5-1-2020

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These patients' stories provide evidence of the increased care capacity that is the main goal of Show-Me ECHO.

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Abstract

In this article, we describe three life-changing patient cases demonstrating high-quality and timely care they received in their communities, thanks to the Show-Me ECHO project. Early autism diagnosis, a potentially deadly tumor manifesting as a benign-looking rash, a recalcitrant case of hepatitis C: rural and underserved Missourians now have access to state-of-the-art care through their local providers receiving interdisciplinary telementoring on evidence based practices.

Introduction

Early interventions for a toddler result in his increased independence and improved quality of life for the family; a woman obtains information that corrects a misdiagnosis and saves her life; and another receives services that cure a life-altering disease. At first glance these seem unrelated, however none of these individuals would have realized life-changing benefits if not for Show-Me ECHO.

Show-Me ECHO (Extension for Community Healthcare Outcomes) is a continuing education and telementoring project that leverages videoconferencing technology and adult learning theory to improve care for rural and underserved patients in Missouri. Founded as a replication of New Mexico's Project ECHO, Show-Me ECHO seeks to "move knowledge rather than patients."[1] ECHO invites primary care providers (PCPs) to attend regularly scheduled virtual learning sessions in a didactic and case-based format, where they gain expertise and confidence in treating their existing patients within their own community. ECHO sessions are strategically focused and organized to follow a tested model: a) amplification of scarce resources through leveraging virtual technology, b) best-practices: a multi-disciplinary hub team content experts provide short didactic presentations on best practice, c) case-based learning: PCPs present real-life but de-identified cases for guidance and mentoring, and d) data monitoring: process and outcomes data are collected and analyzed.

Hub-team specialists are trained facilitators who foster an inclusive and judgment-free environment, and cultivate a community of practice by working through cases with all members of the ECHO. This practice fosters development of regional experts as described in other articles in this series. Most providers join an ECHO because they have noticed a gap in their knowledge, or have identified

a health issue in their patient population that they feel ill-prepared to address, and many continue to participate for years.

ECHO increases the capacity of participating PCPs which, in turn, improves timely diagnosis and quality of patient care. Patients benefit in general by their providers' increased knowledge gained through ECHO. Some benefit directly by having their de-identified case discussed within the ECHO specialty hub team. Here they benefit from the combined wisdom of a large group of providers with differing perspectives and specialties. During case discussions, the hub team shares expertise, and participants contribute their knowledge of local resources and culture. The patient's PCP is available to answer questions. Care provided through the ECHO model is potentially superior to referral to specialists, because each specialist would only have access to a reductive snapshot of the patient's problems, and the PCP would need to integrate recommendations from different specialists.

We examine three patient cases that illustrate Show-Me ECHO's impact on improved patient outcomes in Missouri.

Methods

Three cases were selected from Show-Me ECHO archives for autism, dermatology, and hepatitis C. The PCPs presented the cases to help the individual patient and foster learning among all ECHO participants. Cases highlight disparate diseases, patient populations (children, inhabitants of rural areas, and older adults), and ECHO goals (empowering pediatricians to diagnose autism, educating PCPs to address complex skin problems, and bringing cure to patients who would not get treated otherwise).

We used: 1) transcripts of the recorded case presentations, 2) PCP submitted summaries of patient's demographics, medical history, and current complaint ("case forms") and 3) hub team case recommendation forms, highlighting the diagnosis and next steps. All cases were de-identified prior to presentation. The project was reviewed and acknowledged by the University of Missouri Institutional Review Board (IRB).

Results

Case 1: ECHO Autism

Autism Spectrum Disorder affects 1 in 59 children in the U.S. and is an early childhood neurodevelopmental disorder.[2,3] It can be reliably identified by age 24 months, however, age of diagnosis for the United States is four years seven months.[2,3] This delay significantly impacts outcomes as early intervention is critical for optimal improvement.[4,5,6] Missouri's Show-Me ECHO Autism is empowering primary care providers to diagnosis young children with obvious symptoms of autism.[5, 7]

A two-year nine-month-old boy is referred to a primary care clinic for autism evaluation by his First Steps support specialist who had convinced foster parents to seek care due to concerns for delayed speech, excessive emotional meltdowns, restrictive eating, and poor interaction with peers. Missouri First Steps is "an early intervention system that provides services to families with children, birth to three years of age, with disabilities or developmental delays."[8] With the support of ECHO Autism, a local pediatrician had been providing comprehensive Autism evaluation for four years and routinely received referrals from community agencies, local school districts, and other medical practices.

The pediatrician noted that the boy had been saying a few single words and was using sign language by nine months of age, but had regressed to no words or use of sign. He had multiple foster placements intermixed with biological parents as caregivers. At the time of presentation he was in emergency foster care with a relative who had consistently been in his life. His foster parents had noted the regression in his speech and changes in his behavior. The boy had a complete two-part Autism evaluation within four weeks.

He had considerable symptoms across diagnostic categories based on the Diagnostic and Statistical Manual of Mental Disorders (DSM) 5 parent interview. He did not respond to his name when called, had minimal to no engagement with caregivers and did not seek to engage others in activities or share emotions. He was noted to give forceful hugs and kisses. His play skills were limited and he showed minimal interest in peers. Additionally, he made no eye contact, vocalizations, or gestures to communicate his wants and needs. His preferred method was to place his hand on another person's and move it to the item he wanted. All of these behaviors are noted as significant for deficits in social communication, social pragmatics, and interaction with peers. He had restricted interests in his toy cars, which he liked to line up. He sorted

his objects in color and followed patterns when lining them. He exhibited repetitive hand flapping or running in circles. He liked to put his head on the floor, and showed extreme distress in changes in routine or transitions, which manifested as excessive crying, screaming, spitting, and putting fingers down his throat to gag himself. His insistence on sameness was highlighted in his restrictive eating pattern, limited to ramen noodles, spaghetti sauce and noodles, crackers or chips from a bag. He was obsessed with mirrors, water, and rocks. He liked to carry his sippy cup and blanket, and it was challenging for him to transition away from these items. Additionally, he visually inspected items like the floor and other objects.

His physical exam was negative for dysmorphic features. Consistent with foster parent reporting, he demonstrated very limited eye contact, difficulty with transitions, significant emotional distress, no words, hand flapping, running in circles, and gagging himself. With these restrictive repetitive behaviors and deficits in social communication, there was enough concern for Autism Spectrum Disorder (ASD) and further testing using Screening Tool for Autism in Toddlers and Young children (STAT). With foster parent consent, his First Step records were reviewed, which showed significant delays in communication and social-emotional development, and behavior concerns exhibited in the home setting. He had no formal hearing evaluation completed and no other testing for his developmental delays. He was also having staring spells, which both First Steps provider and foster parents had noted, concerning for a seizure. General developmental screening using Ages and Stages Questionnaire (ASQ) showed global developmental delay in the areas of social communication, fine motor skill development, social skills and problem solving. Modified Checklist for Autism in Toddlers-Revised (MCHAT-R) was at risk for autism. With ASD as a possible diagnosis for his behavior and delays, STAT testing was done showing significant risk for ASD. Given the complexity, the pediatrician presented the case at ECHO Autism, for further guidance and mentoring from the hub team.

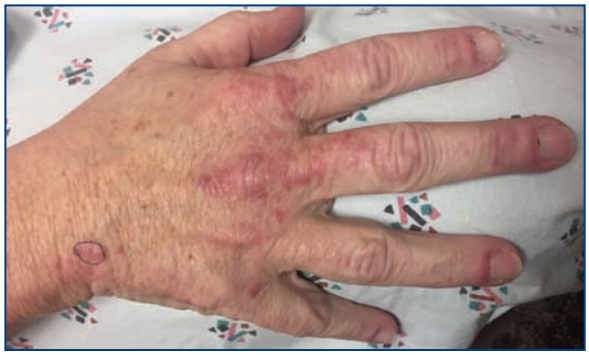
Together with clinical history, records reviewed from First Steps, at risk STAT testing and other developmental tools such as MCHAT-R, ASQ, the boy met the criteria for ASD, which was confirmed at ECHO Autism. Autism resources, including Autism Speaks, were given to the foster parents. While awaiting testing, the patient was referred to audiology for hearing evaluation and blood tests for micronutrient deficiency completed. Neurology was consulted to rule out a seizure disorder with staring episodes; and later he was sent to genetics due to family history of ASD, his behaviors, and global developmental delays.

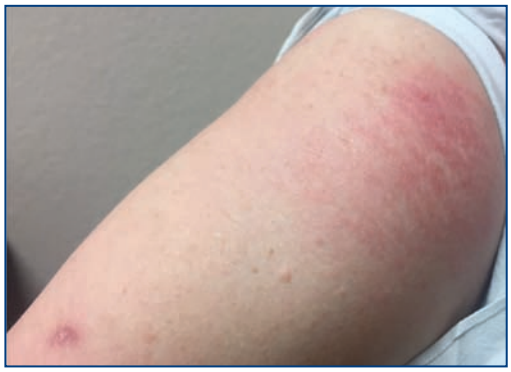
Together with clinical history, records reviewed from First Steps, at risk STAT testing and other developmental tools such as MCHAT-R, ASQ, the boy met the criteria for ASD, which was confirmed at ECHO Autism. His foster parents were relieved they were able to get the diagnosis in their community, and without travel. They received an information packet on ASD and tools to help with communication. He was enrolled in services and guidance for early childhood with local school system special education to begin at the age of three years. An Individual Education Plan (IEP) and Applied Behavior Analysis (ABA) therapy services were requested. Every four months follows up with the pediatrician were scheduled.

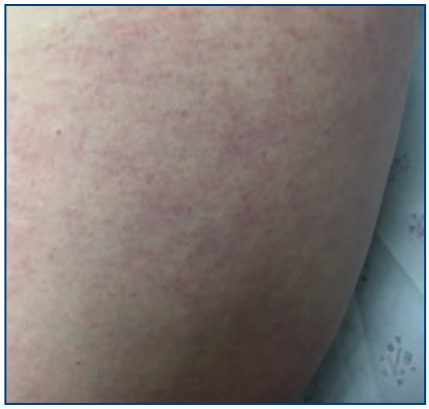
Case 2: Dermatology ECHO

Dermatomyositis (DM) is a complex skin condition characterized by an inflammatory skin rash, muscle inflammation, and the potential for involvement of other organs. DM can be difficult to diagnose due to variability in severity of clinical and histologic features.[9] Classic clinical features include muscle weakness, fever, fatigue, and gastrointestinal symptoms (reflux and diarrhea); which vary significantly from patient to patient.[9] With a prevalence of 1-9 per 100,000 patients, DM is rare and often misdiagnosed.[10,11] Delayed diagnosis of DM may cause significant damage to muscles and other organs, as well as a potential association with internal malignancy. Failure to diagnose DM can lead to prolonged patient suffering and poor patient outcomes, including significant morbidity and mortality.[11]

In 2018, a 66-year-old woman was referred to a Dermatology ECHO-participating PCP with a rash on her hands, upper arm, and lateral proximal thighs that had started a 1.5 months, after a trip out of state (Figures 1-3). The patient reported chronic lower extremity muscle weakness that she blamed on the statins she had taken for a short while in 2005. However, there were no concerns related to proximal muscle weakness, which the PCP confirmed by observing the patient during her visit.







Figures 1, 2, 3. A Patient Presented with These Rashes to a Dermatology ECHO-Participating PCP

A first provider made a working diagnosis of contact dermatitis and prescribed prednisone, after triamcinolone 0.1% cream proved ineffective. After 12 days on prednisone with no improvement, the patient was referred to a local primary care dermatology expert who had participated in Dermatology ECHO for four years, and the patient remained under her care until her issues were resolved. The appearance of the skin rash, including exam findings of ragged cuticles and dilated capillaries, suggested Dermatomyositis. The PCP performed a skin biopsy (Figure 1) which revealed changes consistent with lupus or Dermatomyositis,

Table 1 - Summary of Healthcare Visits for Case 2

Timeline of office visits	Diagnosis	Medication prescribed	Procedures performed/ordered	Results
t = -100 days *Routine surveillance*			Colonoscopy	Normal
			Mammogram	Normal
t = -21 days	66-year-old Caucasian female notices rash after travel out of state			
Initial *t* = 0 *Referring PCP*	Contact dermatitis	TAC 0.1% cream		
t = 30 days *Referring PCP*	?	Two-week course of oral prednisone	Biopsy of right upper extremity	Pathology consistent with superficial perivascular dermatitis with eosinophils, possible drug reaction but nonspecific.
t = 42 days *Local dermatology-expert PCP*	Dermatomyositis		Skin biopsy of right hand	Interface dermatitis: lupus or Dermatomyositis
			Various labs	- Mildly elevated aldolase (11.3) - Markedly elevated ANA levels (1:1,280, speckled pattern) - Normal CA-125 levels (12.8)
t = 49 days ***ECHO consult*** *by dermatology-expert PCP*	Dermatomyositis confirmed	Methotrexate or Imuran recommended	CT chest-abdomen-pelvis suggested every 6 to 12 months; baseline PFTs; proximal muscle testing	
t = 61 days *dermatology-expert PCP*	Shared ECHO recommendations with patient; referred to rheumatology			
Rheumatology	Amyotrophic Dermatomyositis	Initially plaquenil, but rash developed; then methotrexate with improvement in rash	Various labs	- Repeat aldolase normal at 4.5 - Low white blood count so methotrexate dosing limited to 15 mg weekly
			CT scan	Ovarian mass; possible endometriomas
			MRI of pelvis and pelvic ultrasound	Patient referred to gynecological oncology
Gynecological oncology			Serial imaging	
			Serial CA-125	- 11.9 at *t* = 115 - 16.4 at *t* = 235 - 46.6 at *t* = 325
t = 325 days *Surgery*			Hysterectomy with BSO	Pathology consistent with right ovary serous borderline tumor and left ovary clear cell borderline adeno-fibroma. Peritoneal cytology negative for malignancy.
Second ECHO consult: Resolution	Asymptomatic	No longer on MTX		

Both aldolase and antinuclear antibody panel (ANA) levels were elevated, but cancer antigen 125 (CA-125) levels were normal. A routine mammogram and colonoscopy performed three to four months prior were also normal (Table 1).

The Dermatology ECHO hub team focused mentoring discussion on: a) yearly evaluation for lung disease using appropriate pulmonary function tests, and b) screening for malignancy by repeat (6-12 month) computerized tomography (CT) scans of the chest, pelvis, and abdomen, for the first three years after diagnosis. Muscle strength evaluation was recommended to establish a baseline should her existing weakness progress. The diagnosis and recommendations were shared with the patient and the patient was referred to rheumatology for further treatment.

The PCP presented a follow-up case a year later. The CT scan showed ovarian cancer in both ovaries, which had been successfully treated by a hysterectomy nine months after the first case presentation. The rash and Dermatomyositis immediately resolved without need for further treatment. The Dermatology ECHO recommendation for continued CT monitoring resulted in timely treatment and may have saved this patient's life.

Case 3: Hepatitis C

Hepatitis C is a viral liver infection that becomes chronic in 70-85% of patients. [12] Untreated Hepatitis C may result in liver cirrhosis, liver cancer, and death.[6] Hepatitis C infection is often asymptomatic and many people are unaware of it. The virus spreads easily though contact with blood or body fluids and is a major public health concern. Estimates are about 3.5 million people are living with Hepatitis C virus (HCV) in the US.[13] Hepatitis C is curable with appropriate, timely treatment.[14] Studies show that newer medications yield sustained virologic response (SVR) rates in excess of 95% after eight to twelve weeks of treatment.[15] In 2017, a 61-year-old, woman presented to her PCP, a family nurse practitioner, for a well-woman exam with a complaint of fatigue. Routine HCV screening, as recommended by the CDC for baby boomers, yielded a diagnosis of hepatitis C. The route of transmission was believed to have been a 30-year-old tattoo.

Table 2 - Summary of Healthcare Visits for the Patient in Case 3

Timeline of office visits	Diagnosis	Meds.	Procedures	Results
t ≈ -30 years	Patient acquires a tattoo			
Initial *t* = 0	Hepatitis C Chronic Hepatitis B?		Hep B serology	- HBsAB negative - HBsAG negative - HBcAB IgM negative - HBcAB positive
			Hep C serology	- Genotype 1A - HCV viral load 1,243,483
			Other serology	- Hepatitis A negative serology - HIV negative
			Other labs	- WBC 7.9 - HGB 14.3 - Platelets 42.5 - INR 1.1 - Creatinine 0.74 - ALT (SGPT) 76 - AST (SGOT) 65 - Total bilirubin 0.6 - Albumin 4.1 - HCG negative - TSH 1.67 - Urine drug test negative - HGB A1c 6.6%
			Fibrosure	- METAVIR score of F3 (bridging fibrosis) - Abdominal ultrasound results not yet available (will be normal)
ECHO consult (*t*=1 mo)	Hepatitis C	Harvoni (8 weeks) recommended		
Follow-up with patient (*t* = 1 month)		Harvoni	Updated labs	- WBC 7.6 - Platelets 332 - INR 1.1
Follow-up with patient (*t* = 3 months)				- Negative Hep C RNA
t = 9 months	Hepatitis C relapse		Updated labs	- HGB 8.6 - Creatinine 0.84 - ALT (SGPT) 31 - AST (SGOT) 41 - Albumin 3.8 - HBcAB positive - HB-DNA negative - Total bilirubin 0.5 - HBsAB negative - HCV viral load 740,992 IU/mL
			Blood transfusion	Normalized HGB
ECHO follow-up (*t* = 9 months)		Vosevi recommended		
Follow-up with patient *t* = 13 months	Fibrosis cured	Vosevi (1 month in)	Updated labs	- HGB 7.6 - ALT 20 - AST 35
			Cancer screening	- Large abdominal mass palpable - CA-125 1,550

The patient had a medical history of diabetes, hypertension, anxiety, and depression, the latter two exacerbated by her Hepatitis C diagnosis. She reported smoking one pack of cigarettes per week and drinking one small glass of wine daily, and denied getting drunk or binge drinking. She also had a history of marijuana use. Smokers have increased risk of liver damage, and smoking has been shown to negatively impact hepatitis C anti-viral therapies.[16] During her initial visit, the PCP ordered Hepatitis B serology screen and suggested a Fibrosure test for liver damage (Table 2). Results showed a METAVIR score of F3 (bridging fibrosis). An abdominal ultrasound results were not available at the time. As of her initial visit, patient medications included losartan (50 mg daily), glimepiride (1 mg daily), cinnamon tablets (two 500 mg capsules daily), and acetaminophen, naproxen, or ibuprofen taken as needed.

The case was presented to the Hepatitis C ECHO in May, 2017. The PCP's main questions were: "Is eight weeks of Harvoni the optimal treatment choice for this patient? Does the patient have inactive Hepatitis B?" The PCP was assured of continual support in treating her patient until a cure of Hepatitis C was achieved. The team would come back to this patient's case two additional times before a cure was achieved, about 20 months later.

The first ECHO discussion focused on validating the provider's proposed course of treatment. While the hepatitis C hub team specialists suggested several medications to consider, they ultimately agreed with the proposed eight weeks of Harvoni.

While Hepatitis C RNA was negative at the end of treatment, it was positive again at her next visit, indicating relapse, although lab tests showed some improvement (Table 2). The PCP brought the case ECHO follow-up. A severe nosebleed necessitated a blood transfusion. An abdominal ultrasound indicated that the patient's liver was normal. The patient reported that she still smoked one pack of cigarettes a week but denied drinking or using marijuana. After discussion, the PCP was advised to treat with Vosevi, another Hepatitis C medication indicated for treatment following failure or relapse.

The patient committed to using Vosevi as a treatment and arrived for follow-up after her first month on the medication at which time the PCP palpated a large mass on abdominal exam. The PCP shared her concerns of ovarian cancer with the patient and recommended a CT scan, which revealed a tumor of about 13 centimeters. This PCP returned to ECHO with a concern of continuing treatment while the patient underwent surgery. At this point, the patient was in the normal range for ALT and AST (20 and 35 respectively) and liver inflammation was resolved. The PCP was encouraged to continue treatment despite the ovarian cancer surgery, and to make sure that the patient did not miss a dose.

The final follow up was presented ten months later, 23 months after the case was first discussed. The PCP reported the patient, having followed all treatment plans, had tested positive for a sustained virologic response (SVR) three months after the end of treatment, and had been declared cured. The entire ECHO team celebrated this victory with the PCP.

Discussion

These three cases highlight the profound effects that ECHO has on both providers and patients. Show-Me ECHO discusses approximately 400 cases annually. Because they have access to a learning community for education and support, providers gain the knowledge and confidence to treat complex patient cases that they might feel compelled to otherwise refer to far-away specialists. Patients gain the ability to access state-of-the-art care in a familiar, local, primary care setting.

In two of the cases, the patient went to see a particular primary care provider because of her expertise in their condition: both the pediatrician from Case 1 and the family practitioner from Case 2 have become known as the regional expert in Autism and Dermatology respectively. These patients' stories provide evidence of the increased care capacity that is the main goal of Show-Me ECHO. To review available ECHO topics please consult Appendix 1. We invite you to join an ECHO: observe, participate, and consider presenting a case of your own. We're excited for you to join our community of learners and start benefitting yourself, your patients, and your community.

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Disclosure

None reported. **MM**