



**mc10<sup>®</sup>**

*RESHAPING HEALTHCARE*



# **Value Proposition for Clinical Trials**

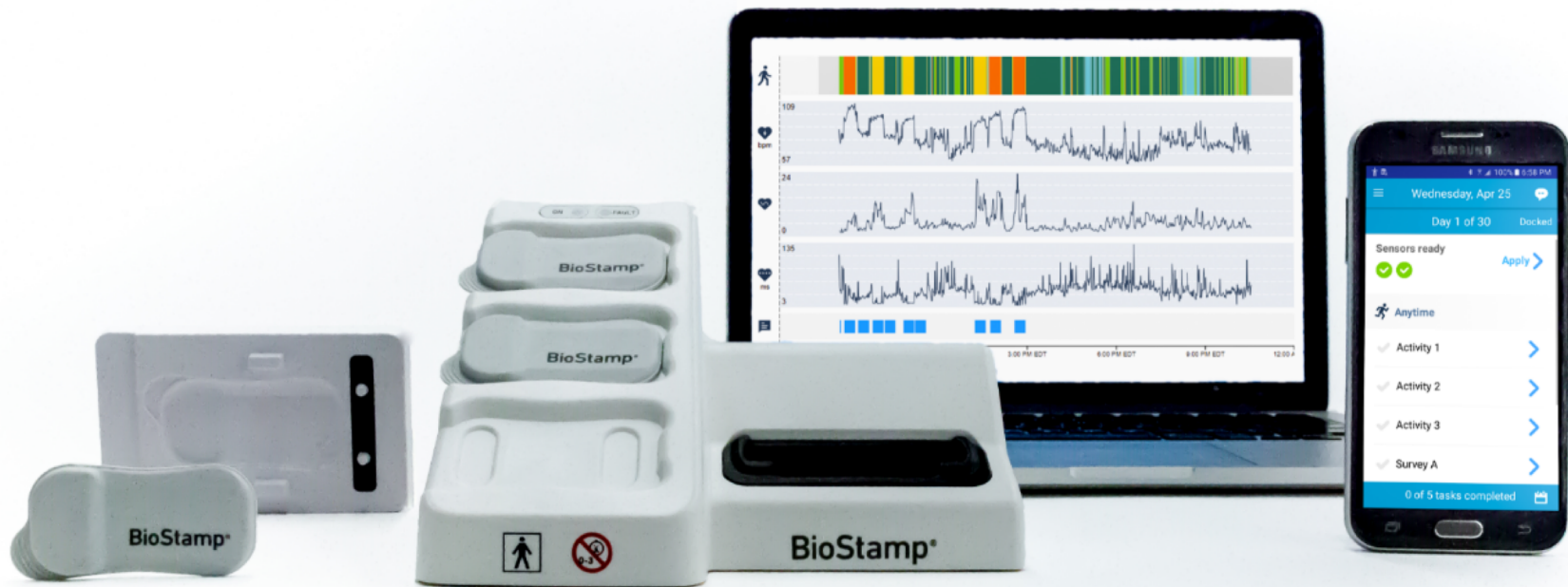
**Arthur H. Combs, MD, FCCP, FCCM**

**Chief Medical Officer, MC10 Inc.**

- **There is an increase in:**
  - roles for in-home testing during clinical trials;
  - roles for medical grade wearables in gathering longitudinal/continuous data for clinical trials, in between or in lieu of clinic visits;
  - use of QOL metrics (ADL, actigraphy, sleep metrics) as endpoints (primary or secondary) in clinical trials.

## ▪ **BioStamp nPoint**

- MC10's product designed specifically for use in **clinical trials**;
- The product is an **end-to-end** system starting with wearable multimodal biosensors, both patient and investigator applications, cloud data storage and algorithmic processing, and a portal in which investigators both design trials and review data;
- The emphasis in value proposition is on gathering continuous multimodal data and being able to do so with the **subject in their own home**;
- MC10 is not producing consumer devices – these are medical grade, clinical quality instruments, **FDA 510(k) cleared** after a Pivotal Clinical Trial;
- The **algorithmic data sets** include: HR, HRV, RR, activity classification, posture classification, sleep metrics including onset/wake, duration and movements/posture changes;
- All data can be viewed in the **investigator portal** and can be downloaded in raw or processed form through the **API**.

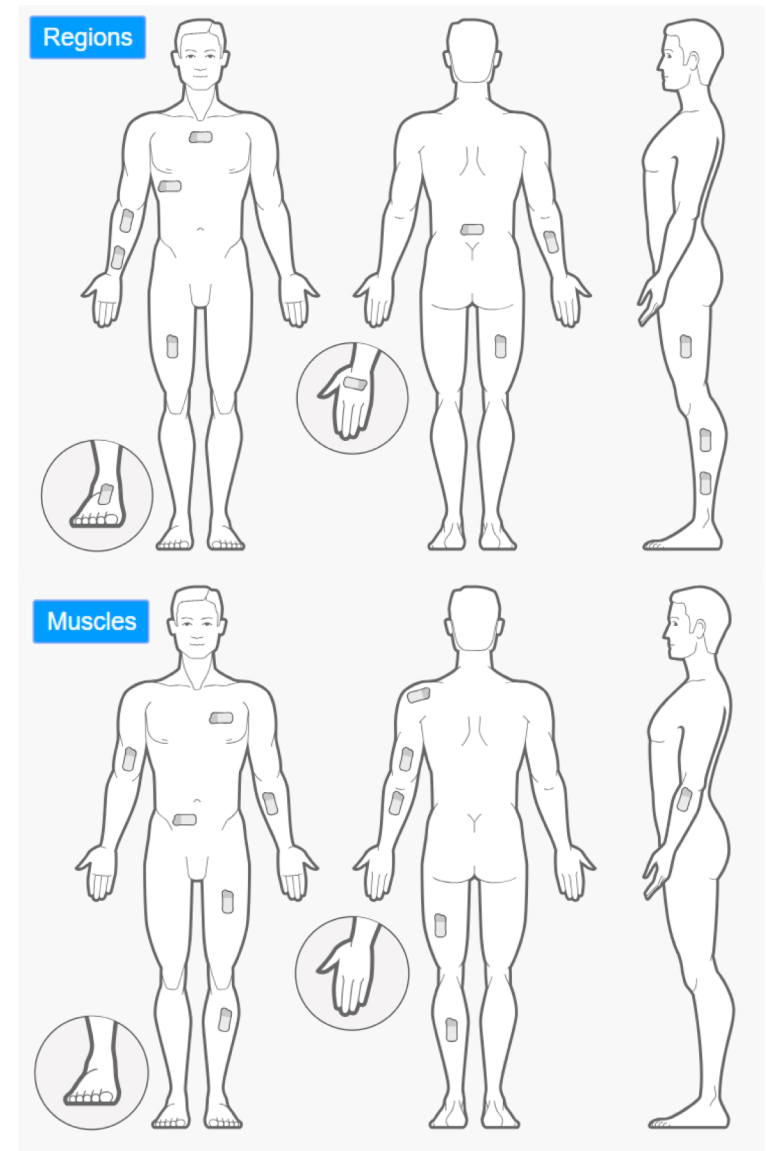


## Clinical Research

**BioStamp® nPoint**  
Clinical Validation Trial Complete  
FDA 510(k) Clearance Q2 2018



- **Tight Skin Coupling, Multimodality, Multi-location Sensors**
- **High accuracy motion sensing**
  - Accelerometry
  - Gyroscopy
- **High accuracy surface electromyography**
- **High accuracy electrocardiography**



## ACTIVITY CLASSIFICATION METRICS

- Activity state & duration:
  - Lying Down
  - Sitting
  - Standing
  - Walking
  - Biking
  - Other (moving) states over time
- Activity transitions (count)

## MOVEMENT ANALYSIS METRICS

- Resting Time (hours and %)
- Moving Time (hours and %)

## CARDIAC

- Heart Rate
- Heart Rate Variability

## GAIT ANALYSIS METRICS

- Steps (count)
- Gait Cadence (steps/min)

## SLEEP ANALYSIS METRICS

- Duration in Sleep/Awake state (hours)
- Sleep onset and wake (time)
- Sleep Posture states & duration
  - Front, back, left, right
- Sleep postural transitions (count)
- Sleep Respiration Rate (breaths per min)

## POSTURE

- Resting duration
- Upright duration
- Slouch/ lean duration

## PRESCRIBED ACTIVITIES

Principal Investigator can define self-prescribed activities over a defined period of time, and sensor data can be captured and tagged over that time.

Note: these can all be gathered from the subject while at home in their own environment

- The Wave of the Future
- Actigraphy is now an accepted tool for clinical trial outcome assessment
- Actigraphy and quality of life are now bona fide endpoints in pharmaceutical clinical trials
- Assessing patients' response to medication while in their own homes and habitat is now a desirable metric for drug efficacy

## ORIGINAL ARTICLE

### Isosorbide Mononitrate in Heart Failure with Preserved Ejection Fraction

Margaret M. Redfield, M.D., Kevin J. Anstrom, Ph.D., James A. Levine, M.D., Gabe A. Koeps, M.H.A., Barry A. Borlaug, M.D., Horng H. Chen, M.D., Martin M. LeWinter, M.D., Susan M. Joseph, M.D., Sanjiv J. Shah, M.D., Marc J. Semigran, M.D., G. Michael Felker, M.D., Robert T. Cole, M.D., Gordon R. Reeves, M.D., Ryan J. Tedford, M.D., W.H. Wilson Tang, M.D., Steven E. McNulty, M.S., Eric J. Velazquez, M.D., Monica R. Shah, M.D., and Eugene Braunwald, M.D., for the NHLBI Heart Failure Clinical Research Network

## ABSTRACT

### BACKGROUND

Nitrates are commonly prescribed to enhance activity tolerance in patients with heart failure and a preserved ejection fraction. We compared the effect of isosorbide mononitrate or placebo on daily activity in such patients.

### METHODS

In this multicenter, double-blind, crossover study, 110 patients with heart failure and a preserved ejection fraction were randomly assigned to a treatment regimen of isosorbide mononitrate (from 30 mg to 60 mg) or placebo, with subsequent crossover to the other group for the second study phase. The primary end point was the daily activity level, quantified as the average daily accelerometer units during the 120-mg phase, as assessed by patient-worn accelerometers. Secondary end points included hours of activity per day during the 120-mg phase, quality-of-life scores, 6-minute walk distance, and levels of N-terminal pro-brain natriuretic peptide (NT-proBNP).

### RESULTS

In the group receiving the 120-mg dose of isosorbide mononitrate, as compared with the placebo group, there was a nonsignificant trend toward lower daily activity (−381 accelerometer units; 95% confidence interval [CI], −780 to 17;  $P=0.06$ ) and a significant decrease in hours of activity per day (−0.30 hours; 95% CI, −0.55 to −0.05;  $P=0.02$ ). During all dose regimens, activity in the isosorbide mononitrate group was lower than that in the placebo group (−439 accelerometer units; 95% CI, −792 to −86;  $P=0.02$ ). Activity levels decreased progressively and significantly with increased doses of isosorbide mononitrate. There were no significant between-group differences in the 6-minute walk distance or NT-proBNP levels.

The primary end point was the daily activity level, quantified as the average daily accelerometer units during the 120-mg phase, as assessed by patient-worn accelerometers

Patients with heart failure and a preserved ejection fraction who received isosorbide mononitrate were less active and did not have a better quality of life or submaximal exercise capacity than did patients who received placebo. (Funded by the National Heart, Lung, and Blood Institute; ClinicalTrials.gov number, NCT02053493)

From the Mayo Clinic, Rochester, MN (M.M.R., B.A.B., H.H.C.); Duke Clinical Research Institute (K.J.A., S.E.M., E.J.V.); Duke University Medical Center (M.M.R.) — both in Durham, NC; Mayo Clinic Scottsdale, AZ (J.A.L., G.A.K.); University of Vermont Medical Center, Burlington (M.M.L.); Washington University of Medicine, St. Louis (S.M.J.); Western University, Chicago (S.J.S.); Massachusetts General Hospital (M.J.S.); Harvard Medical School (E.B.) — Boston; Emory University, Atlanta (J.L.); Thomas Jefferson University, Philadelphia (G.R.R.); Johns Hopkins University School of Medicine, Baltimore (B.A.B.); and the National Heart, Lung, and Blood Institute, Bethesda (M.R.S.). Dr. Redfield is in Maryland; and the Cleveland Foundation, Cleveland (W.H.W.T.).

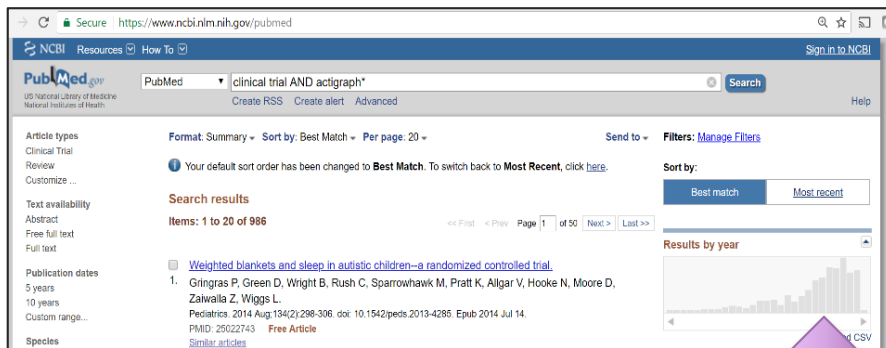
Reprint requests to Dr. Redfield: First St. SW, Mayo Clinic, Rochester, MN 55905, or at redfield.margaret@mayo.edu.

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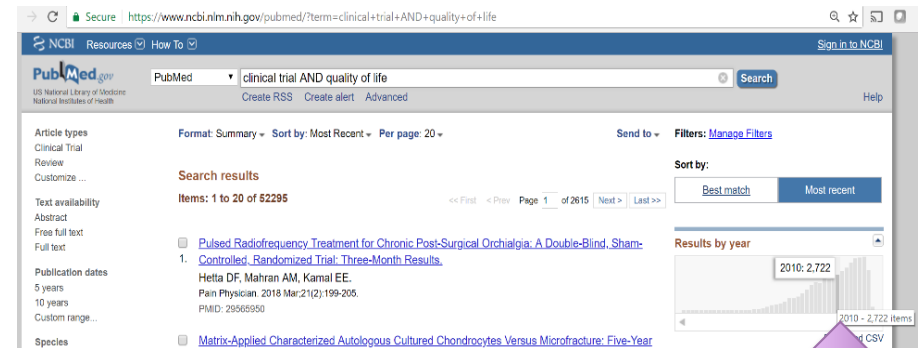
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# Increasing Prevalence of Actigraphy/QoL Metrics in Clinical Trials



- 114 industry sponsored clinical trials using actigraphy registered on clinicaltrials.gov
- Actigraphy is being used in Phases I – IV trials
- Utilization broadly across clinical areas

- Cardiovascular
- Respiratory
- Sleep
- Neuroscience
- Dermatology
- Pain



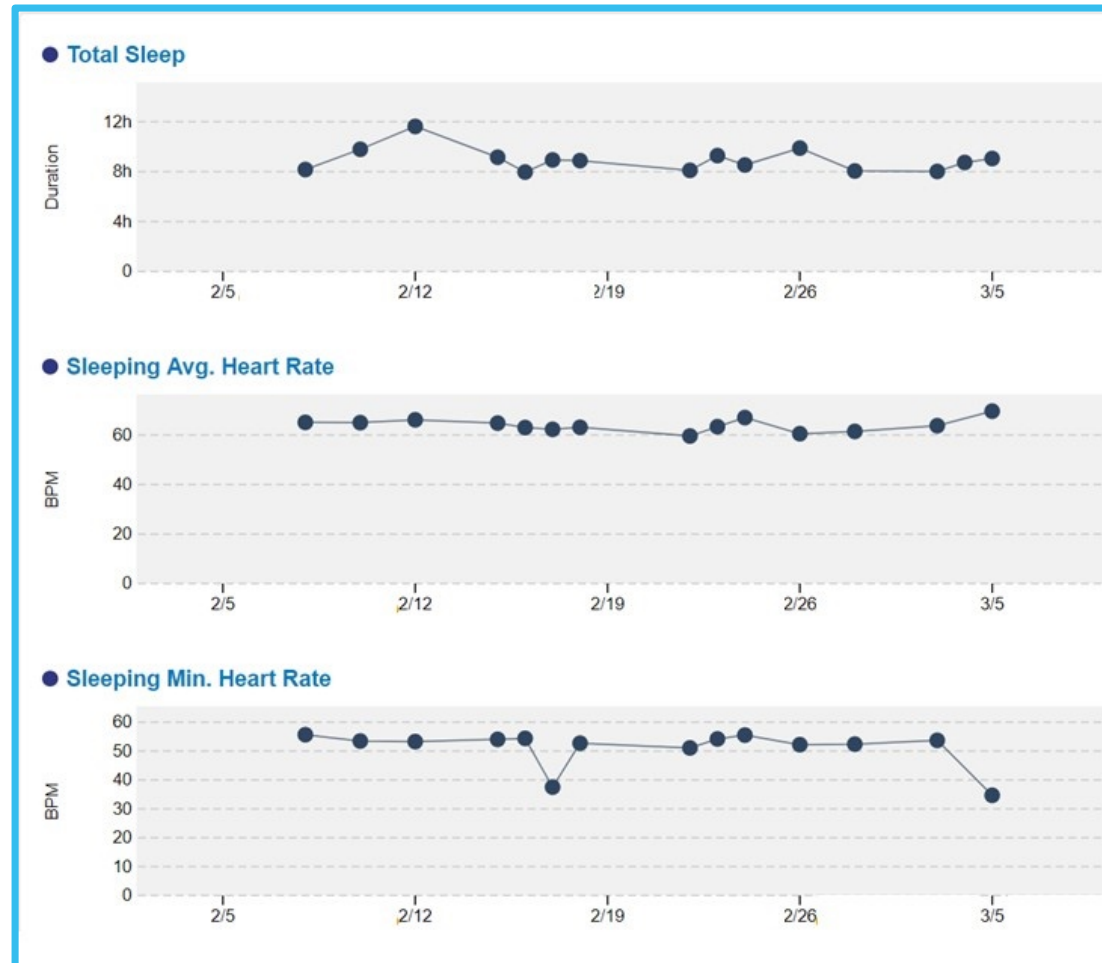
- 8,161 industry sponsored clinical trials with QoL endpoint(s) registered on clinicaltrials.gov
- QoL is a major focus of Phase III & IV trials and is increasingly incorporated into Phase II trials

- Behavioral Health
- Musculoskeletal
- Oncology
- Diabetes
- Rare diseases



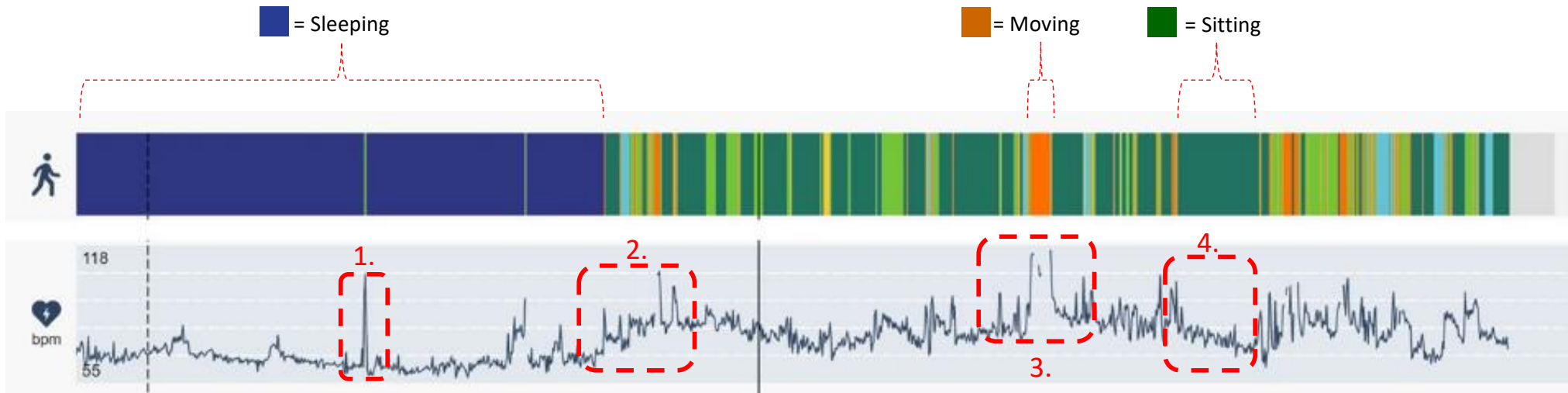
## BioStamp.nPoint™

### Longitudinal Data Example: Sleep Dashboard



Monitor trends in sleep metrics over time

# Contextualized Vital Signs



1. A sleep disturbance verified by actigraphy with an accompanying spike in heart rate
2. A systemic increase in heart rate associated with waking and beginning daily activities
3. A spike in heart rate associated with a sustained period of vigorous movement
4. A decrease in resting heart rate associated with a sustained period of sitting

**The impact of daily activities on vital signs is intuitive, yet has been difficult to quantify until now**

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Thank You

