU nurses can be resistant to change<sup>21,49</sup> or use of new technology<sup>11</sup> if they feel that it will require more time and distract from other care tasks, they can adapt to the new technology when they believe that it improves patient care and they are supported by peers and supervisors.<sup>50,51</sup> The nurses perceived that substantive changes were made on the basis of regular meetings and the anonymous survey results. This outcome made them feel respected and reinforced support for the VV program. Over time, the nurses have overwhelmingly noted benefits of the VV program. During the COVID-19 pandemic, nurses were evenly divided about whether the VV program caused increased workflow issues, but they overwhelmingly supported the program as a way for families to stay connected with their babies.

The major limitation of our study is that it was performed over a 5-year period. Because some nursing turnover occurred during this period, not all the nurses participated in the VV initiative from the beginning. Thus, new nurses had to "learn" how the VV program fits into their workday. When this initiative was conceived, it was uncommon across the state and nationally. Thus, there was likely more resistance during the early project stages, and there were limited data on how to integrate the program into the NICU. In addition, over the 5 years, the changes in people's attitudes toward social media could have affected some of the qualitative data. The PDSA cycles depended on collection of quantitative and qualitative data to test the intervention and testing changes made from previous cycles. Successful completion of these requirements increased the chance of VV program success, and although many of the comments collected were objective (eg, mechanical and workflow issues), other comments were subjective (eg, parental visitation) and required addition of validation methods such as chart auditing. In addition, while some nurses complained that parents called more, others felt that parents called less because they were able to view their baby. Finally, we relied on the company hosting the servers and supplying the web cameras to access the viewing data. Thus, we were unable to independently test data validity, and some useful data (eg, length of time a baby was viewed) were not collected.

It is important to understand that success of new technology implementation depends on whether it makes a user's life easier. It is unrealistic to think that implementing new technology, even if innovative, has no disadvantages. The key is ensuring that the advantages outweigh the disadvantages, and the disadvantages are temporary or minimized, if possible. Some disadvantages might include an initial decrease in productivity or pushback from users, as indicated by our results.

Therefore, it is vital to understand the possible frustrations of those who will be affected by implementation of VV and to make adjustments in response. Using models for change and improvement can help this process be successful. The bottom line is that good technology should benefit everyone who interacts with it. If an organization is following best practices by investigating in technology, transparently explaining the benefits to their teams, committing to timely training of team members, and instituting balancing measures,<sup>52</sup> then the likelihood will be high that the advantages will outweigh the disadvantages.

Advantages of a new technology vary depending on an organization's mission, but one very popular goal of workplace technology is improved communication. Our results indicated that the VV program allowed for more transparency in the highly technical healthcare en-

vironment of the NICU and potentially contributed to development of best practices to improve communication and enhance trust between parents and providers.

The involvement of neonatal healthcare professionals in decision making with evidence-based schemes to implement a program as complex as the VV program was crucial to achieve the results.<sup>53</sup>

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