INTRODUCTION
Changes in limb volume over the day complicate prosthesis use for many people with limb loss. Volume fluctuations can adversely affect socket fit and induce gait instability. Understanding a patient’s volume fluctuation patterns and factors that affect them is a formidable challenge faced by practitioners. The purpose of this research is to evaluate a clinical diagnostic tool for assessing a patient’s limb fluid volume changes and establishing their fluid volume profile.

METHOD
A custom bioimpedance analyzer was developed to monitor extracellular fluid volume (ECF) changes in the anterior and posterior regions of a residual limb (Fig. 1). The device is a portable version of a larger instrument used previously to evaluate limb fluid volume in a laboratory testing (Sanders, 2015). The device injects a small electric current between two electrodes, and monitors voltage from other pairs of electrodes on the residual limb. Current and voltage data are used to calculate impedance (DeLorenzo, 1997), which is converted to fluid volume using a limb segment model (Fenech, 2004).

RESULTS
An example fluid volume profile for a trans-tibial prosthesis user is illustrated in Fig. 2. This individual’s fluid volume loss during weight bearing (i.e., standing and active periods) is countered by gains experienced during sitting. However, he is weight-bearing often thus experiences an overall fluid volume loss during a typical day. An accommodation strategy that facilitates fluid volume gain during active periods (e.g., suction, elevated vacuum) may therefore benefit this individual.

DISCUSSION
The developed instrument may provide insight relevant to prosthesis design and fitting. By knowing when and during what activities prosthesis users are prone to limb fluid volume loss or gain, practitioners can more effectively adjust socket design and educate users about strategies to accommodate volume changes.

CLINICAL APPLICATIONS
A next step is to determine if a patient’s limb fluid volume profile helps to predict effectiveness of different accommodation strategies such as sock addition/removal, elevated vacuum, size-adjustable sockets, or temporary (periodic) socket doffing. Large scale clinical testing will need to be conducted.

REFERENCES
DeLorenzo A. J. Appl. Physiol. 82, 1542-58, 1997