Towards the longitudinal measurement of day and night blood pressure with the Aktiia optical device: improving the diagnosis and management of hypertension at scale

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***Abstract*— Hypertension is a major cause of premature death worldwide. Accurate blood pressure (BP) measurement is essential in the diagnosis and management of hypertension and the latest available clinical evidence shows that the strongest predictor of cardiovascular risk comes from day and night ambulatory measurements. Unfortunately, most of the time, the diagnosis of hypertension relies on sparse and often unrepresentative BP measurements. The transition from spot measurements towards persistent long-term BP monitoring could be achieved by wearable devices, that are nowadays widely accepted for the continuous tracking of various health parameters. However, their ability to measure BP in real-life conditions has not been reported yet.**

Aktiia Bracelet is a CE-marked BP monitor that persistently gathers SBP and DBP values of a user across days and nights, with no need to inflate a cuff at each measurement (Figure 1).

This medical device records green photoplethysmographic (PPG) signals at the wrist and further processes the optical time series via a library of Pulse Wave Analysis (PWA) algorithms that generate uncalibrated estimates of systolic BP (SBP) and diastolic BP (DBP) values. A companion Aktiia oscillometric cuff and an Aktiia smartphone application (available for Android and iOS) are used during an on-boarding process to train the PWA algorithms to transform the uncalibrated BP values (expressed in arbitrary units) into calibrated BP values (expressed in mmHg). The initialization process is further required at least once per month.

Because the onset of the optical recordings is automatically triggered by the device when the user is quiet, Aktiia Bracelet allows to persistently obtain BP values at different times of the day and the night, in real-life body positions (*e.g.* in sitting, lying, …), and most importantly, with no user interaction required (*e.g.* eliminating the need to press a button to trigger a measurement). Therefore, to the best of our knowledge, Aktiia Bracelet is the first cuffless BP monitor commercially available over the counter that can effectively be used to monitor SBP and DBP values persistently during days and nights. Figure 2 illustrates examples of BP readings acquired during 30 consecutive nights, showing different trends of night SBP values across the monitored population.

By obtaining longitudinal BP readings that are persistently recorded during normal life conditions, the Aktiia Bracelet is expected to generate unprecedented information on the BP phenotype of its users, and could potentially improve the diagnosis and management of hypertension at scale.

Keywords—Hypertension, Blood Pressure measurement, Optical Blood Pressure, Cuffless Blood Pressure, Photo-plethysmography

Figure 1: The Aktiia 24/7 BP monitor is a wearable device that persistently measures optical signals at the wrist and further displays day and night BP values on a companion smartphone application.

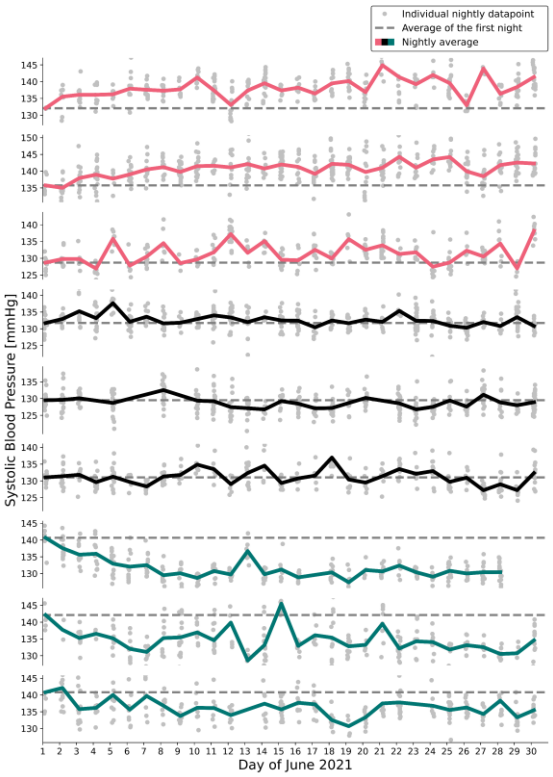

Figure 2: The Aktiia 24/7 BP monitor generates unprecedented information on the BP phenotype of a user. In this figure, nine longitudinal examples of average night SBP values recorded during the month of June 2021 are provided, showing increasing (**red**), stable (**black**) and decreasing (**green**) trends of night SBP values over the month.

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