Original Research

The Financial Impact of a Pediatric Telemedicine Program: A Children's Hospital's Perspective

Madan Dharmar, MBBS, PhD,[1,2] Candace K. Sadorra, BS,[1] Paul Leigh, PhD,[2,3] Nikki H. Yang, DVM, MPVM,[1] Thomas S. Nesbitt, MD, MPH,[4] and James P. Marcin, MD, MPH[1,2]

[1]*Department of Pediatrics, University of California Davis Children's Hospital, Sacramento, California.*
[2]*Center for Healthcare Policy and Research, University of California Davis, Sacramento, California.*
[3]*Department of Public Health Sciences, University of California Davis, Sacramento, California.*
[4]*Department of Family Practice and Community Medicine, University of California Davis, Sacramento, California.*

Abstract

Introduction: *This study evaluates the financial impact of telemedicine outreach in a competitive healthcare market from a tertiary children's hospital's perspective. We compared the number of transfers, average hospital revenue, and average professional billing revenue before and after the deployment of telemedicine.* ***Materials and Methods:*** *This is a retrospective review of hospital and physician billing records for patients transferred from 16 hospitals where telemedicine services were implemented between July 2003 and December 2010. Hospital revenue was defined as total revenue minus operating costs. Professional billing revenue was defined as total payment received as the result of physician billing of patients' insurance. We compared the number of transfers, average net hospital revenue per year, and average professional billing revenue per year before and after the deployment of telemedicine at these hospitals.* ***Results:*** *There were 2,029 children transferred to the children's hospital from the 16 hospitals with telemedicine during the study period. The average number of patients transferred per year to the children's hospital increased from 143 pre-telemedicine to 285 post-telemedicine. From these patients, the average hospital revenue increased from \$2.4 million to \$4.0 million per year, and the average professional billing revenue increased from \$313,977 to \$688,443 per year. On average, per hospital, following the deployment of telemedicine, hospital revenue increased by \$101,744 per year, and professional billing revenue increased by \$23,404 per year.* ***Conclusions:*** *In a competitive healthcare region with more than one children's hospital, deploying pediatric telemedicine services to referring hospitals resulted in an increased market share and an increased number of transfers, hospital revenue, and professional billing revenue.*

Key words: *telemedicine, business administration/economics, policy*

Introduction

In the past decade, the use of telemedicine to deliver consultations to remote communities has been rapidly increasing. Despite the increased adoption of telemedicine, there are limited data supporting its financial impact and cost-effectiveness, especially from a tertiary hospital's point of view. Among studies that have conducted economic evaluations on the use of telemedicine, a majority have not found any conclusive evidence supporting its cost-effectiveness.[1–3] A recent systematic review of economic evaluation studies on telemedicine concluded that it is unrealistic to broadly gauge all telemedicine to be cost-effective.[4] Instead, the review recommended that more specific cost-effective analysis be conducted, limiting analyses to single specialty programs with control groups, with a specific focus on the patient group served.[4] In addition, the review recommended that economic analyses consider other factors, including sustainability and the organizational environment in which the telemedicine program is being administered.[4]

The Pediatric Telemedicine Program at the University of California Davis Children's Hospital (Sacramento, CA) includes a comprehensive outpatient pediatric specialist program, a pediatric telemental health program, a unique video interpreting program, on-demand telemedicine consultations to inpatient wards, and asynchronous telemedicine programs including pediatric telecardiology, teleneurology, tele-ophthalmology, teledermatology, and distance education. This has enabled the Pediatric Telemedicine Program to offer expertise to rural healthcare facilities that typically have less access to pediatric subspecialists. In addition, we have had a longstanding pediatric telemedicine program where pediatric critical care physicians deliver consultations to children presenting to remote and underserved emergency departments (EDs).[5,6] This particular program, which was initially grant funded, has been continued without extramural funding, charges to the remote hospitals, or other external source of revenue.

In this study we sought to evaluate the financial impact of this emergency telemedicine program from the perspective of our children's hospital (tertiary hospital), where telemedicine is used to support surrounding rural and underserved hospitals in a competitive healthcare region. To accomplish this, we compared referral and transfer rates to Children's Hospital, the revenue generated at Children's Hospital, and the revenue generated from specialist professional billing before and after the implementation of our telemedicine program. We hypothesized that the provision of telemedicine services to the referring hospitals would result in an

DOI: 10.1089/tmj.2012.0266

increased market share that would yield (1) increased patient transfers to Children's Hospital, (2) increased hospital revenue resulting from these transfers, and (3) increased revenue from specialist professional billing. We hypothesized that the increased number of transfers from the telemedicine (remote) hospitals would be greater than any temporal trend in patient transfers or market share occurring during the same time period from other hospitals without telemedicine services.

Materials and Methods

STUDY DESIGN

We conducted a retrospective study to compare referral and financial data on patients transferred to our children's hospital from 16 remote hospitals in Northern California, where telemedicine services were implemented during the study period. We determined the number of patients transferred from these remote hospitals and the economic outcomes from the patients admitted to our hospital before (pre-telemedicine) and after (post-telemedicine) the implementation of telemedicine services. For reference, we compared the number of patients transferred from the 16 telemedicine hospital partners with the number of patients transferred from other remote hospitals in the same region to our Pediatric Intensive Care Unit (PICU) and Neonatal Intensive Care Unit (NICU) during the same time period.

TELEMEDICINE SERVICES

The telemedicine program was deployed to the 16 remote hospitals (telemedicine hospitals) on a rolling basis between 2003 and 2009. The purpose of the telemedicine program was primarily to provide the remote EDs (without pediatric expertise) access to pediatric specialists, including pediatric critical care physicians, to assist in the care of acutely ill children. Less frequently, this telemedicine program also allowed for emergent consultations to child abuse experts and cardiologists in cases of suspected child abuse and congenital heart disease, respectively.[7,8] Because federal grants were used to initially pay for the implementation of telemedicine, all of the remote hospitals were located in designated rural areas, as defined by California's Office of Statewide Health Planning and Development[9] and the federal Center for Medicare and Medicaid Services,[10] serving underserved communities according to the Health Resources and Services Administration's definitions of a health professional shortage area, a medically underserved area, and/or a medically underserved population.[11] All of the remote hospitals had existing patient transfer relationships with the University of California Davis Children's Hospital as well as another non-university children's hospital in the same city.

The pediatric specialists from Children's Hospital were available for consultation to the remote ED physicians at the telemedicine hospitals during both the pre- and post-telemedicine periods. The only difference between these periods is that during the pre-telemedicine period, the remote physicians consulted with the specialist using the telephone, and for the post-telemedicine period, telemedicine was used for consultations. The telemedicine hospitals had access to a variety of pediatric specialists using the telephone or telemedicine, but a majority of the consultations from the study sites were to the pediatric critical care and pediatric emergency medicine physicians. The telemedicine hospitals also had access on an *ad hoc* basis to a variety of pediatric specialists, including child abuse, cardiology, infectious disease, pulmonology, hematology-oncology, gastroenterology, and neurology, as well as surgical services including pediatric cardiothoracic surgery, general surgery, otolaryngology, and burn surgery.

SELECTION OF PATIENTS

In this study we included the "pre-telemedicine" and "post-telemedicine" cohort of pediatric patients transferred to Children's Hospital from the telemedicine hospitals between July 2003 and December 2010. We included all children who were between the ages of 1 day and 18 years.

OUTCOME MEASURES

The three primary outcome measures in the study were:

1. *Transfer rate*, defined as the average number of patients transferred per year (annual patient transfers) to Children's Hospital from the telemedicine hospitals during the study period.
2. *Hospital revenue*, defined as average net hospital revenue per year (annual net hospital revenue) at Children's Hospital as a result of the patient transfers. The net hospital revenue was the total hospital revenue (hospital reimbursement from insurance) minus the operating costs directly related to each patient as estimated by Children's Hospital's finance department.
3. *Professional billing revenue*, defined as the average physician revenue per year (annual physician revenue) at Children's Hospital as a result of the patient transfers. The physician revenue was the total payment received as the result of physician billing of patients' insurance.

DATA COLLECTION

Hospital billing records were retrospectively reviewed to collect transfer and financial data on the pediatric patients transferred from the 16 study sites to Children's Hospital. Data was collected on patient acuity (emergent, urgent, and non-urgent), patient source location (emergency room, inpatient ward), type of insurance, and length of stay at the tertiary hospital. We collected data on the hospital charges, hospital revenue, direct hospital costs, professional charges, and physician revenue (payments) for each patient during the pre- and post-telemedicine periods.

The pre-telemedicine period and post-telemedicine period for each study hospital were determined by the date of deployment of telemedicine services at each hospital. Because telemedicine was deployed to the 16 sites over several years, each hospital had a different date delineating the pre-telemedicine and post-telemedicine periods. Hence, the study data were analyzed individually for each hospital comparing the pre-telemedicine and post-telemedicine periods. For the overall comparisons, the financial outcomes from the 16 hospitals were aggregated.

As a reference, we also determined the total number of pediatric patients transferred to Children's Hospital from all other hospitals during the study period. We did this to differentiate changes in the number of transfers as a result of our telemedicine program from changes in market share and/or changes in the number of transfers as a result of some temporal trend during the study period.

STATISTICAL ANALYSIS

We performed all statistical analyses using STATA software version 12 (StataCorp, College Station, TX). For descriptive analysis, we used the chi-squared test to compare categorical variables and Student's t test to compare continuous variables.

Results

In total, 2,056 patients were transferred to Children's Hospital from the 16 remote hospitals where telemedicine services were deployed during the study period. Among these, 5 (0.2%) of the billing records could not be found, and 22 (1.1%) had incomplete billing information. Therefore, a final sample of 2,029 patient transfers was used in the analyses. Based on the time of deployment of telemedicine at the remote hospitals, 515 patients were transferred during the pre-telemedicine period, and 1,532 patients were transferred during the post-telemedicine period.

Table 1 summarizes the characteristics of the patients transferred to Children's Hospital. The mean age was 4.2 years (standard deviation = 5.5 years), and the mean length of stay was 8.8 days (standard deviation = 15.1 days). The majority of the patients transferred were from the ED (67.5%), and of these, a majority were classified as "urgent" in their acuity level (76.9%). Public insurance (58.7%) was the most common type of insurance for these patients. When comparing the pre- and post-telemedicine cohorts, we found differences with regard to some baseline demographics. The pre-telemedicine cohort was older (5.0 versus 3.9 years, $p < 0.05$) and had a shorter mean hospital length of stay (7.7 versus 9.2 days, $p < 0.05$) compared with the post-telemedicine group. The cohorts were also significantly different in their acuity level and the location from which the patient transferred to Children's Hospital.

Table 2 describes the number of years and transfers from each telemedicine hospital to Children's Hospital before and after the deployment of telemedicine. The average number of years for the pre-telemedicine period was 3 years, and that for the post-telemedicine period was 5 years. Eight hospitals had less than 1 patient transfer per year in the pre-telemedicine period compared with

Table 1. Characteristics of Children Transferred from Telemedicine Hospitals to University of California Davis Children's Hospital Before and After Deployment of Telemedicine ($n = 2,029$)

VARIABLE	ALL ($N = 2,029$)	PRE-TELEMEDICINE ($N = 515$)	POST-TELEMEDICINE ($N = 1,514$)	P VALUE
Age (years) [mean (SD)]	4.2 (5.5)	5.0 (5.9)	3.9 (5.3)	< 0.05
Length of stay (days) [mean (SD)]	8.8 (15.1)	7.7 (14.2)	9.2 (15.4)	< 0.05
Acuity level [n (%)]				< 0.05
Emergent	446 (22.0)	90 (17.5)	356 (23.5)	
Urgent	1,561 (76.9)	421 (81.8)	1,140 (75.3)	
Non-urgent	15 (0.7)	2 (0.4)	13 (0.9)	
Unknown	7 (0.3)	2 (0.4)	5 (0.3)	
Patient source location [n (%)]				< 0.05
Emergency room	1,369 (67.5)	367 (71.3)	1,002 (66.2)	
Inpatient	660 (32.5)	148 (28.7)	512 (33.8)	
Insurance [n (%)]				0.09
Public	1,190 (58.7)	293 (56.9)	897 (59.3)	
Private	463 (22.8)	122 (23.9)	341 (22.5)	
Self-pay	99 (4.9)	24 (4.7)	75 (5.0)	
Other	15 (0.7)	2 (0.4)	13 (0.9)	
Non-funded	242 (11.9)	64 (12.4)	178 (11.8)	
Unknown	19 (0.9)	10 (1.9)	9 (0.6)	

SD, standard deviation.

Table 2. Number of Years and Transfers to University of California Davis Children's Hospital Before and After Deployment of Telemedicine at Telemedicine Hospitals ($n = 2{,}029$)

HOSPITAL	NUMBER OF YEARS		TOTAL PATIENT TRANSFERS		ANNUAL PATIENT TRANSFERS	
	PRE-TELEMEDICINE	POST-TELEMEDICINE	PRE-TELEMEDICINE	POST-TELEMEDICINE	PRE-TELEMEDICINE	POST-TELEMEDICINE
A	0.5	7.5	9	166	18.0	22.1
B	3.5	4.5	104	181	29.7	40.2
C	2.4	5.6	3	31	1.2	5.6
D	2.8	5.3	0	1	0.0	0.2
E	2.4	5.6	11	52	4.5	9.3
E	4.4	3.6	0	12	0.0	3.4
G	5.3	2.7	49	35	9.2	13.1
H	2.8	5.3	2	14	0.7	2.7
I	0.5	7.5	0	580	0.0	77.3
J	3.5	4.5	143	265	40.9	58.9
K	0.5	7.5	0	23	0.0	3.1
L	5.3	2.8	184	111	35.0	40.4
M	3.4	4.6	3	11	0.9	2.4
N	0.5	7.5	0	15	0.0	2.0
O	2.1	5.9	4	13	1.9	2.2
P	5.8	2.2	3	4	0.5	1.8
Total			515	1,514	142.6	284.6

one hospital in the post-telemedicine period. The average number of annual transfers was 285 patients in the post-telemedicine period compared with 143 patients in the pre-telemedicine period. On average, there were in total 142 more patient transfers in the post-telemedicine cohort each year. On average, the annual number of pediatric transfers at each site was greater by 9 patients during the post-telemedicine period.

Table 3 describes the total hospital revenue and the annual hospital revenue at Children's Hospital from the patients transferred from each telemedicine hospital before and after the deployment of telemedicine. The total hospital revenue was $29.8 million in the post-telemedicine period compared with $5.8 million in the pre-telemedicine period. On average, the total annual hospital revenue was greater by $1.6 million in the post-telemedicine period compared with the pre-telemedicine period. On average, Children's Hospital's annual hospital revenue per remote hospital with telemedicine was $101,744 greater during the post-telemedicine period.

Table 4 describes the total professional billing revenue and the annual professional billing revenue at the Children's Hospital from the patients transferred from each telemedicine hospital before and after the deployment of telemedicine. The total professional billing revenue was more than $4 million in the post-telemedicine period compared with nearly $1 million in the pre-telemedicine period. On average, the total annual professional billing revenue was greater by $374,466 in the post-telemedicine period compared with the pre-telemedicine period. On average, the total annual professional billing revenue per remote hospital with telemedicine was $23,404 greater during the post-telemedicine period.

Figure 1 demonstrates the temporal trend in the number of patients transferred to Children's Hospital from telemedicine hospitals as well as the number of patients transferred to Children's Hospital's PICU and the NICU from other hospitals during the same time period. During the study period, in total, 2,056 patients were transferred from the telemedicine hospitals to Children's Hospital. During the same time period, in total, 2,487 and 2,866 patients were transferred from other remote hospitals in the same region to the PICU and NICU, respectively.

Discussion

In this study we assessed the financial impact of a pediatric telemedicine program from the tertiary hospital's perspective before and after the deployment of telemedicine. First, we found an increase in the tertiary hospital's market share, reflected by the increased number of patients transferred across all 16 remote hospitals

Table 3. Total Hospital Revenue and Annual Hospital Revenue at University of California Davis Children's Hospital Before and After Deployment of Telemedicine at Telemedicine Hospitals

HOSPITAL	TOTAL HOSPITAL REVENUE ($)		ANNUAL HOSPITAL REVENUE ($)	
	PRE-TELEMEDICINE	POST-TELEMEDICINE	PRE-TELEMEDICINE	POST-TELEMEDICINE
A	490,461	1,752,218	980,923	233,629
B	2,416,111	7,046,042	690,317	939,472
C	−4,143	346,921	−1,712	46,256
D	0	1,073	0	143
E	107,140	732,216	44,273	97,629
E	0	33,924	0	4,523
G	461,166	332,259	86,523	44,301
H	−3,573	436,735	−1,299	58,231
I	0	13,471,904	0	1,796,254
J	901,217	3,143,991	257,491	419,199
K	0	475,610	0	63,415
L	1,260,195	1,244,105	240,037	165,881
M	63,160	119,226	18,468	15,897
N	0	635,873	0	84,783
O	68,597	66,041	32,979	8,806
P	7,276	−9,456	1,248	−1,261
Total	5,767,607	29,828,683	2,349,247	3,977,158

following the deployment of telemedicine. The annual number of patients transferred in the post-telemedicine period was nearly twice the number of patients transferred during the pre-telemedicine period. Second, we found that the increase in annual transfers resulted in an increase in the annual hospital revenue during the post-telemedicine period. Third, we found that the increase in annual patients transferred also resulted in a significant increase in annual professional billing revenue. The increase in patient transfers resulted in an average increase in hospital revenue of $101,744 and professional billing revenue of $23,404 per hospital per year. We believe that the increased number of patients transferred to Children's Hospital was the result of the telemedicine program in a competitive healthcare region because the number of patients transferred to Children's Hospital's PICU and NICU from other hospitals in the same region did not increase during the same period.

This study is one of the few studies that have examined the benefits of telemedicine by comparing transfer rates and financial outcomes before and after the implementation of telemedicine. Our findings show the positive impact of telemedicine on market share and financial outcomes, when used in a competitive hospital market. Our results are similar to findings from other studies investigating the financial impact of telemedicine services. Duchesne et al.[12] evaluated the use of telemedicine in rural trauma care and reported that telemedicine had a positive impact both on the medical management and utilization of hospital resources. Barnett et al.[13] determined a telemedicine program used to treat Veterans with diabetes to be cost-effective in one-third of patients by examining the cost-effectiveness ratios and comparing differences in cost with the differences in quality-adjusted life year utility scores. Both studies evaluated outcomes from a societal or healthcare perspective and concluded that the use of telemedicine was cost-effective. Breslow et al.,[14] using a similar study design to evaluate telemedicine in an intensive care setting, also demonstrated improvements in both clinical and financial outcomes from the perspective of the tertiary/specialist hospital.

Implementing telemedicine programs at remote hospitals is always associated with a financial cost. These costs include the initial equipment purchase price, installation and software licensing costs, ongoing costs of telecommunications, and the salary costs of technology support, staff, and physician time. Because a majority of telemedicine is initiated by tertiary hospitals, it is reasonable to conclude that they incur a financial cost to deliver specialty services using telemedicine. Therefore, it is important for hospitals to evaluate the financial benefits of investing in telemedicine to expand the reach of specialty services beyond their brick and mortar clinics. This becomes even more significant as many studies have evaluated the

Table 4. Total Professional Billing Revenue and Annual Professional Billing Revenue at University of California Davis Children's Hospital Before and After Deployment of Telemedicine at Telemedicine Hospitals

HOSPITAL	TOTAL PROFESSIONAL BILLING REVENUE ($)		AVERAGE PROFESSIONAL BILLING REVENUE PER YEAR ($)	
	PRE-TELEMEDICINE	POST-TELEMEDICINE	PRE-TELEMEDICINE	POST-TELEMEDICINE
A	37,096	288,222	74,192	38,430
B	358,691	628,309	102,483	139,624
C	8,563	49,190	3,538	8,815
D	0	141	0	27
E	17,350	47,971	7,169	8,597
E	0	12,152	0	3,394
G	78,407	27,690	14,711	10,371
H	1,844	37,879	671	7,215
I	0	2,100,539	0	280,072
J	224,627	577,457	64,179	128,324
K	0	35,384	0	4,718
L	226,573	122,858	43,157	44,676
M	6,154	6,933	1,799	1,514
N	0	53,540	0	7,139
O	4,006	17,018	1,926	2,875
P	887	5,759	152	2,654
Total	964,198	4,011,042	313,977	688,443

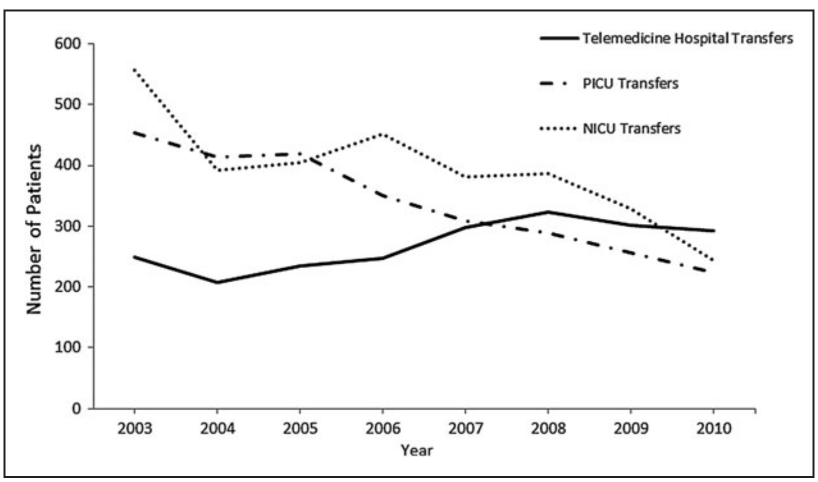

Fig. 1. Temporal trends in the number of patients transferred to the University of California Davis Children's Hospital from telemedicine hospitals and patients transferred to Children's Hospital Pediatric Intensive Care Unit (PICU) and Neonatal Intensive Care Unit (NICU) from other hospitals. Note that for 2003 we estimated the annual transfers by doubling the study period data (6 months).

cost-effectiveness of telemedicine by reporting either dollars saved or transfers avoided as a result of using telemedicine.[15–18] In 2004, Marcin et al.[19] demonstrated that a pediatric critical care telemedicine program significantly increased the revenue collected at a remote hospital because the telemedicine program enabled the remote hospital to keep more patients. Furthermore, the reduction in patient transfers resulted in a cost savings from avoided patient transports.[19] These studies evaluated telemedicine from an individual or societal financial perspective, which may be different than a tertiary hospital's financial perspective. Our study is one of the first to describe the benefits of a telemedicine program from the tertiary hospital perspective by reporting on its impact on market share and financial revenue in a competitive hospital market.

There are several strengths to this study. This study is one of the first to evaluate the financial consequences to a children's hospital using actual billing record data from patients transferred before and after the deployment of telemedicine. Although a few studies have reported that telemedicine can be cost-effective, there is a lack of studies reporting the financial rewards of starting or expanding a telemedicine program. This study investigated the benefits to the tertiary hospital by comparing patient referrals and the financial outcomes before and after the deployment of telemedicine.

This study has several limitations. This study was a retrospective of analysis of billing record data, which does not include clinical data; therefore it was not possible to know the exact case-mix of patients transferred between the two time periods. Also, it was not possible to definitively assess whether other factors could have contributed to the increase in number of transfers seen in this study. However, our finding of a decreasing trend in the number of patients transferred to Children's Hospital's PICU and NICU from other hospitals in the same region suggests that the telemedicine program in a competitive healthcare market could be the primary factor for the increased number of patients transferred to Children's Hospital. Lastly, this study included rural hospitals in Northern California that could transfer their critically ill pediatric patients to more than one children's hospital. If a similar program was initiated in a region where there was only one children's hospital, we would expect that there would not be the increase in patient transfers that we saw in our study. Last, telemedicine was not randomly deployed, and, as a result, our findings may not be representative of other telemedicine programs serving a different selection of remote hospitals.

Conclusions

In this study, we found that a pediatric telemedicine program deployed to remote hospitals in a competitive healthcare market resulted in an increased market share as reflected by an increased number of transfers, hospital revenue, and professional billing revenue to a children's hospital. From a children's hospital's perspective, investing in a telemedicine program that increases access to specialists in remote hospitals could potentially result in favorable changes in referrals and reimbursement. In conclusion, this study demonstrates that the deployment of telemedicine not only can benefit the patient and remote hospitals, but also can increase the tertiary hospital's market share as well.

Disclosure Statement

No competing financial interests exist.

REFERENCES

1. Davalos ME, French MT, Burdick AE, Simmons SC. Economic evaluation of telemedicine: Review of the literature and research guidelines for benefit-cost analysis. *Telemed J E Health* **2009;**15:933–948.
2. Whitten PS, Mair FS, Haycox A, May CR, Williams TL, Hellmich S. Systematic review of cost effectiveness studies of telemedicine interventions. *BMJ* **2002;**324:1434–1437.
3. Roine R, Ohinmaa A, Hailey D. Assessing telemedicine: A systematic review of the literature. *CMAJ* **2001;**165:765–771.
4. Mistry H. Systematic review of studies of the cost-effectiveness of telemedicine and telecare. Changes in the economic evidence over twenty years. *J Telemed Telecare* **2012;**18:1–6.
5. Marcin JP, Kuppermann N, Andrada ER, Cole SL, Romano PS. The impact of telemedicine consultations on the quality of care provided to critically ill children in rural emergency departments. *Pediatr Crit Care* **2006;**7:511.
6. Marcin JP, Nesbitt TS, Kallas HJ, Struve SN, Traugott CA, Dimand RJ. Use of telemedicine to provide pediatric critical care inpatient consultations to underserved rural Northern California. *J Pediatr* **2004;**144:375–380.
7. Huang T, Moon-Grady AJ, Traugott C, Marcin J. The availability of telecardiology consultations and transfer patterns from a remote neonatal intensive care unit. *J Telemed Telecare* **2008;**14:244–248.
8. MacLeod KJ, Marcin JP, Boyle C, Miyamoto S, Dimand RJ, Rogers KK. Using telemedicine to improve the care delivered to sexually abused children in rural, underserved hospitals. *Pediatrics* **2009;**123:223–228.
9. Office of Statewide Health Planning and Development. Available at: www.oshpd.ca.gov/HWDD/FAQs.html (last accessed June 12, 2013).
10. Centers for Medicare & Medicaid Services. Available at: www.cms.gov/Regulations-and-Guidance/Legislation/CFCsAndCoPs/RHC_FQHC.html (last accessed June 12, 2013).
11. Health Resources and Services Administration (HRSA). Available at: http://bhpr.hrsa.gov/shortage/ (last accessed June 12, 2013).
12. Duchesne JC, Kyle A, Simmons J, et al. Impact of telemedicine upon rural trauma care. *J Trauma* **2008;**64:92–97; discussion 97–98.
13. Barnett TE, Chumbler NR, Vogel WB, Beyth RJ, Ryan P, Figueroa S. The cost-utility of a care coordination/home telehealth programme for veterans with diabetes. *J Telemed Telecare* **2007;**13:318–321.
14. Breslow MJ, Rosenfeld BA, Doerfler M, et al. Effect of a multiple-site intensive care unit telemedicine program on clinical and economic outcomes: An alternative paradigm for intensivist staffing. *Crit Care Med* **2004;**32:31–38.
15. McCue MJ, Mazmanian PE, Hampton C, et al. The case of Powhatan Correctional Center/Virginia Department of Corrections and Virginia Commonwealth University/Medical College of Virginia. *Telemed J* **1997;**3:11–17.
16. Sable C, Roca T, Gold J, Gutierrez A, Gulotta E, Culpepper W. Live transmission of neonatal echocardiograms from underserved areas: Accuracy, patient care, and cost. *Telemed J* **1999;**5:339–347.
17. Wootton R, Bloomer SE, Corbett R, et al. Multicentre randomised control trial comparing real time teledermatology with conventional outpatient dermatological care: Societal cost-benefit analysis. *BMJ* **2000;**320:1252–1256.
18. Daucourt V, Sicotte C, Pelletier-Fleury N, Petitjean ME, Chateil JF, Michel P. Cost-minimization analysis of a wide-area teleradiology network in a French region. *Int J Qual Health Care* **2006;**18:287–293.
19. Marcin JP, Nesbitt TS, Struve S, Traugott C, Dimand RJ. Financial benefits of a pediatric intensive care unit-based telemedicine program to a rural adult intensive care unit: Impact of keeping acutely ill and injured children in their local community. *Telemed J E Health* **2004;**10(Suppl 2):S-1–S-5.

Address correspondence to:
Madan Dharmar, MBBS, PhD
Department of Pediatrics
University of California Davis Children's Hospital
2516 Stockton Boulevard
Sacramento, CA 95817

E-mail: mdharmar@ucdavis.edu

Received: October 28, 2012
Accepted: October 28, 2012