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## DIGEST: Developing innovative gastroenterology specialty training

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## ABSTRACT

Individuals with cystic fibrosis (CF) now have an increased life expectancy, due to advances in care provided by a multidisciplinary team. The care model has expanded over time to include multiple subspecialties. The Cystic Fibrosis Foundation conducted a survey of Care Center Directors and identified a need for pediatric and adult gastroenterologists with expertise in the diagnosis and treatment of intestinal, pancreatic and hepatic complications of CF. To address this need, the Developing Innovative Gastroenterology Specialty Training (DIGEST) program was created. The development, implementation, and early results of this training program are reported herein.

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## 1. Background

Individuals with cystic fibrosis (CF) now survive, on average, well into the fifth decade of life. This increase in life expectancy is due to numerous advances in CF care, including antibiotics, airway clearance techniques, nutritional management, and most recently, the advent of cystic fibrosis transmembrane conductance regulator (CFTR) modulators. Prolonged survival of individuals with CF, coupled with improvements in pulmonary therapies, has led to an appreciation of disease beyond the lungs. Care for individuals with CF has been provided by a multidisciplinary care team, and this model has evolved over time.

Despite longstanding recognition of pancreatic exocrine insufficiency as a hallmark of CF, the general gastrointestinal (GI) symptoms experienced by individuals with CF have not been appreciated fully and the spectrum of pancreatic and liver involvement has raised many clinical and research questions. Several studies have shown that children and adults with CF have a high incidence of undertreated abdominal pain throughout life. [1,2] A study of 73 children and 110 adults with CF found that the abdomen was the most prevalent location of chronic pain in children and the second most prevalent in adults, with 60% of children and 36% of adults in the study reporting chronic abdominal pain [3]. Recent publications have called attention to the high frequency of gastrointestinal symptoms in CF, including abdominal pain, distension, nausea and constipation [4,5]. In addition, there is a significantly increased risk of gastrointestinal cancers in individuals with CF [6].

Although CF clinical expertise initially had been provided by generalists and gastroenterologists, by the latter half of the 20th century in the US, care became a focus for pediatric pulmonologists. Through the years, a small percentage of the US Cystic Fi-

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brosis Foundation (CFF) research and career development fellowships in North America supported gastroenterology fellows, usually in pediatrics, so the pool of trained individuals with CF-GI expertise has been limited. In 2009 the National Institutes of Health and the CFF supported the Cystic Fibrosis Liver Disease Network for the Prediction by Ultrasound of the Risk of Hepatic Cirrhosis in Cystic Fibrosis (PUSH) study, a multicenter study to assess the role of hepatic ultrasound in early diagnosis of CF-related liver disease (CFLD). As a result, a group of pediatric hepatologists with CF expertise was convened.

In the fall of 2013, the CFF surveyed the Directors of the accredited CF Care Centers about the need for gastroenterologists with expertise in CF. There were 109 respondents (approximately a 40% response rate), 90% of whom were pulmonologists. Of the respondents, 41% were caring for pediatric patients only, 33% for adults, and 26% for patients of all ages. When asked about their comfort and competency in dealing with GI issues, 68% reported feeling competent most of the time, and 25% some of the time. When asked about the availability of a reliable gastroenterologist at their centers, 88% reported having a gastroenterologist to rely on, with about two-thirds of those being pediatric gastroenterologists. Regarding an available hepatologist, 93% reported having one, which in 42% of cases was the same person as the gastroenterologist. Sixty-two percent stated that they could approach the division chief in gastroenterology to identify help. The Directors' comments suggested a lack of gastroenterologists with specific expertise in CF, particularly for adult patients, difficulty retaining gastroenterologists in CF Centers, and a lack of knowledge regarding CFLD among gastroenterologists.

In response to the survey results, the CFF explored strategies to increase the availability of gastroenterologists with expertise in the diagnosis and treatment of intestinal, pancreatic and hepatic complications of CF. The development, implementation, and early results of this training program are reported herein.

## 2. Methods

### 2.1. Development of DIGEST

In 2013, a pediatric Center Director (D.B.) and an adult gastroenterologist (S.F.) with significant expertise in GI manifestations of CF explored creating a program to train gastroenterologists in CF care and research. The inspiration for this program came from the CFF Program for Adult Care Excellence (PACE) which had been successfully implemented to recruit and develop adult pulmonologists to care for the increasing number of adults with CF. The basic concepts of the PACE were adapted in the development of the GI-focused program. The initial focus was to develop adult CF-GI expertise; however, during subsequent discussions, it was decided that the program would be expanded to include both pediatric and adult gastroenterologists. The CFF provided financial support for a three-year training program named Developing Innovative GastroEnterologic Specialty Training (DIGEST).

There were four overarching goals for DIGEST:

- 1 Facilitate DIGEST awardees becoming clinical experts in CF-gastroenterology, and educators of other gastroenterologists to ensure optimal care in CF
- 2 Identify and implement ways to bring best practices in CF-GI care to patients and increase their access to CF-GI specialists
- 3 Define what is known and unknown about gastrointestinal disease in CF, and provide information regarding best practices to the greater CF community
- 4 Develop clinical and translational researchers to expand the evidence base for management of GI symptoms and conditions in CF

A curriculum was developed and gastroenterologists with expertise in CF became the core faculty. They in turn identified speakers to cover additional topics.

### 2.2. Selection process

A request for applications was circulated to CF Center Directors and Gastroenterology Division Chiefs in January 2014. Physicians trained in Internal Medicine or Pediatrics, who had completed subspecialty training in Gastroenterology, were eligible for the program. The application included an NIH-style biosketch, a statement of other grant support, a personal statement describing previous clinical training and future plans. A mentoring plan developed in conjunction with the local CF Center Director was required. The sponsoring CF Center Director also needed to commit to allowing the trainee to practice gastroenterology in conjunction with the CF clinic. The Gastroenterology division director was expected to provide sufficient protected time for these clinical activities and for the required educational activities (described below). To facilitate this, the award included approximately 0.15 full-time equivalent salary support for the trainee.

Core faculty were individuals demonstrating long-term interest in CF-related gastrointestinal disease, primarily pediatric gastroenterologists, and one internal medicine gastroenterologist, as few internal medicine gastroenterologists were focusing on CF at this time. The faculty represented a broad range of interests in CF, including nutrition, luminal gastrointestinal disease, pancreatic and liver disease. An adult CF program director who was a pulmonologist was also included to provide broader context with pulmonary management and CF adult care; this individual had been involved in the creation of PACE. Both clinical and basic researchers were included.

The review committee considered the following factors when selecting the awardees:

- Results of past CFF support (if any)
- Publications, especially those related to CF
- Previous exposure to the care of patients with CF
- Participation in clinical or basic research
- Area(s) of focus in gastroenterology and interest in CF
- Opportunity to participate in the CF clinic and CF Center activities
- How clinical care of patients with CF would fit into current clinical and research obligations
- Career goals related to a long-term commitment to CF care and research
- Commitment of the CF Center Director and GI Division Director to mentoring the awardee

Ten pediatric and five adult gastroenterologists were selected for the first DIGEST class. All were early career faculty. They represented 15 separate CF Care Centers.

### 2.3. Curriculum and support

The training program started with a one-day face-to-face meeting, attended by faculty and awardees to introduce the awardees to CF, the work of the CFF, and provide an overview of CF gastrointestinal disease. The meeting, facilitated by the faculty members and key CFF leadership, included a general introduction to the Care Network, an overview of clinical aspects and particularly gastrointestinal and nutritional issues in CF, an introduction to the DIGEST program and faculty, and a preview of opportunities for clinical research within the CFF and the CFF-sponsored Therapeutics Development Network (TDN). Each awardee was assigned a mentor from the core faculty based on their field of interest. They were encouraged to have contact at least quarterly. The mentor provided re-

**Table 1**  
List of didactic lectures for year 1 of DIGEST 1.

Topic
Introduction to the Cystic Fibrosis Transmembrane Conductance Regulator (CFTR), CFTR in the gastrointestinal tract
Animal models of CF
Pancreatic dysfunction and treatment of pancreatic insufficiency
Pancreatic sufficiency and pancreatitis
GI radiology
GI cancers
Recurrent abdominal pain
Gastroesophageal reflux disease
Intestinal inflammation and dysbiosis
Constipation and Distal intestinal obstruction syndrome
CF liver disease
Malnutrition and use of enteral feedings
CF Center dietician and gastroenterologist interactions

views of their required case presentations and also offered career guidance.

Following the face-to-face meeting, faculty and awardees participated in monthly webinars (see Table 1). In the first year, the majority of these were didactic, given by recognized content experts. The topics covered aspects of clinical CF-gastrointestinal disease, but also animal models of CF, radiology in CF, and a discussion of interfacing with the CF dietitians. In the second and third years the webinars were case presentations prepared by awardees, with mentorship from DIGEST faculty.

Webinars lasted one hour and were accessed by computer or telephone. The technology platform had a chat feature, which allowed attendees to type in questions and comments during the presentation without interrupting the speaker. It also facilitated audience participation, as the speaker was able to pose questions to the group, which were answered on the chat board. For example, after a case presentation, participants worked together to develop a differential diagnosis or a plan for evaluation and management. One of the faculty members moderated each webinar to ensure that questions and comments were addressed thoroughly. Citations or links could be added as needed. All slides and other learning materials were posted to a Sharepoint site (Microsoft, Redmond, WA) for later reference.

Awardees were given access to a closed listserv to share cases, post questions, or share new or interesting information between scheduled webinars.

Awardees were required to attend the annual North American Cystic Fibrosis Conference (NACFC) during each of the three years of their award. Funding for travel was provided. In the first year they attended scientific sessions to increase their knowledge of CF in general, and CF-associated problems in gastroenterology, endocrinology, and nutrition. In years 2 and 3 the faculty worked with the NACFC planning committee to engage many of the awardees as session moderators, symposium chairs, and/or speakers. During all three years, awardees attended a meeting with DIGEST faculty during which the program components were discussed and opportunities for curriculum development and improvement were identified.

Awardees were required to attend CF clinic regularly, to see patients with CF with gastrointestinal problems in conjunction with their CF clinic visits. The awardees were encouraged to work closely with the CF dietitian. They were also required to attend that care center's weekly CF clinic conference, during which plans for future CF visits were discussed. The lead faculty talked to the mentees regularly to make sure that this was happening and overall there were very few problems. If they experienced barriers in accomplishing this, the issues were discussed with the local CF center director or Gastroenterology division chief, by the DIGEST leadership or the CFF leadership.

Awardees submitted an annual progress report. They were also given additional opportunities to contribute to scholarly activities, including book chapters, journal articles, CFF guideline development, and educational material for people with CF. In the second and third years they were encouraged to become involved with their local CFF Therapeutic Disease Network (TDN) site (if applicable), as this was considered the best way to provide them with the opportunity to become involved in research.

### 3. Results

Two major goals of DIGEST were to facilitate the development of the awardees as clinical experts in CF-gastroenterology and to bring best practices to patients and increase their access to CF-GI specialists. As of July 2019, we have completed training of two 3-year DIGEST awardee cohorts for a total of 30 DIGEST trainees. The initial cohort began training in 2014. Of these, 13/15 continue to practice at sites with a CF Center and remain engaged in CF gastroenterology care. Table 2 lists the tangible accomplishments of the initial cohort over these years. A third cohort of 21 attended face-to-face training on July 30, 2019, with an anticipated program completion date of June 2022.

In 2017 a follow up assessment survey was sent to the DIGEST 1 awardees, their CF Center directors, and their Gastroenterology division chiefs. Eight of 15 awardees (53%) responded to the survey, including 2 from Adult programs. All 8 respondents were attending a CF Clinic, all were seeing most CF patients in their centers with gastrointestinal problems, and all were attending the CF center clinical conferences. Seven of eight were involved in CF-related research. All eight reported it "very likely" that they will continue with a CF clinical focus, and four of eight reported it "very likely" they will continue with a research focus in CF (the other four reported it "probably likely").

Responses were obtained from nine of fifteen CF Center directors (three from adult programs). All reported that a DIGEST awardee was attending CF clinic or had a designated time for patients with CF and gastrointestinal problems and that the DIGEST physician was seeing most patients with gastrointestinal problems; 6/9 reported their DIGEST physician attended the CF center clinical conference. 8/9 reported their DIGEST physician was involved in CF-related research. All stated that the DIGEST program has resulted in improved care for their patients with CF.

An additional survey was sent to the DIGEST 1 awardees in 2019 to assess the medium-term impact of the program. Ten of the 15 awardees responded (4 adult and 6 pediatric gastroenterologists). All of them were seeing CF patients and half of the respondents reported doing so at least weekly. Eighty percent were seeing the majority of CF patients at their centers, most were attending team meetings and all of them had attended NACFC at least once since the DIGEST program ended. Eighty percent were involved in

**Table 2**  
Accomplishments of awardees in DIGEST 1.

Experience	Number
Peer-reviewed CF-related journal articles	43
Guidelines participation	1
Sessions moderated at NACFC	19
Oral presentations at NACFC	14
Roundtables moderated at NACFC	12
Short course NACFC	2017 short course on gastroenterology, involved 7 DIGEST awardees
CRSP fellows	1

In addition, several DIGEST 1 awardees have created educational information for people with CF, used by their individual centers or the CFF. NACFC: North American Cystic Fibrosis Conference, CRSP: Clinical Research Scholars Program.

CF-related research, many had published or presented their work and 100% reported giving clinical or teaching conferences related to CF at their institutions. When asked to describe how the DIGEST program influenced their careers, the most frequent response was that it gave them a clinical focus and niche in CF. All of the respondents said they would recommend the program to other gastroenterologists.

A third goal of DIGEST was to provide information regarding best practices to the CF community. As a result, the group developed a 10-article supplement focused on the key areas of CF related gastrointestinal disease and symptomatology ([https://www.cysticfibrosisjournal.com/issue/S1569-1993\(17\)X0003-9](https://www.cysticfibrosisjournal.com/issue/S1569-1993(17)X0003-9)). Ten of the DIGEST awardees from the first cohort were paired with international leaders in their respective gastroenterology areas of CF. In addition to providing informative articles for all CF health care providers, this proved to be a valuable learning experience for the trainees. The topics covered the major luminal GI/pancreatic/liver/nutrition complications of CF. The supplement was published in Journal of Cystic Fibrosis in 2017 and has since been downloaded over 70,000 times. The topics and authors are listed in Table 3 (supplemental content).

The final goal of DIGEST was to develop clinical and translational researchers to expand the evidence base for management of GI symptoms and conditions in CF. DIGEST awardees developed and led two multicenter grants through the Cystic Fibrosis Therapeutic Disease Network (CF TDN). The first study, entitled: The role of oral glutathione on growth parameters in children with cystic fibrosis (GROW Clinicaltrials.gov NCT0.020719) was a double-blind placebo-controlled trial of glutathione as a supplement to improve growth in children with CF. The second, entitled Multicenter study of patient reported gastrointestinal symptoms in people with cystic fibrosis (GALAXY NCT 03801993) is a multicenter study of the prevalence of gastrointestinal symptoms in people with CF which

has now completed recruitment. In both studies, the majority of the site PI's were DIGEST awardees. This represented an opportunity for the awardees to participate in a multicenter trial, and to learn more about the CF TDN and advance the understanding and treatment of GI diseases related to CF. DIGEST awardees are also participating in two multicenter TDN studies of the effects of the recently approved, highly effective "triple modulator therapy", A Prospective Study to Evaluate Biological and Clinical Effects of Significantly Corrected CFTR Function (The PROMISE Study clinicaltrials.gov NCT 04038047) and The Baby and Early Childhood Endocrine and Growth (BEGIN) Study. In all four of these studies DIGEST faculty participated to mentor awardees in grant writing, study design and operations.

#### 4. Conclusions

The DIGEST program has been successful in providing greater access to CF-gastroenterology expertise to a larger portion of the CF community. Beyond the improvements in access to clinical care, CF Care Centers with DIGEST awardees have become more aware of gastrointestinal complications in CF. Many Center Directors underestimated the need in their population for CF-GI expertise, as their patients did not report gastrointestinal problems to their pulmonologists. We have seen increased demand for DIGEST training from centers. While we limit training to one individual at each center to maximize the geographic reach for patients with CF, we have trained both an adult and a pediatric provider at several centers and have also enrolled awardees from Canadian centers. Future efforts might include the development of regional CF-GI programs to bring best practices in CF-GI care to non-DIGEST CF Centers.

Fig. 1 lists the key factors that contributed to the success of the DIGEST program, which may inform the development of other professional training programs. In retrospect, the web-based model

- Performing a needs assessment
- Being aware of mentorship concepts unique to the content area
- Identifying and securing a funding source
- Designing an application and selection process, including clarification of objectives
- Designing a structured curriculum
- Facilitating both face-to-face and virtual opportunities for interaction
- Providing opportunities for expansion of impact
  - On direct patient care
  - On education of colleagues
  - On expanding the evidence base
- Post implementation survey to inform modifications in the program

**Fig. 1.** Key Contributors to the success of the DIGEST Program

that was used for DIGEST is even more relevant than we could have predicted, given the recent shift to virtual learning and communication due to the COVID-19 pandemic.

Indeed, the success of the DIGEST program led the CFF to create the Emerging Leaders in CF Endocrinology (ENVISION) program to train endocrinologists in the unique problems of people with CF, modeled after DIGEST.

It is true that DIGEST awardees were intentionally tapped for opportunities to participate in research and speak or moderate sessions at NACFC. CF clinical care, research and scholarship are collaborative by nature. As one of the major goals of DIGEST was for the awardees to serve as clinical resources for CF Centers, intentionally involving them at NACFC increased their visibility in the CF community. This was a self-fulfilling outcome, but the sessions were well attended and due to the positive feedback there has been continued interest in GI-focused sessions at NACFC.

The DIGEST1 participants faced challenges as they transitioned out of the program that reflect issues within the US healthcare system. The complexity of CF Gastroenterology care leads to lower productivity measures compared to other areas of care (particularly for adult GI physicians), there has been pressure on some of our awardees to spend less time in CF clinic and more time in higher revenue-generating activities. This was balanced by scholarly activities and research funding that has helped protect the time of some DIGEST awardees following completion of the 3-year program. The survey responses, as well as the response rate, may reflect some selection bias as those who remained more involved may have been more likely to respond to the survey. However, from conversations with awardees and center directors, it is known that the vast majority have stayed involved in CF clinical care and research.

In summary, we have successfully increased expertise in detecting and managing gastroenterological complications in people with CF. We have been astounded by the interest and excitement of these early career physicians coupled with the strong interest from our patients and their families to have their GI needs addressed. Most DIGEST awardees are now working as part of the multidisciplinary CF team, providing care collaboratively with pulmonologists and dietitians. These types of working relationships reflect the evolution of the multidisciplinary model that has been so instrumental in advancing care for individuals with CF.

This type of webinar-based program can be a model for training gastroenterologists as well as other subspecialists around the globe, not only in CF, but also in caring for individuals with other complex, chronic multisystem diseases.

#### Declaration of Competing Interest

None of the authors has any real or perceived conflict of interest pertaining to the content of the manuscript.

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#### Supplementary materials

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