

# Wearables, Sports and Health

## *ERS 2021 Presidential Summit: digital respiratory medicine: realism versus futurism*

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Package of interventions for Rehabilitation

*British Thoracic Society, Pulmonary Rehabilitation Specialist Advisory Group member*



**Northumbria  
University**  
NEWCASTLE



# Objectives

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- Review current developments in the use of wearable technology to enhance elite sports performance
- Address issues of quality assurance and data standardisation for consumer wellness wearables
- Lessons to be learned from Sports Medicine for establishing a Global Standard for Wearable Devices in Sport and Fitness

# Initiative: Beat the heat at Tokyo Olympics



INTERNATIONAL  
OLYMPIC  
COMMITTEE














Open access

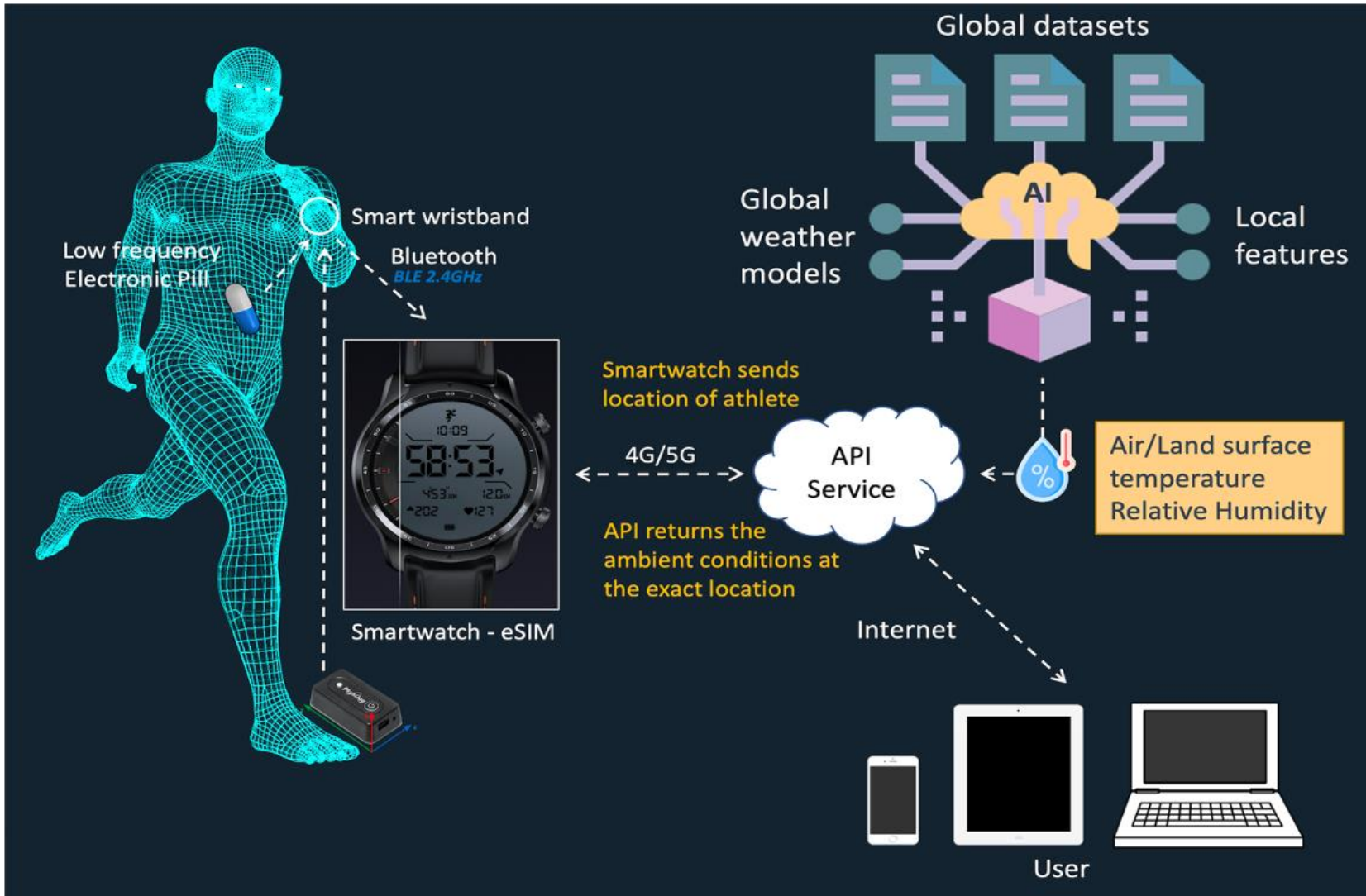
Review

BMJ Open  
Sport &  
Exercise  
Medicine

## Ethical dilemmas and validity issues related to the use of new cooling technologies and early recognition of exertional heat illness in sport

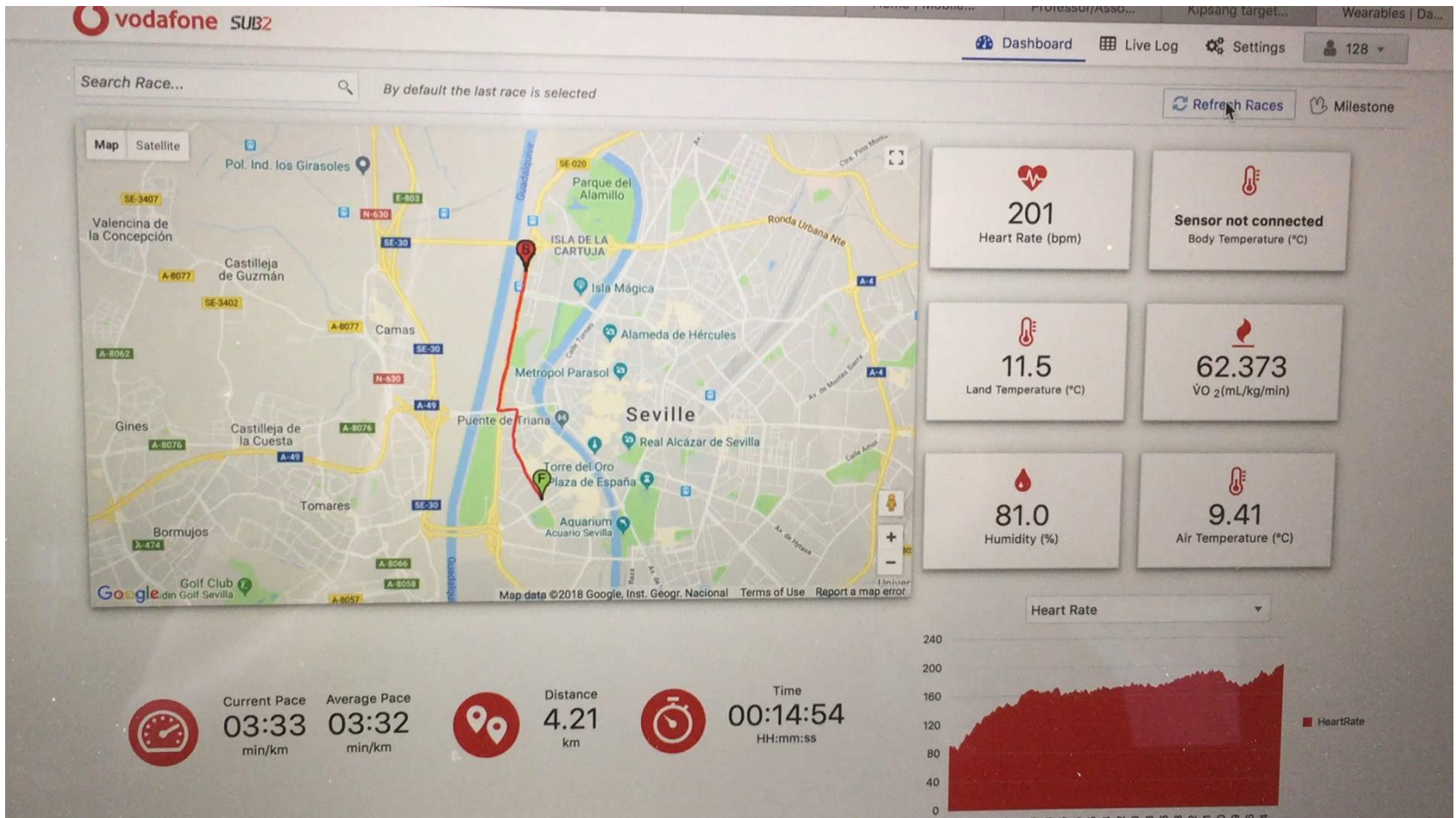
Borja Muniz-Pardos ,<sup>1</sup> Konstantinos Angeloudis ,<sup>2</sup> Fergus M Guppy,<sup>2,3</sup> Kumpei Tanisawa ,<sup>4</sup> Yuri Hosokawa ,<sup>4</sup> Garrett I Ash ,<sup>5,6</sup> Wolfgang Schobersberger ,<sup>7</sup> Andrew J Grundstein ,<sup>8</sup> Fumihiko Yamasawa ,<sup>9</sup> Sebastien Racinais ,<sup>10</sup> Douglas J Casa ,<sup>11</sup> Yannis P Pitsiladis  <sup>2,12,13,14</sup>

# Sub-2hrs marathon mobile application





# Tracking data in real time during a marathon



# Wireless foot-worn inertial & insole pressure sensors

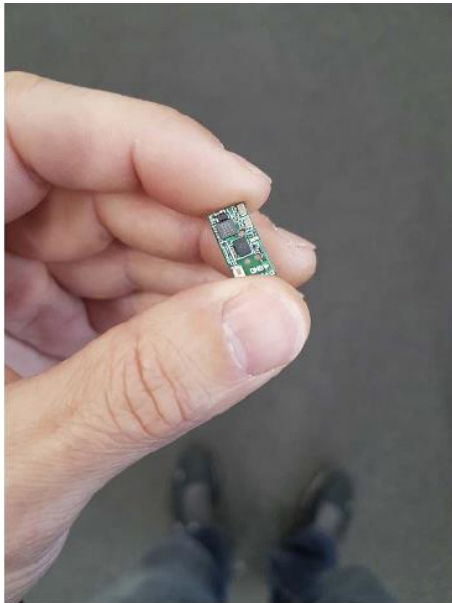
INTERNATIONAL FEDERATION OF SPORTS MEDICINE

## Integration of Wearable Sensors Into the Evaluation of Running Economy and Foot Mechanics in Elite Runners

Borja Muniz-Pardos, MSc<sup>1</sup>; Shaun Sutehall, BSc<sup>2</sup>; Jules Gellaerts, MSc<sup>3</sup>; Mathieu Falbriard, MSc<sup>3</sup>; Benoît Mariani, PhD<sup>3</sup>; Andrew Bosch, PhD<sup>2</sup>; Mersha Asrat, MSc<sup>4</sup>; Jonathan Schaible<sup>4</sup>; and Yannis P. Pitsiladis, MMedSci, PhD<sup>4,5,6</sup>

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Prototype of a miniaturization of FWIS



# Lab on-skin technology



LAB-ON-SKIN™: THE NEXT FRONTIER IN WEARABLES

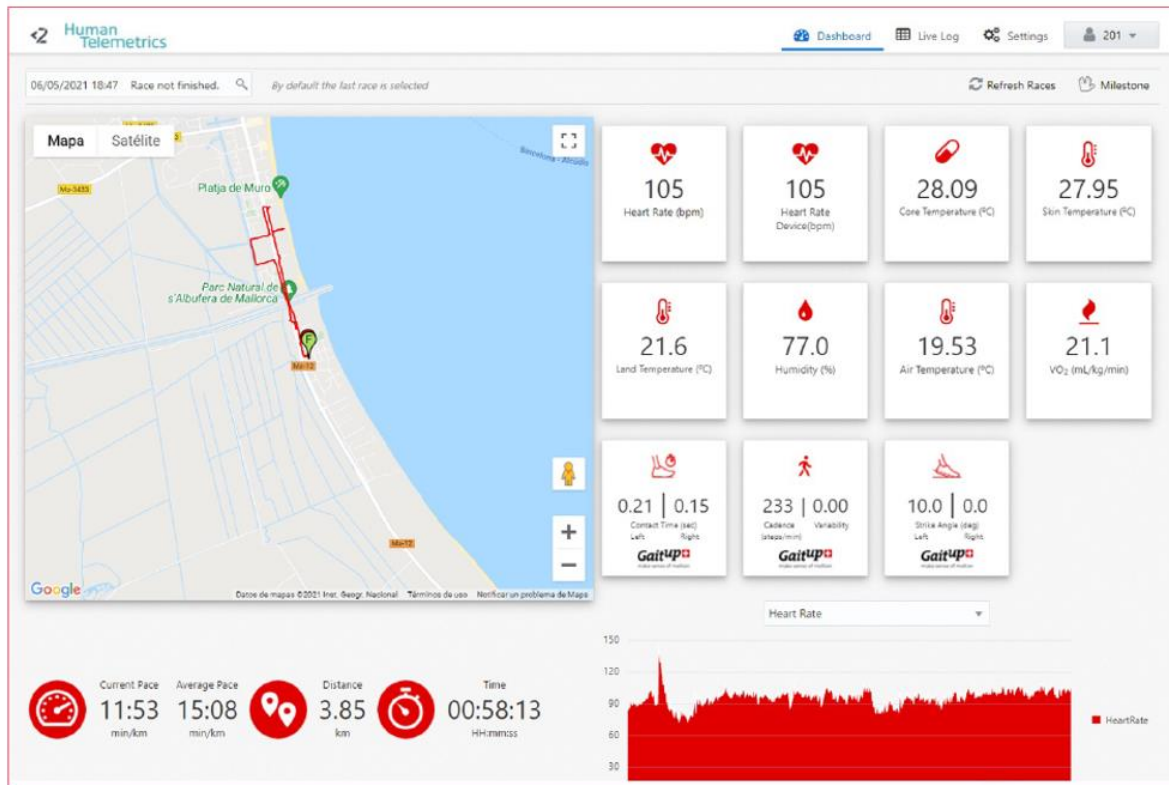
Dec. 4<sup>th</sup>, 9-5pm, Swissnex San Francisco, Pier 17, #800, CA 94111.



- Glucose / lactate
- pH
- electrolytes

# Variables assessed in real time

## The prototype - dashboard



## Human Telemetrics Measure\*

- Heart Rate
- Body Temperature
- Land Temperature
- Humidity
- Cadence (steps per minute)
- Foot - Strike Angle (degree)
- Current/Average Pace
- Distance/Location (within 1 m)
- Bioenergetics (oxygen uptake)
- pH
- Electrolytes
- Metabolites (e.g, lactate and glucose)

\*only a small subset but virtually any parameter Human Telemetrics can build a sensor for



# Need for a guiding reference for wearables

## WT HEALTHCARE MARKET



© 2018 Wearable Technologies AG

# Major Concerns of Wearables Industry

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- **Quality assurance:** for example some wearables lack of accuracy in estimating energy expenditure or step counts
- **Population-specific validation:** e.g. the validity of a measure (step counts) is certified to a specific population, however gait patterns vary widely between healthy people and those with neurological diseases
- **Privacy:** e.g. personal information like GPS location can be hacked
- **Data interpretation and presentation to consumers:** e.g. people will obsessively wake up at night to check their sleep watch statistics
- **Standardization of data for technical purposes:** devices have different units, timescales, and coding languages not allowing these devices to interoperate

# Establishing a Global Standard for Wearable Devices in Sport and Fitness

- Establish a central resource at FIMS-accredited laboratories that evaluates consumer sport and fitness wearables for quality and/or data standardization
- Guiding *companies* to achieve these aspects
  - Educating *stakeholders* to critically consider them

FIMS: INTERNATIONAL PERSPECTIVES

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Current Sports Medicine Reports Volume 19 • Number 2 • February 2020

Establishing a Global Standard for Wearable Devices in Sport and Fitness: Perspectives from the New England Chapter of the American College of Sports Medicine Members

Garrett I. Ash, PhD;<sup>1,2</sup> Matthew Stults-Kolehmainen, PhD;<sup>3,4</sup> Michael A. Busa, PhD;<sup>5</sup>  
Robert Gregory, PhD;<sup>6</sup> Carol Ewing Garber, PhD, FACSM;<sup>4</sup> Jason Liu, BS;<sup>7</sup> Mark Gerstein, PhD;<sup>7</sup>  
José Antonio Casajus, MD;<sup>8,9</sup> Alex Gonzalez-Aguero, PhD;<sup>8,9</sup> Demetri Constantinou, MD;<sup>9,10</sup>  
Michael Geistlinger, PhD, Jur;<sup>9,11</sup> Fergus M. Guppy, PhD;<sup>12</sup>  
Fabio Pigozzi, MD;<sup>9,13</sup> and Yannis P. Pitsiladis, PhD, MMEDSci, FACSM<sup>9,13,14</sup>



# Stakeholder Panel consultation for a global standard for wearables in sport & fitness

## Stakeholders

- Industry representatives
- European Respiratory Society Digital Health Working Group
- Consumer Technology Association

## Audience

- Yale Center for Biomedical Data Science Digital Health Monthly Seminar Series (16 September 2020)
- New England Chapter of the American College of Sports Medicine Annual Meeting (16 October 2020)

### Academics

- Yale University (medicine, nursing, computer science)
- University of Connecticut
- Southern Connecticut State University
- University of Massachusetts
- University of Brighton
- Hong Kong Baptist University

### Clinicians

- Yale-New Haven Hospital
- Veterans Affairs Healthcare System

## Topics

- Key facilitators and barriers to participation by sport and fitness wearable manufacturers
- Stakeholder priorities



# Which objectives should be highest priority?

Median Priority Score	Objective	Number of Top Priority Votes
1	Quality assurance	75%
2	Data standardization	21%
3	Interoperability of devices with electronic health records	4%
4	Interoperability of devices with each other	0%

“without high quality data, other priorities are not meaningful”

# The Roadmap to the FIMS Central Resource for Wearable Devices



January, 2022: Full implementation

September, 2021: Market the central resource to larger companies. Begin to offer benchtop testing, alongside the field and implementation testing

**July-August, 2021: Implementation testing of 2-3 devices at Tokyo Olympics – Finalize SOPs**

November 2020-June, 2021: **Testing of standard operation procedures (SOP) with devices from small companies**

May-September, 2019: **Establish a FIMS Guiding Reference Centre for Wearable Devices**

April, 2019: Exploratory meetings with notified body/CE providers

January-March, 2019: Set up the **FIMS Guiding Reference Steering Group (FRSG)**



# Acknowledgements

## Professor Yannis Pitsiladis, University of Brighton

- Head of Sub2hrs marathon project
- Lead of the *Beat The Heat project* in Tokyo Olympics
- Member of the IOC Medical and Scientific Commission
- Member of the Executive Committee and Chair of the Scientific Commission of FIMS



## Professor Garrett Ash, Yale University

- Lead of consultations with the ACSM
- Lead of consultations with industry stakeholders



FIMS: INTERNATIONAL PERSPECTIVES

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## Establishing a Global Standard for Wearable Devices in Sport and Exercise Medicine: Perspectives from Academic and Industry Stakeholders

