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A.	H.H. Asada, et al. "Mobile monitoring with wearable photoplethysmographic biosensors" IEEE Engineering in Medicine and Biology Magazine, Vol. 22, Issue 3, May-June 2003.

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11. H.H. Asada, et al. "Mobile monitoring with wearable photoplethysmographic biosensors" was published in IEEE Engineering in Medicine and Biology Magazine, Vol. 22, Issue 3, IEEE Engineering in Medicine and Biology Magazine, Vol. 22, Issue 3 was published in May-June 2003. Copies of this publication were made available no later than the last day of July 2003. The article is currently available for public download from the IEEE digital library, IEEE Xplore.

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Executed on: 25 Oct 2016

EXHIBIT A

Mobile monitoring with wearable photoplethysmographic biosensors

5 Author(s)

H.H. Asada ; P. Shaltis ; A. Reisner ; Sokwoo Rhee ; R.C. Hutchinson

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Abstract:
We address both technical and clinical issues of wearable biosensors (WBS). First, design concepts of a WBS are presented, with emphasis on the ring sensor developed by the author's group at MIT. The ring sensor is an ambulatory, telemetric, continuous health-monitoring device. This WBS combines miniaturized data acquisition features with advanced photoplethysmographic (PPG) techniques to acquire data related to the patient's cardiovascular state using a method that is far superior to existing fingertip PPG sensors. In particular, the ring sensor is capable of reliably monitoring a patient's heart rate, oxygen saturation, and heart rate variability. Technical issues, including motion artifact, interference with blood circulation, and battery power issues, are addressed, and effective engineering solutions to alleviate these problems are presented. Second, based on the ring sensor technology the clinical potentials of WBS monitoring are addressed.

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Wbs System Paradigm
For novel healthcare applications to employ WBS technology, several system criteria must be met. The WBS hardware solution must be adequate to make reliable physiologic measurements during activities of daily living or even more demanding circumstances such as fitness training or military battle. There must exist data processing and decision-making algorithms for the waveform data. These algorithms must prompt some action that improves health outcomes. Finally, the systems must be cost effective when compared with less expensive, lower technology alternatives.

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Biomedical monitoring, Biosensors, Wearable sensors, Patient monitoring, Telemetry, Data acquisition, Cardiology, Sensor phenomena and characterization, Heart rate measurement, Heart rate

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