

Literature Review of Telemedicine in Pediatric Infectious Diseases

Reference	Methods	Results/Conclusions
GENERAL ARTICLES <p>So You Want to Start an Infectious Diseases Telemedicine Service? Vandana L. Madhavan and Chadi M. El Saleeb Location: Massachusetts General Hospital for Children (MGHfC) Boston, Massachusetts, USA JPIDS 2020;9 (July) • 357</p>	<p>*Discussion of Experience at Massachusetts General Hospital and Massachusetts General Hospital for Children.</p> <p>*Peds ID: started in 2016 and provides virtual visits (VV's- between provider and established patients) and eConsults (specialty consult requested by other providers, usually PCP's)</p> <p>*VV's: patients have existing care relationships with Peds ID. On desktop, laptop, tablet or smartphone using secure platforms. Provided care to patient's from 7 states. Mean encounter 26 minutes, level 4.</p> <p>*E-consults: straightforward, non-urgent, do not require in-person consultation. Turnaround: 3 business days. Top reasons: diagnostic evaluation, lab result interpretation, TB screening</p>	<p>*Steps to successful implementation of telemedicine program involves evaluation of:</p> <ol style="list-style-type: none"> 1) Target population: geographic, disease specific, etc. Canvass PCP's, patients, other subspecialists for needs 2) Operational and technical issues: equipment, platforms 3) Licensing and credentialing factors 4) HIPAA and privacy concerns 5) Billing and reimbursement workflows 6) Malpractice coverage 7) Provider training 8) Real-time feedback from users, administrative, technical support, and billing 9) Clinical outcomes, financial impact, patient-provider satisfaction at division and institutional levels 10) Mistakes and pitfalls; apply change as needed <p>*Additional COVID-19 considerations: telemedicine allows continued care while minimizing viral spread. MGHfC moved majority of outpatient care to VV's including offering families option of initial consultations for select and uncomplicated conditions.</p> <p>*COVID-19 pandemic offers unique opportunity to accelerate telemedicine and work through challenges that accompany implementation.</p>
<p>Reliability and accuracy of smartphones for paediatric infectious disease consultations for children with rash in the paediatric emergency department. Devrim İ, et al. Location: Izmir, Turkey. 400 bed teaching hospital</p>	<p>*194 pediatric patients in ED with rash</p> <p>*2 smartphone images sent to remote Peds ID consultant along with demographics, PMH and labs.</p> <p>*Resulting diagnosis compared to second diagnosis from in person exam by second clinician. Both</p>	<p>*Initial diagnosis via smartphone showed 96.3% compatibility with the final diagnosis</p> <p>*Two clinicians (one via smartphone and second in-person) showed almost perfect agreement (0.944), p<0.005</p>

BMC Pediatr. 2019 Jan 31;19(1):40.	diagnoses compared to definitive diagnosis after diagnostic tests (serologic, etc) returned. *Typical diagnoses: chickenpox, SSTI, shingles, insect bite, HSV, measles, other viral exanthems	*Conclusions: Excellent correlation between rashes diagnosed via smartphone pictures versus in-person physical exam
Physician-to-Physician Electronic Consultation: A Tool for the Pediatric Infectious Diseases Specialist to Document Encounters and Quantify Effort. Gonzalez BE, Sabella C, Esper FP, Daniels HL, Saracusa C, Boutros J, Foster CB. Location: Cleveland, OH, USA J Pediatric Infect Dis Soc. 2020 May	*April 2018, Cleveland Clinic Children's (CCC) began electronic consults (E-consults) initiated through EMR (Epic) by general practitioners or NP's to subspecialists. E-consults answered within 24 hrs except on weekends. NOTE: RVU's calculated but no charges submitted to patient or insurance *200 Peds ID E-consults reviewed between 4/11/18 and 4/22/19	*64.5% E-consults came from providers 11-20 miles from main CCC campus. 86% placed by physicians. *Time spent: 5-25 minutes (51% were 15 minutes) *59.5% came on either Friday or Monday *No difference between MD's and NP's in reasons for E-consults *23% recommended face-to-face evaluations *Breakdown: 25%: Vaccine questions predominated (catch-up, boosters, travel, immunocompromised hosts) *21.5%: exposures (hepatitis B and C, animals, rabies) *45% Diagnosis and/or Treatment *RVU's generated were equivalent to 70 level 4 initial outpatient consults (99244)
Infectious Disease Society of America Position Statement on Telehealth and Telemedicine as Applied to the Practice of Infectious Disease. Clinical Infectious Diseases. 2019;68(9): 1437-43.	Position statement to educate members regarding use of telehealth and telemedicine technologies and development of telehealth/telemedicine programs.	
PERINATAL HIV		
Virtual support for paediatric HIV treatment decision making Le Doare K, Mackie NE, Kaye S, Bamford A, Walters S, Foster C. Location: St. Mary's Hospital, London, UK Arch Dis Child. 2015;100:527–31.	*Retrospective review of clinical outcomes of pediatric and adolescent referrals (0-18 yrs) to the pediatric virtual clinic (PVC) at St. Mary's Hospital between 10/2009 and 11/2013 *Goal: to ensure and standardize care across UK for pediatric HIV *Healthcare professionals requesting referrals submit anonymous patient data (age at diagnosis,	*During time period, 234 referrals made for 182 children (17.6% discussed more than once) *Majority of referrals from within the center, but also from other London centers and from across UK. Also 15 came from other countries such as Ukraine, Russia, Cyprus, Australia, etc. *Most children were HAART experienced *Most common reason for referral: virologic failure, followed by other treatment issues (simplification,

	<p>CD4 history, infection history, HIV-1 resistance data, drug side effects, etc)</p> <p>*PVC meets once per month to review cases and send management recommendations</p>	<p>complications, starting HAART or restarting after interruption)</p> <p>*Of the 119 referrals for virologic failure, 90 were HAART experienced; 48% of these experienced virologic suppression after 1one PVC visit.</p> <p>*PVC recommendations followed in 80% of cases</p> <p>*PVC found to be a valuable tool to aid in management of complex chronic diseases by giving access to diverse range of expertise regardless of location.</p>
ADOLESCENT TELEMEDICINE (INCLUDING HIV)		
<p>The Supporting Adolescent Adherence in Vietnam (SAAV) study: study protocol for a randomized controlled trial assessing an mHealth approach to improving adherence for adolescents living with HIV in Vietnam.</p> <p>DeSilva M, Vu CN, Bonawitz R, Hai LT, Van Lam N, Yen LT, Gifford AL, Haberer J, Linh DT, Sabin L.</p> <p>Study Location: National Hospital for Pediatrics, Hanoi, Vietnam</p> <p>Trials. 2019 Feb 28;20(1):150.</p>	<p>*Study number at ClinicalTrials.gov: NCT03031197</p> <p>*Phase I: interviews with perinatally infected adolescents and caregivers to discover facilitators and barriers to ART adherence</p> <p>*Phase II: prospective randomized experiment using intervention package consisting of wireless pill containers to track adherence, triggered text reminders when ART doses are not taken on time, and support from nurse and physician providers</p> <p>*Interventions will be personalized by each patient-form, sound and content of reminders to either adolescent's or caregiver's cell, "youth friendly" handouts at counseling sessions, and whether to use a "buddy system" to review adherence with the adolescent</p> <p>*Based on Self-Determination Theory; will measure baseline and endpoint SDT constructs of autonomy and competence</p>	<p>Study will contribute valuable information on:</p> <ol style="list-style-type: none"> 1) Barriers to and facilitators of adolescent adherence adherence to ART 2) Technology ("mHealth") approaches as ART adherence support tools <p>Factors affecting adolescent ART adherence</p> <p>Trial status:</p> <p>Protocol version number 1.2, approved by UNE IRB on 20 April 2017. Enrollment is active; RCT enrollment began on 15 May 2017 and was expected to be completed by 31 August 2017.</p> <p>Currently states completed on ClinicalTrials.gov</p>
<p>Timeliness and access to healthcare services via telemedicine for adolescents in state correctional facilities.</p> <p>Fox, K. C., Somes, G. W., & Waters, T. M.</p> <p>Location: Four adolescent detention facilities in Tennessee, USA</p> <p>Journal of Adolescent Health 41 (2007) 161–167</p>	<p>*Aim: first study to examine the effectiveness of a telemedicine program in improving timeliness of and access to healthcare services in adolescent (vs adult) correctional facilities.</p> <p>*Telemedicine infrastructure developed in facilities-clinic room with locking cart, camera, microphone, and digital stethoscope. On site staffed by full-time RN's and/or LPN's. Staff clinicians asked to refer</p>	<p>*Saw 57% decrease in overall wait time for referral and a significantly decreased time from referral to treatment after the program was implemented</p> <p>*Outpatient visits increased 40% via telemedicine and emergency room visits significantly decreased by year two, a statistically significant difference</p> <p>Peds ID not specifically mentioned</p>

	<p>patients to subspecialty services (more than half were psychiatric)</p> <p>*Pre- (1 year) and post (2 years) implementation parameters assessed</p>	
Efficacy of a Telephone Delivered Sexually Transmitted Infection/Human Immunodeficiency Virus Prevention Maintenance Intervention for Adolescents A Randomized Controlled Clinical Trial. D' Clemente RJ, Wingood GM, Sales JM, Brown JL, et al. JAMA Pediatr. 2014 October; 168(10): 938-946.	<p>Aim: Evaluate telephone counseling prevention maintenance to sustain HIV preventive behaviors</p> <p>Methods: 2 arm randomized supplemental treatment trial</p> <p>One arm received regularly scheduled telephone calls with HIV/STI prevention messages</p>	<p>Percentage of participants with lab confirmed GC or chlamydia infection during follow up was lower in intervention arm.</p> <p>Frequency of high risk behavioral outcomes was lower in intervention arm.</p>
COVID-19		
Letter to the Editor: Telemedicine for management of paediatric infectious diseases during COVID-19 outbreak. Esposito, S., Parma COVID-19 Pediatric Working Group (PaCoPed), Voccia, E., Cantarelli, A., Canali, A., Principi, N., & Prati, A. Author location: University of Parma, Parma , Italy Journal of clinical virology 129 (2020) 104522	<p>*Hypothesis: PCP's would benefit from telemedicine by having rapid access to subspecialists to address patients' emerging COVID-19-related problems. To verify this, a comprehensive paediatric infectious disease telemedicine programme at an urban academic medical centre in Parma, Emilia-Romagna Region, Italy, was developed and activated on March 7, 2020.</p> <p>*Used telemedicine peripheral devices, smartphone apps and broadband connections</p>	<p>*From 3/7/20-5/3/20 during lockdown in Italy, 61 requests for Peds ID telemedicine consultation were logged</p> <p>*90% of consults that previously (without telemedicine) might have led to an ED visit were solved in the community by telemedicine. The rest that required in-person visit were because of skin rash, and acrocyanosis (SARS-CoV-2 negative). None required further evaluation in the community or hospital</p> <p>*Conclusions: telemedicine may be an easy and effective measure to solve many pediatric problems in the community during COVID-19 outbreak, reducing emergency room visits</p>
PEDIATRIC ANTIMICROBIAL STEWARDSHIP		
Parent Satisfaction and Antibiotic Prescribing for Respiratory Infections by Telemedicine Charles B. Foster, MD, ^a Kathryn A. Martinez, PhD, MPH, ^b Camille Sabella, MD, ^a Gregory P. Weaver, MD, MPH, ^{b,c} Michael B. Rothberg, MD, MPH Location: Cleveland Clinic, Cleveland, OH, USA PEDIATRICS Volume 144, number 3, September 2019	<p>*Background: during direct-to-consumer (DTC) telemedicine visits for pediatric respiratory tract infections (RTI's), antibiotic prescribing rates are higher than in-person visits and less concordant with guidelines</p> <p>*Knowledge of factors influencing antibiotic prescribing during DTC telemedicine is important for judicious use of antibiotics</p> <p>*Paper explores correlates between parent satisfaction with video-only DTC telemedicine visits and encounter characteristics such as: encounter length, and whether antibiotic prescribed</p>	<p>*12,852 encounters provided by 560 physicians. Family medicine doctors provided majority of care across all age groups (69-74%), although younger patients were seen more often by pediatricians and older adolescents were also seen by internal medicine</p> <p>*Most common diagnoses were pharyngitis (29%) and sinusitis (23%)</p> <p>*Overall, 55% of children with RTI diagnosis received an antibiotic. Prescribing rates varied by diagnosis and were high: sinusitis (92.1%), otitis</p>

	<p>*Visits for RTI's (pharyngitis and/or tonsillitis, sinusitis, bronchitis and/or bronchiolitis, otitis media, influenza, or other viral infections (laryngitis, rhinitis, cough, viral upper respiratory tract infection, NOT pneumonias): 0-19 years, between July 2016 and July 2018</p> <p>*Data gleaned were administrative only; no access to charts</p>	<p>media (96.0%), pharyngitis (76.7%), and bronchitis and/or bronchiolitis (62.0%)</p> <p>*12% were treated with azithromycin, which is not recommended as firstline treatment of pediatric URIs when an antibiotic is indicated.</p> <p>*Compared with nonpediatricians (AP 56.4%; 95% CI 55.8 to 57.2), pediatric providers were less likely to prescribe antibiotics (OR 0.44; 95% CI 0.29 to 0.68); however, pediatricians received higher encounter satisfaction ratings (OR 1.50; 95% CI 1.11 to 2.03). Still, among pediatricians, those who prescribed more antibiotics had higher satisfaction ratings.</p> <p>*The provider was more likely to receive a 5-star rating from the parent when an antibiotic was prescribed (93.4% vs 80.8%).</p> <p>*Further work is required to ensure that antibiotic use during DTC telemedicine encounters is guideline concordant</p>
<p>Antibiotic prescribing during pediatric direct-to-consumer telemedicine visits.</p> <p>Ray KN, Shi Z, Gidengil CA, Poon SJ, Uscher-Pines L, Mehrotra A.</p> <p>Location: Pittsburgh, Boston, USA</p> <p>Pediatrics. 2019;143:e20182491</p>	<p>*Goal: compare the quality of antibiotic prescribing for acute respiratory infections (ARIs) among children (0-17) across 3 settings: Direct to consumer (DTC) telemedicine (parental personal devices; in some cases only the telephone), in-person urgent care, and in-person primary care provider (PCP) office.</p> <p>*ARI definition per ICD-9 includes diagnoses for which antibiotics may be warranted (sinusitis, pneumonia, streptococcal pharyngitis, acute otitis media, and diagnoses for which antibiotics are not warranted (eg, viral upper respiratory infection [URI], bronchiolitis, viral pharyngitis, serous otitis media</p> <p>*Retrospective cohort study reviewing 2015-2016 claims data from national commercial health plan, excluding patient who did not have pharmaceutical coverage during the time period</p> <p>*Excluded bacterial pneumonia due to small number of DTC visits</p>	<p>*4,604 DTC telemedicine, 38,408 urgent care, and 485,201 PCP visits for ARIs in the matched sample.</p> <p>* Antibiotic prescribing was higher for DTC telemedicine visits than for other settings (52% of DTC telemedicine visits versus 42% urgent care and 31% PCP visits; p <0.001 for both comparisons</p> <p>* Guideline-concordant antibiotic management was lower at DTC telemedicine visits than at other settings (59% of DTC telemedicine visits versus 67% urgent care and 78% PCP visits; p<0.001 for both comparisons).</p> <p>*Above differences were primarily driven by increased use of antibiotics for visits receiving viral diagnoses.</p> <p>*Findings emphasize the need for improvement in guideline-concordant antibiotic use and ongoing antibiotic stewardship efforts in outpatient settings</p>

	*Using matched samples, compared the percentage of ARI visits with any antibiotic prescribing and the percentage of ARI visits with guideline-concordant antibiotic management	
Telemedicine as an effective intervention to improve antibiotic appropriateness prescription and to reduce costs in pediatrics. Ceradini J, Tozzi AE, D'Argenio P, Bernaschi P, Manuri L, Brusco C, Raponi M. Location: Bambino Gesù Children's Hospital, Rome, Italy Ital J Pediatr. 2017 Nov 17;43(1):105. doi: 10.1186/s13052-017-0423-3.	*Peds ID telemedicine antimicrobial stewardship consult service to a pediatric cardiology center (including ICU) housed within a 220 bed pediatric hospital, which did not have an onsite infectious disease expert *Aim: evaluate the impact of the remote stewardship program compared to the previous period in terms of: a) appropriateness of antibiotic prescription; b) incidence of multi-resistant infections; and c) costs. *25 real-time meetings in one year, consisting of biweekly discussion of all clinical cases with cardiologists, anesthesiologists, surgeons, Peds ID and Micro present. *Included real-time file sharing, high definition cardiac and radiology images	* 'Before - after' study comparing a period immediately before the intervention (683 patients, 1 January 2014–1 March 2015) to a post-intervention period (531 patients, 1 March 2015–1 March 2016). * Hospital infections in ICU rate per 1000/person days decreased from 9.5 in the pre-intervention period to 6.1 for 1000/person days in the post intervention, though the difference was not statistically significant ($p = 0.23$). * The rate of MDR isolation decreased from 104 to 79 per 1000 person days with a significant reduction of 25% ($p = 0.01$). *Overall costs of antimicrobials fell dramatically, from 25,000 EUR in 2014 to 15,000 EUR (no statistical data given). *Average hospital stay between the two groups was not statistically different * The infectious diseases meeting at the CCPM was an effective tool for economic and professional development and multidisciplinary management of complex patients
PEDIATRIC OPAT		
Poster: Pilot of a home telehealth platform in a pediatric OPAT program. Vaz L, Wagner T, Cochran B, Lovgren M. Location: Oregon, USA Open Forum Infect Dis 2017; 4(Suppl 1): doi: 10.1093/ofid/ofx163.789. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5631487/	* Virtual clinic was established between provider and family using parent driven physical exam * Two pediatric OPAT patients completed the pilot in Spring 2017 for treatment of 1) CLABSI with retained line and 2) chronic ulcer with osteomyelitis *Total time was under 20 minutes	* Demonstrated feasibility and functionality of telemedicine platform to conduct a billable OPAT clinic visit in a patient's home