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THOUGHT LEADERSHIP

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Considerations for Optimizing the Quality of Wearable Technology Data

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The wearable technology market is projected to reach almost $34 billion by the end of 2019[1]; specific to healthcare, it is expected to grow to $15 billion in the same timeframe.[2] In the high-end performance (e.g., sports and military) health and wellness sectors, wearable device technologies have rapidly enabled us to move beyond the systematic constraints of the laboratory and redefine how we quantify and understand human performance and health. Wearable devices have changed the way both elite and recreational athletes define and optimize their "performance." They have offered clinicians new ways to implement and evaluate targeted medical or therapeutic interventions rapidly and on massive scales. Similarly, in the military, they have enabled unique insights into how combined factors such as sleep, activity, and mood manifest in resultant readiness for activity.

The diversity in the wearables sector has also paved the way for what can truly be considered the "quantifiable self," where increased device integration with the Internet of Things (IoT) provides end users with expanded insights into critical short- and longer-term personalized health and performance outcomes.

While the benefits of wearable consumer and medical device technologies are evident, it is important to balance them against key limitations that can adversely affect the quality and viability of the outcomes they promise. These limitations include compromised data accuracy and reliability, undefined requirements and assurances for data privacy and discovery, and the challenges associated with distilling the vast array of data typically generated by these technologies into simple yet meaningful metrics for the desired performance or health outcomes.

Limitations to data accuracy and/or reliability:

While wearable technology affords unique insights into key performance outcomes in natural environments, data generated through these technologies are typically less accurate and reliable than traditional laboratory-based data streams. For general consumers, the "wow" factor associated with wearable technology often over-shadows such important underlying data concerns, where detailed accuracy may not be the main priority. As such technologies are more frequently adopted in the elite sports, military, and health and wellness spaces, however, accurate and reliable data become far more critical.

Associated risks:

Compromised wearable technology accuracies in the health sector can leave clinicians and patients misinformed and open to adverse short- and longer-term health outcomes. Similarly, in the elite sports

[1] Statista, B.I. Wearable Device Sales Revenue Worldwide from 2016 to 2022 (in Billion U.S. Dollars); Statista Inc. New York, NY, USA, 2017.
[2] Yussuff, V.; Sanderson, R. The World Market for Wireless Charging in Wearable Technology; IHS: Englewood, CO, USA, 2014.

sector, inconsistencies in product-specific data accuracy and quality can severely compromise performance optimization and quantification, in turn adversely impacting performance-based (e.g., financial) incentives. Inaccurate performance data can also substantially increase the risk of traumatic injury and further compromise the rehabilitation process. In the military sector, inaccurate wearable-based performance data can incur more catastrophic life-threatening outcomes.

Contributors and considerations:

Several trends continue to prevail in the wearables market that feed directly into data accuracy and quality concerns. It is here that externally driven efforts can be made to address this far-reaching issue.

First, wearable performance technology hardware and algorithms are commonly prototyped, developed, tuned, and validated via constrained and largely homogeneous human test populations of limited sample size. The resultant accuracy and reliability of these technologies when applied to the much broader (e.g., age, fitness level, morphometry, sex, location) population base and range of activities, while currently unknown, may be compromised. Our team at Exponent is now initiating strategic partnerships with key early-stage product incubators to help overcome this challenge by designing and implementing studies that generate rich data sets on representative populations within targeted clinical, military, or sporting sectors.

Another challenge is the lack of established and universally adopted wearable performance technology accuracy standards. While efforts are ongoing to provide some form of wearable technology standardization, these standards and the underlying methods adopted to assess products against them are typically generated by the invested product developers themselves, with limited independent oversight. Moving forward, the wearable technology sector must enlist stronger and more broadly applied third-party oversight that enables and supports technologies to successfully meet independently generated and governed accuracy and quality standards.

Finally, the evolving diversity in wearable performance technologies makes it increasingly challenging to develop and implement such data standards. With this in mind, there is an immediate need to establish meaningful wearable performance technology categories, inherent data accuracy and quality requirements, and associated (adequately scoped) test paradigms to successfully evaluate the rapidly growing product space. Standards should consider and be sensitive to these underlying technology category applications and requirements. Standards for clinically and elite performance focused technologies, for example, should be far more stringent than those designed to govern consumer-grade products.

Limitations to data ownership and privacy:

A second growing concern in the expanding wearable technology space pertains to data ownership, privacy, and discovery. Currently, data ownership requirements and standards and the corresponding legal obligations remain largely undefined. When an end user purchases a new technology, he or she signs over data rights to the parent company with limited knowledge of how data are stored, evaluated, shared, or sold to third-party (e.g., health or insurance) companies. In parallel, despite increased integration of wearable technologies into mainstream health and clinical practices, few of these devices comply with what should be considered critical U.S. Food and Drug Administration (FDA) and Health Insurance Portability and Accountability Act (HIPAA) regulations and standards. Sharing wearable-derived health and activity data through mainstream social media channels may additionally precipitate immediate adverse employment or health coverage outcomes through inadvertent or targeted personal data discovery. There is thus a growing and immediate need to establish strongly regulated standards regarding wearable technology data ownership, privacy, and discovery.

Limitations to meaningful data distillation:

A third concern in the expanding wearable technology space pertains to the distillation of data. Today's consumers are bombarded with performance data via a wide range of wearable/mobile/cloud-based/AI technologies. The majority of technologies fail to accumulate all of these data into individual-specific performance descriptors of the "integrated self" that can empower consumers to successfully take charge of their own long-term health and wellness outcomes. It is important for performance/health/wellness technologies to consider how best to distill the vast array of generated data into meaningful and modifiable metrics that all users—from athletes and patients to clinicians and military personnel—can easily understand and implement to optimize and maintain their desired performance or health outcomes.

To assist with this, our team at Exponent aims to consolidate and further develop partnerships with a variety of clinical and sporting entities to help them determine the optimal technologies to deliver the desired performance or health outcome and distill the large-scale data generated through these technologies into the most critical, easily digested, and modifiable performance or health outcome metrics. Long-term, by utilizing our extensive in-house statistical and data analytics expertise, we are uniquely positioned to support these same entities through predictive modeling of optimal and adaptive performance insights in an innovative Big Data framework.

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How Exponent can help:

Exponent's multi-disciplinary team of scientists, physicians, and data analytics experts can help technology developers define, scope, collect, and consolidate meaningful data that delivers actionable insights to end users. We also help leaders in the clinical, sporting, and military sectors target and integrate optimal technologies into their respective environments to successfully and uniquely support specific performance and health outcomes.

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