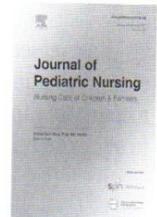




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Quality improvement and rapid PDSA cycles to maintain routine surveillance of pulmonary pathogens during the COVID-19 pandemic in a pediatric cystic fibrosis clinic

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ABSTRACT

Background: The COVID-19 pandemic necessitated immediate transition from in person to telehealth encounters; novel nursing practices were needed to ensure that children with cystic fibrosis (CF) receive care that approximates evidence-based guidelines.

Local problem: The aim was to ensure that as many children as possible received routine surveillance of pulmonary pathogens by a CF culture sputum culture during a pandemic.

Methods: Multiple Plan-Do-Study-Act (PDSA) cycles were utilized to implement practice change over four months.

Interventions: Cultures were obtained via curbside appointment with a registered nurse (RN) or at the patients' home with mailed equipment.

Results: 133 cultures obtained: 50.37% (67) by RN collection curbside and 49.62% (66) by self/caregiver at home. 120 culture swabs or sterile cups were mailed; 55% (66) were returned. Cost of mailing equipment was \$760.16.

Conclusion: Nursing utilization of PDSA cycles developed novel processes that ensured guideline-based care during the initial months of the pandemic.

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Introduction

Cystic Fibrosis (CF) is a life limiting genetic disease that causes cellular membrane protein dysfunction and impaired ion transport. It results in viscous secretions, primarily in the pulmonary and gastrointestinal systems, that cause decreased lung function and nutrient absorption (Goetz & Clement, 2019). The median predicted survival age for individuals born with CF increased from 32 years in 2009, to 46 years in 2019 (Cystic Fibrosis Foundation, 2020). This dramatic increase can be attributed to treatment advances and CF diagnosis earlier in life. Coordinated care from an accredited multidisciplinary team is the ideal health care delivery model for individuals with CF. The focus of pediatric CF care is to prevent complications, slow the progression of lung disease, and promote normal growth and development.

Problem description

A multidisciplinary team of healthcare professionals at a large CF center in the Intermountain West manages the care for over 300 children with CF. The team includes four registered nurses (RNs) and two advanced practice nurses (APRNs) who are responsible for delivering and coordinating evidence-based, guideline compliant CF care. The geographic area served by this CF center covers four states: Utah, Idaho, Nevada and Wyoming. Many families live in rural areas of these states and often travel long distances to the care center. Data from October 2017 to August 2020 revealed the clinic had seen 403 patients; 34% (137) lived in a rural area. Of those 403 patients, 51.6% (208) lived more than 40 miles from clinic, and 25.0% (101) lived more than 90 miles from clinic based on their home zip code. At the beginning of March 2020, 53 patients lived out of state.

On March 11, 2020 the World Health Organization declared COVID-19 a pandemic (World Health Organization, 2020). The model of care delivery had to change quickly and dramatically due to the increase in risk to the CF population, risk to health care workers, and a shortage of personal protective equipment. Prior to the pandemic all routine CF

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clinic visits took place in person. By March 18, 2020, in-person clinic visits decreased from seven half days per week to one, for sick or urgent visits. With institutional support, the center was able to shift the majority of care to telehealth virtual video visits; however, the ability to obtain routine CF sputum cultures emerged as a significant issue.

Available knowledge

Specific guidelines have been developed to direct the care of patients with CF (Borowitz et al., 2009; Lahiri et al., 2016; Mogayzel et al., 2014; Yankaskas, Marshall, Sufian, Simon, & Rodman, 2004). These guidelines were written when in person care was the standard. There are no guidelines related to CF virtual video visits and remote monitoring.

Rationale

The need for quick, systematic changes in a rapidly developing pandemic lead the clinic to utilize Plan-Do-Study-Act (PDSA) cycles. This is a four-step model that has gained wide acceptance and utilization in healthcare quality improvement (QI) (Christoff, 2018; Khan, 2017; Taylor et al., 2014). This CF center has a QI team well versed in using this model as a guide for QI projects. Given the nature of this model, interventions can be implemented and evaluated over long periods of time (allowing ample time to analyze the resulting change) or in rapid succession (to address a pressing need such as in this scenario).

Specific aims

The aim of this project was to implement novel solutions to meet the CF guidelines of four sputum cultures a year in the setting of a pandemic and limited in-person clinic visits.

Methods

Context

The center has an established culture of QI and a dedicated team. Members include pulmonologists, RNs, APRNs, RTs, social workers, pharmacy technologists, dietitians, and parents of children with CF. There has been institutional support for QI as well as grant funding to support this team in general and the process changes. Funds from the CF Center Grant are occasionally utilized to promote QI activities.

Interventions

A multidisciplinary team met weekly via a video platform to implement QI interventions and review PDSA cycles related to these interventions. Each week, interventions were planned, implemented, and evaluated. Interventions included: 1) curbside cultures, 2) mailing swabs for oral pharyngeal sampling or sterile specimen cups for expectorated sputum to families within reasonable driving distance to an affiliated facility where the specimen could be dropped off and couriered to the hospital's laboratory; 3) identifying appropriate laboratories for specimen processing and then mailing swabs or sterile specimen cups to families in more rural communities; 4) changing shipping providers to lower cost, and 5) contacting families via phone or the electronic health record messaging (EHR) system to remind them to obtain and send cultures to appropriate facilities (Fig. 1). As the processes were refined, nurses and providers discussed the option of curbside culture visits or obtaining cultures at home as part of the telehealth video visit.

PDSA cycle 1&3

The process for curbside cultures was piloted with a single patient on March 20, 2020. The process was expanded as the number of telehealth virtual visits increased. During telehealth appointments or via a phone

call, the RN would schedule a date and time with families. At their scheduled time, families would drive up to the front of the building and call the nursing phone number from their car. A RN wearing appropriate PPE (as designated by our institution: N95 mask, face shield, gown, and gloves) would meet the families/patients and obtain the oral pharyngeal or expectorated sputum sample while the patient remained in the car. Many of the younger children would even remain in their car seat.

PDSA cycle 2

The CF center is part of a greater system that has medical facilities located across the state. The center established a process in which CF cultures obtained at home by caregivers could be taken to any of these affiliated facilities, rather than driving to our facility for a curbside culture. Families preferring this option were shipped either a culture swab or specimen cup for the caregiver to collect the oropharyngeal specimen or for the patient to provide a sputum sample. The package also included instructions on how to obtain, label, store, and transport the specimen. After the patient/family dropped off the specimen, the facility would courier the specimen to the center's hospital laboratory, where it was processed. The oropharyngeal swabbed or expectorated specimen was transported to the laboratory within 2 to 24 hours of the caregiver obtaining it, depending on the temperature at which it was kept.

PDSA cycle 4

Next, the center focused on how to obtain CF cultures for patients who lived out of state or a distance from an affiliated facility. RNs identified alternative laboratories near these patients which could process the specimen as needed for a CF culture. RNs would communicate via telephone with the caregivers regarding insurance coverage and feasibility of distance to the identified laboratory. Needed equipment (swab or sterile specimen cup) were shipped along with the instructions and orders.

PDSA cycle 5

After sending many culture kits, the center observed that the shipping costs were high. This led staff to investigate shipping alternatives; costs were lower with the United States Postal Service (USPS) than the private shipping company. Subsequently, the center changed mail services to USPS.

PDSA cycle 6

Through ongoing review of the data, the center found that many patients did not complete the home cultures that were ordered. To increase percent of completed home cultures, a designated staff member called or sent EHR message to families reminding them to obtain and return the sample.

Study of the interventions

Prior to the pandemic, the clinic obtained 30–35 cultures per week. During the week of March 16 to 20, 2020 one culture was obtained. From thereon, all cultures obtained via curbside or mail, culture kits sent, and mailing costs were tracked. Postal costs were covered by funds from the CF center grant. The cost of processing the specimens remained the same as prior to the pandemic.

Zip codes were obtained from the EHR. Distances to clinic from patients' zip codes (not exact addresses) were obtained using an internet-based search engine. These zip codes were compared to the Federal Office of Rural Health Policy Eligible zip codes (Health

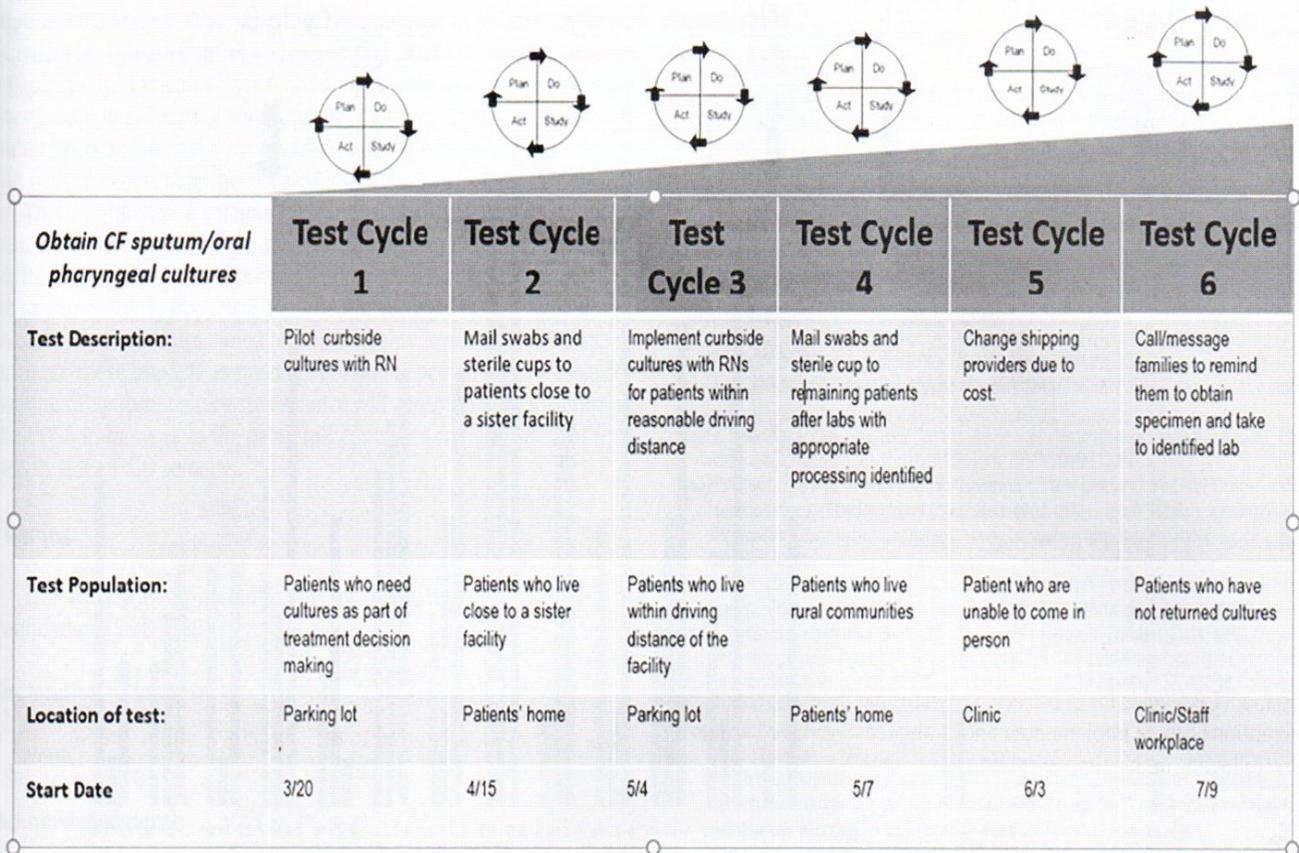


Fig. 1. PDSA Cycles.

Resources and Services Administration, 2021) Services to define which patients lived in rural communities.

The QI team continued to work on other projects unrelated to cultures, such as increasing telehealth video visits and improving patient/family communication during visits, for the purposes of this paper those interventions are not included. There were ongoing social media notifications, weekly to every other week emailed newsletters and electronic health record (EHR) patient communication portal reminders.

Measures

Rates of sent cultures versus returned cultures were noted, as well as number of curbside cultures per week. The number of patients who required treatment based on culture results were noted. The cost of shipping culture kits was obtained. Costs related to patient travel to the CF center for curbside cultures or to take the cultures to a processing facility were not gathered. Data were obtained through a combination of chart review in the EHR and prospective record keeping. Data collection and mining was done by the CF center nursing group, as well as other clinic support staff.

Analysis

Quantitative data were analyzed using descriptive statistics. Given the nature of this QI project and the lack of relevant comparison inferential statistical analysis was not utilized.

Ethical considerations

This project is QI and not subject to IRB oversight. Tracking files with patient identifiers were stored on encrypted platforms. Weekly tracking was done with deidentified data.

Results

Cultures, curbside

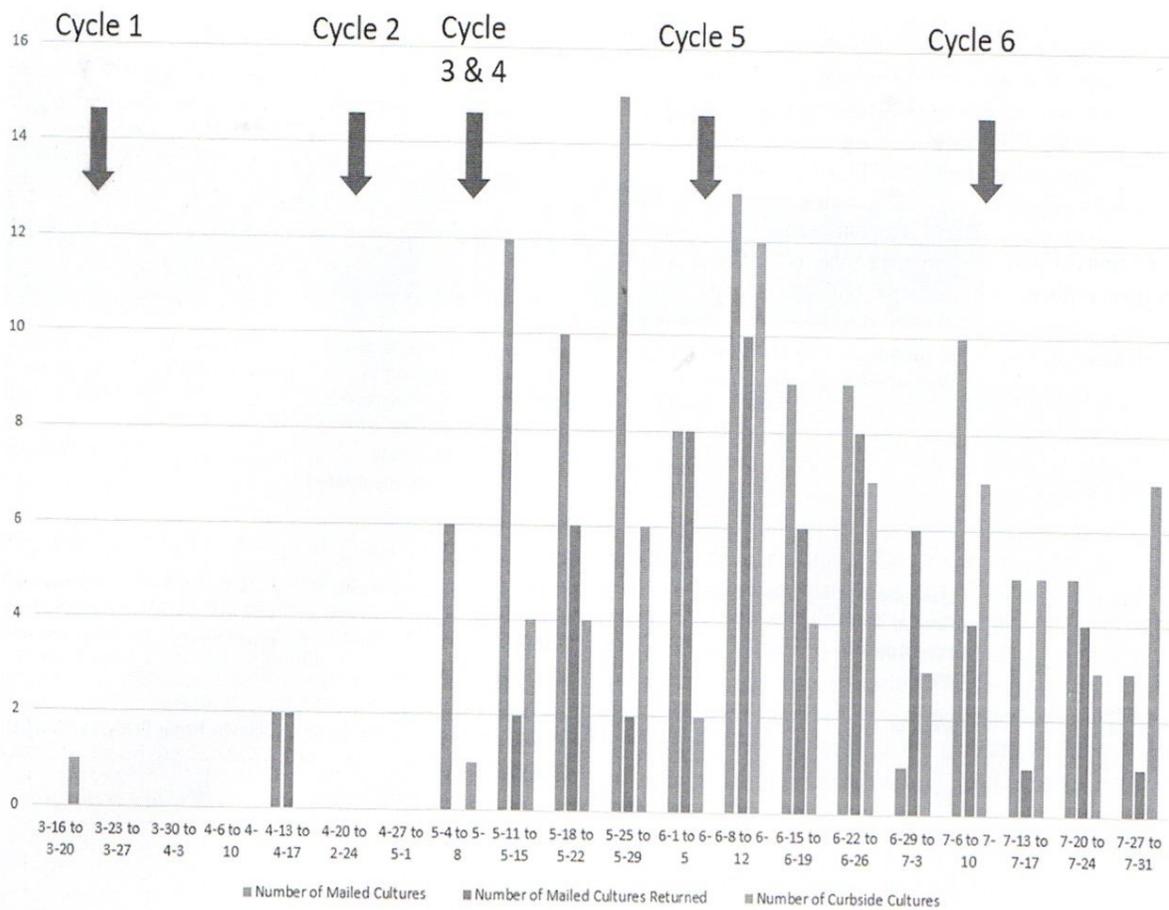
PDSA cycles 1 and 3 piloted and expanded curbside cultures. The number of curbside cultures slowly increased and reached their peak in June prior to increasing the number of in-person clinics (Fig. 2). From March 20 to July 31, 2020, 67 curbside cultures were completed.

Cultures, mailed

PDSA cycles 3 and 4 focused on mailing cultures to patients who could not complete curbside culture due to distance or preference. Ninety-eight patients (81.7%) lived within reasonable distance, as defined by the caregivers, of an affiliated facility where the specimen was dropped off and couriered to the hospital's laboratory. The remaining 22 (18.3%) patients required coordination to determine a laboratory within a reasonable distance that could process the specimen accurately. The return rate was similar for both groups: 12 out of 22 (54.5%) of the non-affiliated facilities and 54 out of 98 (55.1%) of the affiliated facilities group. A total of 120 cultures were mailed between April 15 to July 31, 2020 and 66 (55%) were returned.

PDSA cycle 5 evaluated costs and explored options for more cost-effective shipping. From May 6 to June 2, 2020, 29 swabs/specimen cups were sent via a private shipping company for a total cost of \$543.56. Individual items were shipped at a cost of \$16.83 to \$22.65 depending on delivery address (See Table 1). On June 3, 2020 delivery was changed to the USPS with a cost of \$3.80 per item. Cost of shipping the cultures for the rest of June and July 2020 was \$216.60 for 57 cultures. Padded envelopes for mailing the equipment cost \$9.99. Total shipping and supply costs were \$770.15.

Average time from telehealth video visit encounter to return of culture was 22.65 days; range 2 to 117 days; median 13 days. Prior to PDSA cycle 6, the average was 23.10 days; range 2–117; median 13. After



Number of Cultures By Week

Fig. 2. Number of cultures by week.

PDSA cycle 6 the average was 19.22 days; range 5–43; median 9. The number of cultures completed after PDSA cycle 6 was 9 and prior was 68. The post intervention culture numbers were too low for inferential statistical analysis.

Treatment

Four patients required treatment based on culture results; two had returned mailed cultures and two had curbside cultures. Two patients required hospitalization for intravenous antibiotics, one from the curbside and one from mailed culture group. The other two patients were treated at home with inhaled or oral antibiotics.

Discussion

Summary

Nursing utilization of PDSA cycles developed novel processes that ensured guideline-based care during the initial months of the pandemic. This provided vital health information that would not have otherwise been obtained. As a result, four patients received early treatment and intervention, which is of clinical significance.

Table 1

Shipping costs.

Shipping method	Average Cost Per Item	# Swabs/ Specimen Cups	Total Cost
Private Shipping Company	18.74	29	\$543.56
United States Postal Service	\$3.80	57	\$216.60

Interpretation

Without the curbside and mailed processes, oropharyngeal and sputum specimens would not have been obtained in association with newly implemented telehealth virtual video visits and opportunities for early treatment may have been missed. There were not any publications related to this process at the time of implementation. Cost for the shipping of equipment was funded through existing CF center grant funding. The funding will continue and can be allocated to this practice if deemed necessary as the pandemic continues or resolves. The RN time to identify nonaffiliated sites was approximately five to ten hours in April 2020. Once identified, the time burden was less with subsequent cultures. Other non-measured nursing time included curbside culture collection, family education on home collection, assembling and mailing culture kits, and follow up on uncollected cultures.

Limitations

This project was impacted greatly by the nature of the pandemic; the results may not be relevant post pandemic. There were other ongoing QI projects related to telehealth video visits access and CF team communication with families that may have resulted in awareness of the need for routine CF sputum culture surveillance. A small but uncounted number of mailed equipment expired prior to the family returning the culture. There is also question about the quality of home collected sputum samples and the ability of outside facilities to appropriately process the specimens.

Conclusions

From March to July 2020, more than three million people in the United States and more than 60,000 people in the states of Utah,

Idaho, Nevada, and Wyoming had documented COVID-19 infection (Centers for Disease Control and Prevention, 2020). There was an identified need for individuals with CF to access care in a safe manner that met guidelines. Creative solutions, new technologies, and telehealth video visits presented a means of delivering care while minimizing the risks of exposure to the novel SARS-CoV-2 virus.

This is an illustration of how PDSA cycles can be used in rapid succession to implement change in the face of a pandemic that dramatically shifted how patients access care. Children with chronic disease may be more negatively impacted than their healthy peers by limited access to care. The clinic team aimed to utilize quality improvement efforts to mitigate these impacts as much as possible. The clinic's processes for routine CF sputum culture surveillance will continue to adapt utilizing the PDSA framework as the pandemic continues and utilization of telehealth video visits remains.

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Declaration of interest

None.

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