Optimizing Telehealth Strategies for Subspecialty Care: Recommendations from Rural Pediatricians

Kristin N. Ray, MD, MS,[1] Jill R. Demirci, PhD,[1] Debra L. Bogen, MD,[1] Ateev Mehrotra, MD, MPH,[2,3] and Elizabeth Miller, MD, PhD[1]

[1]Department of Pediatrics, University of Pittsburgh School of Medicine, Children's Hospital of Pittsburgh, Pittsburgh, Pennsylvania.
[2]Department of Healthcare Policy and Medicine, Harvard Medical School, Boston, Massachusetts.
[3]RAND Corporation, Boston, Massachusetts.

The funders of this work had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Abstract

Background: *Telehealth offers strategies to improve access to subspecialty care for children in rural communities. Rural pediatrician experiences and preferences regarding the use of these telehealth strategies for children's subspecialty care needs are not known. We elicited rural pediatrician experiences and preferences regarding different pediatric subspecialty telehealth strategies.* ***Materials and Methods:*** *Seventeen semi-structured telephone interviews were conducted with rural pediatricians from 17 states within the United States. Interviewees were recruited by e-mails to a pediatric rural health listserv and to rural pediatricians identified through snowball sampling. Themes were identified through thematic analysis of interview transcripts. Institutional Review Board approval was obtained.* ***Results:*** *Rural pediatricians identified several telehealth strategies to improve access to subspecialty care, including physician access hotlines, remote electronic medical record access, electronic messaging systems, live video telemedicine, and telehealth triage systems. Rural pediatricians provided recommendations for optimizing the utility of each of these strategies based on their experiences with different systems. Rural pediatricians preferred specific telehealth strategies for specific clinical contexts, resulting in a proposed framework describing the complementary role of different telehealth strategies for pediatric subspecialty care. Finally, rural pediatricians identified additional benefits associated with the use of telehealth strategies and described a desire for telehealth systems that enhanced (rather than replaced) personal relationships between rural pediatricians and subspecialists.* ***Conclusions:*** *Rural pediatricians described complementary roles for different subspecialty care telehealth strategies. Additionally, rural pediatricians provided recommendations for optimizing individual telehealth strategies. Input from rural pediatricians will be crucial for optimizing specific telehealth strategies and designing effective telehealth systems.*

Key words: *communication, coordination, electronic medical record, pediatrician, physician access hotline, rural, subspecialty, telehealth, telemedicine*

Introduction

Pediatricians in the United States are caring for children with increasing rates of chronic disease and increasingly complex medical needs.[1,2] This translates into greater demand for pediatric subspecialty care, but the current healthcare system does not consistently facilitate the receipt of timely, coordinated subspecialty care. Nearly one-quarter of children with subspecialty care needs experience difficulty accessing subspecialty care.[1] Additionally, although parents and providers endorse the importance of communication with subspecialists,[3] this communication remains poor,[4–6] with over half of general pediatricians reporting difficulty communicating directly with subspecialists.[6] Children in rural communities face additional barriers to accessing pediatric subspecialty care due to decreased subspecialty provider supply[7–9] and increased distances to subspecialist practice sites.[10,11]

Telehealth, defined broadly as "the use of electronic information and telecommunications technologies to support long-distance clinical healthcare,"[12] offers specific strategies to extend subspecialty care to rural communities. These strategies include physician access hotlines,[13,14] remote electronic medical record (EMR) access, e-consults,[15,16] and live video telemedicine encounters.[17–19]

Prior studies have examined user feasibility and satisfaction with pediatric subspecialty care via telehealth[18–22] but have not adequately explored rural pediatricians' experiences and

 DOI: 10.1089/tmj.2014.0186

preferences regarding telehealth strategies. Rural pediatricians are local child health experts as well as target telehealth users; understanding and incorporating the views of such providers regarding new health technology have been crucial in prior work.[23–25] Because details of telehealth design and implementation vary across rural communities,[26] rural pediatricians in different settings can also offer insight into comparative advantages and disadvantages of telehealth strategies. We conducted in-depth interviews with rural pediatricians to understand the current role and to optimize the future potential of different telehealth strategies in meeting the subspecialty care needs of children in rural communities.

Materials and Methods

Individual semistructured telephone interviews were conducted during June–October 2013. Potential interviewees were recruited through e-mails to the American Academy of Pediatrics Rural Health Interest Group listserv and to additional potential participants identified by interviewees through snowball sampling. To maximize diversity of responses, we used a sampling frame to include rural pediatricians in solo, group, and hospital-based practice settings and in states with high and low subspecialty supply (determined by 2010 Area Health Resource File pediatric subspecialists counts[27] adjusted for the 2010 Census pediatric population[28]). We further maximized geographic diversity by sampling pediatricians in different states. Pediatricians were excluded if they practiced in a county with a metropolitan area with >250,000 people based on 2013 rural–urban continuum codes[29] and were also excluded if they did not self-identify as a rural pediatrician.

The lead investigator obtained verbal consent and conducted interviews, which averaged 39 min (standard deviation = 9 min; range, 19–63 min). We used a semistructured interview guide with open-ended questions, informed by prior subspecialty care process conceptualizations[30–32] and refined during the interview process. Interview questions explored subspecialty care barriers and facilitators, with specific questions inquiring about telehealth strategies (see the Supplementary Data for the full interview guide; Supplementary Data are available online at www.liebertpub.com/tmj). Interviews were recorded and transcribed with identifiers removed. A $25 gift card was e-mailed to interviewees. Ethical review and approval were provided by the Institutional Review Board at the University of Pittsburgh.

Thematic analysis was used to identify and code responses[33] using Atlas.ti version 7.1.4 software (Atlas.ti GmbH, Berlin, Germany). An initial list of codes was generated *a priori* based on domains of interest and themes identified in the first five interviews. The code list was refined during coding with differentiation of subthemes. Interviews were coded independently by two investigators (K.N.R. and J.R.D.), compared for agreement, and finalized, with code additions or changes determined by consensus among coders.

Seventeen rural pediatricians were interviewed from 17 states, including each U.S. Census region. Interviewees discussed interactions with subspecialists and telehealth at 39 distinct pediatric tertiary medical centers. No new codes emerged after the 12th interview, suggesting content saturation.

Results

Interviewees averaged 22 years of experience (range, 2–37 years) (*Table 1*) and cared for patients in varied settings, including ambulatory, inpatient, nursery, emergency, and school-based settings. Ten (59%) held current or past state or national leadership positions. On average, interviewees practiced 2.4 h by car from the nearest pediatric tertiary medical center (range, 0.75–5 h). Most (71%) reported no local pediatric subspecialists. Most (71%) referred to some adult specialists, often in surgical fields. Sixty-five percent reported at least one local outreach/satellite clinic. Thirty-one percent reported current live video telemedicine availability, most

Table 1. Demographics of Interviewees (*n*=17)

	MEAN	SD	RANGE
Years in current community	16.6	12	2–37
Years practicing pediatrics	22.4	11	2–37
Number of pediatricians in practice	4.6	3	1–13
Number of midlevel practitioners in practice	1.9	1.7	0–8
Hours of travel time to nearest pediatric tertiary medical center	2.4	1.4	0.75–5
	NUMBER		**%**
Male	11		65%
Current practice type			
Solo	3		18%
Group	8		47%
Hospital-based	6		35%
Practice has care coordinator	13		76%
U.S. Census region			
Northeast	5		29%
South	4		24%
Midwest	3		18%
West	5		29%

SD, standard deviation.

commonly psychiatry or intensive care. The most commonly identified unmet subspecialty care needs were psychiatry, developmental pediatrics, and neurology.

OPTIMIZING SPECIFIC TELEHEALTH STRATEGIES FOR SUBSPECIALTY CARE

Interviewees discussed two mechanisms of subspecialty care: patient–subspecialist interaction and pediatrician–subspecialist communication. Telehealth strategies identified as facilitating improved patient–subspecialist interaction were live video telemedicine and telehealth triage systems. Telehealth strategies identified as improving pediatrician–subspecialist communication were formalized physician access hotlines, remote tertiary medical center EMR access, and electronic messaging systems. For each of these strategies, interviewees discussed their value and identified features that increased their perceived effectiveness (*Table 2*).

To optimize live video telemedicine, interviewees recommended increasing scheduling flexibility, improving system efficiency, and matching offered services to local needs: "[Telemedicine] has to answer the real-time needs of the community that you're dealing with." Additionally, interviewees expressed interest in the increased flexibility that live video telemedicine could offer compared with traditional subspecialty visits, such as on-demand consultations and generalists participating in patient–subspecialist encounters: "I would love to have [telemedicine] in my office, because I would love to pop in and tell the doc, 'Hey they forgot to tell you about this….' That would be great." Additional recommendations are listed in *Table 2*.

To increase the value to patients of subspecialty visits, interviewees also expressed interest in using live video telemedicine, telephone, or other telehealth mechanisms to triage patients' needs prior to travel for subspecialty visits: "The first part is to get the evaluation done, and if there's procedures and things, I think that ultimately the family will get [to the tertiary referral center], but to get to the point where we know if we need [procedures] or not… to at least have that consultation [prior to traveling], if it was done at an outreach, or if it was done as a telemedicine, I think that would be great."

To optimize physician access hotlines, interviewees recommended "one-call" hotlines that connect providers directly with attending subspecialists: "Just having one phone number that I call always makes it much easier…. You never get placed on hold, so I have this number now by heart." In contrast, physician access lines that did not function effectively were described: "When I call… I get referred to the academic secretary, or to the clinic secretary. And my message gets referred to a nurse whose voice-mail box has not been emptied in three months, and I won't get a phone call back for a week."

Interviewees with remote access to tertiary medical center EMRs appreciated the ability to view subspecialty notes to facilitate communication and care. To optimize the utility of remote EMR access, interviewees recommended reducing the time required to access information: "Connecting is a big hassle…. To go and sit by a computer and try to connect, and it's not an easy system to find a patient…it's really not that easy to get into. But if there's something that I really need right now, I can ultimately find it."

Interviewee current experience with electronic messaging systems was generally limited to texting or e-mailing subspecialists with whom the interviewee had a personal relationship: "The gastroenterologist—I've got his cellphone so I can text him. It's not going to interrupt him seeing patients; he can look at my text when he gets a chance, and he can text me back when he gets in-between patients…." Some interviewees had access to subspecialist electronic messaging through shared EMRs, but many lacked the ability to contact specialists through e-mail or electronic messaging systems and believed such contact would be helpful: "I'm not asking them to post their e-mail address for everybody in the universe to bug them. But, if I'm going to send you a patient and ask you a question, I think having your e-mail would really be helpful… it would make that stuff so much faster and easier."

In addition to the above recommendations regarding specific telehealth strategies, interviewees also identified the ongoing need to address concerns about reimbursement, credentialing, liability, and security to improve telehealth implementation. Additionally, interviewees identified the time required to partner with tertiary medical centers and to build new programs as a significant barrier to telehealth implementation.

COMPLEMENTARY ROLE OF DIFFERENT TELEHEALTH STRATEGIES

No single telehealth strategy superseded other strategies, with interviewees instead appreciating different strategies for specific clinical contexts. We developed a framework to conceptualize the roles of different telehealth strategies in meeting specific clinical needs (*Table 3*).

The need for *cognitive advice/interpretation* was often efficiently met by physician access hotlines, e-mail, and EMR-based messaging systems. Such synchronous or asynchronous generalist–subspecialist communication could replace some in-person visits or could facilitate improved evaluation and care coordination prior to in-person subspecialty visits.

The need for *specialized diagnostic evaluations* was facilitated effectively through remote interpretation of locally

Table 2. Recommendations to Optimize Telehealth Strategies for Subspecialty Care

STRATEGY	POSITIVE EXPERIENCES AND RECOMMENDATIONS TO OPTIMIZE
Live video telemedicine	"[Live video telemedicine has] been extremely positive. I can't think of any downside to doing this."
	"I think [telemedicine is] great. You know, it's just really wonderful to have a second set of eyes, and for families in which kids are being transferred to make that connection prior to the transfer is really helpful to have that relationship in place."
	Recommendations to optimize: • Optimize efficiency of interface • Increase flexibility of scheduling • Match offered services to local needs • Facilitate on-demand, real-time consultations from clinic • Incorporate generalist into subspecialist–patient visits through videoconferencing • Colocate live video telemedicine clinic in the pediatrician's office • Incorporate generalist staff (medical assistant, nurse) into subspecialist–patient visits • Provide adequate training for rural staff facilitating live video telemedicine encounters
Physician access hotline	"That's the one wonderful thing about [this state] because we're out in the middle of [rural area] and there's so many rural health practices elsewhere, they set up [physician access hotline] which is basically a 1–800 number, you call in, and there's a 24-hour operator, that will connect you to whatever pediatric subspecialist you need to talk to, either for a consult or a question or a transfer of care. And so via that line, they set that up, and you're able to actually talk to anyone even before they see the patient—even if they're never going to see the patient—often you can set up visits over that, with that conversation or with subsequent conversation on that line, and then you can even find follow-up afterwards and find out what their recommendations are through that line."
	Recommendations to optimize: • Create central "one-call" number • Connect directly to subspecialist (rather than to clinic or voice mail) • Connect to attending (rather than trainees) • Connect to dedicated attending (rather than attending with competing clinical obligations)
Remote EMR access	"One valuable thing that's happened this year that hadn't happened before is we have access to [tertiary medical center] charts for our patients now, so they've designed this system where we're assigned as their designated provider in the system so when the patient comes to attention at the [tertiary medical center], they say, 'Oh, Dr. [Name] is my primary care doctor,' and so automatically, that's entered into their electronic medical chart, and when I go to log into their electronic medical chart remotely via web … I can access my patients' charts …. And so I can read their notes in real time, I can see reports of MRI [magnetic resonance imaging] and scans, and labs drawn, so that has been an invaluable thing to happen."
	Recommendations to optimize: • Increase availability of remote EMR access • Improve efficiency of log-on process • Facilitate provider-to-provider messaging capabilities within the EMR
E-mail/ texting/EMR messaging	"Within our system, we have an excellent resource. We can simply send a message through our EHR [electronic health record], and they will get that. And I have often done that, and I'd get great feedback. I'm able to get that usually within a day or two it's been answered already by the person I sent it to. Absolutely great system."
	Recommendations to optimize: • Provide access to e-mail/texting by providing contact information • Facilitate provider-to-provider messaging capabilities within EMR
Telehealth referral triage	"I can think of a few—I mean, some GI [gastroenterology] patients that might be helpful [to review with subspecialist before referral] whether they needed any imaging or labwork beforehand. Definitely. We're just recently added a geneticist to their staff, and a lot of those labs take a while to come back, so a lot of times, it would be a lot more useful to get that rolling beforehand, you know, so they would have, by the time they were able to go to their appointment, they would have those results available."
	Recommendations to optimize: • Provide access to previsit consultation or triaging through the above mechanisms (live video telemedicine, hotline, web, or e-mail)

EMR, electronic medical record.

performed diagnostic studies (such as tele-echocardiography), which allows patients to receive studies locally while still receiving subspecialist interpretation.

The need for subspecialty evaluation involving *remote assessment of patients* could be met through telehealth mechanisms that transmit relevant visual and audio information, such as live video telemedicine or store-and-forward imaging.

Finally, the need for *in-person patient–subspecialist interactions* required face-to-face visits, which could be driven by

Table 3. Framework of Subspecialty Care Needs and Potential Telehealth Strategies

IDENTIFIED NEED	EXAMPLES	POTENTIAL STRATEGIES
Cognitive interpretation or advice	Discussion of management prior to referral; discussion of need for referral; questions regarding implementation of subspecialist recommendations; interval co-management of a patient with stable chronic illness	Telephone physician access line Electronic messaging/texting E-consultation
Example: "One that might be useful would be follow-up rheumatology. It's a long drive for an eight-minute visit.... [It]always seems like, jeez, I wish they could have just made it so that it was just in conversation [with me]: 'Here are all the labs, we got everything set up, I've had my hands on the patient, here's what I saw today,' and then let the rheumatologist decide [remotely], make choices about medications and progress and things like that."		
Specialized diagnostic study or procedures	Locally performed studies interpreted remotely, such as pulmonary function tests, echocardiograms, radiographic studies	Synchronous or asynchronous remote interpretation of studies
Example: "We use a telecardiology service with [pediatric tertiary medical center] where the echos [echocardiograms] and ekgs [electrocardiograms] are performed at our hospital but sent to [pediatric tertiary medical center] for interpretation, and if we have a question about the interpretation, we can always call them and get a response about why this interpretation or what this means."		
Remote assessment of patient by subspecialist	Visual examination (such as dermatologic examination); examination with remotely viewed images (such as tele-otoscopy); direct patient–subspecialist communication (such as telepsychiatry)	Live video telemedicine Store-and-forward patient images
Examples: "I think that probably most of the [medical] interviews can be done just as well by videoconferencing as in person. I don't like to say that it's never important to see someone in person... but I would think that medically, probably the majority could be accomplished that way." "I think it would be really useful also in the field of dermatology.... 'I have this patient in the office, would you mind if I sent you this photo?', or if we can use the telemedicine equipment to let you actually see the patient.		
In-person interaction between patient and subspecialist	Specific examination, diagnostic, or therapeutic procedures requiring hands-on interaction Patient preference may also result in need for in-person encounter.	In-person visits Outreach/satellite clinic visit
Example: "Obviously any procedure-based specialty it would be pretty hard to do an endoscopy, liver biopsy, you know, trach aspirate, you know, so any time you get to the point where the patient needed a procedure, that's not going to happen by telemedicine." "Well I guess all this surgical subspecialty stuff at this point is, you know, is that they've got to get their hands on, and the patients have to, if you're going to develop confidence in any procedures, they need to see them."		

the need for a hands-on exam, face-to-face procedures, or patient preference.

ADDITIONAL BENEFITS OF TELEHEALTH

Interviewees identified additional benefits of subspecialty telehealth beyond improvement of patient care. Interviewees suggested that improved connection with subspecialists would improve rural pediatrician recruitment and retention by providing clinical support and combatting professional isolation: "I wonder if it wouldn't be helpful for recruitment... it might go a long way to reassure a rural practitioner, particularly a new young one, that they have good access to subspecialty care and ICU [intensive care unit] care...that might make a difference in terms of them being willing to practice in a rural area. I mean there are times in a rural area where you have a sick baby or a sick kid, the weather has gone to hell, the helicopter can't fly, the ambulance can't get here, and you're managing a patient for longer than you feel comfortable in your facility.... So the telemedicine might help a lot in terms of getting people the resources that would make them more comfortable to practice here." Another interviewee commented: "I'm two hours away from any kind of major pediatric medical center, and I miss that. I miss that kind of collaboration as part of my practice... and I think telemedicine... really could help that, both for professional satisfaction and patients."

Additionally, rural pediatricians described serving as consultants to local midlevel providers and family practitioners, and they expressed interest in using live video telemedicine themselves to provide supervision to these providers.

PERSONAL RELATIONSHIPS AND TELEHEALTH

Finally, an important recurring theme in discussion of telehealth for subspecialty care was the role of personal relationships between generalists and subspecialists. Many interviewees described informal networks of subspecialists who they contacted by phone or e-mail for subspecialty care questions. Interviewees estimated they had spent 5–10 years developing these personal relationships. They readily identified issues with these informal networks, including not having alternative contacts when specific subspecialists were unavailable (e.g.,

vacation or retirement) and not wanting to "overuse" their network: "I have worked really hard at developing relationships with the subspecialists I refer to, so I don't need a hotline. I mean, I can just call them up…. I don't overuse them, so I don't take advantage of it…. I just don't feel like I can do it all the time." Interviewees describe difficulty building these systems for new pediatricians entering rural areas: "What we try to do is hook [new pediatricians] up with mentors… and we would have a lot of these conversations of 'Here's how to get through to [tertiary medical center], here's how to get through to [different tertiary medical center],… here's how to get through to GI [gastroenterology], here's how to get through to derm.' But… there's nothing formalized." Although some discussed the potential for formalized physician access hotlines and messaging systems to provide more reliable connections in place of personal networks, they expressed that telehealth should build and support personal connections rather than replace them.

Discussion

Rural pediatrician interviewees described subspecialty care through patient–subspecialist encounters and generalist–subspecialist communication. They discussed telehealth strategies to improve subspecialty care, including live video telemedicine, telehealth triage systems, physician access hotlines, remote EMR access, and electronic messaging systems. Overall, interviewees were enthusiastic about telehealth, which may represent a cultural shift—a decade ago, general pediatricians had low readiness for e-mail for patient care.[6]

In discussion of telehealth strategies, our interviews identified important details of design and implementation. For example, many interviewees spoke highly of one-call physician access lines where operators connected pediatricians directly with attending subspecialists, whereas others described frustration with telephone systems that resulted in voice-mail messages and unreliable call-backs. The variation in implementation of specific strategies, accompanied by variation in perceived effectiveness of these strategies, suggests that objective comparison of telehealth strategies across pediatric tertiary medical center referral regions may further improve our understanding of how telehealth can be optimized.

Interviewees also expressed interest in using telehealth in ways that were not currently supported by their tertiary medical centers. Interviewees recommended use of telehealth to triage appointments and coordinate ancillary testing to consolidate in-person specialty visits. Successful telehealth triage systems have been reported,[34] but this desired use of telehealth was at odds with interviewees' experiences, which often required patients to attend their initial subspecialty visits at the tertiary care center before using outreach clinics or live video telemedicine. Interviewees also highlighted ways that live video telemedicine could improve upon (rather than simply replace) traditional subspecialty visits, such as on-demand consultation and three-way patient–generalist–subspecialist encounters (similar to a previously explored teleconsultation model[35]). Such innovative strategies warrant broader exploration of the acceptability, effectiveness, and cost-effectiveness for patients, pediatric subspecialists, and pediatric healthcare delivery systems.

The value of personal relationships (and the tension between personal relationships and technology) was a recurring theme. Interviewees attributed value to relationships built with subspecialists over time, believing that these relationships improved patient care and also increased professional connectedness and satisfaction. They recognized, however, that informal relationship-based networks did not always meet their needs and left new providers unsupported. Interviewees were enthusiastic about more formalized telehealth systems to connect rural pediatricians to subspecialists, believing such systems would improve patient care and improve rural pediatrician recruitment and retention, as was similarly proposed in one prior study.[36] Interviewees expressed caution, however, about technology eroding meaningful personal relationships. Future work should consider this tension between efficiency and personability in designing telehealth systems and should examine the impact of telehealth strategies on the rural pediatric workforce in addition to the impact on patient outcomes.

It is important that interviewees identified different telehealth strategies for different clinical needs, which we organized into a framework illustrating the complementary role of telehealth strategies. Subspecialists in different clinical roles[31] may use these strategies to meet the specific needs of individual care episodes. For example, a cognitive consult may be completed entirely through a physician access hotline, whereas an ongoing comanagement relationship may benefit from electronic messaging at one point and live video telemedicine at another. Thus optimal systems may require integration of multiple telehealth strategies to allow use of appropriate telehealth tools for specific clinical scenarios. Although prior work has discussed aspects of clinical encounters that may allow effective use of live video telemedicine compared with in-person visits,[37] our framework addresses the role of additional telehealth strategies. Given that over 70% of pediatric subspecialty referrals are primarily for "advice,"[38] promoting generalist–subspecialist telehealth communication strategies to meet generalist need for cognitive advice could have substantial impact on the demand for in-person visits, potentially increasing the availability of

subspecialists for the clinical scenarios requiring remote and in-person patient–subspecialist interaction. Although reimbursement for live video telemedicine is gaining traction, this framework highlights that ongoing attention should also be given to complementary physician access hotlines and electronic messaging systems, as these systems address different, complementary clinical needs.

LIMITATIONS

This exploratory qualitative study aimed to describe the range of experiences and recommendations of rural pediatricians regarding telehealth for subspecialty care. To increase the diversity of our responses, we used a sampling strategy targeting pediatricians in a range of practice settings and multiple states. As with all qualitative work, however, our findings should be viewed as hypothesis-generating and may not be generalizable beyond our interviewees. Additionally, we focused specifically on rural pediatricians because these providers are positioned as clinical and thought leaders on rural pediatric health within their communities. A potential limitation of this approach is that our interviews may not capture the full range of experiences of all providers caring for children in rural communities (e.g., family practitioners, nurse practitioners, physician assistants, school nurses, or public health nurses). However, we believe we succeeded in capturing viewpoints from clinical and organizational leaders in pediatric rural health, with over half of our interviewees self-identifying as state- and national-level leaders and advocates for pediatric rural health.

Because our framework was developed from generalist interviews, future research should explore patient and subspecialist views on telehealth strategies to determine if patients, generalists, and subspecialists agree on the appropriateness and trade-offs of different telehealth tools for different clinical scenarios. In particular, subspecialists have expressed concern regarding "curbside" consults in terms of adequacy of information, accuracy of diagnosis, and reimbursement[39]; further work should determine how best to address these concerns within formalized telehealth strategies. Additionally, given the perceived complementary role of different telehealth strategies, the optimal integration of different strategies requires further investigation.

Conclusions

Rural pediatricians across the United States described varied experiences with telehealth for subspecialty care and provided recommendations to optimize specific telehealth strategies. Designing telehealth systems to integrate multiple telehealth strategies and to maintain or enhance personal relationships is needed. Rural pediatricians can provide crucial input for optimizing specific telehealth strategies and designing effective telehealth systems.

Acknowledgments

The authors would like to thank the interviewees for their time and participation. This work was supported in part by the HRSA NRSA for Primary Medical Care (grant T32HP22240; to K.N.R. and J.R.D.) and subsequently by the AHRQ PCOR K12 (grant 1K12HS022989-01; to K.N.R.).

Disclosure Statement

No competing financial interests exist.

REFERENCES

1. Bethell CD, Kogan MD, Strickland BB, Schor EL, Robertson J, Newacheck PW. A national and state profile of leading health problems and healthcare quality for US children: Key insurance disparities and across-state variations. *Acad Pediatr* **2011;**11(3 Suppl):S22–S33.
2. Perrin JM, Bloom SR, Gortmaker SL. The increase of childhood chronic conditions in the United States. *JAMA* **2007;**297:2755–2759.
3. Stille CJ, Fischer SH, La Pelle N, Dworetzky B, Mazor KM, Cooley WC. Parent partnerships in communication and decision making about subspecialty referrals for children with special needs. *Acad Pediatr* **2013;**13:122–132.
4. Forrest CB, Glade GB, Baker AE, Bocian A, von Schrader S, Starfield B. Coordination of specialty referrals and physician satisfaction with referral care. *Arch Pediatr Adolesc Med* **2000;**154:499–506.
5. Stille CJ, McLaughlin TJ, Primack WA, Mazor KM, Wasserman RC. Determinants and impact of generalist-specialist communication about pediatric outpatient referrals. *Pediatrics* **2006;**118:1341–1349.
6. Stille CJ, Primack WA, Savageau JA. Generalist-subspecialist communication for children with chronic conditions: A regional physician survey. *Pediatrics* **2003;**112:1314–1320.
7. Mayer ML. Disparities in geographic access to pediatric subspecialty care. *Matern Child Health J* **2008;**12:624–632.
8. Pletcher BA, Rimsza ME, Cull WL, Shipman SA, Shugerman RP, O'Connor KG. Primary care pediatricians' satisfaction with subspecialty care, perceived supply, and barriers to care. *J Pediatr* **2010;**156:1011–1015.
9. Hardy R, Vivier P, Rivara F, Melzer S. Montana primary care providers' access to and satisfaction with pediatric specialists when caring for children with special healthcare needs. *J Rural Health* **2013;**29:224–232.
10. Mayer ML. Are we there yet? Distance to care and relative supply among pediatric medical subspecialties. *Pediatrics* **2006;**118:2313–2321.
11. Mayer ML, Beil HA, von Allmen D. Distance to care and relative supply among pediatric surgical subspecialties. *J Pediatr Surg* **2009;**44:483–495.
12. Telehealth. Available at www.hrsa.gov/ruralhealth/about/telehealth/ (last accessed April 17, 2014).
13. Jantausch BA, O'Donnell R, Rodriguez WJ. The pediatric forum. Physician use of a telephone access line for infectious disease consultation. *Arch Pediatr Adolesc Med* **2000;**154:1170–1171.
14. Wegner SE, Humble CG, Feaganes J, Stiles AD. Estimated savings from paid telephone consultations between subspecialists and primary care physicians. *Pediatrics* **2008;**122:e1136–e1140.

15. Horner K, Wagner E., Tufano J. *Electronic consultations between primary and specialty care clinicians: Early insights.* Commonwealth Fund publication 1554. New York: The Commonwealth Fund, **2011:**1–13.

16. Liddy C, Maranger J, Afkham A, Keely E. Ten steps to establishing an e-consultation service to improve access to specialist care. *Telemed J E Health* **2013;**19:982–990.

17. Farmer JE, Muhlenbruck L. Telehealth for children with special healthcare needs: promoting comprehensive systems of care. *Clin Pediatr (Phila)* **2001;**40:93–98.

18. Karp WB, Grigsby RK, McSwiggan-Hardin M, et al. Use of telemedicine for children with special healthcare needs. *Pediatrics* **2000;**105:843–847.

19. Marcin JP, Ellis J, Mawis R, Nagrampa E, Nesbitt TS, Dimand RJ. Using telemedicine to provide pediatric subspecialty care to children with special healthcare needs in an underserved rural community. *Pediatrics* **2004;**113:1–6.

20. Davis AM, James RL, Boles RE, Goetz JR, Belmont J, Malone B. The use of telemedicine in the treatment of paediatric obesity: Feasibility and acceptability. *Matern Child Nutr* **2011;**7:71–79.

21. Mulgrew KW, Shaikh U, Nettiksimmons J. Comparison of parent satisfaction with care for childhood obesity delivered face-to-face and by telemedicine. *Telemed J E Health* **2011;**17:383–387.

22. Myers KM, Valentine JM, Melzer SM. Feasibility, acceptability, and sustainability of telepsychiatry for children and adolescents. *Psychiatr Serv* **2007;**58:1493–1496.

23. Gagnon MP, Duplantie J, Fortin JP, Landry R. Implementing telehealth to support medical practice in rural/remote regions: What are the conditions for success? *Implement Sci* **2006;**1:18.

24. Zapka J, Simpson K, Hiott L, Langston L, Fakhry S, Ford D. A mixed methods descriptive investigation of readiness to change in rural hospitals participating in a tele-critical care intervention. *BMC Health Serv Re*s **2013;**13:33.

25. Davis MM, Currey JM, Howk S, et al. A qualitative study of rural primary care clinician views on remote monitoring technologies. *J Rural Health* **2014;**30:69–78.

26. Institute of Medicine. *The role of telehealth in an evolving healthcare environment: Workshop summary.* Washington, DC: The National Academies Press, **2012.**

27. *Area health resource file (AHRF), 2011–2012.* Released **2012**. Rockville, MD: Bureau of Health Professions, Health Resources and Services Administration, U.S. Department of Health and Human Services.

28. U.S. Census Bureau. 2010 Census. Available at www.censusgov/2010census/data/ (last accessed January 22, 2013).

29. U.S. Department of Agriculture. 2003 rural-urban continuum codes. Available at www.ersusdagov/Data/RuralUrbanContinuumCodes/ (last accessed June 9, 2013).

30. Mehrotra A, Forrest CB, Lin CY. Dropping the baton: Specialty referrals in the United States. *Milbank Q* **2011;**89:39–68.

31. Forrest CB. A typology of specialists' clinical roles. *Arch Intern Med* **2009;**169:1062–1068.

32. Guevara JP, Hsu D, Forrest CB. Performance measures of the specialty referral process: A systematic review of the literature. *BMC Health Serv Res* **2011;**11:168.

33. Ryan G, Bernard H. Data management and analysis methods. In: Denzin N, Lincoln Y, eds. *Handbook of qualitative research.* Thousand Oaks, CA: Sage, **2000:**769–802.

34. Kim Y, Chen AH, Keith E, Yee HF Jr, Kushel MB. Not perfect, but better: Primary care providers' experiences with electronic referrals in a safety net health system. *J Gen Intern Med* **2009;**24:614–619.

35. Harrison R, Macfarlane A, Murray E, Wallace P. Patients' perceptions of joint teleconsultations: A qualitative evaluation. *Health Expect* **2006;**9:81–90.

36. Gagnon MP, Duplantie J, Fortin JP, Landry R. Exploring the effects of telehealth on medical human resources supply: A qualitative case study in remote regions. *BMC Health Serv Res* **2007;**7:6.

37. Locatis C, Ackerman M. Three principles for determining the relevancy of store-and-forward and live interactive telemedicine: Reinterpreting two telemedicine research reviews and other research. *Telemed J E Health* **2013;**19:19–23.

38. Forrest CB, Glade GB, Baker AE, Bocian AB, Kang M, Starfield B. The pediatric primary-specialty care interface: How pediatricians refer children and adolescents to specialty care. *Arch Pediatr Adolesc Med* **1999;**153:705–714.

39. Stille CJ, Korobov N, Primack WA. Generalist-subspecialist communication about children with chronic conditions: An analysis of physician focus groups. *Ambul Pediatr* **2003;**3:147–153.

Address correspondence to:
Kristin N. Ray, MD, MS
Department of Pediatrics
Children's Hospital of Pittsburgh
Children's Hospital Office Building
3414 5th Avenue, 3rd floor
Pittsburgh, PA 15213

E-mail: kristin.ray@chp.edu

Received: September 12, 2014
Revised: October 16, 2014
Accepted: October 17, 2014