Improving anaerobic threshold determination: a quality improvement study in a pediatric clinical exercise laboratory

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PURPOSE

- Cardiopulmonary exercise testing (CPET) has become a routine outcome measure in the long-term follow-up of patients with congenital heart disease.
- Anaerobic threshold (AT) is a submaximal measure of exercise capacity and cardiovascular function that is obtained during CPET
- Measuring VO2 at AT vs. peak may result in more significant exercise outcomes in patients with CHD that have cardiac output deficits (1).
- AT's utility can be limited by multiple accepted methods for identification resulting in low rates of interrater reliability.
- We designed and implemented a quality improvement intervention to standardize AT measurement in pediatric cardiology patients undergoing CPET.

Global aim:
Our lab aims to use psychology, education, technology, and exercise to engage our patients in a healthy lifestyle and modify cardiovascular risk and improve quality of life for patients undergoing diagnostic cardiopulmonary testing.

SMART aim:
By May 1, 2021, we will increase the frequency of concordant measurement of VO2 at anaerobic threshold with the physician verified value to 80% for patients with congenital heart disease undergoing cardiopulmonary exercise testing at MCHC exercise lab.

Population:
All patients with congenital heart disease undergoing cardiopulmonary exercise testing in our pediatric exercise lab.

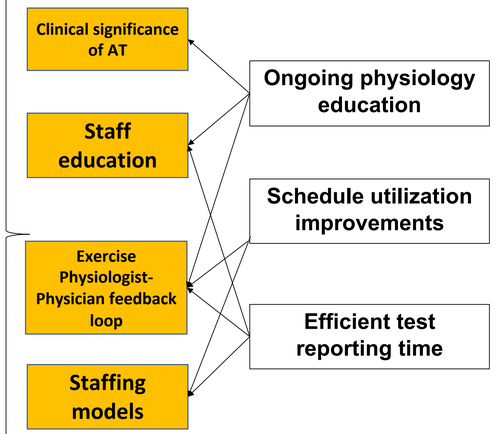

Figure 1. SMART aim chart

PROJECT DESIGN

- After identifying key drivers for appropriate AT determination, Plan-Do-Study-Act (PSDA) cycles (*Figure 3*) started with N=1 tests of change and ramped to laboratory-wide adoption of new methods addressing staffing models, exercise physiologist (EP) education, and multi-modal feedback mechanisms

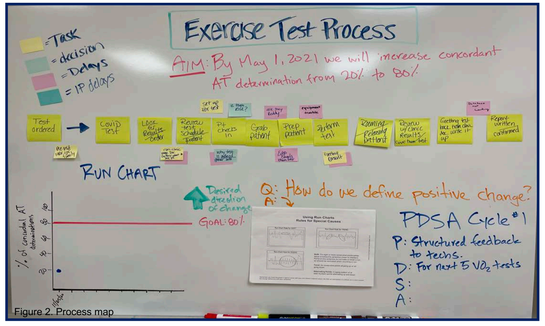

Figure 2. Process map

- A process map (*Figure 2*) was used to track concordance of AT determination in real-time
- Primary outcome measure was interrater reliability between the EP and the interpreting physician
- Baseline data was collected using retrospective analysis of historical testing data
- AT determination was measured using the v-slope method (2)
- Concordance was defined as less than 10% difference in the value of AT (in mL/min of O2 consumed)

Figure 3. PDSA Cycles

	Cycle 1	Cycle 2
Test Description:	Staffing model & education changes	Implementing changes with AT determination feedback and staffing model
Test Population:	Pediatric CPET patients	Pediatric CPET patients
Location of test:	MCHC exercise lab	MCHC exercise lab
Executed by:	Singular exercise physiologist	Entire exercise staff
Test Results:	Efficiency of testing, concordance of AT determination, and test report turn around time was improved. Additionally, there was increased volume and quality of feedback between exercise physiologist and interpreting physician.	Improved staff education and feedback loop mechanism
Action (Adapt, Adopt or Abandon):	Adapt	Adopt

RESULTS

- Baseline interrater reliability was less than 20%
- Key drivers of low reliability included reliance on incorrect automated AT determination by vendor platform and lack of prior utilization of AT for clinical purposes.
- After implementing staffing changes and education interventions, baseline to sustained interrater reliability increased to above the team's goal of 80% within 6 months.
- Improvements have been sustained for more than 12 months post-intervention.

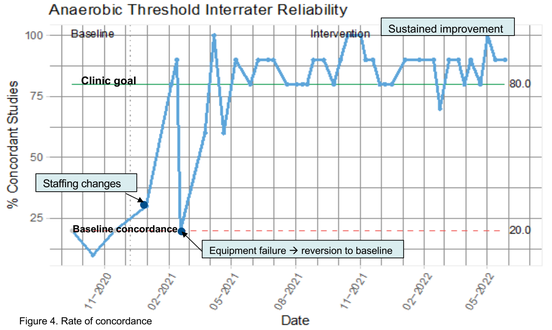

Figure 4. Rate of concordance

CONCLUSIONS

- We demonstrated a significant increase in interrater reliability of AT determination on CPET for pediatric cardiology patients at the University of Michigan.
- Reliability was maintained through public data tracking, continuing education curriculum, and an emphasis on the importance of quality data for utilization of AT in our clinical exercise prescription program.
- High interrater reliability of AT will enable its use as a clinically important submaximal exercise and cardiovascular function marker in our pediatric exercise laboratory.

FUTURE DIRECTIONS

- Improved interrater reliability for the determination of AT will produce higher quality CPET results, improving our laboratory's ability to address cardiovascular function and fitness changes in our population of patients with congenital heart disease.
- This data will be used to further expand on our clinic's implementation of exercise prescription and consultation for this specific population.

SOURCES

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