

“Use of Technology in Sports Training”

Dr. Daniel C.W. Lee
Associate Director
Elite Training Science and Technology Division
Hong Kong Sports Institute

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- Hong Kong Sports Institute (HKSI)
- Elite Training Science & Technology Division (ETSTD)
- Technologies used in Sports Training
 1. Athlete data management
 2. Physiological assessment & training monitoring
 3. Strength and conditioning training

Hong Kong Sports Institute (HKSI)



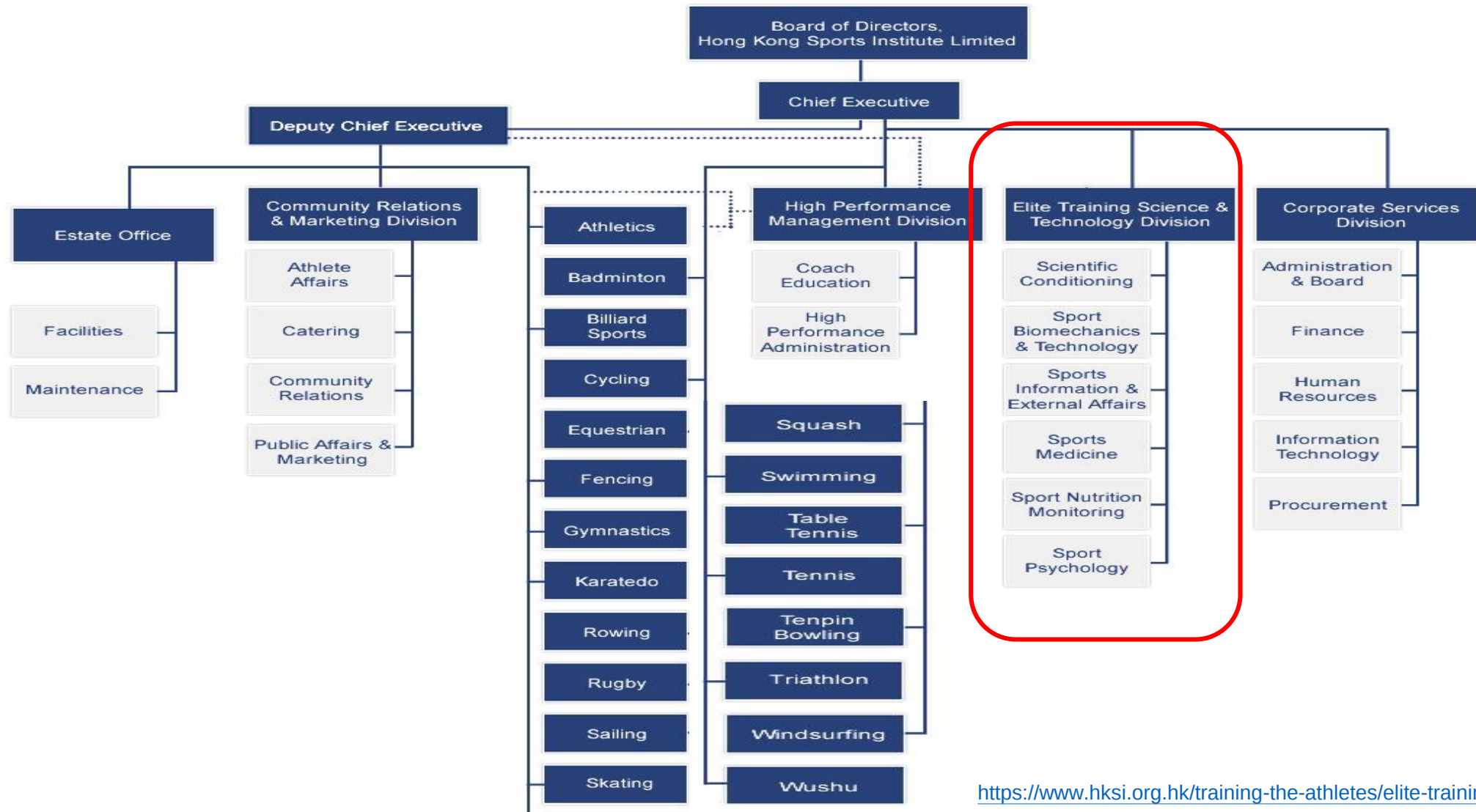
Vision: ... to become the elite training systems delivery leader for the region, with state-of-the-art, evidence-based, elite sports training, and athlete support systems resulting in sustainable world-class sports results ...

Mission: ... Government's elite sport training systems delivery agent to provide an environment in which sports talent can be identified, nurtured, and developed ...

Values: ... operates in an environment characterized by an uncompromising, and ethical pursuit of excellence in sport ...

Multi-disciplinary biopsychosocial model to formulate its support strategy in order to provide science-based, athlete centered support for elite training.

Elite Training Science & Technology Division (ETSTD)



Elite Training Science & Technology Division (ETSTD)



1. Scientific Conditioning Centre (SCC)
 2. Sport Biomechanics & Technology Centre (SBT)
 3. Sport Nutrition Monitoring Centre (SNM)
 4. Sport Psychology Centre (SPC)
 5. Sports Medicine Centre (SMC)
 6. Sports Information and External Affairs Centre (SIEAC)
- These centre work as a team to identify the various training problems and concerns, and develop evidence-based solutions with the coaches

“Technology” refers to methods, systems, and devices which being used for sports training.

1. Athlete data management

Technologies used in sports training

Athlete management system

- Data management system
- Allows for centralized location of data.
- Enables secure access to athlete status.
- Remote access anywhere globally.
- Acute and Longitudinal trend analysis.
- Helps predict injury, fatigue, build effective periodized plans.

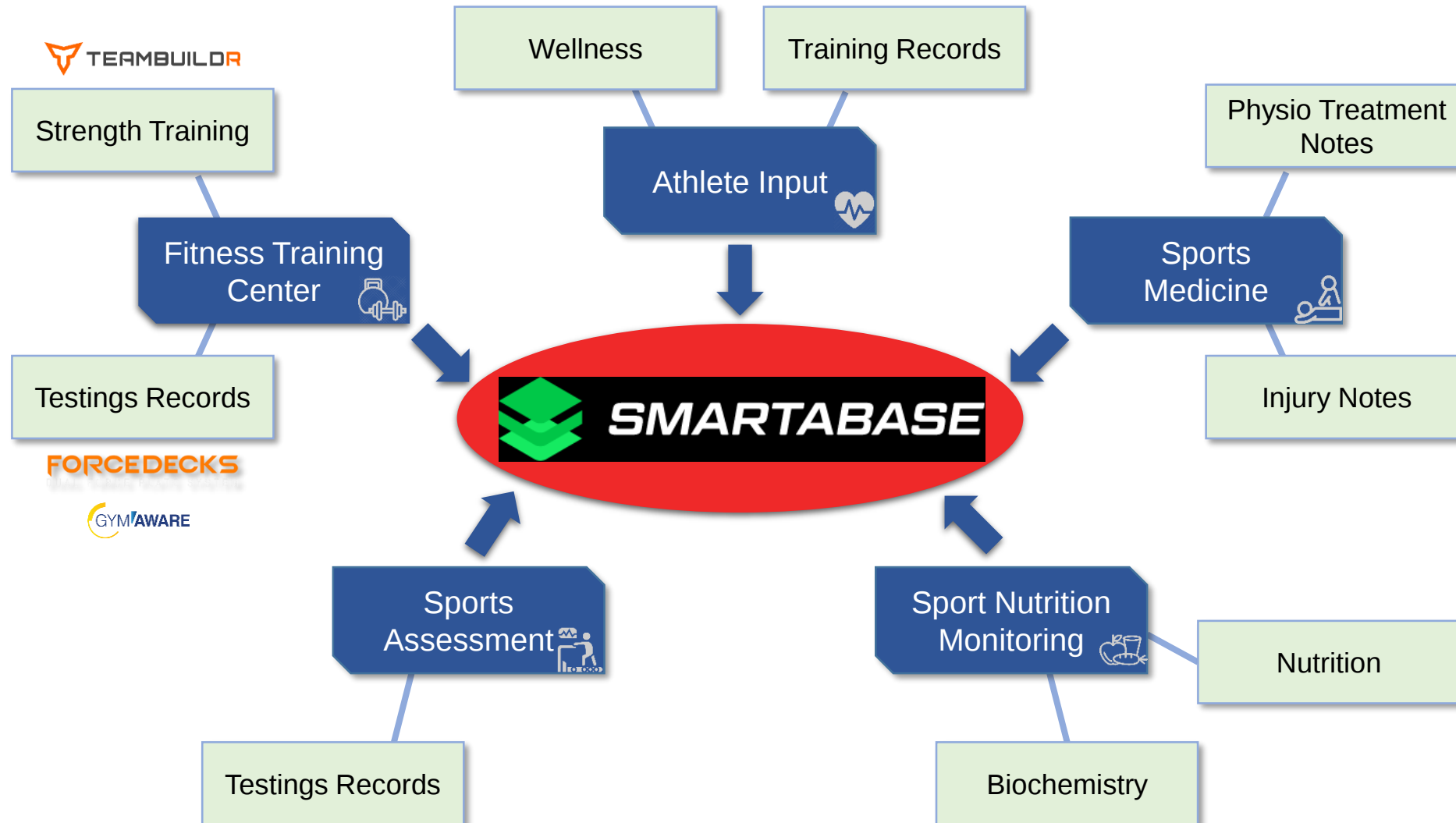


Athlete management system

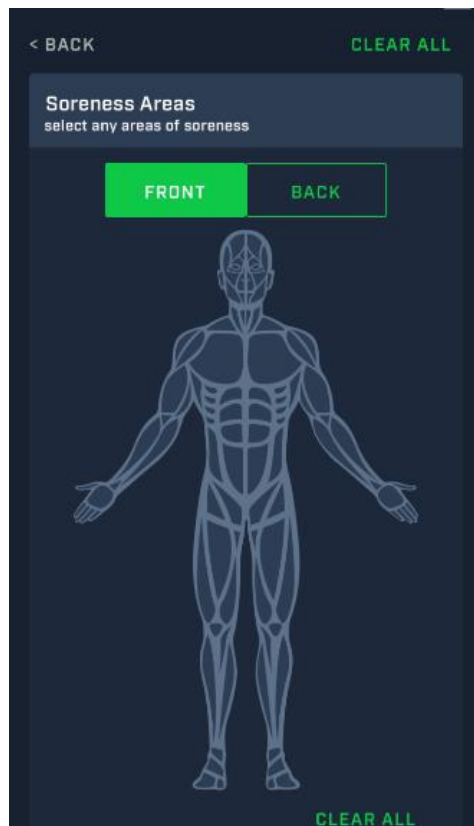
- In HKSI,
 - ~1000 athletes are on the AMS across 23 Sports.
 - Wellness, strength & conditioning training records, testing data and exercise prescriptions are logged.
- **Collect:** subjective/objective data and centralize
- **Analyze:** monitor and review the workload
- **Report:** visualize and report in customized dashboards
- **Inform:** data to make informed decision



Smartabase: Integration



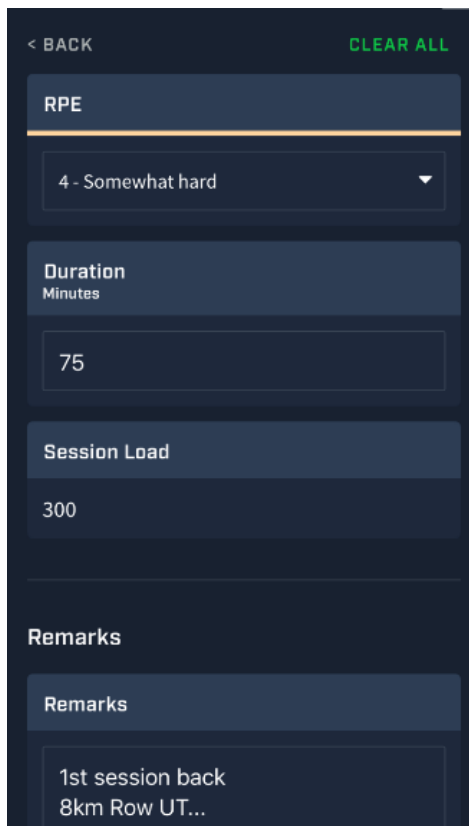
Smartabase: Athlete's input



The Wellness input screen features a dark blue background. At the top, there are navigation buttons: '< BACK' in white and 'CLEAR ALL' in green. Below this is a section titled 'Soreness Areas' with the instruction 'select any areas of soreness'. Two green buttons, 'FRONT' and 'BACK', are positioned above a white line-art illustration of a human figure. At the bottom right of the figure, there is a green 'CLEAR ALL' button.

Wellness

Soreness and Fatigue
Rating, Sleeping Quality
and Hours, Hydration,
Morning Heart Rate, etc.



The Daily Training Log input screen has a dark blue background. It starts with '< BACK' and 'CLEAR ALL' buttons. The 'RPE' section includes a dropdown menu showing '4 - Somewhat hard'. The 'Duration' section, labeled 'Minutes', has a text input field with '75'. The 'Session Load' section has a text input field with '300'. Below these is a 'Remarks' section with a text input field containing '1st session back 8km Row UT...'. A green 'CLEAR ALL' button is at the bottom right.

Daily Training Log

Session RPE
Session Time
(Session Load)



The Strength Training input screen features a dark blue background. At the top, it shows '1a' and 'Back Squat', along with an 'EDIT ENTRY' button. Below is a table with two columns: a left column for details and a right column for numerical values.

#	#
1a	1
Exercise	E
Back Squat	B
Max	N
100	4
Scheme	S
Accumulation Plateau 4x10 Wk2	C
Int1	Int1
%	%
51	4
Load1	L
51	4
AL1	A
Rep1	R
4	5

Strength Training

Loads
Reps
(Volume Load)

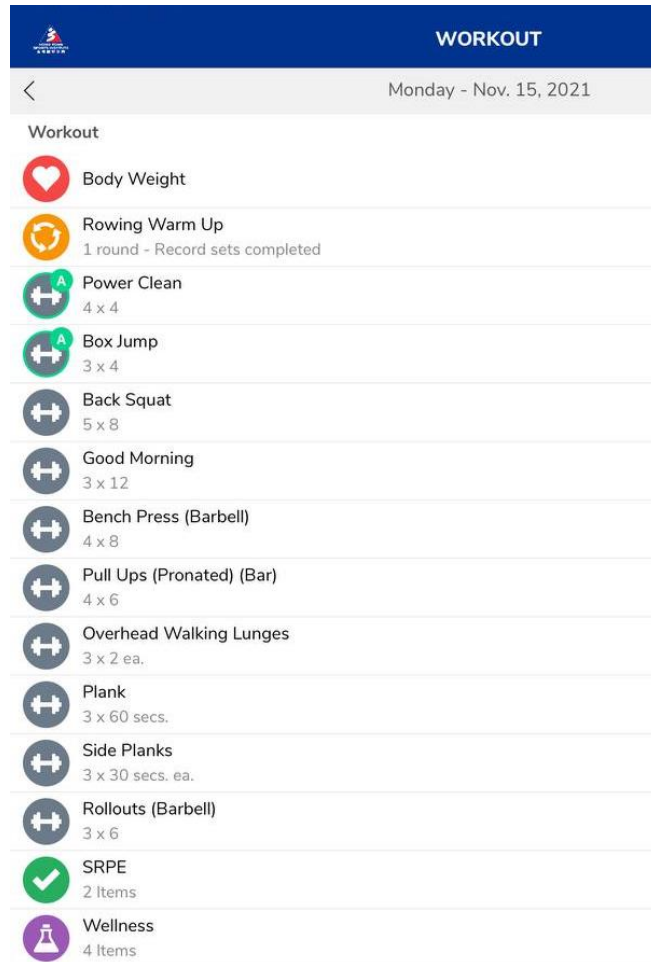
Smartabase: TeamBuildr

- For writing training programs, building questionnaires, and accessing athlete performance data

 Mobile Friendly Download our free app for iOS and Android.	 TV Modules Put your weight room TV's to life with our Weight Room Timer, Live Feed and Live Leaderboard modules.	 Program Templates Program your workouts from scratch or use 50+ templates ranging from sport-specific to Conjugate & Triphasic.
 Weight Room View Our tablet app lets athletes receive programming and input data into rack-mounted tablets.	 Max Tracking Training Max? APRE? Whatever your method, our platform lets coaches manage 1RM's any way they would like.	 15+ Reports Reporting sucks if it's complicated. Our average report takes 3 clicks to generate, and they're exportable to PDF and Excel.
 Evaluation Testing Whether you're testing 1RM, 3RM, movement screens or combine-style test - we've got you covered.	 Goal & Standard Setting Set goals for individuals or set standards for groups on lifts, SAQ+C and Circuits.	 Sports Science In addition to creating your own questionnaires, we'll alert you when something needs to be seen.

Smartabase: Integration

Coach Prescribes Programs



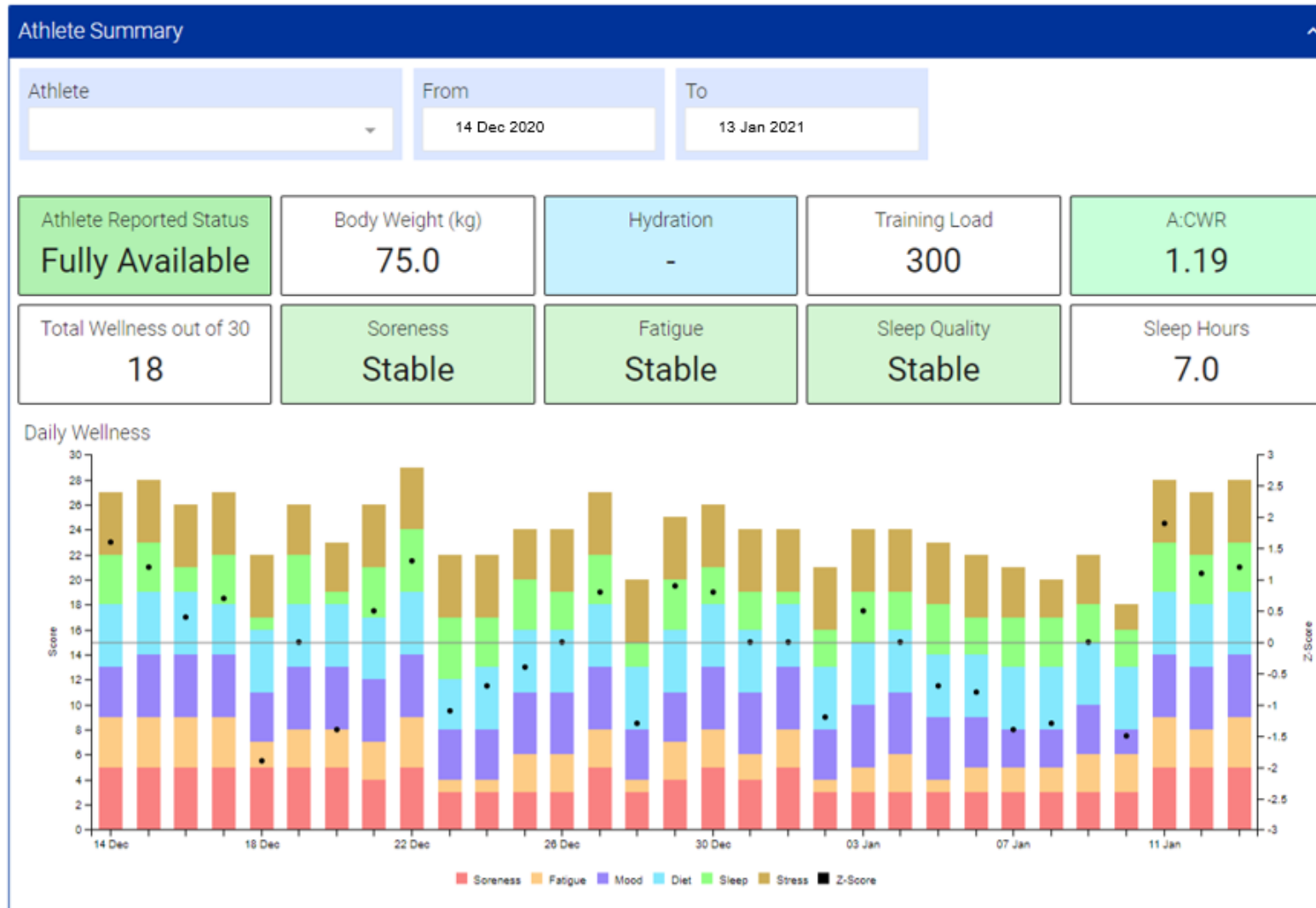
Athlete can look through the program and enter the weights and reps on their phone



The screenshot shows a table for recording 'POWER CLEAN' performance. The table has four columns: '#', 'WEIGHT', 'REPS', and 'SPEED (m/s)'. There are four rows of data. Above the table, it says 'POWER CLEAN' and '4 x 4'. There is also a 'Max: 90' indicator and a red camera icon.

#	WEIGHT	REPS	SPEED (m/s)
1	60	4	2.47
2	70	4	2.35
3	80	4	2.2
4	90	1	2.17

Smartabase: Dashboard

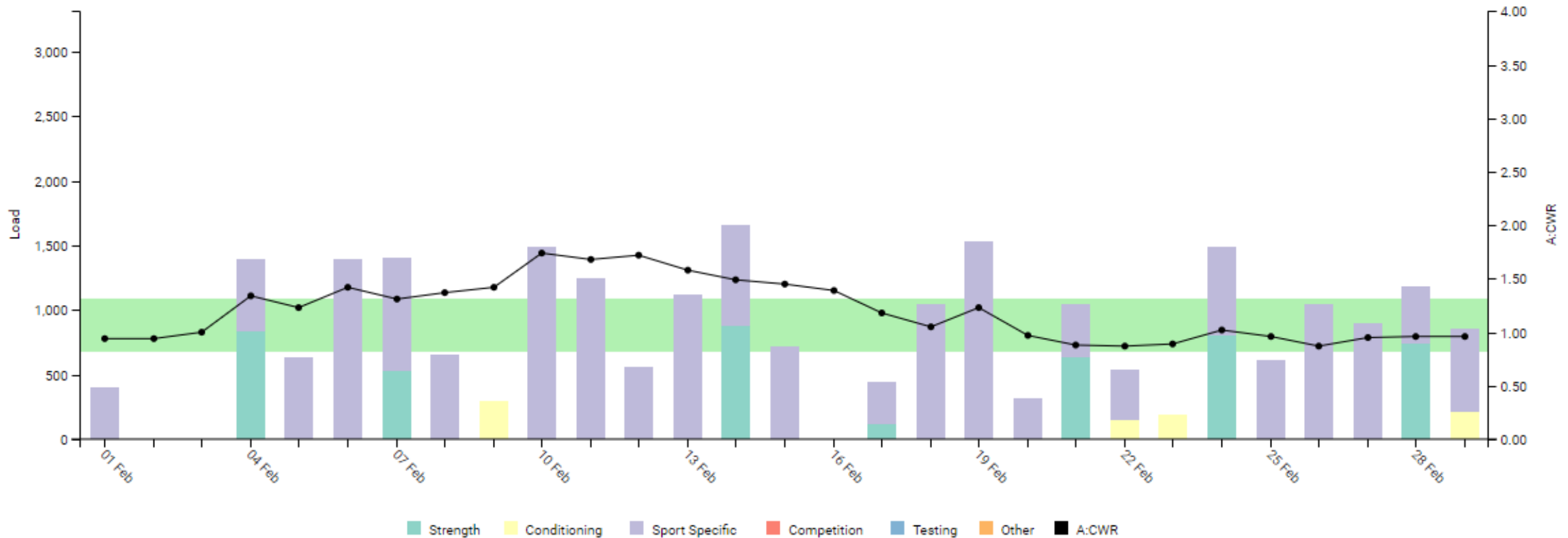


Today's
Athlete
Status

Past 30
Days
Wellness

Smartabase: Dashboard

Training Load



Physiological assessment & training monitoring

Technologies used in sports training



Physiological assessment & training monitoring

- Allows for precise determination of characteristics.
- Enables exact prescription of cardio training.
- Provides close monitoring of training sessions.
- Enable training sessions to be adjusted real-time.
- Assists in recovery.

Physiological assessment & training monitoring

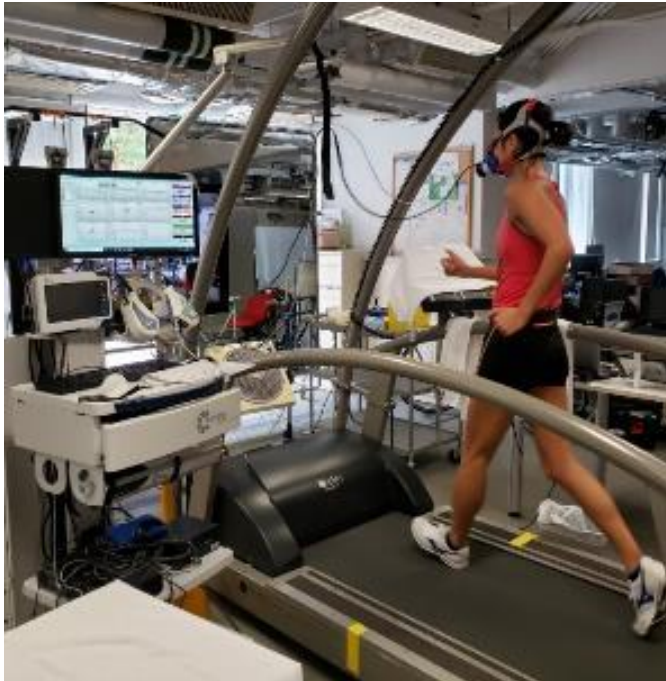
- In HKSI,
- ~7,000 scientific assessment service sessions provided per year;
- 1,035 athletes from 23 sports used the scientific assessment services in 2020;
- Athletes such as:
 - Ching Siu Nga (race walking)
 - Lee Wai Sze & Lee Hoi Yan (track cycling)
 - Cheung Ka Long & Cheung Siu Lun (fencing)
 - Shek Wai Hung & Wong Hiu Ying (gymnastics)

Functional physiological capacity technology

- Respiratory gas analyzers (MetaMax 3BR2):
- Stationary or portable use
- Breath-by-breath measurement system
- Cardiopulmonary Exercise Testing (CPET)
- Reflect athletes performance from exercise gas exchange data
- Measure maximal oxygen uptake (MVO_2)
- Determination of anaerobic threshold (AT)



Cardiopulmonary exercise testing (CPET)



Running / Race-walking

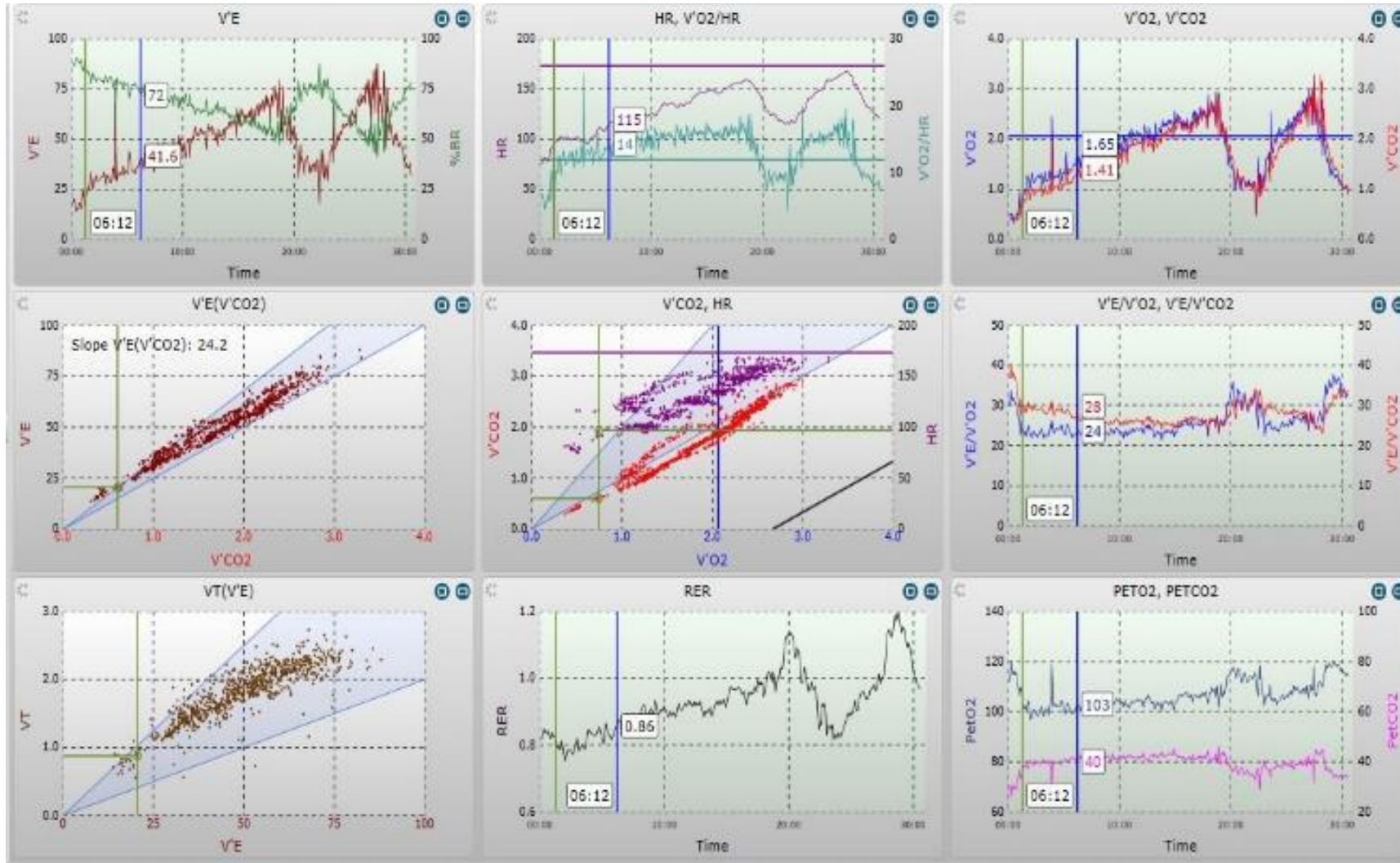


Cycling



Rowing

Cardiopulmonary exercise testing (CPET)



- Circulatory / metabolic parameters
- Ventilatory parameters / efficiency
- Respiratory exchange ratio (RER)
- Breathing frequency

Blood analysis of exercise intensity

- Blood lactate measures
- Monitor blood lactate concentration during training
- Indication of training load & intensity
- Lactate profile is essential for performance assessment



Lab based
lactate
analyzer



Portable
lactate analyzer

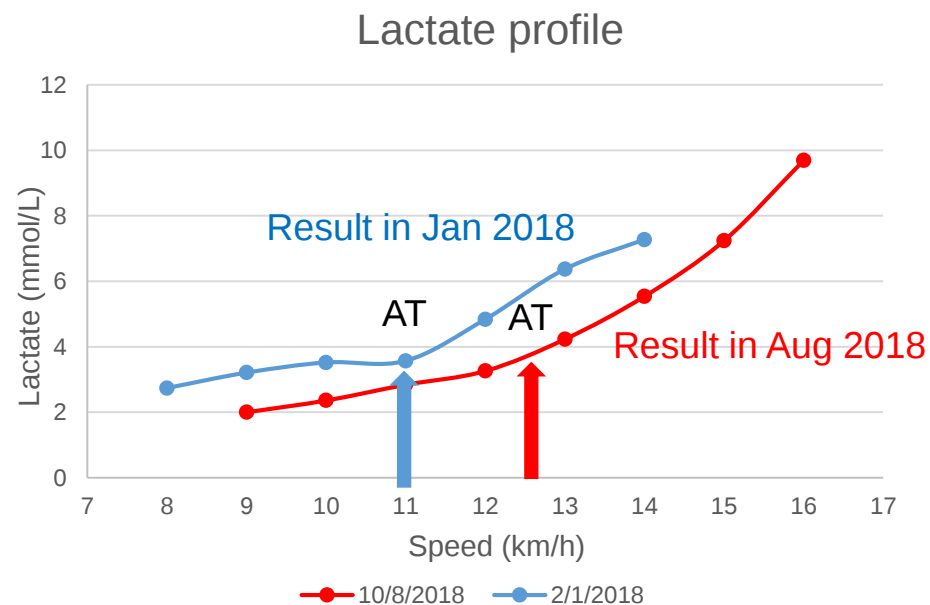
Blood analysis of exercise intensity



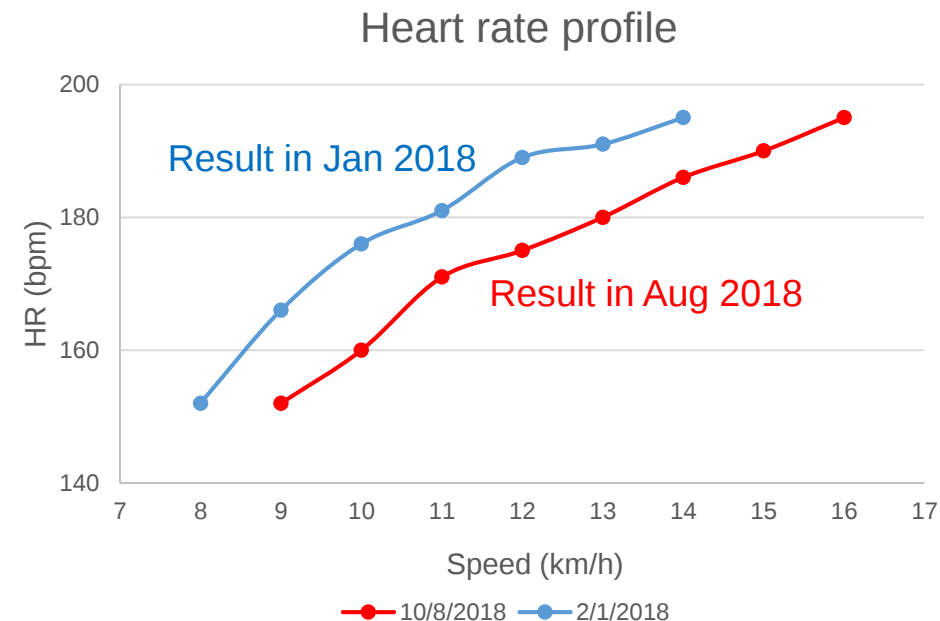
Lactate measurement during training sessions

Blood analysis of exercise intensity

- Outputs determine 'key thresholds'
 - Combined data with heart rate profile, speed/ power output and gas exchange data in training session or testing
 - Determination of anaerobic threshold (AT)



At same speed (9-14 km/h), lactate is lower in Aug 2018 than that in Jan 2018



At same speed (9-14 km/h), heartrate is lower in Aug 2018 than that in Jan 2018

Real time heart rate monitoring

- Polar HR technology
- Real-time feedback on individual & multiples athletes' heart rate
- Allows coaches to monitor training zones
- Achieve maximum training effect
- Recording heart rate profile during training for further data processing
- Easy-to-use, portable, convenient
- Ideal training tools for on-field / overseas training / overseas competition



Real time heart rate monitoring



Arm band
(Optical sensor)



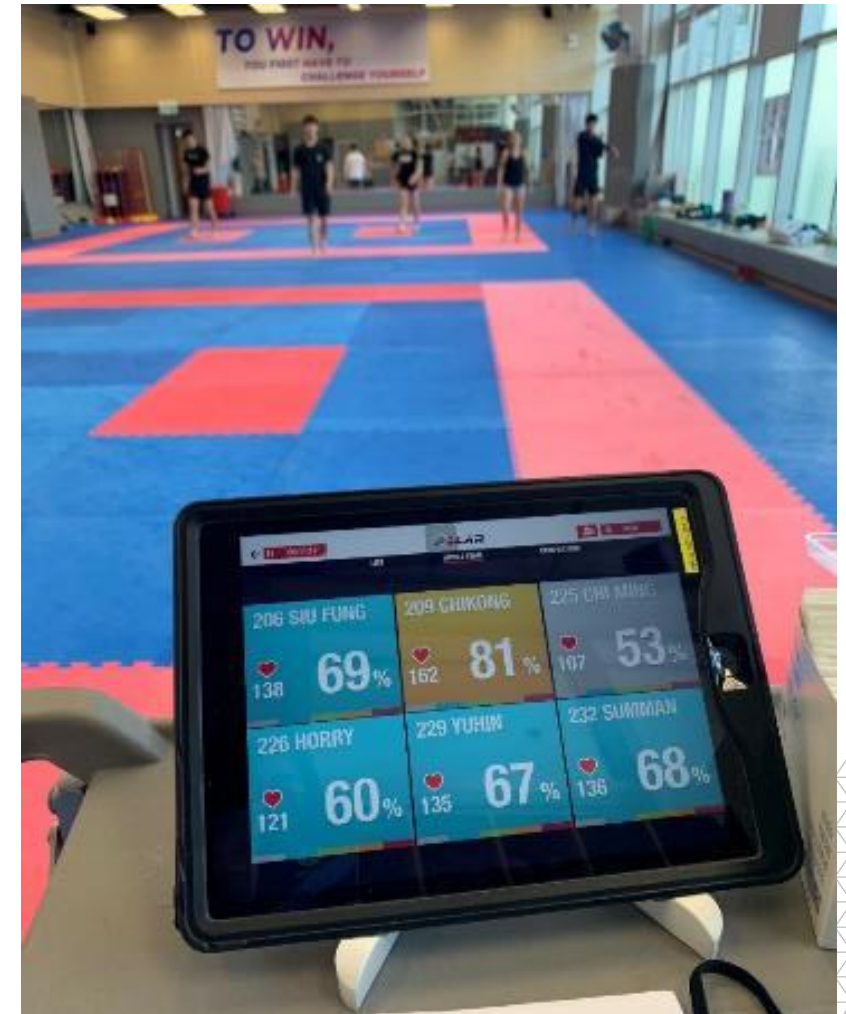
Chest strap
(ECG sensor)



Sport watch, tablet
(Real-time heartrate monitoring)

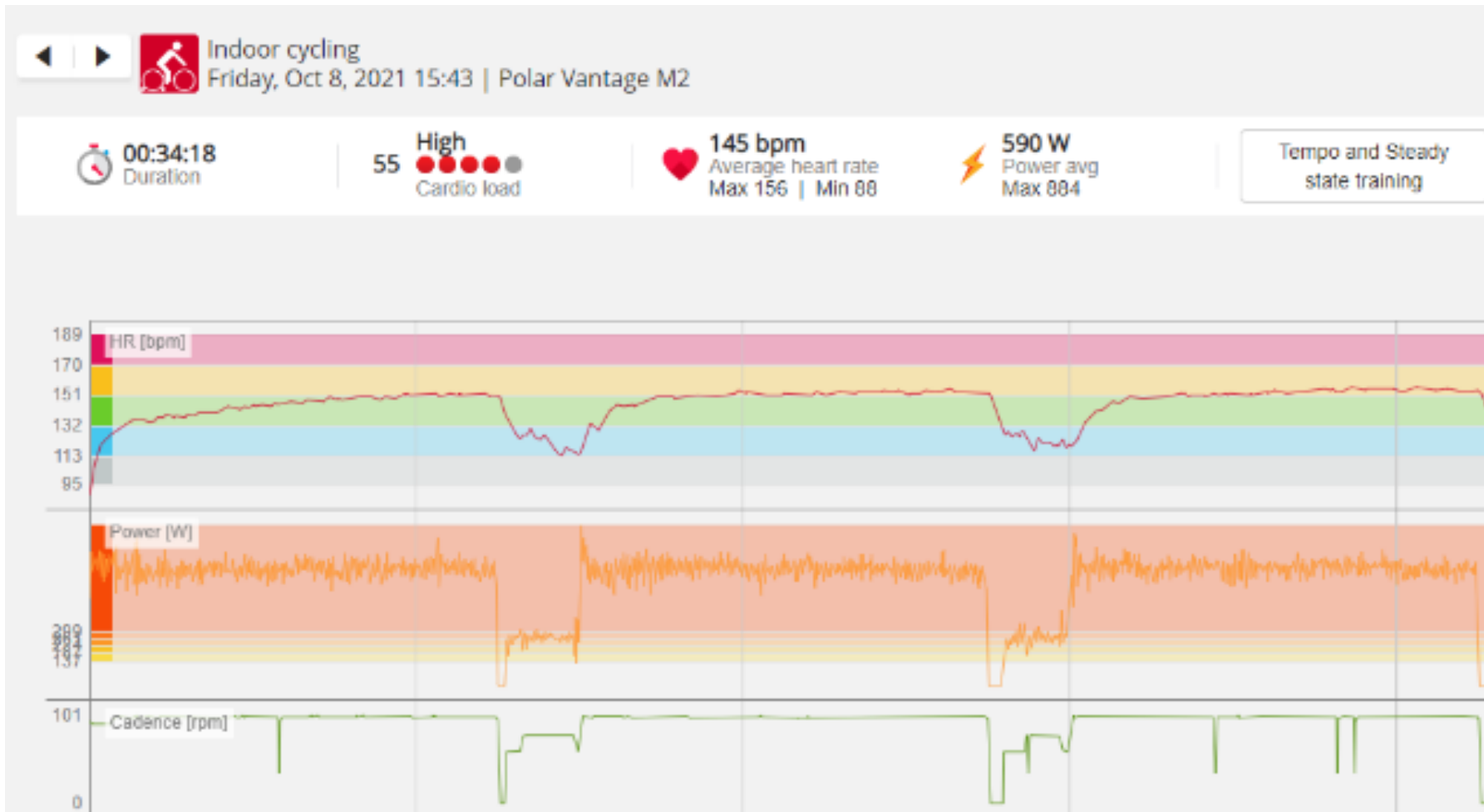
Real time heart rate monitoring

- Team training
- Real-time feedback on heart rate
- Monitoring the whole team at the same time
- Help coaches & athletes to stay in the targeted training zone
- Different colors indicate different heart rate zones
 - Grey = resting
 - Blue = recovery
 - Orange = sub-maximal



Analyze heart rate

- Training Session Profiling



- Heart rate profile of a bike training session
- Combined data with power & cadence sensors
- Analysis of training performance – comparison to past training result

High speed treadmill

- A special designed treadmill with 1.25m wide treadmill belt
- Allows running, biking, wheelchair training
- Maximum speed: 80km/h
- Custom speed and inclination settings
- Imitates real-world feel compared to regular gym treadmills



High speed treadmill



Sprint training



Wheelchair exercise testing



Cycling training

Environmental chamber

- Closed chamber for simulation of temperature, humidity and altitude (by controlling concentration of O₂)
- Simulate altitude training strategies
- Heat/Cold & Altitude acclimation for sport performance
- Simulating environmental condition in the competition location, e.g. tropical area, high altitude area



Environmental Chamber

- Training and testing inside the chamber



Hypoxic sleeping room



Temperature, humidity, altitude control



Hypoxic sleeping room

Technology-assisted recovery

- Hyperbaric chamber
- Closed chamber with high pressure and high O₂ concentration
- Facilitate healing processes
- Aid in post training and competition recovery
- Potential benefits in recovery from sport injuries, e.g. healing of bones, muscles, ligament injuries



Scientific conditioning training

Technologies used in sports training

Advantages of scientific conditioning (S&C) technology:

- Enables exact prescription of resistance training.
- Determines baseline and progression of neuro-muscular capacity.
- Enables measures of 'readiness to train'.
- Can assist in assessment of fatigue in order to adjusted training real-time.

Force plate

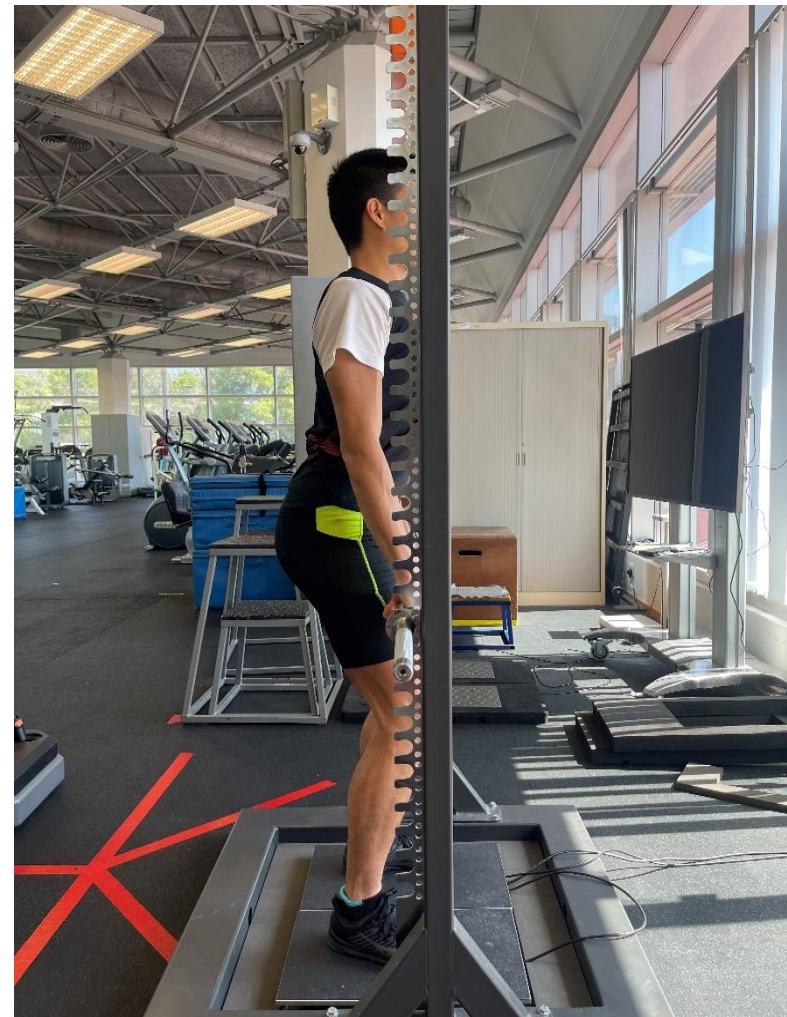
- Used to measure ground reaction forces during walking, jumping, or any other type of movement.
- Force-data provides information such as:
 - Velocity (m/s), Power (Watts),
 - Displacement (Meters),
 - Temporal parameters (seconds),
 - Left/Right Asymmetry (for bilateral systems).
- Enables precise measures of performance and training progression.



Force plate usage



CMJ



IMTP

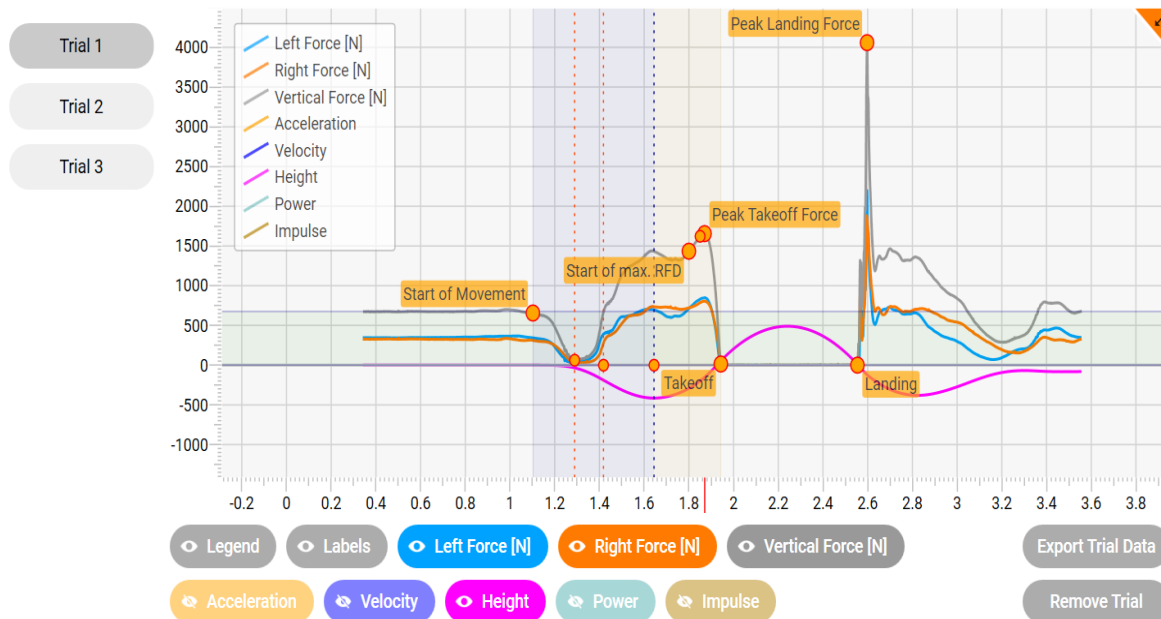
IMTP: isometric mid thigh pull

Force plate usage

- Rapid collection of test results wirelessly from an entire squad with ease.
- Track trends in athlete health and performance with longitudinal reporting.
- Visualize multiple data sets for individuals or entire squads.
- Automatically detect movements and display results relative to past tests.
- Test weekly to monthly across sports and inform future training e.g.
- **Dynamic Strength Index Ratio (CMJ Peak Force/IMTP Peak Force) = DSI Ratio**
 - <0.60 Ballistic Training Emphasis
 - 0.60-0.80 Concurrent Training Emphasis
 - >0.80 Maximum Strength Training Emphasis

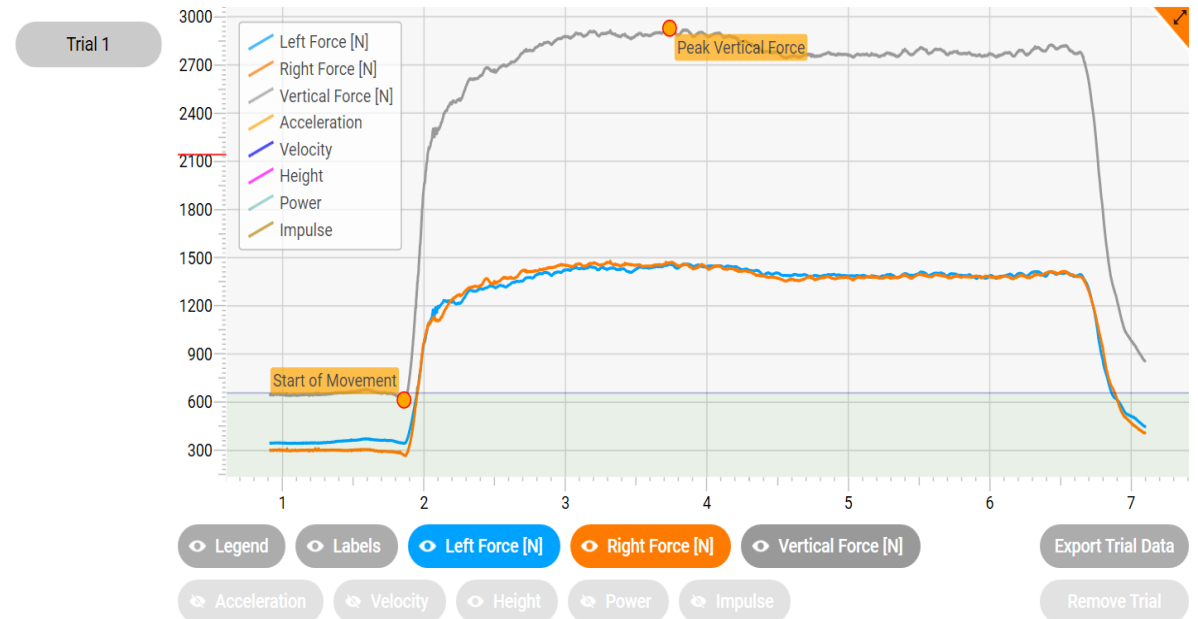
Force plate data

26/7/2021 | CMJ



CMJ data

21/1/2021 | IMTP

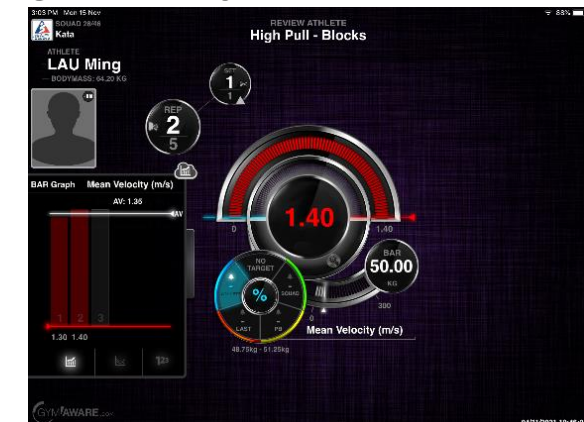


IMTP data

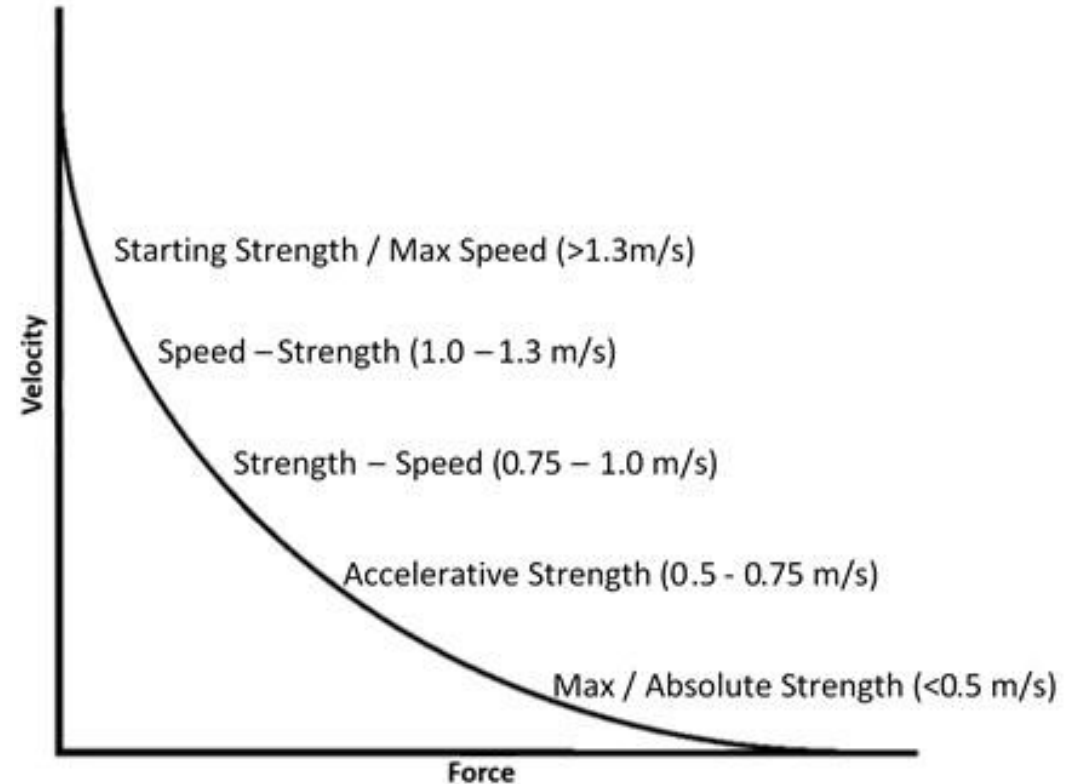
IMTP: isometric mid thigh pull

Velocity-based training (VBT)

- Determine the optimal loading for strength training using the velocity at which an athlete can move a load independent of 1RM
- Training method which uses a piece of technology to track the movement speed of various strength exercises: GymAware
- Benefit
 - Enable day to day adjustment of load based on the load/velocity relationship
 - Motivation to increase the effort on each reps by providing velocity feedback



Velocity-based training - GymAware



Training (bar) Speeds

GymAware use by HKSI athletes

- Used in strength training sessions to get more optimal stimulus/load
- All the sports are currently using this equipment:
 - Karate: To monitor the change of peak velocity/explosive power created in split snatch to make sure they are lifting explosive enough
 - Track Athletic: To monitor the peak velocity of power clean exercise to make sure they can load up if fall into the speed-strength zone

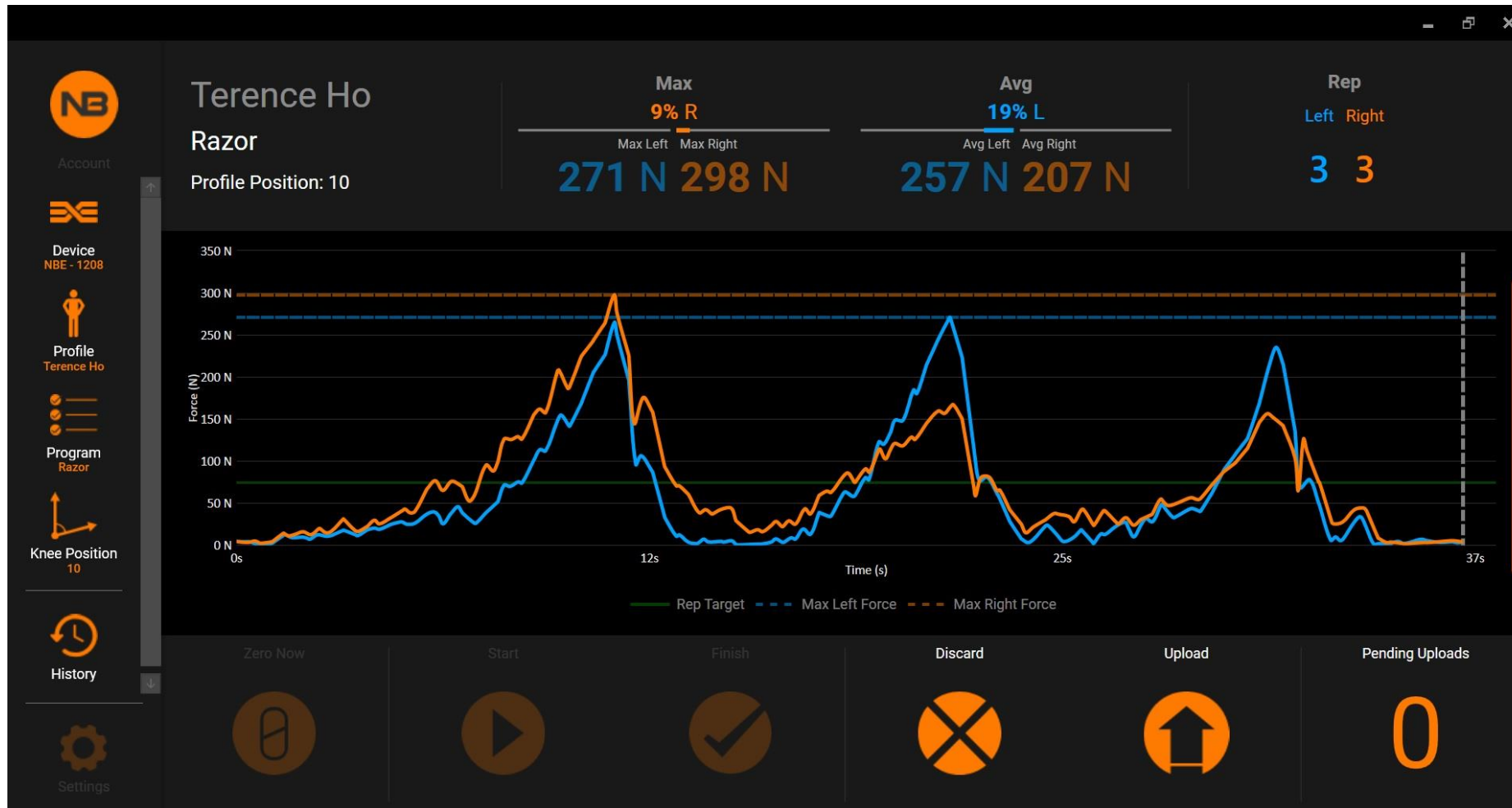


Nordbord

- Test using 'Nordic Hamstring' Exercise to measure the torque/force created by the hamstring.
- To detect bilateral differences and address limb imbalances (goal >15%) as imbalance is associated with an increased risk of a hamstring strain injury.
- Quick and easy test to measure hamstring eccentric strength compared to isokinetic test (5 minutes vs 30 minutes).
- Less fatiguing, less time consuming and able to monitor regularly.



Nordbord



Used every 4-6 weeks to monitor the change in the hamstring eccentric strength and its bilateral difference especially racket sports and field sports.

Flywheel training - kBox

- Strength training modality
- Resistance from the inertial generated from the spinning of heavy metal plate/wheel
- Offer variable resistance, and eccentric overload
- Gravity independent

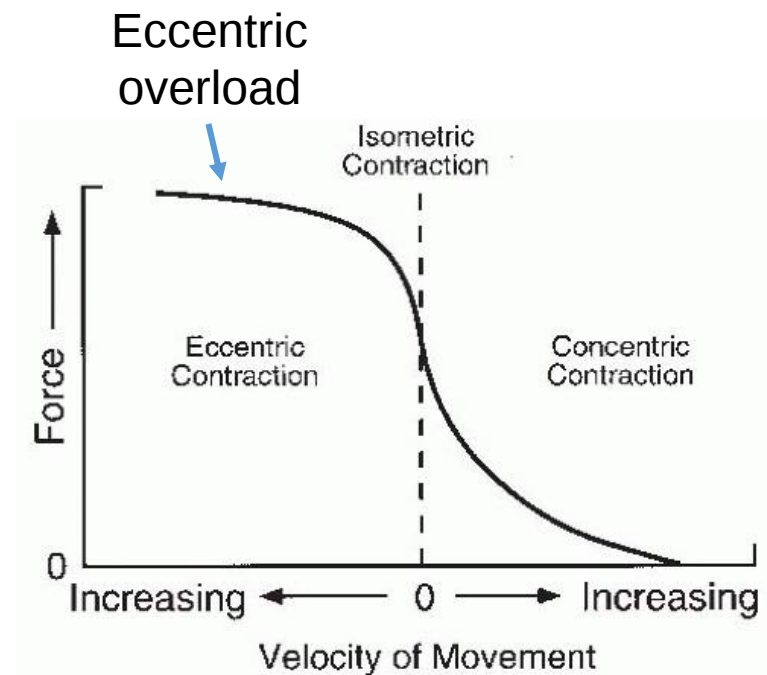
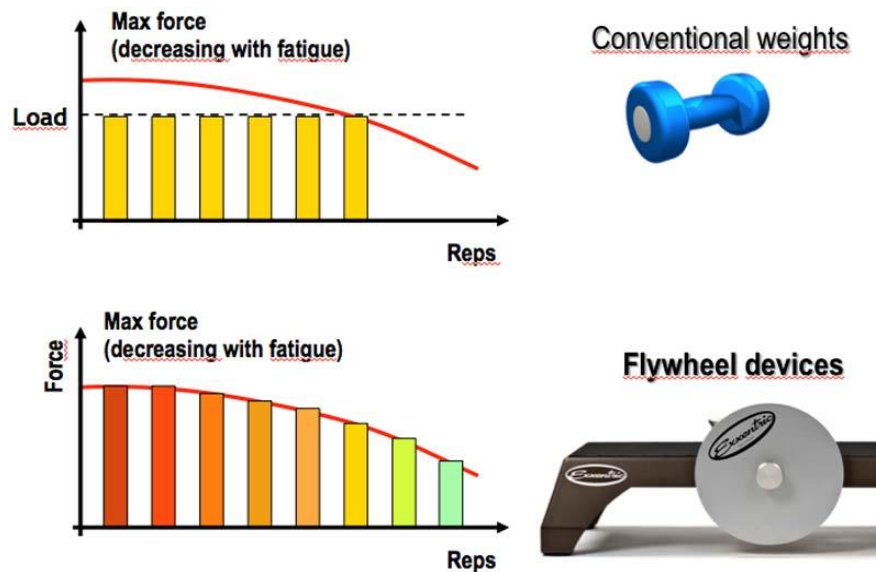


Deadlift



Flywheel training - kBox

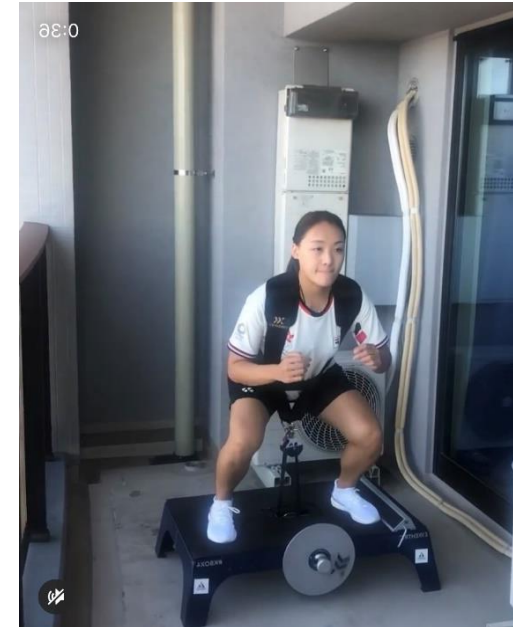
- Constant kinetic energy
- Independent of duration
- Concentric phase force $\uparrow =$ Eccentric overload $\uparrow$
- Controlled manner vs Traditional (Risk)



kBox use by HKSI athletes



- Epee Fencer
- Suffered from ACL injuries
- Completed Flywheel as part of rehabilitation programme
- Key Performance indicator for fencing- requires high eccentric strength levels on the dominant leg



- Mixed Double badminton player
- Suffered from Knee pain
- Completed Flywheel as part of rehabilitation programme
- Lower Limb strength had been improved

Conclusion

The Elite Training Science & Technology Division (ETSTD):

- Use multi-disciplinary model to formulate its support strategy in order to provide science-based, athlete centered support for elite training.
- The support procedures are regularly updated through continuous monitoring, discussion and benchmarking against the latest research data.

Elite Training Science & Technology Division Hong Kong Sports Institute

Thank You

