Wearables, Sports and Health
ERS 2021 Presidential Summit: digital respiratory medicine: realism versus futurism

Ioannis Vogiatzis Ph.D. FERS
Professor of Rehabilitation Sciences

European Respiratory Society, Assembly 1 Secretary: Respiratory, Clinical Care & Physiology, Member of the Digital Health Working Group

Member of the COPD Development Group for the World Health Organisation’s (WHO) Package of interventions for Rehabilitation

British Thoracic Society, Pulmonary Rehabilitation Specialist Advisory Group member
Objectives

- 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

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, Konstantinos Angeloudis, Fergus M Guppy, Kumpei Tanisawa, Yuri Hosokawa, Garrett I Ash, Wolfgang Schobersberger, Andrew J Grundstein, Fumihiro Yamasawa, Sebastien Racinais, Douglas J Casa, Yannis P Pitsiladis
Sub-2hrs marathon mobile application

- **Smart wristband**
  - Low frequency
  - Electronic Pill
  - Bluetooth BLE 2.4GHz

- **Smartwatch - eSIM**
  - Smartwatch sends location of athlete
  - API returns the ambient conditions at the exact location

- **Global datasets**

- **Global weather models**

- **AI**

- **Local features**

- **User**
  - Air/Land surface temperature
  - Relative Humidity

- **Internet**

- **API Service**
Tracking data in real time during a marathon
Integration of Wearable Sensors Into the Evaluation of Running Economy and Foot Mechanics in Elite Runners

Borja Muniz-Pardos, MSc¹; Shaun Sutehall, BSc²; Jules Gellaerts, MSc³; Mathieu Falbriard, MSc³; Benoît Mariani, PhD³; Andrew Bosch, PhD²; Mersha Asrat, MSc⁴; Jonathan Schaible⁴; and Yannis P. Pitsiladis, MMedSci, PhD⁴,⁵,⁶
Lab on-skin technology

- 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
Major Concerns of Wearables Industry

- **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
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
• 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

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)

Topics

• Key facilitators and barriers to participation by sport and fitness wearable manufacturers
• Stakeholder priorities
## Which objectives should be highest priority?

<table>
<thead>
<tr>
<th>Median Priority Score</th>
<th>Objective</th>
<th>Number of Top Priority Votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Quality assurance</td>
<td>75%</td>
</tr>
<tr>
<td>2</td>
<td>Data standardization</td>
<td>21%</td>
</tr>
<tr>
<td>3</td>
<td>Interoperability of devices with electronic health records</td>
<td>4%</td>
</tr>
<tr>
<td>4</td>
<td>Interoperability of devices with each other</td>
<td>0%</td>
</tr>
</tbody>
</table>

“without high quality data, other priorities are not meaningful”
The Roadmap to the FIMS Central Resource for Wearable Devices

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

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

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

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

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

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

January, 2022: Full implementation
Establishing a Global Standard for Wearable Devices in Sport and Exercise Medicine: Perspectives from Academic and Industry Stakeholders

Garrett L. Ash, PhD,1,2 Matthew Stults-Kolehmainen, PhD,3,4 Michael A. Busa, PhD,5 Robert Gregory, PhD,6 Carol Ewing Garber, PhD, FACSM,4 Jason Liu, BS,5,7 Mark Gerstein, PhD,7 José Antonio Casajus, MD,8,9 Alex Gonzalez-Aguero, PhD,9,9 Demitri Constantinou, MD,9,10 Michael Geistlinger, PhD, Jur,9,11 Fergus M. Guppy, PhD,12 Fabio Pigozzi, MD,9,13 and Yannis P. Pitsiladis, PhD, MMEDSci, FACSM9,13,14