The coronavirus pandemic has challenged the U.S. health care system to innovate rapidly in order to effectively protect providers, staff, and patients in an era of social distancing. Virtual connectivity has been implemented widely, with particular emphasis in the outpatient setting. Virtual practices have transformed care delivery models within inpatient units as well. Traditionally, our neonatal intensive care unit at Abington Hospital-Jefferson Health practiced multidisciplinary family-centered rounds in proximity to each other at the patient’s bedside. During the pandemic, this model has been challenged by the importance of social distancing and rapidly evolving personal protective equipment guidelines. In our intensive care unit, we implemented three practices — virtual rounds, virtual handoffs, and video monitoring — that have kept our patients and providers safe, while still emphasizing family-centered care. These practices are relatively low-cost and can be implemented in inpatient units across other medical specialties. We believe that with these simple technologies, our health care system can be better and stronger in the face of these challenging times.

**KEY TAKEAWAYS**

» Virtual connectivity has transformed the care delivery model in our neonatal intensive care unit

» Timely implementation of virtual rounds, virtual handoffs, and video monitoring has kept patients and providers safe, while still emphasizing family-centered care
The majority of providers perceive virtual rounding as safe, without compromising the quality of patient care.

These practices are relatively low-cost and can be implemented in inpatient units across other medical specialties.

The Challenge

The coronavirus pandemic transformed the United States health care system within a matter of weeks. One of the most salient changes is the use of virtual practices to deliver care. While telehealth has captured the spotlight in the outpatient setting, there are also opportunities to expand virtual practices to transform care delivery within inpatient units.

Before the coronavirus pandemic, the medical team made bedside rounds in the neonatal intensive care unit (NICU) in proximity to each other. Our NICU is located at Abington Hospital-Jefferson Health, a 665-bed, regional referral center and teaching hospital in Southeastern Pennsylvania. There are approximately 5,000 deliveries annually. In our 34-bed unit, we care for medically vulnerable newborns, many of whom are preterm. Preterm infants are considered immunocompromised and, therefore, may be at greater risk of severe morbidities if infected with coronavirus. However, data on Covid-19 in the preterm population are limited at this time.

Our unit is organized in pods, each with four babies with all of their equipment within several feet of each other. Parents typically visit their babies in-person and spend time by the bedside. Prior to the pandemic, they were frequently in contact with their bedside nurse and other parents in the unit.

One of the strengths of the family-centered care delivery model is that it fosters close patient-provider relationships. If the parents are unavailable at the time of rounds, the attending neonatologist calls each parent on a daily basis. Our average length-of-stay (LOS) is 23 days and ranges between 30 and 120 days in extremely preterm infants. We are able to build meaningful relationships with families even after discharge. A non-profit organization, Today is A Good Day, started by the parents of NICU graduates to support other parents, grew out of a patient-provider relationship that was fostered in our unit.

We asked ourselves, “How can we pivot toward a virtual care delivery model yet still maintain the family-centered values we worked hard to foster?”

In the first week of March 2020, the coronavirus pandemic became a reality. Our hospital is located north of Philadelphia in Montgomery County, Pennsylvania, which was identified as an early epicenter for Covid-19 in the United States. A neighboring children’s hospital was forced to close its pediatric intensive care unit due to concerns for spread of the virus from a pediatric physician. The risks that coronavirus could pose to our unit include infection of vulnerable
newborn infants and loss of critical staff due to illness. Given these risks, we were confronted with the need to quickly implement social distancing, while still delivering high-value care. We asked ourselves, “How can we pivot toward a virtual care delivery model yet still maintain the family-centered values we worked hard to foster?”

**The Goal**

Our goal was to transform the care delivery model in our NICU into a primarily virtual model to protect patients and providers from the spread of coronavirus, while still maintaining the same quality of care.

**The Team**

The team that developed the virtual model included Abington Hospital-Jefferson Health’s Chief Medical Officer, Chief of Neonatology, NICU Medical Director, and Nurse Manager.

**The Execution**

With the closure of the neighboring pediatric intensive care unit, it became clear that coronavirus-related exposures were an urgent threat to our clinical operations. At the end of the first week of March, the NICU medical director began compiling potential options to decrease coronavirus exposures and presented them to the division chief and nurse manager. On March 9, the NICU leadership team met with the hospital’s Chief Medical Officer (who is also a neonatologist), who agreed to our plans to quickly operationalize the virtual practices outlined below. Between March 9 and 13, the NICU medical director began to assess unit wireless network bandwidth and secured funding for dedicated iPads from our philanthropic partners, Today Is a Good Day. An important aspect of implementation was constant communication of the rationale, critical urgency, and new operational changes to staff and families. The leadership jointly issued written communication via email and letters to parents. The medical director also personally called all parents at the time these new changes were made and consulted previous NICU parents for guidance. The nurse manager, chief, and medical director also conducted virtual meetings during nursing huddles and physician meetings to make announcements about operational changes on a daily basis. In addition, regularly updated protocols were posted on the hospital intranet that could be accessed easily by staff. We invited our team to give us feedback to allow for the process to be iterative with constant improvements to achieve our main goal of keeping staff and patients safe.

There were several major operational changes in our unit over time (Figure 1). We will highlight the three most impactful virtual practices below, one of which we had been doing for years as part of our family-centered approach.
The timeline includes national and local government recommendations (marked with grey diamonds) as well as changes made in the NICU at Abington Hospital-Jefferson Health (orange diamonds).

Source: The authors

**Video Monitoring for Families**

The first of our social distancing interventions began on March 11, 2020, on the same day that the World Health Organization declared the coronavirus outbreak a **global pandemic**. On that date, we altered our visitation policy. Only the infant’s mother and one designated support person were permitted to visit during restricted visiting hours. Prior to these changes, our unit was open for almost 24-hour visitation and other family members were allowed to visit.

Due to these visitation restrictions, it became even more important to help families connect with their infants. Prior to the coronavirus outbreak, in April 2016, we began livestream video monitoring using a small camera (Nicview, Natus Medical, San Carlos, CA) at every bedside so that family members were able to see their baby from home. Bedside nurses were also encouraged to take pictures of the babies and send them to families through a secure digital app that mothers used to track the volume of breastmilk produced and frequency of their pumping sessions (Keriton Kare, Keriton LLC, Philadelphia, PA). We have received feedback from families that these technologies have become even more important during the Covid-19 crisis. One mother said, “I can’t go to sleep at night without knowing my daughter is safe. With the camera, I’m able see her every night before I go to bed to give me peace of mind.”
**Virtual Rounding**

Before the coronavirus crisis, our traditional care delivery model included a physical exam of every baby in the unit by the attending neonatologist, followed by bedside rounds with the medical team. Our multidisciplinary team includes the attending physician, nurse practitioner, nutritionist, pharmacist, respiratory therapist, charge nurse, parent, and bedside nurse. The team would walk to each bedside, discuss the plan, and update the parents in-person (if available).

The layout of our NICU prevents our team from maintaining six feet from the neighboring bedside; therefore, we were unable to maintain social distancing in our traditional care model. In order to protect patients, families, and staff, on March 16, we implemented virtual rounding. The attending neonatologist still performs a physical exam on every patient. Rounds take place on a HIPAA-compliant video conferencing platform (Zoom Video Communications, San Jose, CA) with each member of the care team in a different location. One iPad (Apple Inc., Cupertino, CA) is designated as the rounding device that each nurse uses to connect to the video conferencing software. Parents who are physically present at bedside are also included to maintain our commitment to family-centered rounds. It is also an option to include parents remotely; however, most parents still visit their infants in-person.

"While far from perfect, an unexpected benefit of video conferencing is that it can be more effective than masked interactions when attempting to communicate compassionately."

As personal protective equipment (PPE) guidelines have evolved to include all providers wearing masks at all times in the hospital, we have also found in-person interactions with masks more challenging because non-verbal communication is lost when attempting to empathize with families. This also appears to be an experience described by other frontline clinicians when wearing PPE during the West African Ebola epidemic in 2014.13,14 While far from perfect, an unexpected benefit of video conferencing is that it can be more effective than masked interactions when attempting to communicate compassionately.

**Virtual Handoffs**

We recognized the urgent need to enforce social distancing among the physicians and nurse practitioners to protect ourselves and our patients. On March 16, we implemented virtual provider-to-provider handoffs on the same day that virtual rounds were implemented. Rather than our previous model of in-person handoffs, all physician and nurse practitioner handoffs were done virtually on the phone or on video conferencing.

**Hurdles**

On March 21, six days after implementing virtual rounds and handoffs, one of our providers became ill with respiratory symptoms and was subsequently diagnosed with Covid-19. Due to the virtual
practices already in place, the provider had not had physical contact with any of the other care team members or patients. The provider was instructed to stay at home and quarantine herself and her family. Due to our early virtual care interventions, we have not had any other providers diagnosed with coronavirus through May 12, as we prepare this paper. None of the providers, nurses, or patients have had signs of coronavirus illness.

After implementing virtual rounding, we experienced new workflow inefficiencies that we quickly overcame. In our first iteration, each care team member used his or her own work-assigned iPhone (Apple Inc., Cupertino, CA) to connect to the video conferencing software, which created technical difficulties because some providers were unfamiliar with using the platform. We quickly pivoted and achieved improved nurse-to-nurse transition times after designating one iPad located on a mobile computer cart, which the charge nurse physically moved to each bedside. Bedside nurses were then free to participate in rounds without any additional technical burden.

An additional challenge we encountered involves communicating with families who require a translator. Prior to the era of social distancing, we utilized a medical translator either in-person or on the phone during bedside rounds. During the pandemic, we have experienced translator shortages as well as technological barriers and have not been able to include translators directly during virtual rounds. Our solution at this time, though not ideal, is to call the translator on the phone and include them on speakerphone. We hope to find additional strategies to overcome these barriers in the future.

**Metrics**

To understand whether there were any perceived changes in the quality of care after implementing virtual rounds, we anonymously surveyed all providers (n=49) six weeks after it was initiated. The survey was emailed out to all providers through a Google survey tool and respondents were not asked their name, only their role in the NICU. (See appendix: [Virtual Rounding Questionnaire](#).)

These providers included daytime nurses (72%), physicians (18%), nurse practitioners (6%), pharmacists (2%), and other (2%). Nighttime nurses did not complete the survey because they did not participate in virtual rounds. There was a 100% response rate.

When providers were asked whether there has been any harm to the patients in the NICU as a result of virtual rounding, 98% of respondents (n=48) answered no (Figure 2).
Provider Perception of Harm to Patients After Virtual Rounds

In a survey, the majority of providers (RNs, MDs, NPs, other) responded that there had been no harm to the patients after implementation of virtual rounds for six weeks.

**Do you think there has been any harm to the patients in the NICU as a result of virtual rounding?**

- **NO 98%**
- **Yes - 2%**

49 Responses

Source: The authors

NEJM Catalyst (catalyst.nejm.org) © Massachusetts Medical Society

One respondent answered yes and stated that a “surgical patient was not properly assessed following surgery by the performing surgeon or any surgical team members.” This feedback was addressed, and operational changes were made to improve accessibility to surgeons during the Covid-19 crisis.

When providers were asked whether there were unexpected or expected improvements in care as a result of virtual rounding, 31% of respondents answered yes. (Figure 3) Examples of the improvements include improved efficiency, shorter rounding times, increased safety for babies and families, fewer interruptions, improved social distancing, and shorter rounding times.
FIGURE 3

Provider Perception on Improvements after Virtual Rounds

In a survey, one-third of providers (RNs, MDs, NPs, other) responded that there were unexpected or expected improvements in care six weeks after implementation of virtual rounds.

Do you think there are improvements (either expected or unexpected) to care as a result of virtual rounding?

![Pie chart showing responses: 30.6% Yes, 69.4% No.]

49 Responses

Source: The authors
NEJM Catalyst (catalyst.nejm.org) © Massachusetts Medical Society

During the coronavirus outbreak, there have not been any coronavirus-related safety events in the NICU submitted through the hospital-wide online reporting system.

Additional metrics that we currently collect include data from daily questionnaires that all providers and visitors complete to track any new clinical symptoms and potential Covid-19 exposures outside of the hospital. During the coronavirus outbreak, there have not been any coronavirus-related safety events in the NICU submitted through the hospital-wide online reporting system. Length-of-stay from September 2019 through April 2020 was stable. Additionally, the three-day readmission rate remained zero during this timeframe. The 30-day readmission rate decreased from January to April, although any statistically significant change is difficult to establish in this short timeframe (Table 1).

Where to Start

The two new practices of virtual rounds and virtual handoffs, along with the continuation of the existing video monitoring program during the Covid-19 pandemic have kept our providers and patients safe, while still emphasizing family-centered care. These practices can be adopted by other inpatient specialties to enhance social distancing practices. While we use a specialized camera for video monitoring designed for neonates, other inpatient units with visitation restrictions can use
tablets, iPads, computers, cellphones, baby monitors, or other low-cost devices to allow families to see their loved ones when they are unable to physically accompany them in the hospital. We believe that these virtual practices, along with vigilant hand hygiene and social distancing for all staff and families outside of the hospital is of the utmost importance.

Next Steps

We plan to take the feedback from the qualitative data collected from the questionnaire responses to make further improvements to our virtual care delivery model during the coronavirus pandemic. In the future, we plan to measure parent engagement with the livestream video monitoring technology and determine if time spent viewing the livestream video has changed during the pandemic. We also plan to measure other quantitative metrics to assess the efficiency and effectiveness of virtual rounding including rounding time per patient, the frequency of internet connectivity issues, and parent perception of communication during virtual rounding. While these interventions were designed to decrease coronavirus exposure, we believe these changes may influence our baseline clinical metrics. Therefore, we plan to perform a retrospective study to compare quantitative metrics including average length of stay, average ventilator days, average central catheter days, nosocomial infection rate, length of time to full enteral feeds, safety events, and staff sick days before and after the coronavirus pandemic.

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Virtual Rounding Questionnaire

| Month/Year | LOS | 3-Day Readmission Rate | 30-Day Readmission Rate | Average Daily Census |
|------------|-----|-------------------------|-------------------------|---------------------|
| 9/2019     | 21.3| 0                       | 2.4%                    | 26.0                |
| 10/2019    | 12.6| 0                       | 7.1%                    | 21.6                |
| 11/2019    | 22.6| 0                       | 2.6%                    | 29.0                |
| 12/2019    | 19.0| 0                       | 7.9%                    | 22.9                |
| 1/2020     | 22.4| 0                       | 6.5%                    | 26.8                |
| 2/2020     | 22.6| 0                       | 3.0%                    | 24.6                |
| 3/2020     | 19.0| 0                       | 3.4%                    | 23.3                |
| 4/2020     | 23.0| 0                       | 0                       | 20.5                |

*LOS = length-of-stay, days. Source: Michele Walker, MSN, RN, NE-BC, nurse manager, Abington Hospital-Jefferson Health.
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