Acknowledgements: CFF, Community Voice, Bethesda, Maryland. We would like to thank all the adults with cystic fibrosis and family members across the United States who participated for sharing their insights.

25

Impact of repeated non-treatment on long-term lung function

J. Ostrenga[1], W. Morgan[2], E. Cromwell[1], C. Ren[3,4], D. Sanders[5], M. Schechter[6]. *[1]Cystic Fibrosis Foundation, Bethesda, MD; [2]Pediatrics, The University of Arizona, Tucson, AZ; [3]Children's Hospital of Philadelphia, Philadelphia, PA; [4]Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA; [5]Pediatrics, Indiana University, Indianapolis, IN; [6]Children's Hospital of Richmond at Virginia Commonwealth University, Richmond, VA*

Background: Previous findings from the Epidemiologic Study of Cystic Fibrosis (ESCF) indicated that more-consistent treatment of declines in forced expiratory volume in 1 second (FEV_1) of 10% or greater from baseline in people with CF (PwCF) was associated with better pulmonary outcomes, yet more than one-third of declines were not treated. Data are lacking from a more recent cohort and regarding the effect of repeated untreated declines. Our objective was to determine the prevalence of untreated lung function decline in a pediatric cohort and evaluate the impact of repeated nontreated decline on the probability of percentage predicted FEV_1 (FEV_1pp) recovery to 100% of baseline.
Methods: We included PwCF aged 6 to 17 followed in the Cystic Fibrosis Foundation Patient Registry between 2016 and 2019. Baseline FEV_1pp was the average of the highest three FEV_1pp recorded during a period of stability spanning 30 to 365 days. We assessed relative decreases in FEV_1pp from baseline between 2017 and 2018. Participants must have had three or more relative declines of at least 5% within a 12-month window and have had a follow-up FEV_1pp in 2019 to determine whether they had returned to baseline. Treatment within 28 days of decline was categorized as any (intravenous antibiotics, oral or inhaled antibiotics (non-intravenous antibiotics)) versus no antibiotic treatment. We defined our exposure of repeated nontreatment as 50% or more decline events not treated using any antibiotic therapy. Alternate definitions of repeated nontreatment were tested in sensitivity analyses.
Results: Four thousand eighty-eight children were reported to have three or more declines of more than 5% in a 12-month window between 2017 and 2018. We identified 2,826 (69.1%) who experienced repeated nontreatment and 1,262 (30.9%) with more than 50% of their decline events having received any antibiotic therapy within 28 days. Children who experienced repeated nontreatment had a median (interquartile range) baseline age of 11.6 years (9.2, 14.7) and baseline FEV_1pp of 96.7% (85.4, 106.0). The group for whom at least half of their declines were treated had a median age (IQR) of 13.5 years (10.1, 15.8 years) and baseline FEV_1pp of 85.9% (72.7%, 96.8%). Of the children who experienced repeated non-treatment, 35.5% returned to 100% or more of their baseline, compared with 59.7% of the children who received more frequent antibiotic treatment.
Conclusions: We found that a substantial proportion of pediatric PwCF with multiple declines of at least 5% are not being treated with antibiotic therapy, especially those with high baseline FEV_1pp. Children who experienced repeated nontreatment were younger and had more than a 10% higher baseline FEV_1pp than those who were more frequently treated with antibiotic therapy, and two-thirds did not return to baseline by the end of 2019. Next steps include modeling FEV_1pp to evaluate whether repeated nontreatment is associated with accelerated decline in lung function.

26

Gingivitis in children with cystic fibrosis

A. Alkhateeb[1,2], A. Ko[1], D. Chi[1]. *[1]Department of Oral Health Sciences, School of Dentistry, University of Washington, Seattle, WA; [2]Department of Dental Health Sciences, School of Applied Medical Sciences, King Saud University, Riyadh, Saudi Arabia*

Background: The close links between the oral cavity and respiratory tract increase the potential risk of micro-aspiration of oral bacteria. Thus, it is critical to determine whether children with cystic fibrosis (CF) are at risk of oral disease. CF-related comorbidities such as diabetes, as well as systemic inflammation due to frequent lung infections and continued use of dry-mouth-inducing inhaled treatments, are potential risk factors for gingivitis (gum inflammation) [1,2]. Despite these risk factors, the current literature suggests that children with CF are at lower risk of gingivitis than those without because of chronic use of antibiotics to treat lung infections [3–5], but this literature is outdated (1977–2009) and does not account for potential confounders in the association between CF and gingivitis. Thus, the goal of this study was to compare the prevalence of gingivitis in children with and without CF.
Methods: This was a cross-sectional study comparing the risk of gingivitis in children with CF with the risk in those without CF with other special health care needs aged 7 to 17. We recruited children with CF from a single pediatric CF clinic in Seattle, Washington (n = 69) and non-CF controls from Medicaid enrollment files in Washington State (n = 89). Gingivitis was defined as bleeding in 10% or more of examined gingival sites. We used logistic regression to compare the prevalence of gingivitis between the two groups and adjusted for age, sex, race, antibiotic use, and dental insurance type as potential confounders.
Results: Children with CF were slightly younger (11.3 ± 3.1 vs 12.4 ± 2.8, $p = 0.02$), more likely to be white (93% vs 42%, $p < 0.001$), and less likely to have Medicaid insurance only (32% vs 84%, $p < 0.001$). Sixty-eight percent of children with CF and 40% of non-CF controls had gingivitis. Children with CF had significantly higher odds of gingivitis than non-CF controls (OR 3.1, 95% CI, 1.6–6.1; $p < 0.001$). This remained significant after adjusting for potential confounders (OR 4.7, 95% CI, 1.9, 11.9; $p = 0.001$).
Conclusions: In contrast to previous studies, our study showed greater likelihood of gingivitis in children with CF than in non-CF controls. Ensuring optimal oral health for children with CF is critical to maintain overall health and quality of life.
Acknowledgements: This work was supported by the University of Washington Cystic Fibrosis Foundation Research Development Program (Grant SINGH19R0); the National Institute of Diabetes, Digestive and Kidney Disorders Cystic Fibrosis Research Translation Center Clinical Core (Grant National Institutes of Health P30 DK089507); and the Dr. Douglass L. Morell Dentistry Research Fund, University of Washington.

References

[1] Kinane D, Stathopoulou P, Papapanou P. Periodontal diseases. *Nat Rev Dis Primers* 2017;3:17038.
[2] Demmer R, Squillaro A, Papapanou P, Rosenbaum M, Friedewald WT, Jacobs DR Jr, *et al.* Periodontal infection, systemic inflammation, and insulin resistance: Results from the continuous National Health and Nutrition Examination Survey (NHANES) 1999–2004. *Diabetes Care* 2012;35(11):2235–42.
[3] Ferrazzano G, Orlando S, Sangianantoni G, Cantile T, Ingenito A. Dental and periodontal health status in children affected by cystic fibrosis in a southern Italian region. *Eur J Paediatr Dent* 2009;10 (2):65–8.
[4] Kinirons M. Dental health of patients suffering from cystic fibrosis in Northern Ireland. *Community Dent Health* 1989;6(2):113–120.
[5] Blacharsh C. Dental aspects of patients with cystic fibrosis: A preliminary clinical study. *J Am Dent Assoc* 1977;95(1):106–110.

27

Effect of SARS-CoV-2 on long-term physical and mental health symptoms in people with cystic fibrosis and their caregivers

K. Hudock[1,2,3], P. Cheng[4,5], J. Chmiel[4,6], C. Brown[7], E. Kramer[3,8], V. Indihar[1], E. Kopras[1], E. Aliaj[9], J. Hudson[9], S. Filigno[3,10]. *[1]Division of Pulmonary, Critical Care and Sleep Medicine, Department of Medicine, College of Medicine, University of Cincinnati, Cincinnati, OH; [2]Division of Pulmonary Biology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH; [3]Pediatrics, College of Medicine, University of Cincinnati, Cincinnati, OH; [4]Riley Hospital for Children, Indianapolis, IN; [5]Indiana University—University Hospital, Indianapolis, IN; [6]Pediatrics, School of Medicine, Indiana University, Indianapolis, IN; [7]School of Medicine, Indiana University, Indianapolis, IN; [8]Pulmonary Medicine, Cincinnati Children's Hospital, Cincinnati, OH; [9]Cystic Fibrosis Foundation, Bethesda, MD; [10]Division of Behavioral Medicine and Clinical Psychology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH*

Background: SARS-CoV-2 affects people long after the acute infection has resolved, with 30% to 50% of the general population reporting persistent

physical symptoms after infection. These symptoms last from months to years and range from limited to debilitating. The SARS-CoV-2 pandemic has also affected mental health given the prolonged stress and uncertainty. In the United Kingdom, 54% of people with cystic fibrosis (PwCF) reported clinically significant anxiety, which is double the percentage before the pandemic. The mental health repercussions extended to family members, with mothers of children with CF reporting significantly higher anxiety scores than mothers of children without CF. There is a dearth of knowledge regarding the long-term effect of SARS-CoV-2 on the physical and mental health of PwCF and their caregivers in the United States.

Methods: A 17-question survey garnered 278 responses between December 16, 2021, and January 6, 2022. Respondents included 187 PwCF and 88 caregivers answering questions regarding the experienced of PwCF. Questions asked about demographic characteristics, experiences of acute SARS-CoV-2 infection and level of care required, mental health symptoms of depression and anxiety (Table 1), and physical symptoms lasting at least 1 month after having SARS-CoV-2.

Table 1.
Mental health symptoms reported since start of COVID-19 pandemic

Symptom	PWCF n=187 (% Responding Affirmatively)	Caregiver n= 96
Feeling down, depressed, or hopeless		
Not at all	27	32
Several days	52	44
More than half of the days	14	14
Nearly every day	7	10
Trouble falling or staying asleep, or sleeping too much		
Not at all	27	34
Several days	43	35
More than half of the days	20	17
Nearly every day	10	14
Feeling tired or having little energy		
Not at all	17	23
Several days	53	44
More than half of the days	19	21
Nearly every day	11	13
Not being able to stop or control worrying		
Not at all	26	24
Several days	45	43
More than half of the days	19	22
Nearly every day	10	11
Eating and drinking as much as you normally would		
Not at all	30	23
Several days	20	23
More than half of the days	17	19
Nearly every day	33	35

Note: Survey question was "Since the start of the pandemic, how often have you been bothered by any of the following problems"? Caregivers were answering for themselves.

Results: Forty-five respondents reported having a positive SARS-CoV-2 test or symptomatic COVID since 2020, with more than 80% of those never requiring hospitalization for their acute infection. Of those who had acute infection, almost three-quarters had one or more new physical symptoms that persisted at least 1 month after their acute infection. The most common symptom was "fatigue that made it hard to do things [they] needed or wanted to do," with 74% of PwCF and 24% of caregivers answering affirmatively for their PwCF. Commonly reported symptoms were "problems with memory" in 35% and "difficulty concentrating" in 26% of PwCF. Reports of muscle aches (19–35%), shortness of breath (10–26%), cough (17–29%), and loss of taste or smell (19–22%) were also described. Since the start of the pandemic, 52% of PwCF and 44% of caregivers have had several days of feeling down, depressed, or hopeless. Between 30% and 50% of PwCF and caregivers endorsed sleep-related symptoms and feeling tired or low energy since the start of the pandemic, and 33% to 36% reported uncontrollable worry the previous 2 weeks. Although mental health support has increased in CF care overall, one-third of respondents reported that they did not have regular access to a mental health provider.

Conclusions: We performed this pilot study to characterize mental health and post-COVID symptoms in PwCF and their caregivers in the United States during the SARS-CoV-2 pandemic. Although most of our respondents had mild acute illness, most had lingering physical symptoms 1 month after acute SARS-CoV-2 infection, most commonly significant fatigue. Mental health of PwCF and caregivers was significantly affected, with frequently reported anxiety and depressive symptoms. Many of the reported symptoms are not observable to others and can have significant effects on functioning. Additional studies are essential to facilitate comprehensive understanding of the long-term physical and mental health effects of SARS-CoV-2 in PwCF and their caregivers to inform timely screening and focused interventions.

Acknowledgements: Cystic Fibrosis Foundation Community Voice, "COVID in CF." Survey. January 2022. Funded by the Cystic Fibrosis Foundation.

28

A multi-center study of peripherally inserted central venous catheters: Predictors of difficult line insertion, malfunction, and soft tissue injury

J. Zuckerman[1], A. Hinton[2], J. Mermis[3], P. Flume[4], S. Jia[5], E. Dasenbrook[6], R. Dezube[7], N. West[7], H. Sadeghi[8], S. Nasr[9], E. DiMango[10], D. Polineni[11], E. Zemanick[12], T. Lahiri[13], C. Teneback[14], A. Gifford[15]. *[1]School of Medicine, Tufts University, Boston, MA; [2]Center for Outcomes Research and Evaluation, Maine Medical Center, Portland, ME; [3]Pulmonary and Critical Care, University of Kansas Medical Center, Kansas City, KS; [4]Medicine and Pediatrics, Medical University of South Carolina, Charleston, SC; [5]Division of Pulmonary and Critical Care, University of Michigan, Ann Arbor, MI; [6]Respiratory Institute, Cleveland Clinic, Cleveland, OH; [7]Pulmonary and Critical Care Medicine, Johns Hopkins University, Baltimore, MD; [8]Pediatric Pulmonology, Irving Medical Center, Columbia University, New York, NY; [9]University of Michigan, Ann Arbor, MI; [10]Department of Medicine, Irving Medical Center, Columbia University, New York, NY; [11]Pulmonary and Critical Care Medicine, University of Kansas Medical Center, Kansas City, KS; [12]University of Colorado, Denver, CO; [13]Pediatric Pulmonology, University of Vermont Children's Hospital, Burlington, VT; [14]Division of Pulmonary and Critical Care, University of Vermont, Burlington, VT; [15]Division of Pulmonary, Critical Care, and Sleep Medicine, University Hospitals, Cleveland, OH*

Background: People with cystic fibrosis (PwCF) may have peripherally inserted central venous catheters (PICCs) placed for administration of intravenous antibiotics. Little has been published about factors associated with problematic line placement, subsequent catheter malfunction, and local soft tissue reactions in this population. We present data from PICC-CF, a prospective study of PICC practice patterns and complications in adult and pediatric PwCF at 10 U.S. centers.

Methods: Eligible PwCF were aged 6 and older and undergoing treatment via a hospital-placed PICC. Exclusion criteria included use of a totally implanted vascular access device or peripheral line for the full course of therapy and anticoagulant medication at the time of line insertion. We collected clinical and demographic data before catheter insertion. We made detailed assessments of line insertion, management, and subsequent function, along with patient signs and symptoms related to the indwelling catheter every 2 to 4 days until line removal. We used logistic regression models to evaluate the association between patient and catheter characteristics and line placement, subsequent catheter malfunction, and local soft tissue reactions. Analyses were conducted separately for adult and pediatric patients where appropriate. Analyses of catheter malfunction and local soft tissue reactions were adjusted for length of treatment. Analyses of outcomes in pediatric patients were additionally adjusted for patient age. $P < 0.01$ was considered significant in the context of multiple comparisons.

Results: We screened 429 individuals and enrolled 260 (n = 123 female (47%); median age 20 (interquartile range 13, 28); n = 103 children (40%)), totaling 4,705 catheter-days for 375 lines. Three hundred forty-two of the catheters (91%) were single lumen, 334 (89%) were less than 5 Fr, and venue of line placement was bedside in 90 (24%), dedicated vascular access suite