THE ABILITY to accurately measure athletic training outcomes is vital to the profession. Two potential outcome measures are physical activity and person-environment interaction. Part 1 of the report discussed physical activity as a potential indicator of function throughout the entire recovery process. Previous studies have demonstrated a decrease in physical activity among patients with certain health conditions. Physical activity also has been shown to increase as the health condition improves. These findings support the use of physical activity as a measure of function and recovery. In addition, there are convenient instruments, such as pedometers and accelerometers, available to quantify the total amount of movement a person performs throughout the day. Physical activity alone may not provide a complete assessment of function, however.

According to the World Health Organization International Classification of Functioning, Disability and Health (ICF), the definition of function includes a dynamic interaction between body function, activity and participation, personal factors, and environmental factors that influence those activities. Conceptually, the ICF disability model (Figure 1) is an extension of the Nagi model, which introduces two additional components: personal and environmental factors. Body function refers to the anatomical or physiological components of an injury or illness, which are specified by a diagnosis. The activity and participation component can be quantified by using measures of physical activity. Current assessment methods have not adequately assessed either the environmental or personal factors of the disability model.

Although each component of the ICF model is important, the role of environmental factors appears to be critical to our understanding of function and disability. Environmental factors include the physical, social, and attitudinal environment in which people live. Physical activity, along with the way a person moves within the environment (person-environment interaction), may provide a more comprehensive indication of the influence of an injury or illness on function. Whether or not a person’s environmental interaction changes in manner similar to the change in physical activity is not clear, however. The impact

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**ICF Disability Model**

![Figure 1](image_url)

The ICF model contains two parts, functioning and disability and contextual factors. Environmental factors is shaded to indicate the focus of this article.
that the environment has on the function of an injured person is also unclear. The purpose of this report is to examine the potential for use of geospatial technology to measure environmental factors that relate to the person-environment interaction.

The influence of the environment on health has gained national attention. The built environment may promote physical activity, which has direct health benefits.\(^5\) This avenue of research is important, but the results have been inconclusive.\(^6\) Other aspects of the ICF model, such as the manner in which injured people interact with the environment, are important to examine. Little research has been conducted to determine whether or not people with illness or injuries interact with the environment differently than healthy people do.

The potential use of accelerometers and pedometers for measurement of physical activity in patients was discussed in Part 1. Geospatial technologies, such as the Global Positioning System (GPS), Geographic Information Systems (GIS), and remote sensing offer the means to measure interaction with the environment. Measurement of person-environment interaction in conjunction with activity monitoring may provide a more complete evaluation of function than do current methods.

The data collected by the GPS device can be transferred into a GIS program to create maps that use remote sensing technology, specifically high definition satellite images, to analyze environmental data. The following will identify current geospatial technology and discuss their potential use as an outcome measure in health care.

**Global Positioning System**

The GPS accurately tracks the latitude and longitude of a receiver’s location through space and time, which permits calculation of its speed and direction at any given time. Developed by the United States Department of Defense, the GPS has been available to the public since May 2000. The current GPS is comprised of three major segments: (a) space segment, (b) control segment, and (c) user equipment segment. The space segment consists of 24 satellites that orbit the earth two times per day. The satellites transmit low-power radio signals that travel to the receiver in less than 85 milliseconds. The control segment consists of five monitoring stations and four ground antennas located around the globe that track the locations of each of the satellites.\(^7\)

The user equipment segment consists of a commercially available GPS receiver that uses the satellite locations as references points to triangulate its ground location (Figure 2). A GPS receiver must acquire three individual satellite signals to triangulate a 2-D position (latitude and longitude) or four satellite signals to define a 3-D position (latitude, longitude, and altitude).

The signal transmitted from the satellites can pass through clouds and glass but will not pass through high-density solid objects, such as buildings. To improve signal reliability, most commercially available GPS units are able to receive 12 or more parallel satellite signal channels to update the receiver’s position. Having more parallel channels improves the accuracy and reduces the risk of losing the signal. The cost of a GPS receiver ranges from approximately $100-$800.

GPS can determine a location with a precision of 1–3 meters.\(^7\) There have been three major improvements to the GPS in recent years that have helped improve accuracy. In May of 2000, the United States Department of Defense deactivated selective availability that had deliberately created a random amount of error (approximately ± 100m) to prevent enemies from using the highly accurate technology.\(^8\) This action was taken to improve the accuracy and accessibility for transportation, scientific, and commercial interests. The U.S. government has the ability to reactivate the selective availability in specific regions at any time the nation’s security is threatened.\(^8\) Since 2000, there has been a boom in the consumer GPS market. There are currently over 500,000 GPS users in the United States.