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Innovative capability development process: A Singapore IT healthcare case study

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THE “FEAR FACTOR” IN CRITICAL CARE TELE-PEDIATRICS

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Abstract

How do emotions affect telemedicine adoption and usage for critical-care episodes? We report on early findings from a grounded theory approach in a multiple-case study of critical care tele-pediatrics (research in progress). Thus far our findings suggest that specialists believe that generalist clinicians at remote “spoke” hospitals are anxious and fearful when performing in a high stress crisis situation involving an acutely ill or gravely injured child, leading to tunneling of attention (overlooking important clinical details). The specialists at tertiary care “hub” hospitals feel they are able to keep an emotional distance from the situation and they also report feeling less anxious because they have had extensive training for these acute care situations. Both emotional distance and higher skill level seem to help the specialists to take in more clinically-relevant information and use this to guide the generalists. The generalists’ fear of negative evaluation by the specialists, or embarrassment in front of other clinicians, may have some impact on their decision to use tele-pediatrics, but does not seem to be a salient concern during critical care episodes. These findings suggest that emotions do play a role in telemedicine use and possibly also in other forms of technology-mediated inter-organizational collaboration.

Keywords: telemedicine, anxiety, stress, emotion

1 INTRODUCTION

The emotional side of technology-mediated inter-organizational collaboration has received little attention in the IS literature. Studies in other fields (reviewed below) find that stress leads to anxiety which in some situations will impede learning and in other situations improve learning. Stress may also increase or decrease the likelihood that individuals will seek knowledge from others. Under the stress of extreme time pressure people seek less information and performance degrades.

In critical-care pediatrics a child’s life hangs in the balance. A stressful situation such as this can elicit emotions such as fear or anxiety among clinicians who are not trained in pediatric critical care. Telemedicine can connect these clinicians to critical-care specialists located in tertiary-care teaching hospitals. In this paper we focus on the specialists who use telemedicine to provide assistance to physicians located elsewhere who are caring for acutely ill or critically injured infants and children (critical care tele-pediatrics). We report on early findings from case studies of two “hub” hospitals that provide pediatric critical-care consultation services via telemedicine. Conversations with pediatric intensivists (pediatricians who received additional post-residency certification in pediatric critical care) reveal that fear, anxiety and other emotions do apparently play important roles in both the acceptance and ongoing use of telemedicine in this domain.

This paper is organized as follows: We discuss prior research addressing the influence of stress on learning, information seeking, decision-making and collaboration. We describe our methodology, then discuss how the “fear factor” played out among several stakeholder groups –specialist experts at hub hospitals, generalist physicians and other clinicians at spoke hospitals, and hospital administrators. We discuss these findings and suggest opportunities for further research on the role of emotions in computer-mediated inter-organizational collaboration under time pressure.

2 EFFECTS OF STRESS, ANXIETY AND FEAR ON LEARNING

Human stress is a physiologic and emotional response to a stimulus (the stressor) (Gaillard, 2001). We experience stress and related emotions as follows: A triggering event or stimulus (such as a loud noise) precipitates an immediate pre-attentional orienting reflex (Rohrbaugh, 1984). Next the brain attends to key features of the precipitating event and matches them to past experiences, evoking a previously learned response. A state of arousal, initially experienced as uncomfortable, is subsequently experienced as a more refined emotional cognition. Unexpected stressors cause individuals to focus on their own emotional response, and less on the stressor itself. (Chajut and Algom, 2003; Zohar and Brandt, 2002). When a stimulus is perceived as threatening, the individual is more likely to use selective attention (Baddeley, 1972), attending to a subset of available information. “Under stress, attention appears to channel or tunnel, reducing focus on peripheral information and tasks and centralizing focus on main tasks ... tunneling of attention can result in either enhanced performance or reduced performance, depending on the nature of the task and the situation. ... When peripheral cues are irrelevant to task completion the ability to tune them out is likely to improve performance. On the other hand, when these peripheral cues are related to the task and their incorporation would otherwise facilitate success on the task, performance suffers when they are unattended” (Staal, 2004, p. 31). Also, when anxiety impedes one’s ability to process relevant information, this itself can increase stress. Thus, anxiety is both a response to stress and a cause of it.

Through *attentional* processes a negative feeling is experienced, and through *cognitive* processes it is interpreted as an emotion such as anxiety or fear. Psychologists place situational anxiety and fear on a continuum; not separate emotions but different manifestations of the same emotional state. Anxiety affects one’s ability to learn new material or to apply previously-learned knowledge (Taris and Feij, 2004; Warr and Downing, 2000), but (consistent with the tunneling-of-attention findings above) the nature of that impact varies. One theory proposes that anxiety leads employees to seek help from people who they believe possess useful knowledge or skills. Lower performing employees reportedly engage in such interpersonal help seeking more than high-performing employees (Warr and Downing, 2000) and individuals are less likely to seek help if they fear learning bad news (Sheikh, 1998).

Time pressure is a stressor that can affect both emotions and performance. Novices benefit from being provided meta-information that describes the accuracy, timeliness and completeness of specific data sets (Fisher, et al, 2003), but in real life such meta-information is often not available (Ballou and Pazer, 1995; Cappiello, et al., 2003). Under extreme time pressure decision makers may seek or process less information (Pearson and Clair, 1989) and perform worse (Entin and Srfaty; 1990; Van Galen and van Huygevoort, 2000; and Wickens, et al. 1991). Extensive training and rehearsal improves one’s ability to work effectively under high time pressure (Snizek, et al., 2002) and to attend to the appropriate cues (Lerch and Harter, 2001). The theory of recognition primed decision making posits that when confronted with a new situation, an individual quickly assesses its key features, then recalls a similar previous situation and responds in ways similar to how he acted previously (Lipshitz, et al., 2001). Under time pressure, novices tend to focus on a single comparative situation and set of behaviors, even though a better outcome might be attained by altering the course of action to better meet the unique needs of the current situation (Flin, et al., 1997). Experts are better able to match salient features of a situation against appropriate prior experiences, while novices are more likely to focus on the wrong aspects (Kaempf, et al., 1996; Klein, 1993; Lipshitz, 2001).

While much research has studied the effects of prolonged exposure to chronic stress, we focus in this paper on technology mediated collaboration under acute (situational) stress.

3 TELE-PEDIATRICS

In the US and elsewhere there is a shortage of pediatric intensivists (doctors with advanced post-residency certification in critical-care pediatrics). Indeed, this field is young; following the establishment of pediatric intensive care units in several influential hospitals in the sixties and seventies, the first post-residency fellowship programs in pediatric critical care were offered in the eighties by hospitals in Toronto, Philadelphia, Washington DC, Baltimore, Boston, Dallas and Detroit (Epstein and Brill, 2005; Randolph, et al., 2004). As of 2009, 49 US hospitals offer pediatric critical care fellowship programs to just 116 candidates, according to the National Resident Matching Program (www.nrmp.org). Most fellowship programs admit just one or two fellows per year, and once their training is completed, most pediatric intensivists remain in urban centers; only 3% practice in rural areas. This is a problem since about 21% of U.S. children live in rural areas (Heath, 2008).

Fortunately it is a rare occurrence for physicians (especially in rural locations) to see critically-ill children; common conditions such as ear infections or minor injuries are far more likely. Unfortunately, when a child suffering an acute illness or critical injury is brought in, rural clinicians may not have all the necessary skills to care for them. At a community hospital a critically ill child might be seen by emergency room clinicians who are accustomed to treating adults, or by pediatricians who have little experience providing acute emergency care. The child may require immediate attention and stabilization before being transferred to a pediatric emergency department or intensive care unit at another hospital. So, some clinicians turn to specialists at teaching hospitals for help. Traditionally, that help is provided via brief telephone consultations, but today a few teaching hospitals offer telemedicine-based consultation services. Consistent with Thrall (2007) we define telemedicine as “the delivery of health care services over a distance.” In the current paper we focus on telemedicine-supported real-time consultations by experts working online to assist physicians located elsewhere, to care for acutely ill or critically injured infants and children (i.e., critical care tele-pediatrics).

Telemedicine is not new (early applications of it began in the 1960's) and its scope is broad. Some telemedicine applications entail store-and-forward transmission of video, still images, documents, and graphical data while others utilize real time video conferencing. Numerous studies have led to a consensus among physicians that telemedicine services are safe and efficacious (Hersh, et al., 2001; Taylor, 2005) across a broad range of medical specialties. The top ten telemedicine domains (per the Telemedicine Information Exchange, which tracks more than 200 active programs worldwide) are: mental health, cardiology, dermatology, pediatrics, radiology, home health, orthopedics, neurology, oncology, and general surgery (Tulu, et al. 2007). While pediatrics is included in the above list, *critical-care* tele-pediatrics is not widespread. Fewer than six “hub” hospitals currently provide this service in North America, and the number of participating “spoke” hospitals is also quite low. One reason (as noted above) might be that the number of critical-care episodes is not very high and thus critical care tele-pediatrics is just not yet high enough on the priority list for health care administrators. Another reason might be that the supply of specially trained pediatric intensivists is not yet high enough to support this activity. Or, there may not be enough champions promoting this innovation. To date, studies in tele-pediatrics have largely focused on evaluating the technologies and establishing the appropriate networked applications for diagnosing and caring for infants and children (Marcin and Ellis, 2004; McConnochie, et al., 2006; Mehta, et al., 2001; Sable, et al., 1999).

Prior research hints that fear and anxiety may impact telemedicine use. For instance, a state hospital physician reportedly participated in telemedicine consultations in order to avoid dangerous exposure to patients with certain conditions (Paul and McDaniel, 2004, p. 200): “Would you like to get in the ambulance or the life-flight helicopter with somebody with a very contagious disease?” Yet, the impact of emotions on telemedicine use is largely unexplored.

Our research was conducted at two tertiary-care teaching hospitals that provide critical-care tele-pediatric services. Our purpose is to explore the emotional side of tele-pediatrics. Little is known about the role that emotions play in influencing the behavior of the specialists and generalists on either side of the urgent telemedicine consultation. Thus, our research questions:

- Do emotions influence whether tele-pediatrics is used for critical care consultations?
- How do emotions influence what happens during these consultations?

4 METHODOLOGY

Our research is part of a larger study of telemedicine challenges in several clinical domains. In this paper we draw insights from interviews of 60 to 90 minutes each, conducted with three specialists in pediatric critical care (hereafter “intensivists”) at two teaching hospitals (UrbanHub and RuralHub). We interviewed one of the three pediatric intensivists on staff at RuralHub and two of the pediatric intensivists on staff at UrbanHub. We also conducted interviews with several administrators and other clinicians at each institution, to learn about other telemedicine services and to explore business, legal, technical and other challenges associated with them.

This study is ongoing and we are using an inductive, grounded theory approach, the constant-comparative analysis, and snowball sampling (Stake, 1995; Strauss and Corbin, 1998). Our open-ended interviews explore challenges and issues in pediatric critical care in general and in offering tele-pediatric consultation services. Interviews are recorded and interviewers also take field notes. In the first phase we interviewed specialists at two hub hospitals, and in spring 2009 interviews are being conducted with generalists at participating spoke hospitals. After interviews are professionally transcribed, we review them and add corrections and contextual notes to the transcripts. All members of the research team then code the transcripts, using four forms of coding: 1) Factual coding captures key events and facts (such as the cost of telemedicine equipment and number of pediatric intensivists on staff). Facts and viewpoints obtained in interviews are triangulated against information available in publicly available documents such as web pages, presentation materials, planning reports, news accounts and journal publications. 2) Comparative coding captures findings that are or are not consistent with previously-identified themes from earlier rounds. Our initial comparative coding entailed comparing interview segments with themes identified in earlier telemedicine studies conducted by two of the authors (such as the influence tactics of a telemedicine champion and concerns about licensure, credentialing, and reimbursement), and with findings identified in our literature review of other telemedicine studies. 3) Open coding captures new themes or sub-themes revealed in the interviews (such as in this study a theme about clinician fear which we had not anticipated). 4) Interpretation examines the relationships among themes and sub-themes to reveal the significance of events, actions or viewpoints (Stake 1995).

After each researcher separately codes the transcripts we meet to identify areas of overlap or difference in the coded themes and consolidate them into broader themes or break them out into narrower sub-themes. Each author then revisits the transcripts again with these themes and sub-themes in mind to substantiate or refute them and to identify additional informants and research sites.

In this paper we offer preliminary evidence of how stress, fear, anxiety, and telemedicine usage play out in the context of critical care pediatrics. In this research in progress the themes thus far reflect three experts’ views about critical care tele-pediatrics, but do not yet directly reflect the generalists’ views (although we expect to be able to discuss their perspective at the ECIS meeting in June 2009).

We next provide a brief background of the two hospitals and their critical care tele-pediatric services.

4.1 Case 1: UrbanHub

UrbanHub is a division of a well known urban teaching hospital. UrbanHub’s 14-bed pediatric critical care unit is considered a leader in this specialty, with intense competition for spots in its pediatric

critical care fellowship program. The parent hospital has experimented with telemedicine in a variety of clinical areas, a few of which – such as its tele-stroke service – are now well established.

In the late nineties the UrbanHub pediatric critical care unit launched a grant-funded pilot test of tele-pediatrics with an affiliated suburban hospital. A video camera was set up in a treatment room at the spoke hospital's emergency department. From the pediatric critical care unit at UrbanHub a consulting physician could closely examine the patient, see clinical information provided on various monitors, and observe the clinicians at work. More recently UrbanHub began offering the service to another suburban hospital and (thanks to private funding from a donor with ties to Puerto Rico) to a hospital in rural Puerto Rico. The department head would like to expand the service but reports that a financially viable business model for doing so has not yet been established.

4.2 Case 2: RuralHub

RuralHub, in a state with a very rural population, is the only tertiary care teaching hospital in its state. Its catchment area covers about one million people. Most residents of this state live in towns with populations less than 2500, and its mountainous terrain makes travel to RuralHub time-consuming and challenging, especially in winter.

In 1994 RuralHub had launched a tele-pathology pilot study, involving two remote hospitals. In the nineties pathology was the largest telemedicine user, followed by vascular surgery and nephrology. Some path-breaking telemedicine examples included remote endoscopy exams and a few instances in which telemedicine was used during live surgical procedures. Pediatrics was not a regular user of telemedicine for physician-to-physician consultations at that time. RuralHub began its critical care tele-pediatrics program in the early years of this decade. A RuralHub pediatrician had trained at the prominent UrbanHub pediatric critical care program in 1998, just as UrbanHub was starting to use telemedicine in this domain. When this physician returned to RuralHub after completing his fellowship, he began to offer tele-pediatric consultation services (funded by a federal grant) and to build a department of pediatric critical care, which now has three intensivists.

Before launching a telemedicine service the intensivists visited ten rural emergency departments to help them learn how to comply with new guidelines for pediatric critical care and advanced life support. The field of pediatric critical care was evolving rapidly, however, so there was still a concern that rural clinicians' skills might erode in comparison with best practices in just a few years. The RuralHub intensivists reported that since pediatric emergencies are rare, rural clinicians who underwent training might nevertheless be poorly prepared to provide critical care when needed. Motivated by these concerns, more federal funding was sought to set up a pilot test of a critical care pediatric telemedicine service involving ten rural emergency departments. As was the case at UrbanHub, intensivists provided 24/7 coverage. This pilot test demonstrated the feasibility of using telemedicine for critical care consultations to rural clinicians, and the RuralHub pediatric team continues to offer this service, even though they are not yet being reimbursed for their consultations.

5 EMOTIONS AND CRITICAL CARE TELE-PEDIATRICS

The three specialists at the hub hospitals were unanimous in the belief that clinicians at spoke hospitals are eager to transfer critically-ill children to tertiary-care facilities, because they are anxious about caring for these patients. A RuralHub intensivist discusses this:

“These are low frequency, high morbidity events. ...The level of comfort can become extremely low for someone who doesn't see children very often and is presented with a tiny baby with serious health problems; it's very difficult for them. ...The goal for that provider is to make this problem go away as fast as you possibly can. So they don't hesitate to call us... None of the pediatricians, zero, want to take care of these children; they want them gone. Emergency department physicians feel the same way, because they don't have the technology to care for these children. ... When physicians, nurses, respiratory therapists on the other end are clearly scared to death and we walk them through how to

do absolutely everything and the transport team comes and the kid leaves, they are so happy with the service that we have given them”

Another hub doctor presumed that a physician at a spoke hospital was anxious out of concern about being observed by the experts in the new telemedicine consultation service:

“It took us a while for the person there [at the spoke hospital] to rely on us and feel confident...(It) is a very sensitive relationship. At first, physicians are afraid we are seeing what they are doing wrong; they are concerned about that. Like, ‘Oh my God, these guys are going to see us, we’re not doing well.’ So we have to overcome this barrier. Once they feel that we are friends and that we’re working together and we’re partners (then it is fine). The new person over there is now learning gradually. She prefers to call us over the phone more than talk with telemedicine. We tell her, ‘Turn [the video camera] on.’ She says, ‘Oh no it’s just a quick question on the phone.’ {Laughs} It takes some time.”

Before telemedicine, anxious clinicians at spoke hospitals in the rural state would place a telephone call to request that a critically ill or injured child be transferred to RuralHub, and the intensivist would attempt to determine whether the patient was stable enough for the transfer to take place. However, the intensivist found it difficult to offer advice based on clinicians’ verbal descriptions of what was going on. Being able to see the child, the various monitor displays, and the clinicians at work via video is a huge plus, in his view. He described one particularly vivid case:

“I turn on the telemedicine and can see them doing chest compressions on this kid. I say, ‘You need to slow down a little bit and push harder, make the chest move more.’ Then I see they have a breathing tube in and they’re squeezing the bag and I say ‘Slow down, squeeze harder and longer.’ I could see the cardiogram and monitors and can make recommendations. ‘You put the breathing tube way down too far in the lung.’ That happens all the time because they are anxious and they push it in too far. I say ‘Pull the endotracheal tube back and you will ventilate better.’ I could see the patient had a type of lung injury called non-cardiac pulmonary edema. I could tell the respiratory therapist, who had not had experience using ventilators with children in the past 15 or 20 years, exactly what dials to push on the ventilators and what settings to do exactly what we wanted. I told them the resuscitation drugs and the doses to use, because they may remember what drugs to use but they can’t remember how to use them or how much to use. The child was placed on mechanical ventilation (and transferred to RuralHub). I sent the transport team out and directly supervised them; they talk to me over telemedicine, I told them exactly what to do.”

A RuralHub intensivist felt he was able to “see the big picture” better than clinicians at the spokes:

“...When they’re intubating, everyone’s field of vision focuses down, very, very narrowly on the procedure they’re doing. I can sit up there, move the camera around, pan in and out and I can say, ‘You know something? The level of oxygen in his blood has dropped to a very dangerous level and you need to stop doing what you’re doing right now and fix that and then try your intubation again.’ They don’t hear the alarms and they don’t see the stuff because they’re busy doing other things. And there is just the question of familiarity. I do this for a living; it doesn’t scare me anymore. And we can provide that sort of experience and expertise.”

An UrbanHub intensivist also commented on his ability to retain some emotional distance:

“We have our remote control from here that we can use to control three cameras that they have over there. We can see all the monitoring equipment, see the patient, see the x-rays, see the EKG’s and all the other stuff that we need. ... We supervise them, and move the camera wherever we want ... The system surprised us, how well it works. We really can see a lot. ... We could see the pupils of the patient’s eyes. Clinicians on the ground ... are so stressed caring for the children that they don’t pay attention to things that we can see since we are less emotionally involved. We can see what is happening on the whole ... We can point out that a valve is not functioning too well. For example, a cardiac arrhythmia case: the ventilator connected to the child was not working so well; oxygen was not coming. Even before they had time to get that information on the monitor, even before alarms went off we could see that the chest was not moving well and we could tell them what was wrong. Another

time, they were trying to intubate but the child was nauseous and about to vomit. There again they are so anxious trying to maintain the airways to make the kid breathe. If you say, 'Hey wait a minute, turn the kid to the side' to avoid aspirating. It's amazing sometimes by not being over there (we can be more effective). ...We really can see a lot. The clinicians on the ground, in the field are so stressed caring for the children that they don't pay attention to things that we can see, since we are less emotionally involved. We can see what is happening on the whole at that point."

One hub intensivist states that what the spoke clinician needs is *"having another set of eyes consulting them, helping them to make the decisions."* Another expert offers a similar comment about the importance of his role in reassuring the spoke clinicians that they are making the right decisions. In the interview, we asked whether there were circumstances in which he might say to a clinician at the spoke, "You are doing the right thing." He replied: *"There is a lot of that. 'Yes, I agree absolutely with what you're doing.' These are the – yes, yes, yes – 'I suggest doing this and you've already done that – we'll send a transport team out.'"*

Sometimes the clinicians at the spokes just need assurance that a specialist is present. In one episode a specialist suggested that the two doctors work together: *"I said 'You know, why don't we observe this kid together, give him a couple of nebs (nebulizers) one after the other and let's observe him in twenty minutes again. We'll see how the kid responds.'"*

Many spoke hospital clinicians want to transfer patients immediately; however this can be risky. A Boston physician contrasts what might have happened had the transfer details been done over the phone versus the actual outcome in which they were able to use full video:

"...[without video] it would be a description over the phone. 'We have this 17 years old that's doing fine, having some mild headaches, having a little fever, we don't know what it's going to involve and want to transfer the kid. We have called the ambulance.' I said, 'wait a minute, let me look at the kid. We need a critical care ambulance, we need a critical care doctor, we need her to be ready for the transfer. ...If she had been transferred without us seeing her it could be a disaster en route. The old fashioned way that most of the hospitals do over the phone, they never described her as sick as she was; when we looked at her and said, 'This is a sick patient, we cannot put her on the ambulance and just send her, especially now during the traffic hours. We have to stabilize her over there as well.' And as we are talking, within 10 minutes the patient collapsed over there. So at least they were prepared."

Thus, the specialists that we interviewed at two hub hospitals contended that a) spoke clinicians are more anxious than experts because they don't have the same level of skill; b) some spoke clinicians are, at least initially, anxious about being observed by hub experts; c) hub pediatric intensivists feel that when they use telemedicine they achieve a degree of emotional distance that allows them to take in more relevant information and thus more effectively guide and reassure the generalists.

6 DISCUSSION

From interviews with pediatric intensivists at two "hub" hospitals we uncovered evidence about the influence of emotions on telemedicine adoption and use. Anxiety – whether about using a new technology or out of fear of being exposed as incompetent – apparently led some clinicians to choose a more familiar technology, the telephone, when requesting help from hub specialists. This illustrates the familiar pattern of anxiety impeding new system adoption. Yet, some spoke clinicians did use telemedicine when confronted with critical care cases for which they had little prior experience and inadequate skills, and the specialists who provided help believe that their guidance helped the spoke clinicians provide better care under extreme stress.

We further learned that the intensivists believed that telemedicine extended their expert capacity to take in a great variety of clinical information and to focus on important details that escaped the attention of anxious clinicians at the spokes (because presumably stress caused tunneling of the spoke clinicians' attention). Telemedicine also allowed the experts to achieve some emotional distance; they reported feeling less emotionally involved and better able to see the "big picture," remain calm and

effectively guide the spoke clinicians. These early findings suggest that while stress can cause tunneling of attention for those clinicians who have less specialized and/or less practiced skills, the combination of emotional distance and high-level expertise allows medical experts to take note of important clinical details. This is an important finding that warrants further investigation in other time-pressed clinical situations (such as trauma care, ambulance care, and complex surgical care). Most observers contend that telemedicine provides the “next best” alternative to having an expert physically present in the room to guide the less-expert clinician. However, our finding about emotional distance suggests a more intriguing possibility. The experts that we interviewed indicated that telemedicine gave them a degree of emotional distance that they found beneficial, suggesting that in some circumstances telemedicine might be seen as superior to face-to-face consultation.

It is important to note that all physicians are trained to perform under stress in a variety of clinical situations. However (as mentioned in the introduction to this paper) pediatric critical-care situations are rare occurrences. Thus, even during their internships and residencies, pediatricians or emergency physicians may get few opportunities to learn how to provide effective care in these situations. Post-residency, clinicians at remote spoke hospitals will get especially few opportunities to participate in critical-care events involving young children, and also most of these remote hospitals do not have pediatric intensivists (with their higher level of post-residency training) on staff and available to coach other clinicians in these specialized techniques. With fewer than 120 physicians entering pediatric critical care fellowships each year, this situation is likely to persist for quite some time. While the numbers of board-certified intensivists on staff at tertiary-care centers and perhaps at suburban hospitals will gradually increase, there will continue to be a physicians with this specialized skill set at rural hospitals and clinics. And, with pressure to control costs and with the low frequency of pediatric critical-care episodes, most hospital administrators will choose to allocate scarce resources elsewhere.

Thus, when a critically ill or injured child does arrive at a rural clinic or hospital, the attending clinicians may not have all the knowledge and skills necessary to provide the best possible care and this shortcoming may increase their experience of stress, anxiety, and/or fear. Our interviews revealed that telemedicine can be helpful in these situations. The intensivists that we interviewed explained that specific system capabilities -- such as real-time video transmission and the ability to remotely control video cameras -- were important technical features that helped to reveal important clinical information to them and improved their ability to guide the clinicians at the spokes.

Because pediatric critical-care episodes are rare occurrences, the skills, knowledge, and confidence of even well trained clinicians will tend to erode due to lack of practice. To combat this issue, experts at the hub hospitals offered refresher training (sometimes delivered via the telemedicine tools) to help generalists keep their skills current. One specialist at UrbanHub felt that these training sessions actually reduced the number of requests for telemedicine system for consultations, because (he believed) the spoke clinicians now feel better prepared to handle pediatric emergencies and thus don't feel as anxious when these emergencies arise.

In our study clinical experts freely shared their knowledge via telemedicine consultations, with little concern that this activity would reduce their power or professional standing. Physicians in a teaching hospital are, of course, expected to teach, and a telemedicine consultation is a form of education. Nevertheless, it was interesting to observe this apparent beneficence, since in contrast, some prior knowledge management studies (e.g., Cabrera and Cabrera, 2002) report that business experts sometimes decline to contribute to knowledge repositories, presumably out of anxiety or fear (of losing status or being deemed expendable). This finding also deserves further exploration to uncover specific aspects of hospitals' work climates and incentive schemes that facilitate “unselfish” knowledge sharing. Perhaps organizations in other industries can draw some important knowledge management lessons from health care.

7 LIMITATIONS AND CONCLUSIONS

As a research in progress, to date our findings are based primarily on interviews with three key informants at two hub hospitals (interviews with other administrative and technical employees provided valuable background information but did not speak to this particular issue). In spring 2009 we are scheduled to interview clinicians at the spoke hospitals that these two hub hospitals serve. Until then, we will not be in a position to speculate as to whether generalists really were motivated to request telemedicine consultations out of fear/anxiety versus out of a dispassionate assessment of the skills that are missing from their repertoire, or some other reason. One vignette hinted that some spoke clinicians preferred to use a less transparent communication technology (the telephone) compared with video-conferencing, which might put this clinician's mistakes in full view, causing embarrassment or further stress. A hub specialist believes that once trust is established, such concerns will fade into the background. This view is consistent with Dunn and Schweitzer's (2005) behavioral experiments in which they find that emotions do not influence trusting behaviors when the trustee is someone familiar. Other studies have explored issues surrounding emotions, affect, and trust (e.g., Williams 2001, Weber, Malhotra, and Nunninghan 2005).

Our study findings thus far only hint at circumstances that may impede the use of telemedicine for pediatric critical care, and further study is needed to attain a clearer picture of the facts that impede or encourage adoption by the spoke clinicians. Also, our informants thus far have not brought up any instances when they felt that telemedicine impeded their ability to provide care or had adverse effects, but that does not mean that we can conclude that there have been no problems. Nor at this time are we able to conform whether the infrequent occurrence of critical care episodes is strongly or weakly related to participants' experience of anxiety or fear, although the comments that we heard from our three informants at the two teaching hospitals were strikingly similar. At the June ECIS meeting we should be able to speak to these issues. Further in-depth interviews are needed to tease out a clearer picture of both positive and negative aspects of telemedicine use under time pressure.

Early findings from our research in progress point to fascinating issues concerning how emotions affect technology-mediated collaboration across organizational boundaries in risky, time-pressed situations. Several vignettes reveal specialists' beliefs that fear motivates generalists to seek their help. However, we cannot as yet say whether and how specific features of the technology artifact affected this collaboration. In learning that hub specialists believe that generalists are motivated to participate in telemedicine services because of fear or anxiety about their ability to provide the best care to the critically-ill young patients in their charge, we wondered what actually goes on in the generalist's mind. We do not know if these participants would feel more or less comfortable if the specialist were in the room with them. We do know that most rural hospitals will not have this choice (if they want their clinicians to have access to the guidance of specialists during critical-care episodes, they will need to use telemedicine).

At one of the hub hospitals that we visited, an administrator stressed the importance of having their hospital personnel regularly test the system and its network connectivity in order to ensure that spoke clinicians will be able to use the system when it is most needed. This individual observed that while clinicians are accustomed to employing a great variety of improvisational skills when providing medical care, many clinicians are taken aback when confronted with a piece of video conferencing equipment that is not operating correctly. It may just be a matter of noticing that a plug has come loose or a setting changed, but the clinicians will not know what to do to get the system working correctly. Clearly, while some clinicians are comfortable with a variety of information and communication technologies, others are less so. If they perceive that telemedicine is their only avenue available to get the expert guidance they need, then perhaps they will embrace it even if they normally shy away from using leading-edge technologies. In that case it can be helpful to have nearby technical support personnel on call, and it also may be helpful to give the hub specialist control over the cameras, able to zoom in and out on his/her own. Our reasoning here is that the hub specialist is under less stress

during a critical-care consultation and may be in a better position to perform these tasks than if the harried clinicians at the spoke site are expected to do this.

Our interviews revealed that the experts value their ability to use remote video to take in many more clinical details than are available in telephone consultations, as well as their ability to control the video from their end. This, combined with the findings about emotional distance suggests that system trust (trusting beliefs about ICT applications) interacts with emotions in ICT-enabled collaboration. In future studies we suggest exploring how emotions such as anxiety and fear interact with organizational trust, interpersonal trust, and system trust. For example, further research is needed to investigate specific technical features used by clinicians on both sides of telemedicine consultations (for chronic versus urgent care), and to closely compare how experts coach novices when using ICT versus in face-to-face situations.

This study explored specialists' views on the effect of fear/anxiety on telemedicine usage in a single high-stress domain (critical-care pediatrics), characterized by infrequent episodes and extreme time pressure. Our interviewees emphasized that critical-care episodes occur infrequently in pediatrics, and that ongoing training is thus necessary to ensure that spoke clinicians will initiate telemedicine consultations in those situations when the hub experts can be most helpful. Further research is needed in order to determine whether these findings about emotional aspects of ICT-enabled collaboration would apply in other high-stress domains in which infrequent episodes and time pressure are at play, and to tease out the separate and interacting influences of frequency, time pressure and risk.

These are early days for critical-care telemedicine, especially in pediatrics; we are eager to learn more about this promising use of information and communications technologies to bring needed expertise to underserved populations in this and other clinical domains.

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