ORIGINAL ARTICLE

Surveying Cystic Fibrosis Care Centers to Assess Adoption of Infection Prevention and Control Recommendations

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OBJECTIVE. In 2013, the Cystic Fibrosis (CF) Foundation developed an updated guideline for infection prevention and control (IP&C) practices for CF. We sought to assess the adoption of specific recommendations by CF care centers.

METHODS. Directors of the 277 CF care centers in the United States were asked to complete a confidential online survey regarding the adoption of selected IP&C recommendations. Selected recommendations were those we considered less likely to be incorporated into a center's written IP&C policies.

RESULTS. Center directors from 198 of 277 CF centers (71%) completed the survey between December 2015 and June 2016; pediatric and larger centers were more likely to do so. Overall, 70% have adopted ≥75% of the selected recommendations. As recommended, almost all provided education to CF center staff (98%) and patients and families (97%); fewer developed educational materials in collaboration with local IP&C teams (59%) and/or patients and families (37%). Among 108 centers with non–English-speaking patients, 65 (60%) provided educational materials in relevant languages. Most (74%) held group education events; of the 138 centers with in-person meetings, 45% allowed 1 individual with CF to attend, and 51% allowed no individuals with CF to attend. Most centers (93%) held outdoor events, and 84% allowed >1 individual with CF to attend. Audits of exam-room cleaning were performed by 49% of CF centers.

CONCLUSIONS. Cystic fibrosis centers in the United States have adopted many of the recommendations addressed in this survey. Nonetheless, these findings suggest opportunities for improvement. More CF centers should provide education to non–English-speaking patients and families, and CF centers should perform audits of room cleaning.

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In 2011, the Cystic Fibrosis (CF) Foundation sponsored an update for the previous Infection Prevention and Control (IP&C) Guideline.[1] The updated guideline underwent a public comment period in 2012, was revised and disseminated to CF centers in the United States in 2013, and it was published in 2014.[2] In the current study, we sought to assess the adoption of selected recommendations from the updated guideline. We also sought to assess how the recommendations were implemented because the guideline provided choices for implementation in recognition of the diversity of centers. We focused on those recommendations that we considered less likely to be included within written IP&C policies for CF, but that potentially could impact implementation (eg, educational strategies and audit and feedback). We focused on educational strategies used by CF centers because we have previously shown that lack of knowledge among healthcare providers, individuals with CF, and their families are barriers to implementation of IP&C in CF centers.[3,4] Finally, we focused on the formats of center-sponsored events because the updated guideline recommended that only 1 individual with CF should attend indoor events sponsored by the CF Foundation or CF centers. Notably, this specific recommendation led to a published pro-and-con debate between some of the 2013 guideline authors and adults with CF regarding the merit of this recommendation.[5,6]

METHODS

Study Design, Sites, and Respondents

Between December 2015 and June 2016, center directors of CF care centers in the United States were asked via email to complete a confidential online survey regarding the adoption of selected IP&C recommendations (Qualtrics, Provo, UT). The email addresses of CF center directors were provided to the study team by the CF Foundation. Of the 277 accredited

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CF care centers, 119 (43%) were pediatric centers, 105 (38%) were adult centers, and 53 (19%) were affiliate care centers, which are smaller, often care for both adults and children, and are affiliated with a larger care center. Eligible respondents were the directors (or their designee) at the 277 centers. The Columbia University Medical Center and the University of North Carolina institutional review boards approved this study.

Survey Development and Content

The survey developed by the study team inquired about adoption of and the methods used to implement selected recommendations from the 2013 IP&C Guideline. Survey questions asked about (1) types of IP&C education provided to patients, families, and healthcare providers; (2) involvement of local IP&C teams in developing education and implementing IP&C recommendations; (3) participation in national or local IP&C quality-improvement projects; (4) audits of IP&C practices (eg, hand hygiene and environmental cleaning) and subsequent feedback to CF center staff; (5) types of indoor events; and (6) types of outdoor events held at the centers (Table 1). Responses were not forced. After pilot testing by 7 content experts, including former CF center directors, the final survey contained 27 items with multiple choice and yes–no responses as well as free text and required ~10 minutes to complete (online supplementary table 1). Respondents received a $25 gift card for their participation.

Analysis

We performed χ^2 tests to compare responses by center type (ie, pediatric, adult, affiliate) and the characteristics of responding versus nonresponding centers. P values <.05 were considered statistically significant. We used the Fisher exact test or the χ^2 test to compare center-sponsored events by type as appropriate. Logistic regression was performed to assess center characteristics associated with responding to the survey, including center type, size of center (defined as the number of patients seen at the center at least twice in 2014), and center region: South, Northeast, Midwest, and West.[7] Pediatric (type of center) and South (center region) were chosen as reference groups. As shown by χ^2 test, the sample of responding center types was not representative of the distribution of US center types. Thus, a weighting adjustment by center type was applied to each responding center; results using the weighted values were compared to results using the original unweighted values. The correlation of adoption by pediatric and adult centers from the same institution, as identified by location and institutional affiliation, was assessed by Pearson correlation coefficient treating adoption rate as a continuous variable.

RESULTS

Characteristics of Responding CF Centers

The overall response rate was 71% (198 of 277) with a higher response rate in pediatric centers (84%, 100 of 119) than adult centers (64%, 67 of 105) or affiliate centers (58%, 31 of 53) ($P < .001$). Larger centers were more likely to respond than smaller centers; the mean number of patients cared for at responding versus nonresponding centers was 106 (±67 SD) versus 62 (±45 SD) patients, respectively. The center region was not related to response rate; the response rates were 68% (63 of 93) in the South, 77% (47 of 61) in the Northeast, 68% (50 of 73) in the Midwest, and 76% (38 of 50) in the West. In a multivariate logistic regression model, larger center size remained positively associated with response rate ($P < .001$), and compared with pediatric centers, adult centers remained negatively associated with response rate ($P = .007$). Weighted analysis did not change the significance of associations.

Overall Adoption of IP&C Recommendations

Among the 198 responding centers, 52 (26%) adopted 90%–100% of the selected recommendations; 48 centers (24%) adopted 75%–89% of the recommendations; 91 centers (46%) adopted 50%–74% of the recommendations; and 7 centers (4%) adopted < 50% of the recommendations. The proportions of centers that adopted specific recommendations were similar among different center types ($P = .17$) (Table 2). Adoption was also similar among different regions of the country ($P = .32$) and among different center sizes ($P = .35$).

TABLE 1. Topics and Selected Recommendations Assessed in the Infection Prevention and Control (IP&C) Survey

Topic (NEW or REVISED in 2013)	Recommendation
Education to	
Families and/or persons with CF (REVISED)	Families and/or persons with CF receive age- and language-appropriate education on IP&C
Healthcare providers (REVISED)	All interdisciplinary healthcare providers caring for persons with CF receive IP&C education
Collaboration with local IP&C team (REVISED)	Collaborate with implementation of IP&C recommendations
	Collaborate with developing IP&C education
Participation in quality improvement projects	Participate in national or local IP&C quality improvement projects
Audits and feedback (NEW)	Develop strategies to monitor adherence to selected IP&C practices and provide feedback
Group indoor events (NEW)	Limit attendance to 1 person with CF
	Encourage alternative education methods
Outdoor events (NEW)	Maintain 6 feet (1.83 meters) or greater distance between individuals with CF

NOTE. CF, cystic fibrosis.

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TABLE 2. Adoption of Infection Prevention and Control Recommendations by Pediatric, Adult, and Affiliate Cystic Fibrosis (CF) Care Centers

Survey Content	Pediatric Center (n = 100), %	Adult Center (n = 67), %	Affiliate Center (n = 31), %	Total (N = 198), %
IP&C education provided to				
Patients and families	96	97	100	97
CF center staff	98	97	100	98
Local IP&C team involved in				
Developing IP&C education	61	55	58	59
Implementing IP&C practices	94	90	94	92
QI projects				
Local participation	47	48	34	46
National participation	9	7	7	8
Practice audit and feedback				
IP&C practices of CF center staff	73	73	61	71
Cleaning CF exam rooms	55	49	32	49
>75% exam rooms cleaned[a]	84	84	90	85
Formal indoor group education				
At least annual event	82	69	61	74
In-person meeting	98	91	95	95
≤1 person with CF can attend[b]	96	88	100	94
Outdoor events, eg, Great Strides				
Participate in such events	95	91	90	93
>1 person with CF can attend	86	80	82	84

NOTE. IP&C, infection prevention and control; QI, quality improvement.
[a]Among the 98 centers who audited the cleaning of exam rooms.
[b]Among the 147 centers who held indoor events.

Among the responding sites, 60 pairs of adult and pediatric centers were identified as being from the same institution. The estimated Pearson correlation in the adoption rate between the paired adult and pediatric centers was 0.42 (95% CI, 0.19–0.61). To determine whether this correlation arose by chance, a test for correlation between paired samples was conducted, and the correlation was statistically significant ($P = .001$).

Adoption of Education Recommendations

Nearly all centers provided education to CF clinic staff and individuals with CF and their families (Table 2). Education to individuals with CF and their families was most commonly provided during clinic visits (93%), and nearly half of responding centers (45%) provided education more frequently than annually (eg, at each clinic visit). Other educational strategies included newsletters (57%), signage (54%), and/or distributing educational materials developed by the CF Foundation (49%). Among 139 centers that cared for children, 121 (87%) provided IP&C education at age-appropriate levels. Among 108 centers with non–English-speaking patients, 65 (60%) provided educational materials in relevant languages.

Education to staff was most commonly performed by providing a copy of the guideline or a synopsis of the guideline (83%), discussing the guidelines during face-to-face conferences (71%), and/or discussing them in small group huddles (71%). Most centers provided education to inpatient staff (95%), respiratory therapists performing pulmonary function tests (92%), and social workers (85%), but fewer provided education to housekeepers (48%), physical therapists (47%) and to staff in admissions departments (37%), phlebotomy departments (35%), and radiology departments (32%), as well as operating rooms (23%).

Most CF centers involved their local IP&C teams in developing IP&C education (59%) and implementing IP&C (92%), but fewer involved patients and families in developing IP&C education (37%). Centers were more likely to participate in local quality improvement efforts for IP&C than in national efforts (46% vs 8%, respectively; $P < .05$).

Practice Audits

Overall, 141 (71%) centers provided feedback to staff regarding their IP&C practices (Table 2) using formal observations, small group huddles, and team meetings, as described in free text provided by respondents. Additionally, 98 (49%) of centers performed audits of exam-room cleaning practices, and most (85%) of these centers reported that >75% of exam rooms were cleaned.

CF Center-Sponsored Events

Formal indoor educational events were held by 147 centers (74%), of which 82% were held annually. Pediatric centers were more likely to hold indoor events than were adult or affiliate centers (82% vs 69% vs 61%, respectively; $P < .05$). Education was generally provided during in-person meetings (95%), but other options included video conferences (36%), web-based learning (6%), videotapes (4%), and CD ROMs (3%).

Among the 140 centers that held in-person meetings, 50% did not allow individuals with CF to attend, 44% allowed 1 individual with CF (and their siblings with CF) to attend, and 6% allowed >1 individual with CF to attend (5 adult and 3 pediatric centers). Some centers had no restrictions for individuals with CF who could attend, but other centers excluded individuals based on their respiratory cultures, for example, excluding those with *Burkholderia* spp, multidrug-resistant organisms, and/or methicillin-resistant *Staphylococcus aureus*.

The proportions of pediatric, adult, and affiliate centers that held outdoor events were similar (95%, 91%, and 90%, respectively; $P = .48$). Among the 184 centers (93%) that held outdoor events, 8% did not allow individuals with CF to attend, 8% allowed only 1 individual with CF (and their siblings with CF) to attend, and 84% allowed >1 person with CF to attend. Some centers had no restrictions, but others excluded individuals with CF based on respiratory cultures. Most centers advocated maintaining at least 6 feet (1.83 meters) between individuals with CF, and some implemented mask use by individuals with CF and/or use of a distinctive name badge or T shirt.

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DISCUSSION

The CF Foundation seeks to provide evidence-based guidelines to CF care centers for best IP&C practices. Thus far, there have been 2 consensus documents sponsored by the CF Foundation and most recently an executive summary assessing new publications that could inform IP&C practices.[1,4,8] However, assessing adoption and actual implementation of specific recommendations at CF centers is challenging because actual observations of practices by a research team are not likely to be feasible. Thus, we surveyed center directors regarding adoption of selected recommendations and focused on areas that we anticipated were less likely included within written institutional IP&C guidelines. We had an excellent response rate of 71%, but pediatric and larger centers were more likely to respond. We speculate that these center characteristics may be associated with more willingness and more resources to be involved in IP&C efforts.

Half of responding centers have adopted at least 75% of the recommendations we assessed; pediatric, adult, and affiliate centers adopted a similar proportion of recommendations. Furthermore, when we assessed the correlation between adoption by pediatric and adult CF centers from the same institution, we detected a moderate correlation. This finding is expected because many institutions share IP&C policies among adult and pediatric populations. Additionally, as transitioning care from pediatric to adult providers is a crucial aspect of CF care for adult patients, individuals with CF and their families benefit from consistent practices. In contrast, because the correlation was modest, it is also likely that some policies were easier to implement in a pediatric versus an adult center, even with the same institution due to variable resources, administrative buy-in, and practice patterns.

Among responding centers, education has been provided to 97%–99% of key stakeholders. This finding likely reflects the ongoing and enhanced emphasis on education in general by the CF Foundation and CF community, as well as by the updated IP&C guideline. Increased education may improve the implementation of IP&C. We previously found that lack of knowledge among both healthcare providers and individuals with CF and their families were barriers to IP&C.[3,4] Healthcare providers who had access to a copy of the 2003 IP&C guidelines had increased agreement with the recommendations and increased confidence implementing the recommendations.[3] Also, individuals with CF and their families who had >1 discussion with their CF care team about IP&C were more likely to understand routes of germ transmission and the importance of avoiding close contact with others with CF while hospitalized.[4] In the current study, ~50% of CF centers provided education to patients and families more than once a year, suggesting the adoption of more frequent education. However, only 59% and 39% of CF centers engaged their local IP&C teams and/or patients and families to help develop educational materials. This finding could reflect ready availability and usefulness of educational materials provided by the CF Foundation. Only 60% of centers provided educational materials to non–English-speaking patients and families in their relevant language. Inclusion of families, regardless of language, could improve both the quality of educational materials and facilitate implementation of IP&C recommendations. Notably, fewer centers educated other types of healthcare providers (eg, staff in radiology or phlebotomy). This observation suggests that individuals with CF and their families should be empowered to request that all healthcare providers practice appropriate IP&C when caring for them, but it also highlights the need for education beyond the immediate CF care team.

Most responding centers (71%) provided feedback to CF clinic staff regarding their IP&C practices. In other healthcare settings, such feedback has been shown to improve adherence to strategies to reduce healthcare-associated infections.[9] Practice audits for exam-room cleaning have also been adopted by most CF centers. Free-text responses to the survey indicated that a variety of methods had been used, likely reflecting local practices and resources. Because contaminated surfaces and equipment in healthcare settings are increasingly being scrutinized for serving as reservoirs for a wide range of potential pathogens, therefore, consistent attention to exam room cleaning and practice audits are important.[10,11]

Most CF centers held at least 1 indoor education event annually, and pediatric centers were more likely to do so than adult and affiliate centers. This finding may reflect increased interest in education by families of children with CF as families cope with the diagnosis of CF. However, the new recommendation limiting attendance at indoor events to 1 individual with CF may have adversely impacted the willingness of adult and affiliate centers to hold such events. We acknowledge that there has been controversy about this recommendation among some adults with CF who consider the benefits of attending educational events to outweigh the risks.[5,6] Fortunately, the CF Foundation and individual CF centers have been providing alternative education strategies that do not involve face-to-face contact. Additionally, the CF Foundation launched CF Peer Connect to enable people with CF to connect with one another by video, phone, email, or text.[12]

Studies using data from the CF Foundation's patient registry have found that the incidence of some CF pathogens, specifically *Pseudomonas aeruginosa, Hemophilus influenzae, Burkholderia* spp, and *Achromobacter xylosoxidans* have decreased in the past 20 years.[13,14] While these decreases are likely to be multifactorial as the CF population becomes healthier,[15] it is feasible that improved IP&C has contributed to decreasing incidence by reducing both acquisition and transmission of CF pathogens.

Our findings do suggest potential strategies to improve adoption and performance of IP&C practices at CF centers. The lower response rate by adult and affiliate programs suggests that fewer resources are available at these types of centers. This speculation is supported by our past work in which affiliate centers declined participation due to a lack of resources.[3] Lack of resources could be addressed by local institutions and/or by the CF Foundation. Outreach education based on an

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understanding of the community's viewpoints that reinforces the rationale for and benefits of the updated IP&C guideline could be very useful to promote implementation (personal communication, Dr Drucy Borowitz, CF Foundation). We are currently assessing knowledge, attitude, and practice barriers regarding IP&C that are experienced by patients, families, and providers, which should further elucidate opportunities to improve IP&C in the CF population.

This study has several limitations. There may be respondent bias; 29% of centers did not answer the survey. Pediatric centers were more likely to respond. However, when we weighted responses to adjust for this, the statistical associations were unchanged. The survey assessed reported practices, but we did not observe actual practices. The content of educational materials and quality of audit practices were not assessed. Finally, the design of this study did not allow us to fully ascertain the relative contributions that institution versus CF care center play in the adoption of the recommendations.

In conclusion, the 71% survey response rate supports the generalizability of our findings in the CF community. In the United States, centers have been adopting the selected recommendations and using a variety of methods to do so. Nonetheless, our findings suggest opportunities for improvement including increased education to non–English-speaking patients and families in their relevant language, increased education to healthcare providers other than the CF center staff and inpatient nurses, and increased audits of exam-room cleaning. Assessment of written IP&C policies of CF centers to determine their adoption of additional recommendations is underway.

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SUPPLEMENTARY MATERIAL

To view supplementary material for this article, please visit https://doi.org/10.1017/ice.2018.72

REFERENCES

1. Saiman L, Siegel J. the CF Foundation Consensus Conference on Infection Control Participants. Infection control recommendations for patients with cystic fibrosis: microbiology, important pathogens, and infection control practices to prevent patient-to-patient transmission. *Infect Control Hosp Epidemiol* 2003;24:S6–S52.
2. Saiman L, Siegel JD, LiPuma JJ, et al. Infection prevention and control guideline for cystic fibrosis: 2013 update. *Infect Control Hosp Epidemiol* 2014;35:S1–S67.
3. Garber E, Desai M, Zhou J, et al. Barriers to adherence to cystic fibrosis infection control guidelines. *Pediatr Pulmonol* 2008;43:900–907.
4. Miroballi Y, Garber E, Jia H, et al. Infection control knowledge, attitudes, and practices among cystic fibrosis patients and their families. *Pediatr Pulmonol* 2012;47:144–152.
5. Jain M, Saiman L, Sabadosa K, LiPuma JJ. Point: Does the risk of cross infection warrant exclusion of adults with cystic fibrosis from cystic fibrosis foundation events? Yes. *Chest* 2014;145:678–680.
6. Shepherd SL, Goodrich EJ, Desch J, Quinton PM. Point: Does the risk of cross infection warrant exclusion of adults with cystic fibrosis from cystic fibrosis foundation events? No. *Chest* 2014;145:680–683.
7. Census regions and divisions of the United States. US Census Bureau website. www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf. Accessed January 17, 2017.
8. Infection prevention and control clinical care guidelines. Cystic Fibrosis Foundation website. www.cff.org/Care/Clinical-Care-Guidelines/Infection-Prevention-and-Control-Clinical-Care-Guidelines/Infection-Prevention-and-Control-Clinical-Care-Guidelines/. Updated 2013. Accessed October 10, 2017.
9. Mauger B, Marbella A, Pines E, Chopra R, Black ER, Aronson N. Implementing quality improvement strategies to reduce healthcare-associated infections: a systematic review. *Am J Infect Control* 2014;42:S274–S283.
10. Barnes SL, Morgan DJ, Harris AD, Carling PC, Thom KA. Preventing the transmission of multidrug-resistant organisms: modeling the relative importance of hand hygiene and environmental cleaning interventions. *Infect Control Hosp Epidemiol* 2014;35:1156–1162.
11. Carling PC, Huang SS. Improving healthcare environmental cleaning and disinfection: current and evolving issues. *Infect Control Hosp Epidemiol* 2013;34:507–513.
12. CR Peer Connect. Cystic Fibrosis Foundation website. www.cff.org/Get-Involved/Community/CF-Peer-Connect. Accessed March 8, 2018.
13. Razvi S, Quittell L, Sewall A, Quinton H, Marshall B, Saiman L. Respiratory microbiology of patients with cystic fibrosis in the United States, 1995–2005. *Chest* 2009;136:1554–1560.
14. Salsgiver EL, Fink AK, Knapp EA, et al. Changing epidemiology of the respiratory bacteriology of patients with cystic fibrosis. *Chest* 2016;149:390–400.
15. MacKenzie T, Gifford AH, Sabadosa KA, et al. Longevity of patients with cystic fibrosis in 2000 to 2010 and beyond: survival analysis of the Cystic Fibrosis Foundation patient registry. *Ann Intern Med* 2014;161:233–241.