


## RESEARCH ARTICLE

# Health Care Professionals' Perspectives on Teleneonatology Through the Lens of Normalization Process Theory

Gladys B. Asiedu<sup>1</sup>  | Jennifer L. Fang<sup>2</sup> | Ann M. Harris<sup>3</sup> | Christopher E. Colby<sup>2</sup> | Katherine Carroll<sup>1,4</sup>

<sup>1</sup>Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery, Mayo Clinic Rochester, Minnesota

<sup>2</sup>Division of Neonatal Medicine Mayo Clinic Rochester, Minnesota

<sup>3</sup>Department of Health Sciences Research Mayo Clinic, Rochester, Minnesota

<sup>4</sup>School of Sociology, College of Arts and Social Sciences, Australian National University, Canberra, Australia

**Correspondence**

Gladys B. Asiedu, PhD, Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery, Mayo Clinic, 200 First St SW, Rochester, MN 55905.

Email: asiedu.gladys@mayo.edu

**Abstract**

**Background and aims:** Little research has been done on tele-intensive care unit (ICU) implementation across different types of ICUs, and there exist few studies that have used qualitative research methods to analyze the human and organizational factors influencing optimization of telemedicine for newborn resuscitation. The objective of this study was to understand health care professionals' acceptance, utilization, and integration of video telemedicine for newborn resuscitation (termed *teleneonatology*) in community hospital settings.

**Methods:** Focus group and individual interviews were conducted with 49 health care professionals at six affiliated health system hospitals. Data were gathered from physicians ( $n = 18$ ), nurses ( $n = 30$ ), and a nurse practitioner. Data were inductively analyzed using a thematic approach, and then constructs from normalization process theory (NPT) were deductively applied. NPT rendered a general framework to describe and assess how care teams perceive the implementation of teleneonatology and how they interact with this telemedicine service in their local setting.

**Results:** Local health care professionals accepted teleneonatology as an important, helpful service, yet its implementation was perceived as both valuable and a threat to professional traditions. Utilization may depend on perceived benefit, mutual understanding of the guidelines, and expectations of use, and other relational, human, contextual, and system factors. Participants in this study agreed on the need for collective work to successfully integrate teleneonatology into the local practice.

**Discussions:** NPT uncovered that successful implementation of a teleneonatology program may be facilitated by strong interpersonal relationships among care teams, continuous programmatic training and education, and communicating the clinical value of teleneonatology, including its opportunities and benefits.

**KEYWORDS**

newborn resuscitation, normalization process theory, qualitative research, teleneonatology, video telemedicine

**Abbreviations:** ICU, intensive care unit; NPT, normalization process theory

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## 1 | INTRODUCTION

Telemedicine applications in the intensive care unit (ICU) have been designed to improve quality of care and access to health care, especially for those who live in remote or underserved areas. The importance of telemedicine in general neonatal care has been reported as improving patient outcomes, communication, accessibility, and reducing cost of care.<sup>1-10</sup> In a comparison of actual costs of neonatal telemedicine with actual savings associated with confirmed avoided infant aeromedical transport and nursery costs, there were net savings to the health system of 54,400 AUD (Australian Dollars), which were associated with the use of neonatal telemedicine over a period of 12 months.<sup>1</sup> Utilization of telemedicine has also proved to reduce the number of low birth weight deliveries in hospitals without NICUs, and reduce statewide infant mortality.<sup>8</sup> Other studies, however, have questioned its perceived usefulness and impact on existing workload, workflow, and staffing levels.<sup>11-14</sup> During an evaluation of a telemedicine system and its impact on ICU and non-ICU mortality, total mortality, and ICU-specific length of stay, findings have concluded that there is no reduction in mortality, length of stay, or hospital cost attributable to the introduction of the telemedicine.<sup>12</sup>

Video telemedicine for newborn resuscitation (termed *teleneonatology*) is a system that allows neonatologists to consult with local care teams via a real-time, audio-video connection during high-risk newborn resuscitations that occur in a community hospital. There is a dearth of literature on teleneonatology in resuscitation, and these few studies have demonstrated that teleneonatology positively impacts the quality of newborn resuscitation.<sup>4-6,15,16</sup> In a simulated setting, teleneonatology consults have been shown to reduce the time to effective ventilation (the most critical step of newborn resuscitation) and improve adherence to the Neonatal Resuscitation Program (NRP) algorithm.<sup>5</sup> Clinical studies have shown that teleneonatology significantly improves the quality of newborn resuscitation and increases adherence to process metrics.<sup>4</sup> In addition, neonatal telemedicine programs have been described to shorten the wait time to transfer patients to a higher level of care, and the time to initiate therapeutic hypothermia for neonatal encephalopathy have reduced dramatically.<sup>15,16</sup> Teleneonatology is a complex intervention that takes into consideration human, social, and systemic factors. The context regarding how it is implemented and supported may influence its acceptance and use and, therefore, organizational adaptations would be necessary to make the best use of telemedicine. Little research has been done on tele-ICU implementation across different types of ICUs, and few studies have used qualitative research methods to analyze the social, human, and cultural factors influencing optimization and acceptance of teleneonatology. Organizational and staff readiness for telemedicine, especially in the ICU, needs to be systematically assessed and is important for its long-term success.

Since the implementation of teleneonatology in our institution in March 2013, we have noted that the rate of teleneonatology consultation within our institution's ancillary health system sites does not always correspond with the expected usage based on newborn delivery volumes and acuity. That is, hospitals that offer the same level of neonatal care with similar delivery volumes utilize teleneonatology at very different rates, with consult rates varying from 1 to 9% of annual

delivery volumes. Scheans and colleagues<sup>15,16</sup> reported a telemedicine consult rate of 2% when supporting low-risk maternity centers. In our program, three of the seven hospitals (43%) with level I nurseries have a consult rate of less than 2%. This variation in utilization rates and possible underutilization may be due to poorly understood local facilitators and barriers to using the teleneonatology service. The objectives of this study were to capture local providers' perspectives on teleneonatology, including 1) its current use and value; 2) factors likely to influence utilization; and 3) local initiatives to optimize its integration into the practice of advanced newborn resuscitation. This study used Normalization Process Theory (NPT), a theoretical framework for interpreting how complex interventions can be routinely embedded (normalized) in health care practices, to understand how local health care professionals perceive the implementation of teleneonatology.<sup>17-25</sup> We specifically referenced the human, social, and systemic factors that may contribute to the discrepancy in perceived vs actual usage rates of teleneonatology.

## 2 | METHODS

### 2.1 | Study Design and Setting

This qualitative focus group and individual interview study is part of a larger mixed-method investigation that surveyed physicians and nurses regarding their perceptions and use of telemedicine for newborn resuscitation between October 2015 and June 2016.<sup>3</sup> The larger investigation was approved by Mayo Clinic institutional review board.

The study took place after the introduction of a teleneonatology innovation that was implemented in March 2013 at six of Mayo Clinic's ancillary health system sites. The teleneonatology program allows neonatologists who staff the level IV neonatal ICU at Mayo Clinic Hospital, Rochester, MN to provide synchronous video telemedicine consultations to physicians and care teams located in the surrounding health system hospital sites during advanced newborn resuscitations. Most commonly, these resuscitations include newborns delivered prematurely or those who have respiratory distress or significant perinatal depression.

The six health system sites are staffed by pediatricians or family medicine physicians, have level I ( $n = 4$ ) or level II ( $n = 2$ ) newborn nurseries, and have delivery volumes of 200 to 1,500 births annually per site. The initial technology (introduced between March 2013 and October 2015) used for teleneonatology was a consumer-grade wireless tablet running Health Insurance Portability and Accountability Act-compliant videoconferencing software. The technology was later changed to a wired telemedicine cart equipped with a hardware codec running the same videoconferencing software.

### 2.2 | Participants and Data Collection

A purposive sampling using a criterion-based strategy<sup>26,27</sup> was utilized to identify health professionals who worked directly with newborn resuscitation and teleneonatology at each of the six health system sites. Pediatricians, obstetricians, family physicians, nurse practitioners, and nurses were thus included in this study. Most of the

participants were first recruited as part of an online survey for the larger study,<sup>3</sup> during which they were also asked to indicate their interest in participating in either a focus group or individual interview based on time, availability, and work schedules. Forty-five participants who expressed interest after this sampling strategy were contacted, and interviews were scheduled for focus groups. We also used snowballing recruitment to reach participants who may not have filled out the initial online survey. As a result, emails were additionally sent to 10 potential participants (5 physicians, 5 nurses) out of which telephone interviews were conducted with 4 physicians. One nurse declined to participate and the rest did not respond to our request.

We conducted focus groups and individual interviews at each site at least three months after telemedicine had been implemented. Each site had a separate focus group for physicians and for nursing staff, as illustrated in Table 1. Focus groups and interviews were audio recorded and transcribed. To ensure consistency across the 6 sites, a standard semi-structured interview guide (appendix) was developed to focus on the study aims as structured by the four governing NPT concepts described below. Interview guides were modified after each interview based on what participants are saying in initial interviews and focus groups. This improved the interview guide, and allowed the interviewer the flexibility to explore new concepts and elicit more detailed responses throughout. With the aim of achieving data comprehensiveness, we chose to gather and include data from all individuals who agreed to participate, rather than use data saturation as a criterion for adequacy of data collection and sample size.<sup>28-30</sup> Focus groups and individual interviews were audio recorded and transcribe.

### 2.3 | Normalization Process Theory

Qualitative data from the focus groups and interviews were analyzed using NPT constructs.<sup>17-23,25,31</sup> There are four general analytical concepts NPT uses to describe the organizational work involved in practice change:

1. Coherence: how stakeholders, individually and collectively, make sense of an intervention or new practice, such as having a shared understanding of the objectives and expected benefits of the new practice. It includes individual's knowledge of their own specific tasks and responsibilities within the new practices.
2. Cognitive Participation: the relational work that is done to implement and sustain a specific practice change, such as building communal engagement and commitment, establishing stakeholder

motivation, and ascertaining who works to set up systems and procedures.

3. Collective Action: the operational work involved in the intervention itself, and the work involved in delivering the intervention or innovation.
4. Reflexive Monitoring: the work involved in appraising the benefits and costs of the intervention/innovation, including how the work is framed so that it allows for modification to suit local circumstances.<sup>17-19,21-23,25,31</sup>

These 4 domains are not linear representations of how work unfolds in constructing and implementing innovations in organizations; rather, they are iterative processes that operate in a dynamic relationship with each other and in the context of the intervention or new practice.<sup>17,21,23,25,31-33</sup>

### 2.4 | Analysis

We adopted a 2-stage approach to our analysis. Data were first analyzed inductively using a thematic approach,<sup>34-36</sup> and we then drew on the four governing concepts of the NPT theoretical framework for a deductive analysis. The interviewer read the transcripts to identify major themes for discussion with the study team. During study meetings, the team sought clarification on major themes through discussion. We looked for commonalities in the themes across the data which were then clustered and put into categories. For any discrepancies, the interviewer returned to the original transcripts to further assess the data and confirm or modify the themes for discussion with other team members at the next study meeting. Subsequently, themes were interpreted through NPT constructs to depict participants' acceptance, utilization, and integration of telemedicine (Table 2). We then synthesized the data till we reached a conceptual depth and the findings were grouped into 3 major categories that highlight participants' perspectives. Data management and analysis was aided by qualitative analysis software (NVivo 11 QSR International Pty Ltd.).

## 3 | RESULTS

A total of 49 care providers (18 physicians, 30 nurses, 1 nurse practitioner) participated in either a focus group or individual interviews between December 2015 and June 2016. Specific demographics for the larger study had been reported earlier.<sup>3</sup> There were 9 focus groups and 4 individual interviews. One site did not have nursing staff representation and only participated in physician interviews. Interview participation by the different health system sites are presented in Table 1.

Findings reflecting themes interpreted through NPT are illustrated in Table 2. Three major analytical categories were reached, each of which maps to a study objective: 1) *Positively appreciating telemedicine innovation*, 2) *Relational factors influencing Telemedicine Utilization*, and 3) *the integrative work needed for organizational change*. The identified themes are described below, with representative quotes coded to distinguish between physician and nursing roles (See Table 3). No major differences in perspectives were found across the 6 sites and between focus groups or interviews.

**TABLE 1** Interviews and Focus Groups per site and participant role

Sites	Physician	Nurse	Total # by site
Site 1	4	12	16
Site 2	5	8	13
Site 3	3	3	6
Site 4	3 <sup>a</sup>	3	6
Site 5	1*	4	5
Site 6	3*	0	3

\*Individual interviews.

<sup>a</sup>Includes 1 nurse practitioner.

**TABLE 2** NPT Constructs and Analysis for Health professional's Perspectives on Teleneonatology Use in Newborn Resuscitation

Coherence (sense making work)	Cognitive Participation (Relational work)	Collective Action (Operational work)	Reflexive monitoring (Appraisal work)
<i>Differentiation:</i> Participants understood how the teleneonatology service is different from previous telephone consult technology and reported that teleneonatology is standalone, requires one time set up, no waiting on phone calls from neonatologist and better audiovisuals. Others expressed differences in expectations around the use of the technology. Perceived differences in cultural change for site physicians to have neonatologist in resuscitation code event.	<i>Enrollment:</i> Lead neonatologists, supervisors, and nurse managers worked to advance the use of the technology through staff meetings, simulations, and educational programs. Participants identified the need to expand the service to other care specialties such as anesthesia and respiratory therapy.	<i>Skill set workability:</i> Allocating tasks and key players to integrate the teleneonatology into practice. Technology set up is dependent on staffing availability. Participants discussed designating one staff member to initiate set up. Nurses felt capable because their work role demands skills in technology and ties with technical demands for teleneonatology.	<i>Reconfiguration:</i> Redefine procedures or modify practices such as changing resuscitation tasks to allow for a consult with a remote neonatologist. There is a perceived lack of feasibility of service activation in the midst of resuscitation creates hesitancy to initiate a call.
<i>Communal Specification:</i> working together to build a shared understanding of the aims, objectives, and expected benefits of the new technology: e technology; project lead met with site staff to discuss the service and underwent multiple simulations. Staff gained information about the technology through their supervisors. Participants noted the opportunity to optimize the use of the technology; setting the technology up before each delivery. Some misconceptions about the use of technology.	<i>Activation:</i> Collectively defined the actions and procedures needed to utilize and sustain the service. Arranging administrative and logistic help, including, sharing patient information with remote neonatologist; service activation through the institutional admission and transfer call center; always setting up teleneonatology if there is evidence of neonatal respiratory distress.	<i>Contextual integration:</i> Ensuring the right resources in each local site's context. Participants noted adequate staffing and site specific infrastructure: the need for additional space for teleneonatology equipment. Other site-specific resource needs include advanced laboratory technology to enhance fast transmission patient test results to remote neonatologists. Managing technology malfunctioning.	<i>Communal appraisal:</i> Altering the current technology service to model the emergency department's response system in next phase of designing the teleneonatology to ensure the use of immediate, direct connection versus routing through a call center. Making the technology simple to use; mounting overhead camera to the baby warmer that can be controlled by remote neonatologist.
<i>Individual Specification:</i> Individuals worked to achieve their own understanding of the teleneonatology program: participants watched online videos and participated in simulations.	<i>Initiation:</i> Organizing an individual lead to drive the technology service. Participants noted that high levels of leadership engagement promoted the integration. These individuals included neonatologists, supervisors, and nurse managers who championed the implementation.	<i>Interactional workability:</i> Interactional work with the teleneonatology service/technology in everyday settings. Negotiation by local physicians and remote neonatologist as they try to communicate complex clinical information to each other through video. Letting someone else "take charge" of the resuscitation.	<i>Individual appraisal:</i> Individual assessment of the effects of the new technology on them and the contexts within which they work. Participants expressed their past personal relationships with a video telemedicine system and noted circumstances where the systems had malfunctioned, referencing those experiences as possibly influencing the underutilization of the new technology. Individual appraisal of impact of teleneonatology on workload and assessment of additional work to manage and maintain connection: set up process and constant monitoring.
<i>Internalization:</i> Understanding the value, benefits, and importance, and attributing worth to the technology program. Participants said technology creates sense of relief, feelings of comfort, lessened anxiety, and improves their confidence. Live view of baby and performing visual examination. Decreasing newborn transfer and cost.	<i>Legitimation:</i> The belief that using the technology is the "right thing to do". Participants described evaluative work, making assessment of when to initiate the service. Assessing physician preference before making a judgement to initiate set up. Legitimation may also depend on other human factors such as physician preferring actual person than virtual support.	<i>Relational integration:</i> Developing relationships with and confidence in remote neonatologists. Good interpersonal and communication skills of the remote neonatologist positively influenced use of teleneonatology. Ability to make site physicians feel at ease and not judged are key to great relational integration.	<i>Systematization-</i> Organizing a reliable way of keeping up to date with new technology. Frequent refresher and required supervisor training to keep up to date. Anecdotal examples of what has worked and what hasn't in during and after implementation. Required training for all staff. A quick check list to review-trouble shooting.

### 3.1 | Theme 1: Positively Appreciating Teleneonatology Innovation

Data were mapped to this theme if participants reported having a shared understanding of the utility and differences between telephone

and telemedicine consults, understood the benefits and application of teleneonatology, and shared interest in advancing the use of teleneonatology. Across all sites, participants were generally accepting and supportive of teleneonatology implementation. Some participants identified teleneonatology as an innovative way to quickly connect to

**TABLE 3** Perspectives on Teleneonatology Use in Newborn Resuscitation

Theme	Description	Exemplar Quotes
<b>Theme 1: Positively Appreciating Teleneonatology Innovation</b>	<p>This theme describes how local care providers made sense of the innovation and the shared understanding of the sets of practices regarding telemedicine being introduced at their site.</p> <p>Implementation of a new technology, like teleneonatology, is perceived as valuable.</p>	<p>"But my level of comfort, anxiety, ah, was significantly reduced knowing now as opposed to 16 years ago that if I'm getting through a resuscitation or if I'm doing a resuscitation and I get into trouble, so I've got somebody who can really provide me some assistance." MD</p> <p>"If you're only on call every 14 days and then, you know, and you have to have an intervention maybe 2–3 times a year, um it, you know, it can be challenging to recall all the steps; go through the motions and have that reassurance that you're doing the right thing. So having that, you know, is, I think, is very helpful." MD</p> <p>"It's reassuring to know that they're there for us. I mean, um, 'cause we don't have pediatricians here all the time so they can be a help until it gets here too." RN</p> <p>"They were communicating with the physician on the other side and he was able to actually look at the baby and assess the baby and ... was asking ... the physician or the nurses that were there to do certain things to get a reaction from the baby so that he can determine better what's going on. I think it went really well." MD</p> <p>"Nursing usually starts it ... Have the nurses start it up without even Peds there yet ... And that's why it's reassuring, 'cause it ... least we got somebody until Peds gets here." RN</p>
<b>Theme 2: Relational factors Influencing Teleneonatology Utilization</b>	<p>This theme emphasizes the human and behavioral realities that come with using teleneonatology in a local context and how providers make decisions on using the technology. There is the interest of change and the reality of work that comes with the change, and how the change can be sustained.</p> <p>Several important human factors (often subtle) and considerations for the successful implementation and utilization were discussed. Use of the telemedicine service may depend on perceived benefit, mutual understanding on the guidelines and expectations of use, and personal or contextual factors.</p>	<p>"It seemed like a good idea at the time and but it really, as it's true with many other things, it's not until you actually get into a situation where you might potentially use it where you realize its limitations of it." MD</p> <p>"Its limiting aspects is that if I'm elbow deep in resuscitation, I really can't take the time to troubleshoot what's going on with the iPad [telemedicine device]. I have way too many other important things to do ... just really I have too many hats to wear at that point and I couldn't possibly take on another one in that state." MD</p> <p>"... if I was ... working with providers that I don't know very well or pediatricians ... I can see where ... I could be intimidated, like not one to say, 'Hey, would you like to bring in the EDR [telemedicine] cart' you know and to have a doctor say, I don't know, 'you think I can't handle it myself?' I would never want our pediatricians to think that." RN</p> <p>"I mean if they're thinking that every time we're given a little bit of positive pressure ventilation we'd be calling, then they're right, then we're not using it. But in our mind, it's when we have a very true resuscitation, a large code, um, that's when we're using it. We don't have many of those. So if it's looking like it's not used often, it might be a difference in when the expectation is of usage." RN</p> <p>"Now I've never used the [video telemedicine] because I usually don't need their help with the visual diagnosis. If I need help I need hands on, somebody to intubate the baby or put the chest tube in; and you can't do that by video chat so I haven't really found it something I would use." MD</p> <p>"So if it's looking like it's not used often it might be a difference in when the expectation is of usage." RN</p> <p>"I think [it] also depends, the neonatologist you have at that end. If you have Dr. Z, he's very calm; if you have Y (laughing) it's very different ... you know and they're both excellent neonatologists but the way they approach the resuscitation and what's happening ... they expect things done in a very different way." MD</p> <p>"But whether or not we [nurses] initiated or the physician wants to use it is strictly personal choice. You know they [physicians] decide if they they wanna get it up and start using it." RN</p> <p>"I think um how the reception is received in [the larger city] makes a large difference so when I've contacted them on the obstetrics side it's been positive." MD</p> <p>"I think if the skill sets of the referring pediatricians were to start to be scrutinized or call them [in] to question 'cause a result of something like this; it it's gonna make us decrease ... [how telemedicine is used] ... but I do feel that can be a significant intimidating factors, see that camera go on in resuscitation situations." MD</p>

(Continues)

TABLE 3 (Continued)

Theme	Description	Exemplar Quotes
<b>Theme 3: The integrative work needed for organizational change</b>	<p>This theme describes the integration of the new technology into the routine practices in a local context and the collective work that is involved in the implementation.</p> <p>This theme also highlights opportunities and limitations at the organizational and system levels. For example, whereas local providers may feel compelled to share clinical information about patients with the remote neonatologist, logistical factors may impede this, such as delay in patient testing results, which are beyond the control of the site provider. There is also the need to engage broader medical specialties in using the technology</p>	<p><i>"I know it was tough when it first rolled out because they were saying you know, 'where are the blood gases, what are the blood gases' and we, our labs, take a lot longer than maybe [the larger city] and they usually have like a little thing that tests the blood gases right away but we have to send it somewhere, so understanding that our labs take a lot longer is something for them to learn."</i> MD</p> <p><i>"And there are venues where this works in other areas. You know, for example, an acute heart attack in the emergency department where there is a phone number and there is a routing path that has been established that recognizes the absolute emergency nature of the call. And it's, it's known, it's known, from here to there. So there aren't any middle people ... I mean, that can be established on baby place like if you call a specific line then this is a resuscitation call."</i> MD</p> <p><i>"There's a model in the ER that's working that can be replicated."</i> MD</p> <p><i>"You would just hope you have the extra body and staff to grab the iPad [telemedicine device] ... if we don't have somebody to grab the iPad obviously we're focusing on ... but we don't leave our patient."</i> RN</p> <p><i>"I would like to see this telemedicine cart being used in other fields. Like, you know, sometimes we are not sure with our babies, what's the next step. Rather than transferring the baby out which is, like, much more expensive, just like ah, using it for other reasons other apart from resuscitation."</i> MD</p>

a remote neonatologist and improve outcomes for patients, families, and staff. They noted the benefits and value of the technology by comparing it with past experiences in which the telephone was the only technology available to connect the local physician and the neonatologist. These benefits included the remote neonatologist being able to have a live view of the baby and perform a visual examination, and for local care providers to be able to collaborate more actively with the remote neonatologist during newborn resuscitation.

Major discussions about the benefits of the technology centered around decreasing newborn transfer rates and costs, and instilling confidence and easing anxiety among local site providers. Most nurses reported that the technology improved their confidence and provided reassurance during advanced resuscitations while waiting for the neonatal transport team or arrival of the on-call pediatrician. More than half of the physicians also said that the technology provided a sense of relief, created feelings of comfort and security, and lessened anxiety. Participants also reported that telemedicine created an opportunity to streamline care processes, which makes access to care easier for patients and their families.

### 3.2 | Theme 2: Relational factors influencing Telemedicine Utilization

Data captured under this theme explored human and behavioral factors that could potentially influence care team's utilization of a new technology. These factors include physicians and nurses' attitudes, behaviors, motivation, and interactions with and around the utilization of telemedicine.

The human factors that physicians and nurses needed to navigate for successful telemedicine consultation included subtle everyday non-verbal behaviors. Participants reported doing what could be

considered evaluative work when determining whether and when to begin a telemedicine consultation. For example, some nurses reported having uncertainties about when to set up the technology in advance and having to assess each physician's preference before making a judgment because utilization can depend on the community physician's preferences and choice.

Participants' perceived cognitive appraisal of telemedicine's practicality, significance, and limitations revealed that more than half of the physicians commented on the feasibility of service activation in the midst of resuscitation, and they presented scenarios where they would be hesitant to initiate a call if they are actively involved in newborn resuscitation. Some of the nurse participants mentioned that they always set up the technology if there was evidence of fetal distress, whereas others felt it was unnecessary to set up at every problem delivery. Others reported that experiences around technology malfunction may have influenced the decisions to not use the technology. Many referenced past experiences when there were disconnections or device malfunction, thereby creating additional work to manage and maintain connection with the remote neonatologist. Some participants reported that local physicians' competency may be inadvertently questioned or they may feel less in control of the resuscitation. These factors could potentially inhibit the use of telemedicine and future innovation in telemedicine. Both physicians and nurses agreed on the need to manage perceptions about telemedicine by having clear expectations and guidelines for using the service and ensuring mutual respect between the local care teams and the remote neonatologist. Physicians emphasized that good interpersonal and communication skills of the remote neonatologist positively influenced use of telemedicine and commented on their ability to make site physicians feel at ease and not judged. These skills were perceived as key to enhancing great professional relationships.

### 3.3 | Theme 3: Integrative Work Needed for Organizational Change

Integrative work under this theme refers to work that is required by different systems to effectively integrate a technology into the organizational practices of a group.<sup>37,38</sup> Data were coded to this theme if participants made references to the collective work of the different organizational systems and how the different systems interact for a successful teleneonatology service. This includes opportunities and limitations at the organizational and system levels.

Participants recognized the collective work involved in integrating teleneonatology into the local practice. They reported working collaboratively to share patient information with the remote neonatologist during consultation, but they acknowledged that this could be impeded by logistic challenges and site-specific difficulties. For example, because some sites are not equipped with advanced laboratory technology, the remote neonatologist may perceive patient testing as delayed.

Service activation for teleneonatology is routed through the institutional admission and transfer call center. While, overall, this system has worked well, many participants referenced instances of long wait times and rerouting of calls to reach the neonatologist. Based on the care teams' appraisal and experience with this process, they suggested modeling the teleneonatology service activation after the emergency department's response system, for immediate and direct connection. Other suggestions include making the technology simple enough for ease of use, and to mount a camera (which can be controlled by the remote neonatologist) to the baby warmer.

Space and staffing may also impede the successful use of teleneonatology. Some reported little space for additional telemedicine equipment in small rooms, which was identified as a site-specific infrastructure challenge beyond the control of physicians and nurses. Some participants reported that staffing levels vary depending on the time and day. When staffing is limited, the available providers may be focused on assisting with resuscitation, leaving no extra hands to initiate the consultation and manage the technology.

Participants thought that high levels of leadership engagement promoted the integration of teleneonatology and could promote utilization. Neonatologists, supervisors, and nurse managers championing the integration engaged staff in meetings to provide information on the innovation and the rationale for implementation. Others reported that staff meetings and site visits from the remote neonatologists did not work well with their own schedules and that they were unable to attend those meetings. Participants recognized the collective work needed to train new staff and maintain competencies to promote continued awareness, understanding, and engagement with teleneonatology. They also identified a need to engage care teams from other medical specialties who may be present at newborn deliveries (e.g., anesthesia, respiratory therapy) so they were aware of the teleneonatology program.

## 4 | DISCUSSION

Our research is focused on the meaning that people attribute to new innovations and the effort that is made individually and collectively

to implement and embed the innovation in everyday practice.<sup>18,19,22,23,39</sup> Here, we used qualitative methods informed by NPT to gain understanding of the complexities involved in the acceptance, utilization, and integration of teleneonatology into newborn resuscitations in community hospital settings. We explored how the local physicians and nurses made sense of and accepted the changed teleneonatology program, enacted additional work, and integrated the innovation into their routine neonatal resuscitation processes.

Findings reported in the first theme revealed that teleneonatology implementation was well accepted and important to the practice. Participants clearly understood the benefits of the teleneonatology program, which is consistent with earlier reports.<sup>2-7,13,21-25,33,40-44</sup> They recognized that teleneonatology can increase patient survival, reduce unnecessary neonatal transports and its associated costs, create feelings of comfort and security for care providers, and improve staff satisfaction. The second theme found individual behaviors that can impact utilization of teleneonatology, including local care provider preferences and the interpersonal and communication skills of the remote neonatologist. The third theme reports on systemic factors related to program integration such as the process of teleneonatology activation, staffing and space limitations, and leadership engagement. Although teleneonatology is designed to address local needs, all three themes speak to our finding that additional collaboration and collective work is needed between the local health system site and the remote neonatologist to ensure success of the program.

The use of NPT constructs<sup>21-25,33</sup> reveals the degree to which professional interactions, relationships between staff, and the organizational context shape how teleneonatology may or may not fit with health care professionals' neonatal resuscitation work.

In our study, the application of the first NPT construct, coherence, revealed the work of health professionals' in understanding the new teleneonatology service. Health professionals worked to achieve coherence across contrasting perceptions when the new initiative of teleneonatology was introduced. This coherence was critical to the success of teleneonatology implementation and utilization. Moreover, health professionals expressed appreciation of the technology, while a few mentioned the discomfort they or other providers may experience should their competence be questioned by the remote neonatology consultant. This finding, that is, that health professionals have positive perceptions of telemedicine, is supported in existing literature,<sup>1,3,6,12,44-48</sup> however, its uptake in routine clinical use has been less than expected<sup>12,44-48</sup> due to factors embedded in an organization's context and routines of health care professionals. Factors including perceived usefulness, perceived ease-of-use, clinical practice guidelines and performance standards, feelings of self-sufficiency, and the belief that that the use of the technology will increase burden contribute to suboptimal uptake.<sup>13,45,46,49,50</sup> Physician resistance to new or innovative information systems due to a perceived threat to professional traditions have been extensively explored<sup>13,45,49,50</sup> and can be an inhibiting factor for teleneonatology acceptance and use. Some may view technology-based services as a threat to their expertise, an interruption in their workflow, or an overly intrusive method of observing and evaluating their performance.<sup>13,42,50</sup> These findings highlight the importance of encouraging communication regarding

the purpose, value, and collaborative nature of the teleneonatology service between remote and local site health professionals in order to avoid misconceptions and disparate understandings of the technology. NPT's coherence construct is useful for seeking greater understanding from participants as to how they individually and collectively may make sense of the new technology, which in turn, may help address resistance from health professionals, and differences in expectations and perceptions around the new intervention. It may also create avenue for educational opportunities and assessing content of information that may be useful for participants during implementation.

The second NPT construct, cognitive participation, can be thought of as the relational work<sup>21-25,33</sup> involving site staff, neonatologists, and other leads in the implementation who were described as critical to the integration of the technology. The relational work in our study encompassed a number of different activities. Participants frequently mentioned staff meetings, simulations and educational programs, mobilized logistics including sharing patient information, and setting up the technology before delivery. Participants also spent time assessing whether using the technology is the "right thing to do", which they often found challenging. Cognitive participation and emphasis on the notions of legitimation and buy-in, both in terms of the individual health professionals involved and others, have been extensively reported as central to the successful implementation of any new technology<sup>51-55</sup> even though the work that is aimed at actively involving health professionals in e-health services are rarely reported in existing literature.<sup>55</sup> The work associated with cognitive participation could have disparate outcomes depending on the health professional's attitude to an implementation. For instance, health professionals who actively support the technology or intervention can certainly commit to its use and advocate for its utilization,<sup>55</sup> while those who project a negative attitude can impact other professional's commitment needed to make the technology work and, thus, impede implementation. Engaging staff, physicians, and nurses, and achieving buy-ins to improve a health care technology highlights the importance of both personal, relational, and system level factors in any implementation process, as echoed in other reports.<sup>56-58</sup> This relational work may also aid in organizing resources, identifying local "champions", and other care areas that could benefit from the technology. Practical steps such as communicating the value of technology, generating a high level of physician interest, and continually assuring local physicians that their competencies are not being assessed are opportunities that can enhance acceptance and positive cognitive participation.

The third NPT construct, operational work or collective action, describes the day to day activities (involving technology management and resourcing)<sup>21,23,25,33</sup> that health professionals have to undertake for a teleneonatology service use. Providers in this study reported several concerns that may impede the collective activities around the activation of teleneonatology. These include negotiating how teleneonatology may be used in conditions of limited space and staffing, and setting up a connection with neonatal specialty either before or in the midst of newborn resuscitation, constantly monitoring and ensuring connection with remote neonatologist connection. Health care providers at the host site also needed to collect and share

patients' clinical information. These and other administrative tasks are vital to the reality of the teleneonatology utilization but may be regarded as a barrier to initiating a tele-neonatal consult. Physicians at the host site may have many things to manage, and, additionally, they must negotiate how to communicate complex clinical information to a remote neonatologist through video, in the midst of an advanced newborn resuscitation code. Other aspects of interactional workability involve physicians evaluating whether their competencies are under scrutiny and, in some instances, may feel less in control of the resuscitation. Previous studies have shown that operational tasks and "reality" of innovation<sup>11,45,59-63</sup> contribute to resistance to using systems that add complexity or require additional effort or time from physicians. Bulik<sup>59</sup> reported that some physicians feel less in control of their time and the way that they perform history-taking when utilizing telemedicine. This emphasizes the interactional workability that is necessary to utilize complex intervention like teleneonatology in a clinical setting. These, and other organizational challenges (such as technical support, user training, and lack of existing guidelines and protocols that fit with teleneonatology needs)<sup>11,45,59,60,63</sup> need to be considered in order to progress professionally-led local innovations such as teleneonatology. Understanding the collective action of any implementation may be helpful in tailoring new technology to fit into existing workflows and clinical routines.

The fourth and final construct, reflexive monitoring, refers to the participants' appraisal<sup>14-17,19</sup> of the teleneonatology services, of whom in our study almost all approved of the teleneonatology service. Reflexive monitoring of any implementation is essential to embedding and maintaining new clinical practices, and has been echoed in relevant studies<sup>30,61,62</sup> as either alleviating concerns or confirming the need for improvements to a new implementation. Yet, there is little evidence in the literature of local appraisals or ways in which implementation processes might be reconfigured by user-produced knowledge, and there is even less information on the ways in which health professionals appraise whether an intervention is worthwhile or not.<sup>55</sup> Health professionals in our study reflected upon their own past experiences and that of others to assess the advantages and limitations of the technology service, noting aspects of the technology that have not worked in the past as barriers to the utilization of the technology. Participants identified some areas of the technology that can be improved: almost all participants proposed an improvement to the service that will provide direct connection to a neonatal specialist and change video function to allow remote neonatologists adjust the video to suit their needs. Also, participants suggested continuous refresher programs for staff. For this construct, patterns of collective action are continuously evaluated both formally and informally by participants during the implementation process, which may inform future improvement<sup>21-25,33,52,64</sup> to the technology.

We argue that NPT can be a useful analytical tool for researchers so that they can attune themselves to health professionals' orientations toward potential problems and problem solving during implementation of a new technology.<sup>33,64</sup> Also, technology implementations that directly address findings from an NPT-driven analysis are more likely to normalize within the practice. Although this study provided an opportunity to assess the optimization of teleneonatology in our health system, the findings must be interpreted



and applied cautiously. First, the study involved six health system sites that have various staffing models, annual delivery volumes, and levels of newborn care. The findings may not be wholly transferable to other health care systems or other telemedicine services that may have unique organizational cultures and external constraints, resources, and facilities. However, the transferability of findings from this study is strengthened through our use of NPT. NPT enhanced our exploration of the social processes and systemic issues regarding the individual and collective work involved in the implementation and sustainability of a teleneonatology service, which drew from multiple perspectives across several sites.

## 5 | CONCLUSIONS

Using NPT theoretical constructs aided in explaining the factors that enabled or inhibited implementation and sustainability of teleneonatology. The use of video telemedicine in newborn resuscitation holds promise for improved patient outcomes, reduced costs, and efficient use of resources. It can be used to support teams at birthing centers and augment team composition by including a neonatologist located at a remote site.

## FUNDING

The data reported were collected as part of a larger study that was funded through an internal grant from the Mayo Clinic Department of Pediatric and Adolescent Medicine. The views expressed in the publication are those of the authors and not necessarily those of the funder. The funder had no role in the study design, data collection and analysis, decision to publish or preparation of the manuscript.

## CONFLICTS OF INTEREST

The authors have no financial conflicts of interest.

## AUTHOR CONTRIBUTIONS

Conceptualization: Drs. Christopher Colby, Jennifer Fang  
 Formal Analysis: Drs. Gladys Asiedu, Katherine Carroll  
 Funding Acquisition: Drs. Christopher Colby, Jennifer Fang  
 Investigation: Drs. Christopher Colby, Jennifer Fang, Gladys B. Asiedu, Katherine Carroll, Ms. Ann Harris  
 Methodology: Drs. Gladys B. Asiedu, Katherine Carroll, Ms. Ann Harris  
 Software: Drs. Gladys B. Asiedu, Katherine Carroll  
 Visualization: Drs. Christopher Colby, Jennifer Fang, Gladys B. Asiedu, Katherine Carroll, Ms. Ann Harris  
 Writing-Original Draft Preparation: Drs. Christopher Colby, Jennifer Fang, Gladys B. Asiedu, Katherine Carroll, Ms. Ann Harris  
 Writing-Review & Editing: Drs. Christopher Colby, Jennifer Fang, Gladys B. Asiedu, Katherine Carroll, Ms. Ann Harris  
 Gladys B. Asiedu and Katherine Carroll had full access to all of the data in this study and take complete responsibility for the integrity of the data and the accuracy of the data analysis.

## ORCID

Gladys B. Asiedu  <https://orcid.org/0000-0002-2710-5203>

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**How to cite this article:** Asiedu GB, Fang JL, Harris AM, Colby CE, Carroll K. Health Care Professionals' Perspectives on Teleneonatology Through the Lens of Normalization Process Theory. *Health Sci Rep*. 2019;2:e111. <https://doi.org/10.1002/hsr2.111>

## APPENDIX A

### FOCUS GROUP AND INDIVIDUAL INTERVIEW GUIDE

Question Introductions	Probable Probes	Objective Introductory Question
1. Name, role, number of years at current role.		
2. Do you use any form of eDR to connect to providers in neonatology in Rochester for high-risk newborn resuscitations?	If yes: How often? Can you share those experiences? Eg a. <i>how eDR use is determined, who initiates it and how the process and protocol works.</i> Can you explain? If no Have you had the need to use it but wasn't used and why (ref survey results)?	To understand provider perceptions and engagement in the use of telemedicine for newborn resuscitation at each of the six health system sites.
3. In your experience have you encountered any challenges/difficulties with eDR and can you share?	If challenges are expressed: What were the challenges eg technology, team work dynamics, safety issues etc. How are those resolved?	To identify current barriers to the use of eDR that may impact future use.
4. Are there circumstances that the eDR has worked well and can you share those experiences with us?	How and when eDR has worked so well Why it has worked so well	To identify some positive perception of eDR and to identify components that facilitate utilization
5. How do you perceive the use of other forms eDR in future new born resuscitations?	Do you see any difficulties/problems that could occur with this: Staff Protocol Technology Work environment Others How can these problems be addressed?	To identify potential barriers for successful implementation of eDR technologies in each of the six health system sites.
6. Are there suggestions and recommendations you might have regarding the implementation of eDR or enhancing its use with future high risk newborn resuscitations?	Staff Protocol Technology Training others	To identify potential staff-identified initiatives that will optimize the integration and use of telemedicine into local organizational culture and practice.
7. Can you share with us your interests in partnering with other pediatric sub-specialists through telemedicine consultation to support your local pediatric practice?	Interested-why? Not interested-why? Situational?	To identify potential interests in partnering with other sub-specialists