Project Title

CARE Report: Enhancing Patient and Process Outcomes using Programming

Project Lead and Members

Project lead: Muhammad Alif Bin Abu Bakar

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Organisation(s) Involved

KK Women's and Children's Hospital

Healthcare Family Group(s) Involved in this Project

Medical, Allied Health,

Applicable Specialty or Discipline

Cardiology, Medical & Laboratory Technology

Project Period

Start date: not indicated

Completed date: not indicated

Aims

The aim of this project was to streamline processes by automating mundane tasks, replacing manual calculations data entry and reducing the number of steps within the workflow to generate a CPET report.

During the development of the CA.R.E. Report, the team visited other centres that runs CPET (for adults). The aim was to learn and understand more from the other practitioners. This allowed the team to gain further knowledge to develop a better and an updated method of reporting.

Background

The extensive time required to generate a single CPET report (5 hours), significantly impacted the weekly throughput of tests conducted. Consequently, waiting time for both new and follow-up cases were about four months. More manpower hours were allocated to run CPET, reducing resources for existing and possibly new clinical services.

Methods

See poster appended/below

Results

See poster appended/below

Conclusion

See poster appended/below

Project Category

Care & Process Redesign

Quality Improvement, Access to Care, Productivity, Design Thinking, Job Effectiveness, Turnaround Time, Manhour Saving

Keywords

CPET report, Automation, Raw Data, Slope Graphs, Clinical Exercise Physiologist, Efficiency, Technology, Turnaround Time,

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C.A.R.E. Report:
Enhancing *Patient* and *Process* Outcomes using Programming

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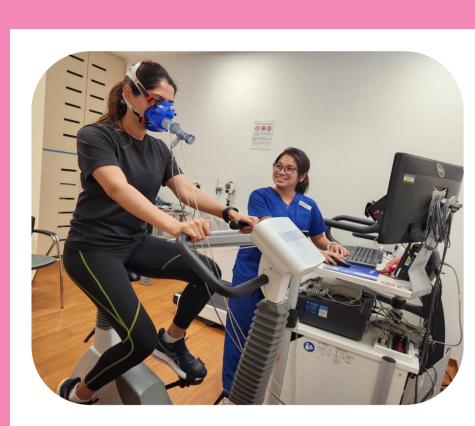SINGAPORE SPORT & EXERCISE MEDICINE CENTRE

ACRONYMS

C.ardiopulmonary exercise testing (CPET)
A.utomated
R.programming and
E.xcel

PROBLEM STATEMENT

The **extensive** time required to generate a single CPET report (~5 hours), significantly impacted the weekly throughput of tests conducted.

Figure 1. A photo of a patient on a Cycle Ergometer undergoing a CPET

Consequently, waiting time for both new and follow up cases were about four months. More **manpower** hours were allocated to run CPET, **reducing** resources for existing and possibly new clinical services.
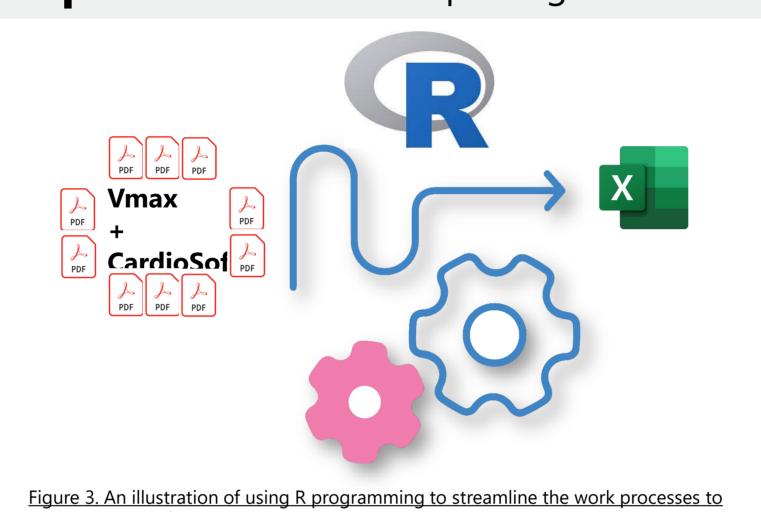

Figure 2. A sample nine-plot panel of CPET report.

PROJECT AIM

The aim of this project was to **streamline** processes by automating mundane tasks, replacing manual calculations data entry and reducing the number of steps within the workflow to generate a CPET report.

During the **development** of the CA.R.E. Report, the team visited other centres that runs CPET (for adults). The aim was to learn and understand more from the other practitioners. This allowed the team to gain further knowledge to develop a **better** and an **updated** method of reporting.

Figure 3. An illustration of using R programming to streamline the work processes to generate an Excel report.

POSSIBLE SOUTIONS

In the **first** version, CPET reports were manually written in Word involving tedious data entry and summarization. The **subsequent** versions in Excel introduced a "Calculator" tab employing functions such as IF, VLOOKUP, and INDEX, alongside referencing keyed-in values to a normative database stored within the workbook. Graphs were generated separately using MatLab, which were then manually inserted into the Excel sheet.

The **current** version uses R script that automatically scans raw data from exported pdfs, converts it into a data frame and does all the calculating and comparing to norms, generating, and inserting slope graphs, inserting values and keying in the text summaries for the interpretation part and generating the report in an Excel.

Figure 4 – Gantt Chart

YEAR	2008	2014	2015	2020	2021	2023	BEYOND
METHOD							
Microsoft WORD	5 Hours						
Microsoft EXCEL			5 Hours				
EXCEL and CALCULATOR					5 Hours		
R programming						2 Hours	
Machine Learning							< 2 Hours

Figure 4. A Gantt Chart for the C.A.R.E. Report

Figure 5 – Steps:
10 pdfs of raw data and text → Copied to an External HDD → Loaded onto R Studio → R script → Loads the CPET Report Excel Template → Scans and converts the 10 pdfs into data frames → Generates graphs of linear regression slopes → Calculates the Anaerobic threshold and Peak values → Inserts all graphs, values and text into the CPET Excel Report → C.A.R.E Report
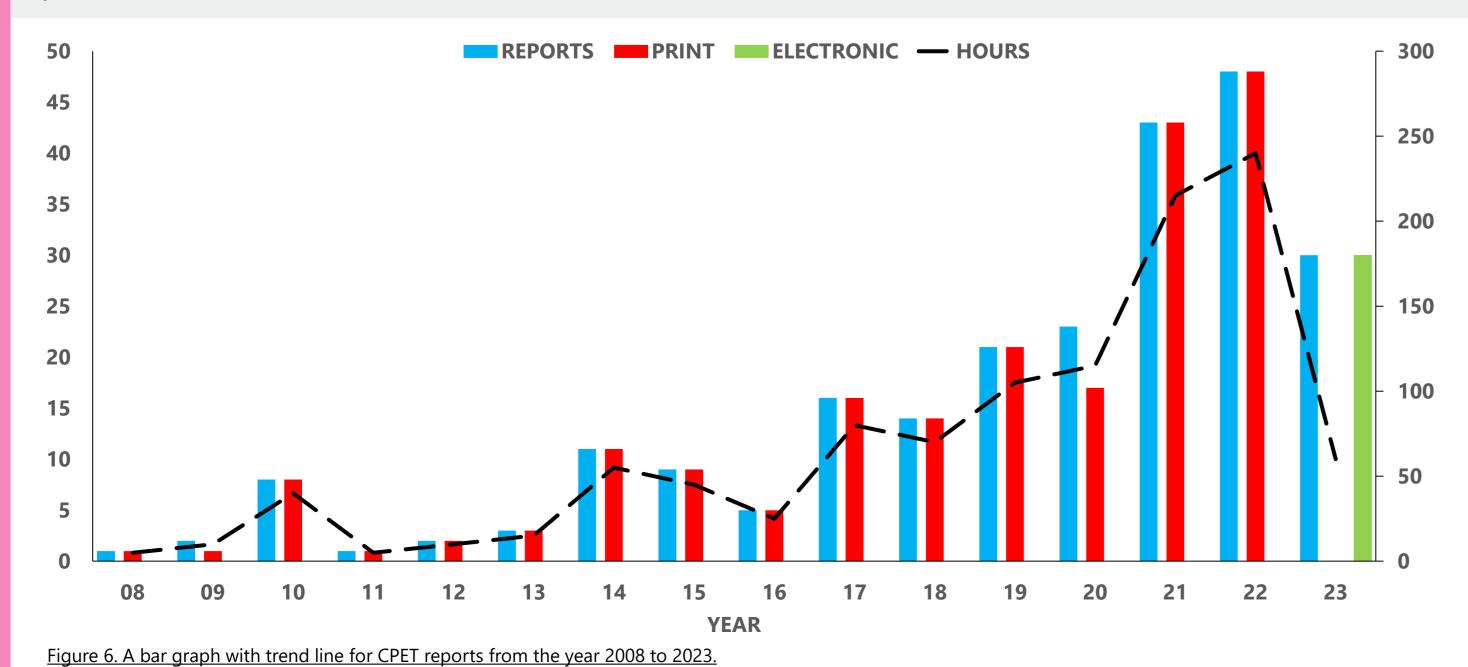
Figure 5. Steps taken to generate C.A.R.E.

LESSONS

Since the **implementation** of C.A.R.E the end-user i.e Clinical Exercise Physiologist have reported that the reduced task completion time allows them to **redirect** their focus towards other clinical priorities. R programming has also contributed to fewer calculation errors as it helps mitigate human error – easing the stress of having to check and re-check every data point and continually performing calculations.

Through this project, we have learnt that automating manual tasks can significantly reduce the amount of time spent on manpower, increasing **efficiency**, and optimising resource allocation. It is important to stay informed with technological advancements as they can enhance the **quality** and efficiency of our work processes.

Figure 6. A bar graph with trend line for CPET reports from the year 2008 to 2023.

OUTCOMES

- **200%** Increased slots / week
- **100%** Improved In reducing papers
- **87.5%** Improved waiting time
- **65%** Improved user satisfaction
- **67%** Improved steps in workflow
- **60%** Improved turnaround time for reports

Figure 7. A illustration of improvements using the C.A.R.E. Report