

Outpatient Cardiac Rehabilitation Services, Participants and Workforce in North Carolina: Results of a 2019 Survey of Cardiac Rehabilitation Program Directors

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BACKGROUND Cardiac rehabilitation (CR) can improve quality of life and reduce subsequent hospitalizations for individuals with cardiovascular disease. Nevertheless, CR is underutilized, and less is known about the current content, patient population, and workforce of CR programs in North Carolina.

OBJECTIVE To describe CR services, patient participation, and workforce in North Carolina in order to characterize CR infrastructure and identify opportunities to improve CR use.

METHODS We distributed an electronic survey to all certified outpatient CR programs in North Carolina in spring 2019. Descriptive statistics were used to summarize program characteristics, participant characteristics, and current workforce. Data were analyzed overall and by region.

RESULTS Responding programs (89.5% response rate, n=68) had been in operation for a mean of 24 (SD: 10.4) years. Programs have similar availability across the state, operating 4 days a week with 5 sessions per day. A majority of programs offered nutrition counseling (98.5%), stress management (94.1%), aerobic exercise (86.8%), and weight training (86.8%). Patients were majority male (65%), aged 65 or older (75%), and White (75%). Nearly half of patients referred to CR attended at least 1 session, though 25% discontinued early. Most programs were staffed by a median of 2 full-time nurses (97%) and by a median of 1.5 full-time exercise physiologists (96%). Mental health and administrative professionals were less frequent in CR settings.

LIMITATIONS Since this survey was primarily completed by program directors, further research is needed to understand the challenges, experiences, and needs of the frontline CR workforce, as well as the direct experiences of patients who participate in CR.

CONCLUSIONS CR programs in North Carolina offer a range of services. While half of patients referred to CR initiate services, interventions are needed to improve initiation and adherence to CR.

Cardiovascular disease (CVD) has long been the leading cause of death in North Carolina [1], both overall and among subpopulations, including women and minorities [2, 3]. The nationwide CVD mortality rate has fallen in the past decades, decreasing from 256.6 per 100,000 in 2008 to 200.3 per 100,000 in 2018 [4, 5]. Survivorship of myocardial infarction (MI) is also on the rise. While an estimated 805,000 MIs occur each year, 85% of patients survive, accounting for the prevalence of individuals with a history of acute MI increasing from 7.6 million to 8.4 million between 2012 and 2016 [5].

For patients with acute coronary syndrome, including MI and stable angina, the American Heart Association (AHA) recommends participation in outpatient cardiac rehabilitation (CR) [6–8]. The Centers for Medicare and Medicaid Services (CMS) standard reimbursement includes up to 36 sessions of CR [9]. CR has a demonstrated effect on health-related quality of life and is associated with a reduction in subsequent hospitalizations and cardiovascular-related mortality [10, 11]. For older adults in particular, CR may have a protective effect, similar to that of pharmacotherapy on subsequent MI, cardiovascular and all-cause hospitaliza-

tions, and 1-year mortality, while also improving functional status [12, 13]. Despite these benefits, participation in CR ranges widely from 6% to 52% of all eligible patients [14]. Further, disparities in CR participation persist and lower participation rates are observed among minorities, women, and patients with multiple comorbidities [15, 16].

The CR participation rate in North Carolina in 1997 was 10.5%, which put the state in the lowest national quartile of participation [14]. However, recent statewide health surveillance data suggest that quality improvement efforts in the past decades have enhanced CR use. In 2018, 39.9% (95% CI, 31.2%–49.2%) of adult North Carolinians with history of MI reported use of rehabilitation services, up slightly from 36.6% in 2011 [17, 18]. Although initiation has improved,

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adherence and program completion lag [19]. Adherence and completion may be influenced by factors such as number of CR facilities per 10,000 people, training programs for CR staff, standing orders, and procedures for initiating and tracking participation [14]. In addition to exercise therapy, comprehensive outpatient CR must include an array of components that support the adoption and maintenance of an active, heart-healthy lifestyle including nutrition counseling; blood pressure, lipid, and diabetes management; tobacco cessation; and psychosocial management [6]. While exercise is beneficial, programs that consist of exercise training alone are not considered comprehensive CR [20].

The first CR programs in North Carolina emerged in 1975 [21]. The state was one of the earliest to develop a certification and licensing program and the state's Cardiopulmonary Rehabilitation Association has been active since 1984 [22]. North Carolina's Department of Health and Human Services (NCDHHS) maintains a registry of active, licensed CR programs, but less is known about the content of those programs, their workforce, and challenges in the field. This article describes the results of a 2019 survey of CR program directors in North Carolina. In the survey, we assessed program services, patient participation, and workforce. Understanding the availability and content of services and staff capacity statewide and by region will help to improve the initiation of and adherence to CR for MI survivors and identify ways to strengthen the state's CR infrastructure.

Methods

An electronic survey was developed and input into Qualtrics survey software (Qualtrics, Provo, UT). The survey updated a previously administered statewide CR survey, which was initiated in 1999 and updated and readministered in 2004 [21, 23]. Several changes necessitated an updated survey: comprehensive CR guidelines were reissued in 2007 [20]; in 2014, CMS extended CR coverage to patients with heart failure [9], and in 2018 the AHA updated clinical guidelines to improve CR participation among underrepresented groups [24]. The UNC IRB deemed this research exempt from review, given its focus on CR programs rather than individual patients. Informed consent was not required.

The 60-item survey was structured around the following themes: program history, affiliation, and location; types of services offered; service availability and capacity; patient population, demographics, and referral source; program participation; and program personnel including volunteers.

Service Definitions

CR is delivered in inpatient and outpatient settings. Inpatient CR typically consists of evaluation and initial rehabilitation efforts. Outpatient CR is divided into 2 phases. Early outpatient CR occurs immediately after hospital discharge. Up to 36 sessions are recommended, and are typically completed with 2-3 sessions per week [25]. Maintenance outpatient CR can continue 3-6 months after

initial outpatient therapy is completed [26], but insurance coverage is not guaranteed [9].

Sampling Frame

A list of licensed outpatient CR providers in North Carolina was obtained in September 2018 from the online state licensing list, administered by NCDHHS, which served as the sample for study. Six program directors who appeared multiple times were contacted to ascertain if their programs ran independently, if the duplicate entry represented a closed location, or if all locations were run as a single program with shared patient data and joint administration. After removing duplicates, 76 CR programs in the state were identified.

Survey Distribution

An introductory letter and survey link were sent by email to each CR director. Directors could complete the survey over multiple sessions or share the link with a proxy such as a deputy director. Participants were asked to report on the period of January 2018 to December 2018. The survey was open from February 2019 to June 2019. Recruitment strategies included a presentation at a statewide CR conference, automated monthly reminders about the survey, and up to 3 personalized emails or phone calls from the study team. Respondents were offered a \$25 gift card as an incentive.

Data Analysis

Survey responses were exported from Qualtrics and analyzed using SAS software version 9.4 (Cary, NC). Descriptive statistics summarized responses overall and by geographic region. The analysis of the survey did not include statistical hypotheses and tests of variance between regions were not conducted. Geographic regions were based upon county of program location according to the North Carolina license registry documentation. The regions were designated as Mountain, Piedmont, or Coastal based upon an online map accessed on October 17, 2019 [27].

Results

Overall, 68 of 76 CR program directors (89.5%) completed the survey. Response rates were similar across regions: 32 (47.1%) respondents were from the Piedmont region; 22 (32.3%) from the Coastal region; and 14 (20.6%) from the Mountain region. Statewide, the median length of program operation was 23 years (range: 2-42 years), with variation by region (Table 1).

Program Location and Affiliations

North Carolina CR programs are dispersed across the state, with clusters of programs in larger metropolitan areas (Figure 1). All responding CR programs were affiliated with a hospital system, and more than half were located on a hospital campus. CR programs may participate in national quality improvement initiatives such as the American Association

of Cardiovascular and Pulmonary Rehabilitation (AACVPR) Outpatient Cardiac Rehabilitation Registry, which tracks patient outcomes and progress toward national benchmarks [28]. Overall, approximately 40% of the outpatient CR programs participated in the AACVPR registry. Fewer sites (19.1%) participated in CMS quality improvement initiatives.

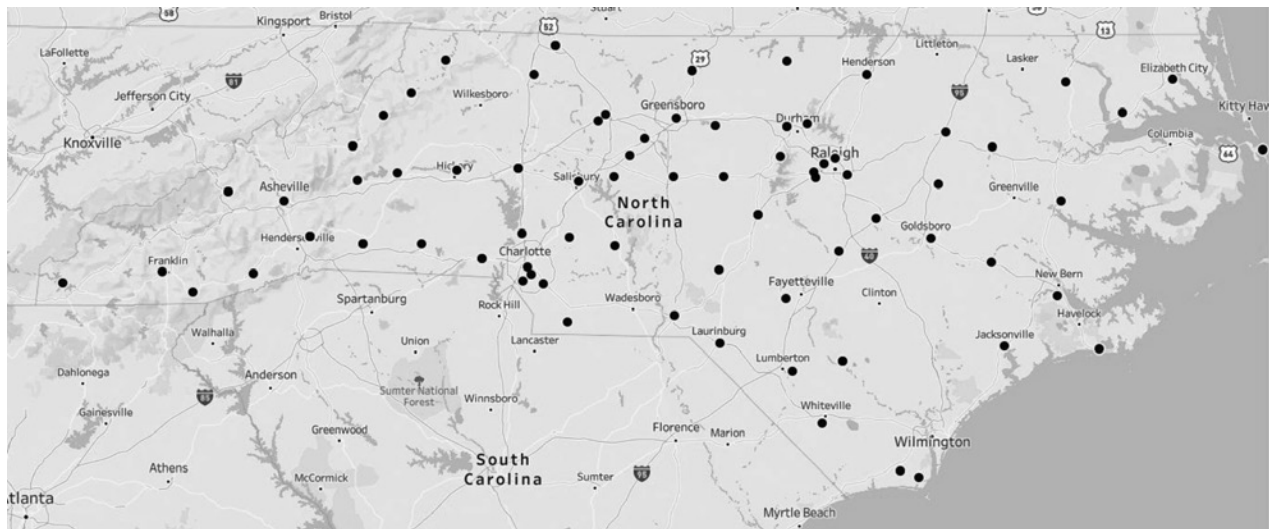
Services Offered

Around a quarter of programs offer CR services in inpatient settings (23.5%), ranging from 31.3% in the Piedmont to 9.1% in the Coastal region (Table 1). Statewide, maintenance CR is widely offered by agencies in the Piedmont

TABLE 1.
Summary of Cardiac Rehabilitation Program Characteristics and Services Offered

| Characteristic | Coastal | Mountain | Piedmont | Overall |
|---|-------------------|-------------------|-------------------|-------------------|
| Programs Included | 22 | 14 | 32 | 68 |
| Mean Program Longevity (SD), years (n=65) | 24.1 (9.95) | 21.8 (7.31) | 24.9 (11.82) | 24.0 (10.42) |
| AACVPR Registry Participant | 7 (31.8%) | 5 (35.7%) | 15 (46.9%) | 27 (39.7%) |
| CMS Initiative Participant | 4 (18.2%) | 3 (21.4%) | 6 (18.8%) | 13 (19.1%) |
| Outpatient program setting | | | | |
| Hospital | 13 (59.1%) | 8 (57.1%) | 21 (65.6%) | 42 (61.8%) |
| Other medical facility | 4 (18.2%) | 2 (14.3%) | 5 (15.6%) | 11 (16.2%) |
| Rehabilitation center | 5 (22.7%) | 5 (35.7%) | 6 (18.8%) | 16 (23.5%) |
| Fitness facility, health club, or wellness center | 2 (9.1%) | 2 (14.3%) | 5 (15.6%) | 9 (13.2%) |
| Types of rehabilitation supported | | | | |
| Inpatient cardiac rehabilitation | 2 (9.1%) | 4 (28.6%) | 10 (31.3%) | 16 (23.5%) |
| Maintenance | 12 (54.5%) | 8 (57.1%) | 27 (84.4%) | 47 (69.1%) |
| Home-based, self-directed, or tele-monitored | 0 | 0 | 1 (3.1%) | 1 (1.5%) |
| Pulmonary rehabilitation | 17 (77.3%) | 13 (92.9%) | 22 (68.8%) | 52 (76.5%) |
| Intensive Cardiac Rehab (ICR): Reversing Heart Disease | 1 (4.5%) | 1 (7.1%) | 0 | 2 (2.9%) |
| Other: Cancer Exercise Program | 1 (4.5%) | 0 | 3 (9.4%) | 4 (5.9%) |
| Other: Supervised Exercise for Peripheral Artery Disease | 7 (31.8%) | 1 (7.1%) | 3 (9.4%) | 11 (16.2%) |
| Other | 0 | 0 | 2 (6.3%) | 2 (2.9%) |
| ICR Programs Considered by Current Traditional CR Programs | | | | |
| Reversing Heart Disease | 1 (4.8%) | 3 (23.1%) | 0 | 4 (6.1%) |
| Pritikin | 3 (14.3%) | 4 (30.8%) | 6 (18.8%) | 13 (19.7%) |
| Services provided | | | | |
| Nutritional counseling | 22 | 14 | 31 (96.9%) | 67 (98.5%) |
| Stress management | 20 (90.9%) | 13 (92.9%) | 31 (96.9%) | 64 (94.1%) |
| Aerobic exercise | 19 (86.4%) | 13 (92.9%) | 27 (84.4%) | 59 (86.8%) |
| Weight training | 20 (90.9%) | 12 (85.7%) | 27 (84.4%) | 59 (86.8%) |
| Pharmacy/medication education | 20 (90.9%) | 12 (85.7%) | 23 (71.9%) | 55 (80.9%) |
| Smoking cessation | 15 (68.2%) | 10 (71.4%) | 26 (81.3%) | 51 (75.0%) |
| Weight loss counseling | 16 (72.7%) | 11 (78.6%) | 22 (68.8%) | 49 (72.1%) |
| Psychosocial services | 15 (68.2%) | 10 (71.4%) | 23 (71.9%) | 48 (70.6%) |
| Symptom management | 15 (68.2%) | 11 (78.6%) | 20 (62.5%) | 46 (67.6%) |
| Vocational counseling | 6 (27.3%) | 7 (50.0%) | 18 (56.3%) | 31 (45.6%) |
| Patient support group | 7 (31.8%) | 5 (35.7%) | 15 (46.9%) | 27 (39.7%) |
| Cardiopulmonary resuscitation | 3 (13.6%) | 1 (7.1%) | 7 (21.9%) | 11 (16.2%) |
| Spouse support group | 2 (9.1%) | 0 | 5 (15.6%) | 7 (10.3%) |
| Water aerobics | 0 | 0 | 1 (3.1%) | 1 (1.5%) |
| Yoga/Stretching | 1 (4.5%) | 1 (7.1%) | 1 (3.1%) | 3 (4.4%) |
| Other | 2 (9.1%) | 1 (7.1%) | 2 (6.3%) | 5 (7.4%) |
| Service availability | | | | |
| Mean (SD) Days per week | 4.0 (0.95) | 3.5 (0.85) | 4.2 (0.95) | 4.0 (0.95) |
| Weekday (before noon) | 22 | 14 | 32 | 68 |
| Weekday (noon to 5PM) | 17 (77.3%) | 11 (78.6%) | 26 (81.3%) | 54 (79.4%) |
| Weekday (after 5PM) | 0 | 1 (7.1%) | 2 (6.3%) | 3 (4.4%) |
| Capacity | | | | |
| Sessions per day, Median (IQR) (n=67) | 5.0 (4.0, 6.0) | 5.0 (5.0, 6.0) | 5.0 (4.0, 6.0) | 5.0 (4.0, 6.0) |
| Patients per session, Median (IQR) | 12.0 (10.0, 16.0) | 10.0 (10.0, 12.0) | 15.5 (12.0, 20.0) | 12.0 (10.0, 16.0) |
| Mean (SD) Length of Session | 58.0 (11.30) | 64.0 (16.03) | 61.7 (15.22) | 61.0 (14.22) |
| Annual full capacity operation %, Median (IQR) (n=62) | 76.5 (40.0, 85.0) | 50.0 (50.0, 70.0) | 75.0 (50.0, 80.0) | 70.0 (50.0, 80.0) |
| Mean (SD) Program Participation | | | | |
| Referred Patients (n=64) | 506.2 (465.27) | 268.8 (184.02) | 613.8 (561.37) | 510.1 (488.99) |
| Patients Attending (n=63) | 246.9 (245.13) | 190.6 (150.96) | 290.7 (168.15) | 257.7 (193.89) |
| % Patients Attending (n=62) | 52.9 (17.95) | 70.4 (18.66) | 57.3 (23.77) | 58.4 (21.69) |
| Session Completed (n=62) | 29.1 (4.67) | 26.6 (6.01) | 28.9 (7.56) | 28.5 (6.38) |
| % Patients Discontinuing (n=64) | 27.8 (20.71) | 21.7 (11.69) | 26.3 (15.52) | 25.9 (16.72) |

FIGURE 1.
Cardiac Rehabilitation Programs in North Carolina (2018)



Source: Tableau Public, version 2020 [4].

(84%), but less prevalent in the Mountain (57%) or Coastal (54.5%) regions. Most outpatient CR programs also offer pulmonary rehabilitation (76.5%) and a few programs offer specialized rehabilitation for conditions such as cancer (5.9%) and peripheral artery disease (16.2%). Two programs offered a Medicare-approved intensive CR program (e.g., Reversing Heart Disease); however, 17 other programs were considering adding an approved intensive CR program at their facilities. Thirteen programs were considering the Pritikin CR Program and 3 were considering the Reversing Heart Disease Program. At the time of survey completion, only 1 program offered home-based, self-directed, or telehealth CR delivery.

The most common services offered by responding CR programs were nutrition counseling, stress management, aerobic exercise, and weight training, with over 84% of programs in each region providing these services. Table 1 shows a full summary of the wide variety of services offered, which ranged from spousal support groups (10.3%) to medication education (80.9%).

Service Availability

On average, programs were open 4.0 days per week (SD: 1.0) (Table 1) and hours of operation were similar across the state. All programs offered sessions on weekdays before noon, with a majority also offering sessions between 12:00PM and 5:00PM. No weekend sessions were offered. Programs in each region offered a median of 5 daily CR sessions, lasting approximately 60 minutes each.

Program Capacity

Programs in the Piedmont had the capacity to serve more patients, with a median of 15.5 participants per session, compared to 10 and 12 in the Mountain and Coastal

regions, respectively. Statewide, programs operated at full capacity 70% of the year (range: 50%–80%). The Mountain region operated at full capacity 50% of the year, over 25 percentage points less than the Coastal and Piedmont regions. Facilities operating at full capacity may have a wait-list for new incoming patients.

Program Participation

Program volume varied widely across the state, with an average of 510 annual referrals per program issued statewide in 2018. The Piedmont region had the highest average referral volume with 613.8 patients referred per program, while programs in the Mountain region received an average 268.8 referrals per program. However, a greater proportion of referred patients initiated CR in the Mountain region (70.4%) than in the Piedmont or Coastal regions (52.9% and 57.3%, respectively).

Across North Carolina, participants completed an average of 28.5 sessions of outpatient CR (SD: 6.38). Participants in the Coastal region completed a slightly greater number of sessions (29.1, SD: 4.67), and participants in the Mountain region slightly fewer (26.6, SD: 6.01). The proportion of patients discontinuing CR programs earlier than medically advisable ranged from 21.7% in the Mountain region to 27.8% in the Coastal region.

Patient Population

On average across the state, CR participants were 65% male and 75% were aged 65 or older (Table 2). The majority (75%) of patients were White, although the Coastal region stands out for serving a higher proportion of Black patients (25%). Patients were predominantly insured by Medicare (60%) or private insurance (20%). In the Mountain region, 1 program accepted other types of payment for all partici-

pants and 7 (50%) programs had some proportion of participants self-pay. A median 10% of patients (IQR: 5%-20%) travelled 30 miles or more to attend CR. CR facilities are more spread out in the Coastal region (Figure 1) and a median of 20% of patients (IQR 10%-25%) in this region travelled long distances to attend CR. The largest proportion of patients were referred to CR after angioplasty/stent procedures (30%), followed by MI (25%) and coronary artery bypass graft surgery (20%).

Personnel and Workforce

The North Carolina Administrative Code requires that CR programs engage an interdisciplinary team of medical and mental health professionals. However, programs may contract with part-time staff or staff may hold multiple

roles appropriate to their scope of practice [29]. Details of the CR workforce by region are reported in Table 3. Nearly every program was staffed by a median of 2 full-time equivalent (FTE) nurses (97.1%) and by a median of 1.5 FTE exercise physiologists (95.6%). Two programs had notably more staff than the state average: 1 large Coastal program employed 7 FTE nurses, 11 FTE exercise physiologists, and 4 FTE students. One large program in the Piedmont employed 8 FTE nurses and 5 FTE exercise physiologists. Over 75% of programs in each region of the state had access to nutritionists/dieticians who were available between 12 and 20 hours per week. Mental health professionals were less often part of program staff: only 26.5% of programs had a psychiatrist or psychologist on staff, although 43% of Mountain region programs counted a part-time (median 0.3 FTE) psychia-

TABLE 2.
Demographics of Cardiac Rehabilitation Participants in North Carolina

| Characteristic | Coastal | Mountain | Piedmont | Overall |
|--|--------------|---------------|-------------|--------------|
| Programs Included | 22 | 14 | 32 | 68 |
| Race/Ethnicity, Median % (IQR) | | | | |
| Black or African American | 25 (20, 40) | 2 (2, 6) | 20 (15, 30) | 20 (13, 30) |
| White | 69 (55, 75) | 98 (90, 100) | 72 (60, 80) | 75 (60, 90) |
| Other Race | 5 (3, 12) | 5 (1, 9) | 5 (2, 10) | 5 (2, 10) |
| Hispanic | 5 (2, 5) | 3 (1, 5) | 2 (1, 5) | 2 (1, 5) |
| Sex, Median % (IQR) | | | | |
| Female | 40 (35, 47) | 28 (23, 45) | 30 (25, 40) | 35 (26, 40) |
| Male | 60 (53, 65) | 73 (55, 77) | 70 (60, 75) | 65 (60, 74) |
| Transgender | 0 | 0 | 2 (2, 2) | 2 (2, 2) |
| Age, Median % (IQR) | | | | |
| >= 65 years old | 75 (60, 80) | 76 (70, 85) | 74 (60, 75) | 75 (62, 80) |
| Did not respond | 3 (13.6%) | 3 (21.4%) | 8 (25.0%) | 14 (20.6%) |
| Travel Time, Median % (IQR) | | | | |
| >= 30 miles to center | 20 (10, 25) | 5 (3, 10) | 10 (4, 20) | 10 (5, 20) |
| Did not respond | 3 (13.6%) | 5 (35.7%) | 8 (25.0%) | 16 (23.5%) |
| Primary Language English, Median % (IQR) | | | | |
| Did not respond | 99 (95, 100) | 100 (99, 100) | 98 (95, 99) | 99 (97, 100) |
| Did not respond | 1 (4.5%) | 2 (14.3%) | 3 (9.4%) | 6 (8.8%) |
| Qualifying Event, Median % (IQR) | | | | |
| Angioplasty/stent (n=66) | 29 (20, 40) | 25 (20, 30) | 30 (20, 30) | 30 (20, 35) |
| Myocardial infarction (n=66) | 15 (6, 25) | 25 (15, 36) | 25 (20, 30) | 25 (15, 30) |
| Coronary Artery Bypass Graft (CABG) (n=67) | 20 (15, 28) | 27 (19, 35) | 20 (15, 25) | 20 (15, 30) |
| Heart failure (n=64) | 10 (10, 16) | 10 (5, 10) | 10 (5, 10) | 10 (5, 10) |
| Valve replacement surgery (n=66) | 5 (5, 10) | 10 (9, 11) | 10 (5, 15) | 10 (5, 11) |
| Angina (n=55) | 8 (5, 10) | 5 (4, 7) | 5 (5, 10) | 5 (5, 10) |
| Other heart surgery (n=22) | 2 (1, 8) | 4 (2, 5) | 2 (2, 8) | 2 (2, 5) |
| Insurance Payer, Median % (IQR) | | | | |
| Private Insurance (n=65) | 15 (10, 25) | 18 (14, 22) | 20 (14, 30) | 20 (12, 25) |
| Medicare (n=66) | 65 (55, 75) | 70 (60, 75) | 60 (52, 70) | 60 (55, 75) |
| Medicaid (n=56) | 10 (5, 15) | 7 (5, 10) | 10 (5, 15) | 10 (5, 15) |
| Dual Eligible (n=38) | 5 (4, 10) | 8 (3, 10) | 5 (2, 10) | 5 (2, 10) |
| Self-pay (n=26) | 5 (1, 5) | 5 (1, 5) | 5 (5, 9) | 5 (2, 5) |
| Other (n= 9) | 7 (3, 12) | 54 (7, 100) | 7 (1, 15) | 7 (4, 15) |
| Insurance Payer, % Programs | | | | |
| Private Insurance, Medicare, Medicaid, Dual Eligible, Other/Self Pay | 8 (36.4%) | 5 (35.7%) | 7 (21.9%) | 20 (29.4%) |
| Private Insurance, Medicare, Medicaid, Dual Eligible | 6 (27.3%) | 1 (7.1%) | 6 (18.8%) | 13 (19.1%) |
| Private Insurance, Medicare, Medicaid, Other/Self Pay | 2 (9.1%) | 1 (7.1%) | 7 (21.9%) | 10 (14.7%) |
| Private Insurance, Medicare, Medicaid | 3 (13.6%) | 2 (14.3%) | 7 (21.9%) | 12 (17.6%) |
| Other Private and Medicare Insurance Combinations | 3 (13.6%) | 4 (28.6%) | 4 (12.5%) | 11 (16.2%) |
| Other/Self Pay | 0 | 1 (7.1%) | 0 | 1 (1.5%) |
| Did not respond | 0 | 0 | 1 (3.1%) | 1 (1.5%) |

TABLE 3.
North Carolina's Cardiac Rehabilitation Workforce

| Characteristic | Coastal | Mountain | Piedmont | Overall |
|--|----------------|----------------|----------------|----------------|
| Programs Included | 22 | 14 | 32 | 68 |
| Program Personnel, n (%) | | | | |
| Nursing | 22 | 14 | 30 (93.8%) | 66 (97.1%) |
| Median FTE (IQR) | 2.0 (1.6, 2.0) | 2.0 (1.0, 2.0) | 2.0 (1.5, 2.8) | 2.0 (1.4, 2.0) |
| Exercise physiology | 21 (95.5%) | 12 (85.7%) | 32 | 65 (95.6%) |
| Median FTE (IQR) | 1.0 (1.0, 2.2) | 1.0 (1.0, 1.5) | 2.0 (1.0, 3.0) | 1.5 (1.0, 2.8) |
| Nutrition/dietitian | 16 (72.7%) | 10 (71.4%) | 27 (84.4%) | 53 (77.9%) |
| Median FTE (IQR) | 0.3 (0.2, 0.5) | 0.4 (0.2, 0.5) | 0.5 (0.3, 0.8) | 0.5 (0.2, 0.5) |
| Psychiatrist/Psychologist | 5 (22.7%) | 6 (42.9%) | 7 (21.9%) | 18 (26.5%) |
| Median FTE (IQR) | 0.2 (0.1, 0.3) | 0.3 (0.2, 0.5) | 0.3 (0.2, 0.3) | 0.3 (0.2, 0.3) |
| Social worker | 5 (22.7%) | 3 (21.4%) | 8 (25.0%) | 16 (23.5%) |
| Median FTE (IQR) | 0.2 (0.1, 0.3) | 0.1 (0.1, 0.5) | 0.5 (0.2, 1.0) | 0.3 (0.2, 0.6) |
| Student in training | 4 (18.2%) | 0 | 6 (18.8%) | 10 (14.7%) |
| Median FTE (IQR) | 1.0 (0.6, 2.5) | | 0.9 (0.5, 1.0) | 1.0 (0.5, 1.0) |
| Other: Respiratory Specialist | 10 (45.5%) | 2 (14.3%) | 7 (21.9%) | 19 (27.9%) |
| Median FTE (IQR) | 0.9 (0.5, 1.0) | 1.3 (1.0, 1.5) | 1.0 (0.5, 1.0) | 1.0 (0.5, 1.0) |
| Other: Administrative Staff/Management | 5 (22.7%) | 2 (14.3%) | 13 (40.6%) | 20 (29.4%) |
| Median FTE (IQR) | 1.0 (1.0, 1.0) | 1.5 (1.0, 2.0) | 1.0 (1.0, 1.0) | 1.0 (1.0, 1.0) |
| Other Medical Professional | 3 (13.6%) | 1 (7.1%) | 4 (12.5%) | 8 (11.8%) |
| Median FTE (IQR) | 1.0 (0.5, 2.0) | 2.0 (2.0, 2.0) | 0.6 (0.2, 1.5) | 1.0 (0.4, 2.0) |
| Volunteers | 4 (18.2%) | 6 (42.9%) | 18 (56.3%) | 28 (41.2%) |
| Median FTE (IQR) | 0.3 (0.2, 0.7) | 0.8 (0.1, 1.0) | 0.5 (0.2, 1.0) | 0.5 (0.2, 1.0) |
| Volunteer Activities | | | | |
| Administrative tasks | 3 (75.0%) | 6 | 12 (66.7%) | 21 (75.0%) |
| Cleaning equipment | 3 (75.0%) | 5 (83.3%) | 13 (72.2%) | 21 (75.0%) |
| Social support | 3 (75.0%) | 4 (66.7%) | 14 (77.8%) | 21 (75.0%) |
| Checking patients in/out | 0 | 3 (50.0%) | 6 (33.3%) | 9 (32.1%) |
| Orientation assistant | 1 (25.0%) | 0 | 4 (22.2%) | 5 (17.9%) |
| Blood pressure monitoring | 0 | 2 (33.3%) | 2 (11.1%) | 4 (14.3%) |
| Other: Equipment Assistance | 0 | 0 | 3 (16.7%) | 3 (10.7%) |
| Other: Patient Transportation | 0 | 0 | 2 (11.1%) | 2 (7.1%) |

trist or psychologist among their personnel. Programs in the Piedmont and Mountain regions engaged volunteers (56.3% and 42.9%, respectively) more than those in the Coastal region (18.2%). According to program directors, volunteers were mainly responsible for administrative tasks, cleaning equipment, and providing social support to participants. One Piedmont program relied significantly on volunteers, functioning with almost twice as many FTE volunteers as nurses and exercise physiologists combined.

Discussion

In this comprehensive survey of CR services in North Carolina, we observed that programs offered a range of services delivered by exercise physiologists, nursing staff, part-time professionals, and volunteers. CR programs have similar levels of availability throughout the state. A high response rate from program directors allowed us to identify bright spots in the state's CR landscape, including a rate of CR initiation that is slightly higher than the national average. However, in this study, the initiation rate was calculated based on directors' report of the number of referrals to programs and number of patients who initiate services; national estimates may be calculated differently. For referred patients, there is still a significant gap in enrollment, with only 50%

of referred patients initiating CR nationally [24, 25, 30]. In North Carolina, the overall statewide CR initiation rate for referred patients was 58.4%, with the Mountain region boasting a particularly high rate of initiation for referred patients. Moreover, North Carolinians who began CR tended to complete a high number of sessions. Many programs are engaged in the national CR network, affording them access to quality improvement resources and initiatives. Similarly, program affiliation with, and often co-location with, regional health systems, may facilitate referrals and communication between CR and specialists providing care after a cardiac event. Increasing CR referral and initiation is a quality improvement (QI) priority for health care systems and for the American College of Cardiology (ACC) and AHA, which recommend strengthening systems of care and improving communication between hospital and community providers to ensure more MI survivors access evidence-based secondary prevention [7, 8]. Both public health efforts and QI efforts are needed to increase the proportion of patients with a qualifying cardiac event who are referred to CR, initiate CR, and adhere to CR to obtain maximal benefit.

While structured exercise constitutes the clinical core of CR, comprehensive guidelines specify that programs provide a range of recovery-promoting services from diet qual-

ity to stress management [6, 25, 31]. However, the average program in North Carolina has a staff of just 2 RNs and 1.5 exercise physiologists. Psychiatrists, social workers, and administrative support are infrequently found in CR programs. Given limited staff resources, nurses and exercise physiologists bear a significant responsibility to provide services, educate patients, and coordinate care. Despite these challenges, CR programs manage to incorporate a wide array of services. More than two-thirds of all programs in each region offer symptom management, psychosocial services, weight loss counseling, smoking cessation, medication education, weight training, aerobic exercise, stress management, and nutritional counseling, suggesting that resourcefulness and holistic knowledge base of staff members is a significant asset to CR participants.

Nationally, the majority of patients with a qualifying cardiac event do not initiate CR [20]. The AHA has raised concerns about a “referral gap,” noting that many patients with qualifying events never receive a referral to CR, including over 20% of MI patients [24]. Less is known about the hospital referral or initiation rates of all North Carolinians with a qualifying cardiac event.

CR tends to be undersubscribed [14, 15, 32]. If CR participation were to increase to 70% by 2022, estimates suggest that 25,000 lives could be saved annually [25]. Though earlier studies estimate lower participation in the US South [14], recent North Carolina data indicate that CR participation among MI survivors is approaching 40% [17]. While this survey highlights North Carolina’s strengths, there is significant progress to be made. Slightly more than half of referred patients attended an initial CR session in the Coastal and Piedmont regions, while over 70% of referred patients attended an initial session in the Mountain region, a geographic trend that bears further exploration. On average, a quarter of patients will discontinue CR before completing the recommended number of sessions. In both metrics, North Carolina demonstrates success in CR compared to national samples, which estimate that 32.6% of referred patients attend at least 1 session and that 75% of patients drop out before completing 36 sessions [15].

Increasing the share of patients who complete the prescribed number of sessions can play a critical role in reducing mortality among survivors of acute cardiac events [33]. In particular, increasing CR participation among racial and ethnic minorities and low-income individuals is another national priority [34]. Although surveillance data from the ACC’s Chest Pain-MI registry suggests CR referrals have increased across all demographics, women and racial/ethnic minorities are referred at lower rates than White males [35]. This is especially important among Black and American Indian North Carolinians who have disparate rates of CVD and CVD mortality. Additionally, more men than women participate in CR in the state, and while CVD and MI mortality is higher among men [36], heart disease is the leading cause of death for women [2, 37]. There are well-described bar-

riers to both CR initiation and program completion, including cost, transportation, travel, and inconvenient program hours [25]. Improving initiation of and adherence to CR will require a range of strategies to make it more accessible and affordable. Home-based and hybrid programs offer a potential solution to access barriers, which have been amplified since the onset of the COVID-19 pandemic. Further research should explore how the COVID-19 pandemic has affected the delivery of CR in the state.

Conclusion

The survey provided rich detail about program services, patients served, and the CR workforce. With a response rate of nearly 90%, results can be used to better characterize CR in North Carolina and identify opportunities to improve participation. As survival after MI increases, patients should be encouraged to participate in evidence-based secondary prevention measures such as CR, which can help patients adapt and maintain important lifestyle changes. Improving CR participation will require patient-level interventions, quality improvement efforts within health systems, and investment in CR infrastructure. Treating physicians should emphasize CR’s value, support patients in attending, and discuss strategies for overcoming barriers to participating in CR. North Carolina’s CR workforce is an essential resource, delivering a range of interventions to participants. Increasing workforce numbers, program capacity, and access to other professionals who can deliver services will be necessary to meet patient demand. **NCMJ**

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