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PRACTICES AND PROCEDURES IN CLINICAL PEDIATRIC EXERCISE LABORATORIES IN NORTH AMERICA

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ABSTRACT

Inter-institutional differences in clinical pediatric exercise laboratory (CEPL) practices may affect consistency of patient care and efficacy of multi-center research. **Purpose:** To 1) describe current practices and procedures in CEPLs; and 2) explore differences in CEPLs that employ an exercise physiologist (ExP) to those that do not. **Methods:** A survey (min 37, max 68 items) was distributed to CEPLs in the U.S and Canada focusing on three domains: 1) staffing (min 6, max 12 items); 2) volumes, reporting, and interpretation (min 12, max 22 items); and 3) procedures/protocols (min 19, max 34 items). **Results:** Of the n=73 responses, n=18 were excluded for being ineligible, not completing the survey, or were duplicated responses, producing a final sample of n=55. Most responses were from the U.S. (92.7%), represented a children's hospital with university affiliation (83.6%), and reported to be cardiology specific (58.2%). ExPs are employed in 56.4% of CEPLs (88.2% ExPs with master's degree or higher). Physicians, cardiovascular techs, respiratory therapists, or nurses were responsible for conducting clinical exercise stress tests (ESTs) in CEPLs without an ExP. Emergency life-support, professional, and clinical certifications were required in 92.3%, 27%, and 21.2% of CEPLs, respectively. 9.6% of CEPLs had no certification requirements. The median volume was 201-400 ESTs/yr. with 20% of the sample performing >800 ESTs/yr. Treadmill and cycle were the primary modalities (80% and 10% of ESTs, respectively). Institution specific exercise protocols were used in 20% of CEPLs. 72% of CEPLs provide services in addition to ESTs such as cardiac/pulmonary rehab. Non-parametric testing found that those CEPLs with an ExP perform a higher volume of ESTs (p<0.001), are more likely to perform metabolic ESTs (p=0.028), participate in more research (p<0.001), and provide services in addition to ESTs (p=0.001). **Conclusions:** Inter-institutional differences in CEPLs staffing and operation may warrant efforts for standardization.

INTRODUCTION

- Exercise stress testing (EST) provides valuable information regarding physiologic limitations, functional status, exertional symptoms and disease progression
- Practice guidelines for pediatric EST do not exist, leading to inconsistencies and variability in clinical pediatric exercise laboratories (CEPL)
- Further investigation into current CEPL practices and procedures is warranted
- **PURPOSE:** to describe current practices and procedures in North American CEPLs by assessing 1) staffing, 2) volumes/reporting/interpretation, and 3) procedures/protocols; and to explore characteristics of CEPLs that have an ExP on staff to those that do not

METHODS

- Questionnaire survey distributed online via Redcap between 9/30/2019-8/8/2020
- Branching tree logic questions focused on 3 domains (total: min 37, max 68 items)
 - Staffing (min 6, max 12 items)
 - Volumes/reporting/test interpretation (min 12, max 22 items)
 - Procedures/protocols (min 19, max 34 items)
- Approved as a non-human subjects' QI study by Children's Mercy Hospital IRB
- **Statistical testing:**
 - Continuous/interval data: median and interquartile range (IQR) reported
 - Nonparametric testing : p-values generated via two-sample Wilcoxon rank-sum (Mann-Whitney) tests, Fisher's exact, or chi-square tests

RESULTS

- n=73 survey responses with 18 excluded (4 for no consent, 2 for blank survey submission, 3 for ineligibility, 9 for duplication) creating a final sample of n=55

Table 1: CEPL Sample Descriptives (n=55)

Survey Item	Response	%
CEPL location	United States	92.7
	Canada	7.3
Institution program characteristics	Children's hospital w/ university affiliation	83.6
	General university hospital	7.3
	Private practice w/ university affiliation	3.6
	Other	5.4
CEPL primary departmental affiliation	Dedicated cardiac	58.2
	Dedicated pulmonary	10.9
	Shared cardiac-pulmonary	27.3
	Other	3.6

Table 3: CEPL Test Volumes, Reporting, and Interpretation (n=55)

Survey Item	Response	%
On average, how many total ESTs does your lab perform per year?	0-200	34.5
	201-800	45.5
	801-2000+	20.0
Does your exercise lab perform ESTs on adult congenital heart disease patients?	Yes	72.7
	No	23.6
Who generates (writes) the preliminary interpretation for the EST? (select all that apply)	Person performing the test	56.4
	Dedicated CEPL physician	38.2
Who signs the EST report in the medical record? (select all that apply)	Person performing the test	12.7
	Dedicated CEPL physician	69.1
	Ordering provider	25.5
Who is responsible for communicating the EST results to the ordering provider? (select all that apply)	Person performing the test	49.1
	Dedicated CEPL physician	52.7
	Ordering provider	7.3

Table 2: Staffing Characteristics (n=55)

Survey Item	Response	%
Does your institution staff an ExP to perform EST?	Yes	56.4
	No	43.6
How many staff members are in the CEPL during a typical EST? (n=53)	1 staff	32.1
	2 staff	60.4
	3 staff	7.5
What staff members are in the room during a typical EST?	ExP	56.4
	Physician/Nurse/NP	70.9
	EKG tech	32.7
	RT	20.0
	ExP	54.5
Who primarily conducts the EST?	Physician/Nurse/NP	56.4
	EKG tech	18.2
	RT	20.0
	Safety	92.3
Which certifications are required for personnel conducting EST? (n=52)	Professional	27.0
	Clinical	21.2
	None required	9.6

Abbreviations: NP=Nurse Practitioner; RT=Respiratory Therapist.
 * Examples of safety certifications – BLS, ACLS, PALS, PEARS, etc.; professional certifications – ACSM, NSCA, etc.; clinical certifications – respiratory therapist, certified cardiographic tech, etc.

Table 4: CEPL Procedures

Survey Item	Response	%
Does your exercise lab have a manual of standard operating procedures? (n=54)	Yes	77.7
	No	22.3
Does your exercise lab have a documented protocol for emergency or adverse events? (n=54)	Yes	77.7
	No	22.3
Have you practiced/conducted mock emergency drills in the past 12 months? (n=40)	Yes	37.5
	No	62.5
Does your exercise lab have a documented policy for high-risk exercise testing? (n=54)	Yes	51.9
	No	48.1

Table 5: CEPL Protocols (n=55)

Survey Item	Response	%
Does your lab perform metabolic EST (VO2)? (n=54)	Yes	92.6
	No	7.4
Does your lab perform Pulmonary Function Testing (spirometry)?(n=54)	Yes	87.0
	No	13.0
Select the percent of all EST performed in your CEPL that use the following modalities? ^a	Treadmill	80
	Cycle	10
	6MWT	3
	Recumbent ergometer	1
What treadmill protocols are routinely used in your CEPL? (select all that apply) (n=54)	Bruce	62.9
	Modified Bruce	66.7
	Institution Specific	20.4
	Other	72.5
What cycle ergometer protocols are routinely used in your CEPL? (select all that apply) (n=47)	Continuous Ramp	61.7
	James	17.0
	Interval Ramp	19.1
	Institution Specific	6.4
	Other	21.3
What other types of testing does your CEPL perform? (select all that apply)	Tilt table /syncope testing	25.5
	Stress-echocardiography	70.9
	Nuclear stress testing	29.1
	Dobutamine stress testing	10.9
	Vascular studies	5.5
What modality(s) does your CEPL use to perform stress-echocardiography? ^e (select all that apply) (n=43)	Upright cycle ergometer	53.4
	Recumbent/supine ergometer	18.6
	Treadmill	67.4
	Dobutamine infusion	4.7
	Other	4.7

Abbreviations: 6MWT=6-minute walk test; SpO2=Oxygen saturation
^a n=2 did not report a percent for treadmill and cycle ergometer; n=3 did not report a percent for 6-minute walk test and recumbent ergometer. Missing data does not equal 0% use of those modalities, but designates the question was skipped by the participant.

Table 6: Comparisons of CEPLs with and without an ExP on staff

Survey Item	Response	ExP (n=31) %	No ExP (n=24) %	p-value
On average, how many total EST does your lab perform per year?	0-200	16.1	58.3	<0.001
	201-800	54.8	33.3	
	801-2000+	29.0	8.3	
Does your exercise lab participate in research studies?	Yes	90.3	33.3	<0.001
	No	9.7	66.6	
Does your lab perform metabolic EST (VO2)? (No ExP: n=23)	Yes	100	82.6	0.028
	No	0	17.4	
Is every patient eligible for a metabolic (VO2) EST?	Yes	48.4	37.5	0.419
	No	51.6	62.5	
Percent of total EST that use the following exercise modalities	Treadmill	n=30 median (IQR) 72.5% (49,89)	n=23 median (IQR) 90% (75,99)	0.004
	Cycle	22.5% (49,89)	2% (0,20)	0.003
Number of treadmill protocols routinely used ^a	6MWT (No ExP: n=22)	3.5% (0,9)	0% (0,10)	0.708
	Other	2 (1,3)	2 (1,2.5)	0.252
Number of cycle ergometer protocols routinely used ^b	Number of CEPLs within division	1 (1,1)	1 (1,1)	0.181
	Number of other tests offered by the CEPL ^c (Examples: tilt table/syncope testing, stress-echo, nuclear/dobutamine stress testing, vascular studies)	1 (1,2)	1 (1,1)	0.089
Number of additional services offered by the CEPL ^d (Examples: cardiac/pulmonary rehab, exercise prescription/counseling)	Number of CEPLs within division	2 (2,3)	1 (1,2)	0.006
	Number of additional services offered by the CEPL ^d (Examples: cardiac/pulmonary rehab, exercise prescription/counseling)	1 (0,2)	0 (0,0)	0.001

Abbreviations: 6MWT=6-minute walk test; IQR=interquartile range
^a n=2 did not report a percent for treadmill and cycle ergometer; n=3 did not report a percent for 6-minute walk test and recumbent ergometer. Missing data does not equal 0% use of those modalities, but designates the question was skipped by the participant.
^b Number of cycle ergometer protocols routinely used in exercise stress lab: range 0-3
^c Number of other tests offered by exercise stress lab: range 0-6
^d Number of additional services offered by exercise stress lab: range 0-3

CONCLUSIONS

- Substantial variations exist in CEPLs regarding who staffs and performs EST, as well as certifications required by the institutions
- EST volumes and types of testing offered is vastly different across institutions
- Protocols used for EST are diverse and could benefit from standardization, particularly treadmill protocols
- Institutions that staff an ExP report higher EST volumes, participate in more research, and offer more diverse testing/services beyond EST
- These results further support the need for CEPL practice standardization in North America

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