Changes in Exercise Data Management

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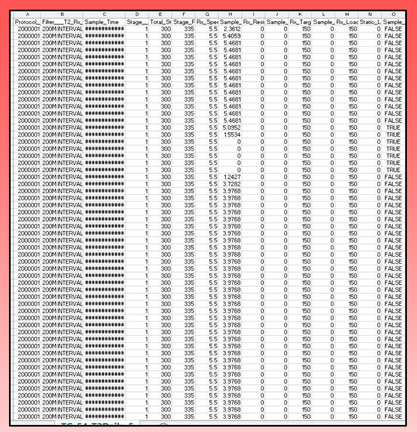
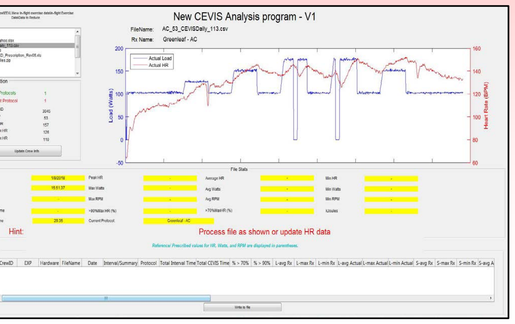
Common Process



Data Management System

Data Management System
Raw Data Repository
Provides "reporting" services

.CSV



MATLAB
Raw Data Post-Processing
Requires user license & maintenance license
Must be updated with every DMS output update
Limits analysts to those who have MATLAB

15 min

.XLS

3 min

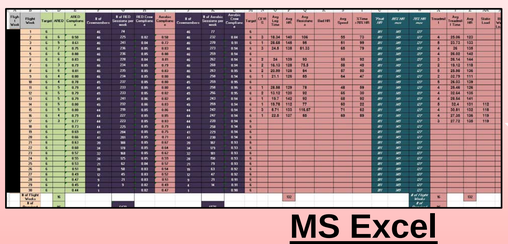
.CSV

Past Process

MS Access
Database Archive
FOUR separate databases
Stores the summary statistics
Direct editing puts data at risk
Manually intensive
Additional calculations through update queries
15 queries for each crewmember

15 min

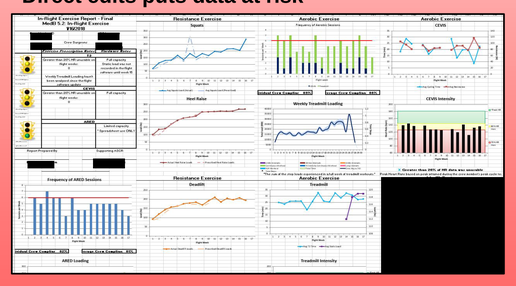
Copy & paste



MS Excel
Data Report
Manual intensive (copy & paste)
Separate workbook maintained for EACH crewmember
Direct edits puts data at risk

90 min

PDF



SharePoint
Report Delivery
Signed PDF copy of report submitted for crew surgeon & deputy crew surgeon to review
Underlying "raw" data submitted to biostatisticians for crew debriefings

Current Process

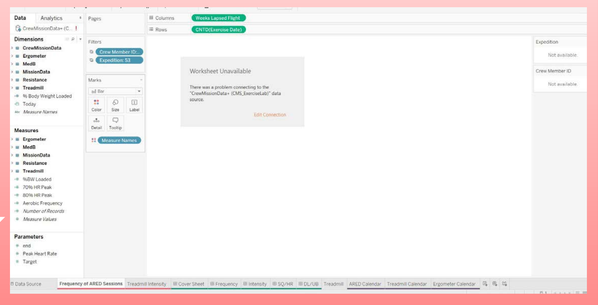
SQL
Database Archive
ONE database for all data (Exp 1 – current mission)
Safeguards data from direct edits

LIVE Data Connection

Tableau
Data Report
Automatic connection with SQL database
Single workbook with filter option to change crewmember
Safeguards data from direct edits

30 min

PDF



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Signed PDF copy of report submitted for crew surgeon & deputy crew surgeon to review
Underlying "raw" data submitted to biostatisticians for crew debriefings

Demonstrated Improvements

- **Improved reporting time by 67% using SQL & Tableau**
- **Consolidation of exercise system data into SQL provides the ability for quick analysis and response to questions**
- **Use of robust SQL database has improved data security and reduced data corruption**
- **Automatic absorption of data files into SQL allows for reporting and analysis within minutes of dropping files**

Future Improvements

Data Management System

- **Live data connection instead of needing to create a text output for every exercise session performed by every crewmember**

RStudio
(or similar analysis software)

- **Improve automations to calculate summary statistics**

Tableau

- **Create a live data connection for the crew surgeon and deputy crew surgeon to view data at any point during the mission**

Data Dashboards

- **Real-time data visualization for users**
- **Dashboards individually built for specific users**

Abstract

The suite of exercise hardware aboard the International Space Station (ISS) generates an immense amount of data. The data collected, treadmill, cycle ergometer, and resistance strength training hardware, are basic exercise parameters (time, heart rate, speed, load, etc.). The raw data are processed in the laboratory and more detailed parameters are calculated from each exercise data file. Updates recently have been made to how these valuable data are stored, adding an additional level of security, increasing accessibility, and resulting in overall increased efficiency of medical report delivery.

Questions regarding exercise performance or how exercise may influence other variables of crew health frequently arise within the crew health care community. Inquiries regarding the health of the exercise hardware often need quick analysis and response to ensure the exercise system is operable on a continuous basis. Consolidating all of the exercise system data in a single repository enables a quick response to both the medical and engineering communities. A SQL server database is currently in use, and provides a secure location for all of the exercise data starting at ISS Expedition 1 to current date. The database has been structured to update derived metrics automatically, making analysis and reporting available within minutes of dropping the in-flight data into the database.

Commercial tools were evaluated to help aggregate and visualize data from the SQL database. The Tableau software provides manageable interface, which has improved the laboratory's output time of crew reports by 67%. Expansion of the SQL database, to be inclusive of additional medical requirement metrics, addition of 'app-like' tools for mobile visualization, and collaborative use (e.g., operational support teams, research groups, and International Partners) of the data system, is currently being explored.