



Using Patient-Generated Health Data to Facilitate Preoperative Decision Making for Breast Cancer Patients

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Is it feasible to use patient-generated data to develop individualized patient recovery models?

Introduction

Motivation

Background

- 1 in 8 women will be diagnosed with breast cancer
- Mastectomy, a complete removal of breast area tissue, is recommended in over one-third of patients
- Mastectomy patients can choose between many types of reconstructive options, but there is little patient-centered information about the course of recovery associated with these surgeries

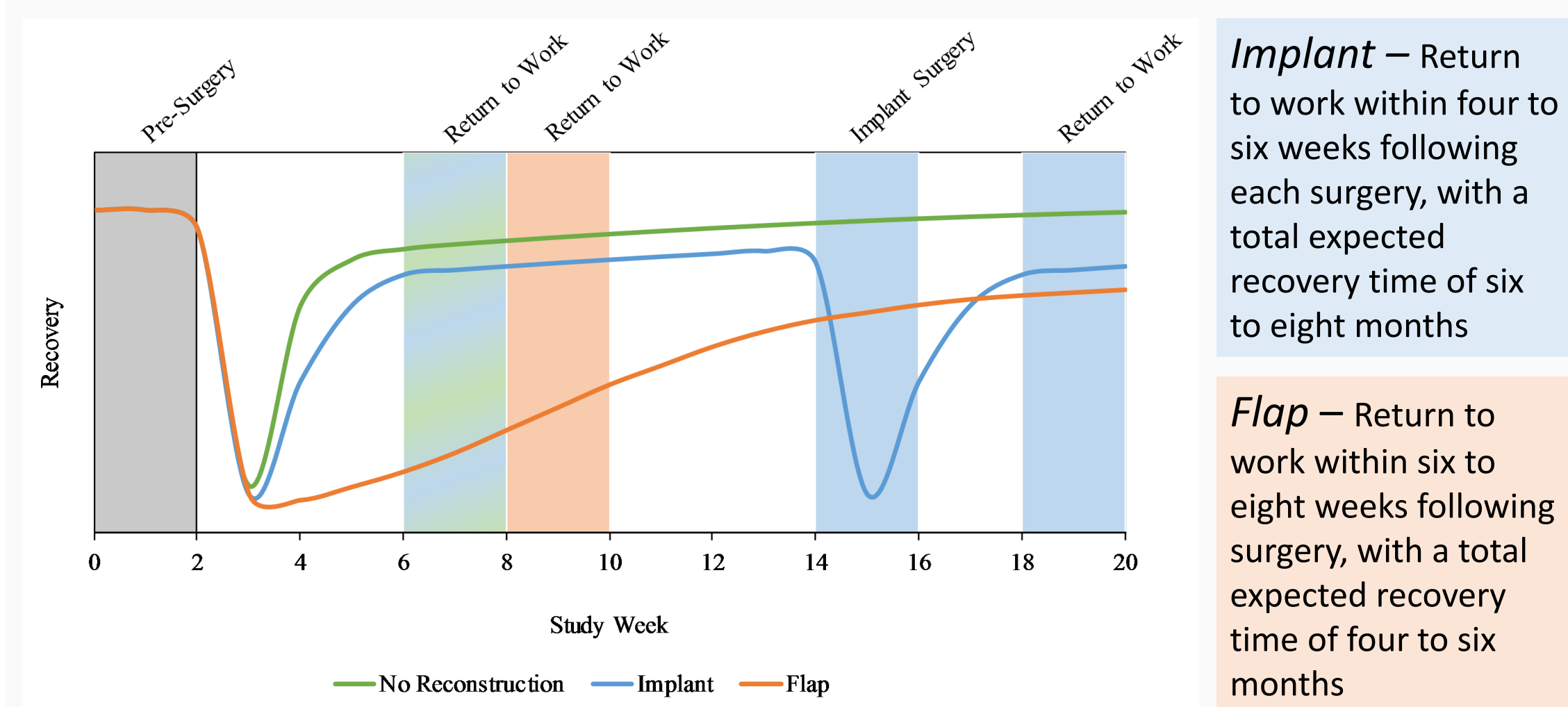
Post-Mastectomy Reconstruction Options

- Implant: most popular form of reconstruction and requires two operations, one which inserts temporary tissue expanders and one which inserts permanent saline or silicone implants
- Flap: riskier and more invasive surgery than implant and uses tissue and fat from other parts of the body to replace the breast tissue removed during mastectomy

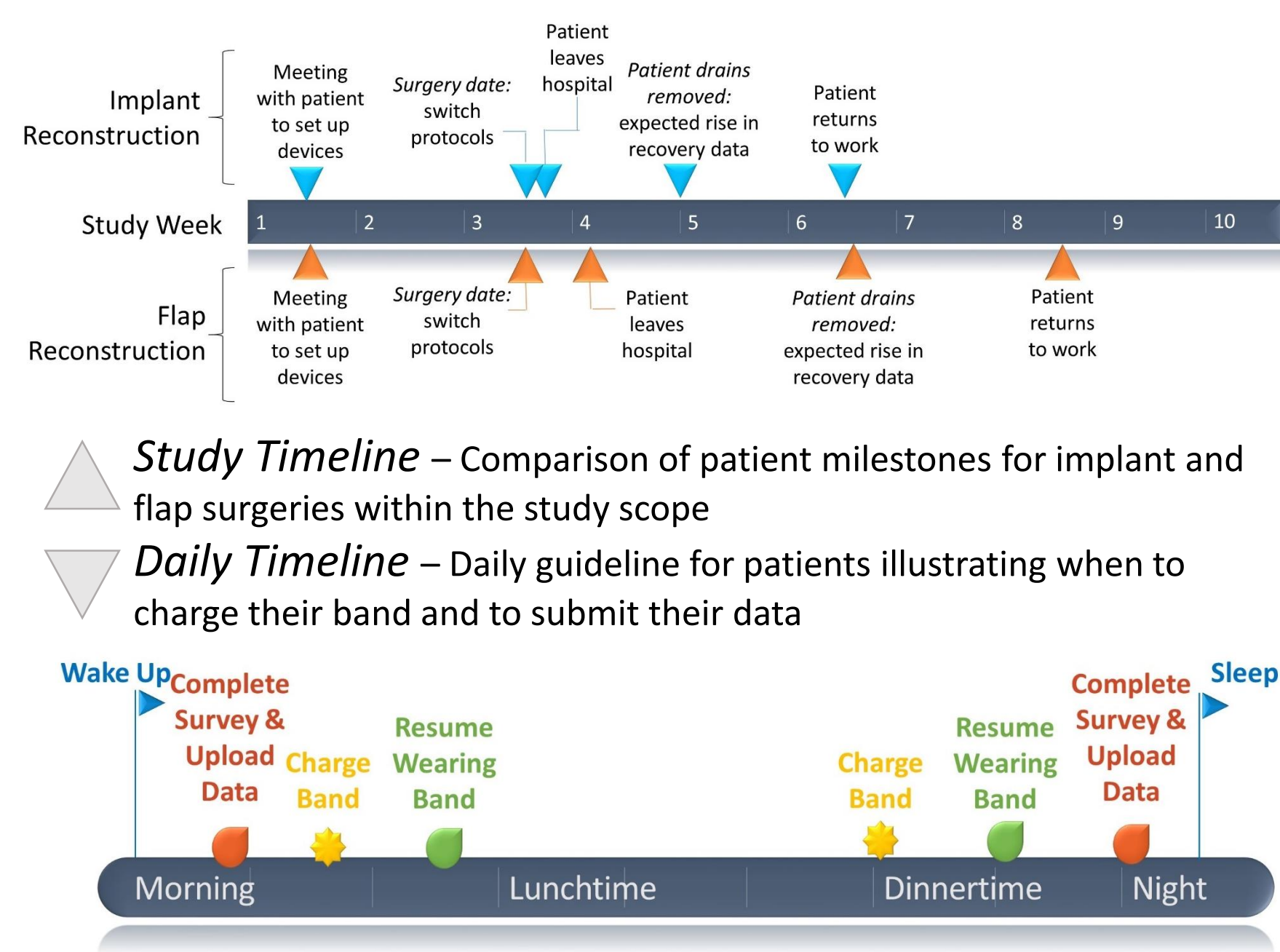
Design Considerations

- Collected qualitative data from patient focus groups to better understand the recovery process
- Used results and return to work milestones to form hypotheses and guide a pilot study collecting data from patients undergoing one of two reconstruction surgery options: implant or flap
- Conducted analysis in terms of a patient's return to preoperative mobility and sleep quality

Hypotheses



Study Design



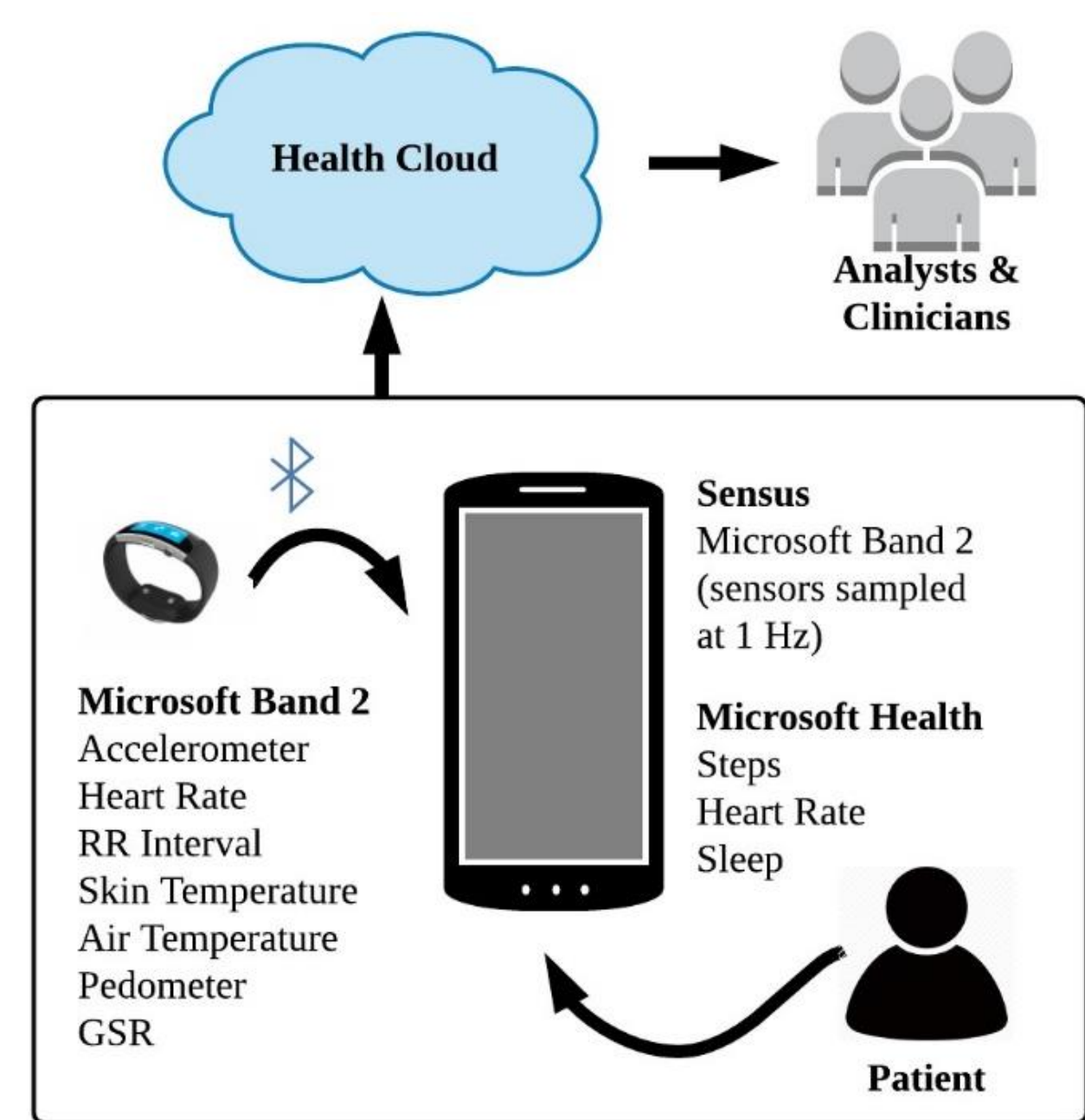
Design Features

Patient Population

- Each new patient that met the inclusion criteria (early-stage breast cancer 0-3a, smartphone, Wi-Fi, and willingness to wear a smartwatch) was eligible for the study
- Women were identified and recruited when a mastectomy was chosen, typically during the first or second clinic visit

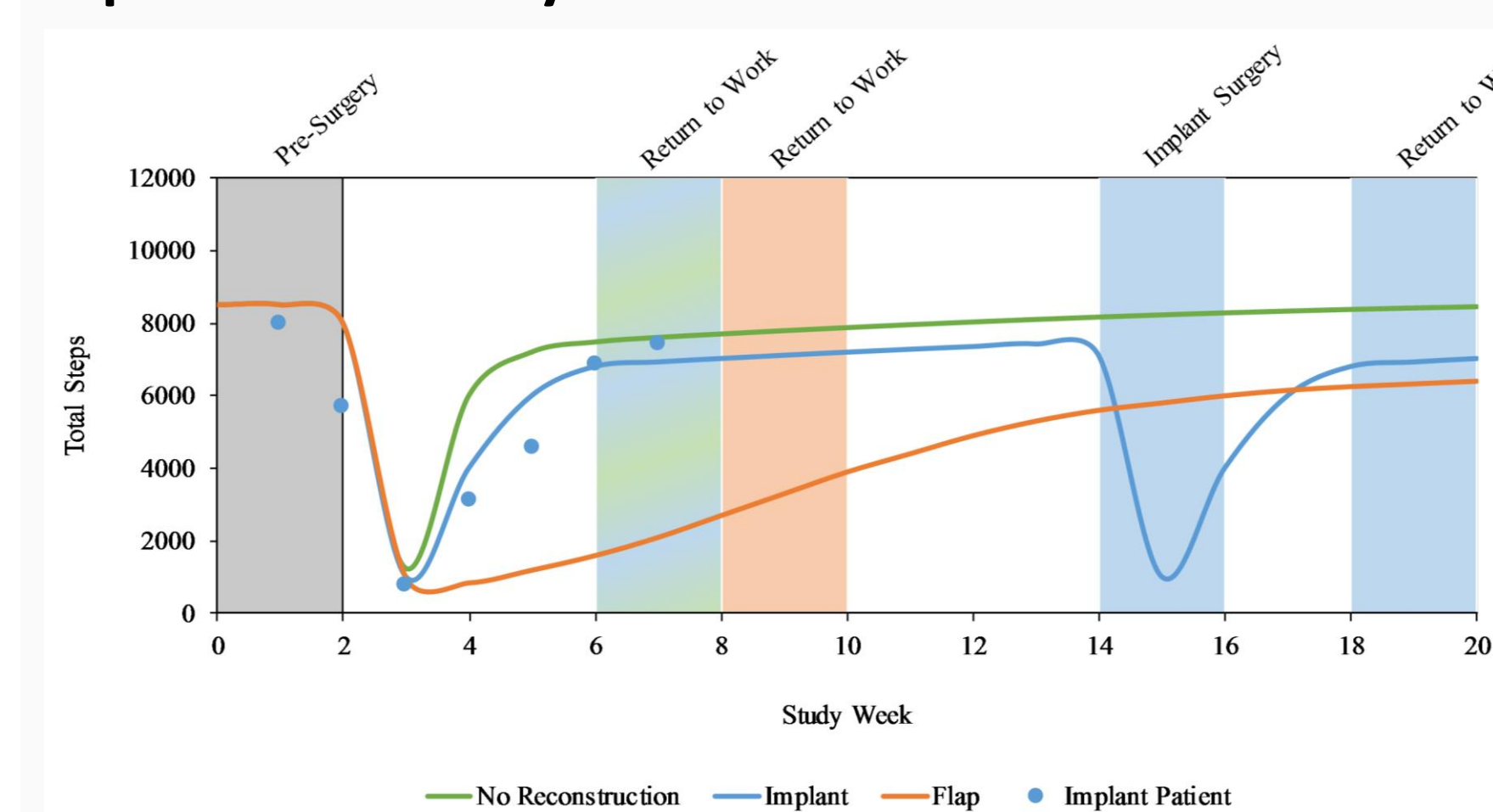
Technology-Enabled Monitoring

- Upon joining the study, patients were allotted a smartwatch to collect baseline measures on activity
- Sensors tracked were accelerometer, heart rate, RR interval, skin and air temperature, pedometer, and galvanic skin response (GSR)
- Sampling rates for all sensors were set to 1 Hz to maximize battery life and data quantity
- Patients submitted their data twice a day through the Sensus and Microsoft Health applications
- Analysts and clinicians accessed the patient data through the Amazon Web Services through Internet2



Analysis & Results

Expected Recovery



No Reconstruction – Mastectomy-only recovery was used as a baseline for comparison and have the fastest recovery rate between four to six weeks

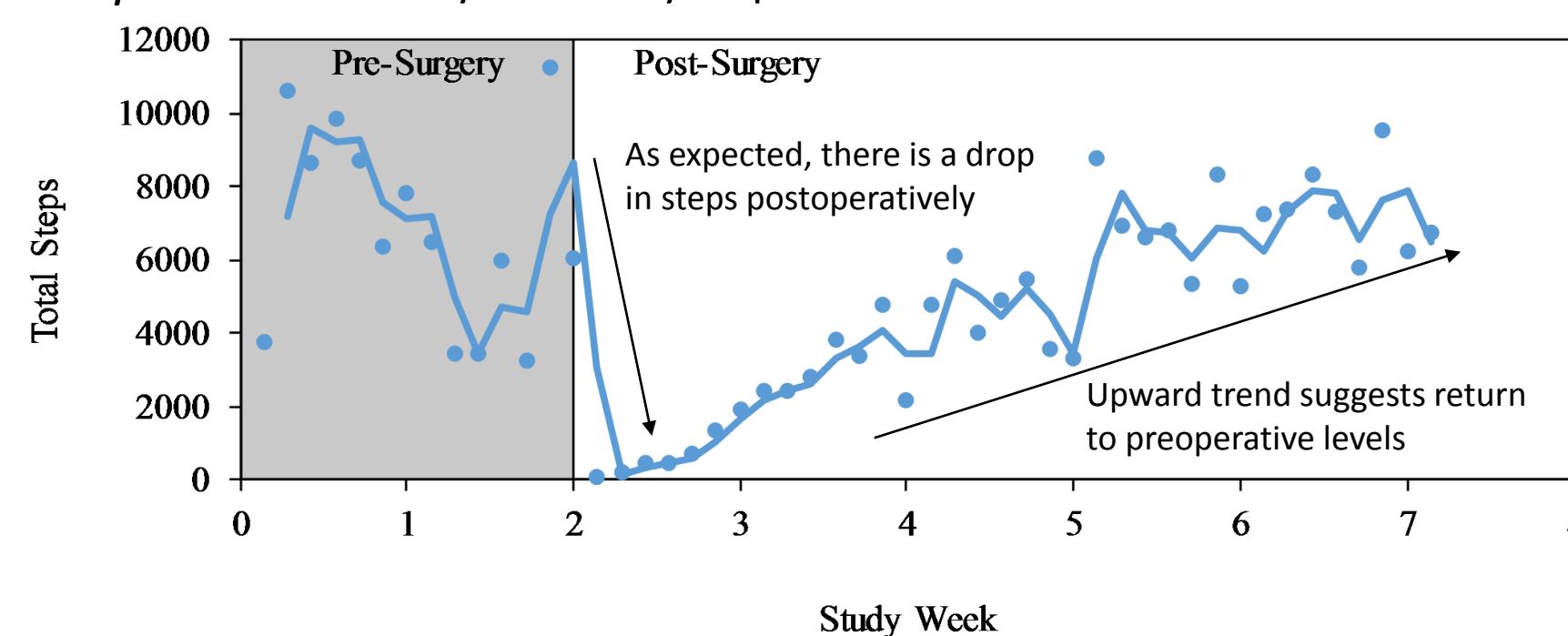
Implant – Implant patients have the longest overall recovery of sixteen to eighteen weeks due to the two surgeries

Flap – Flap patients have a recovery of six to eight weeks, which is slightly longer than the no reconstruction patients

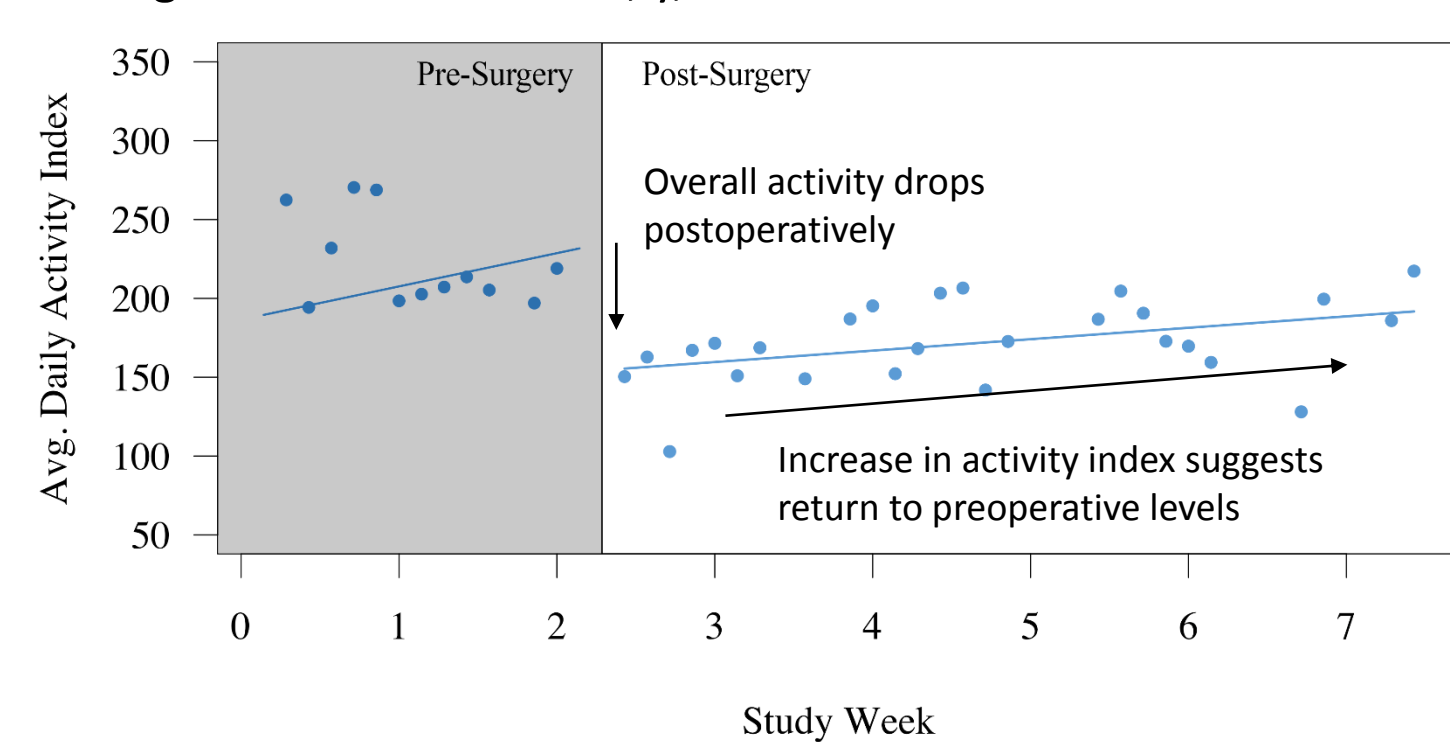
Implant Patient Analysis

While a large patient sample size was preferred, we present step, mobility, heart rate, and sleep results from one implant patient with the most comprehensive pre and postoperative data

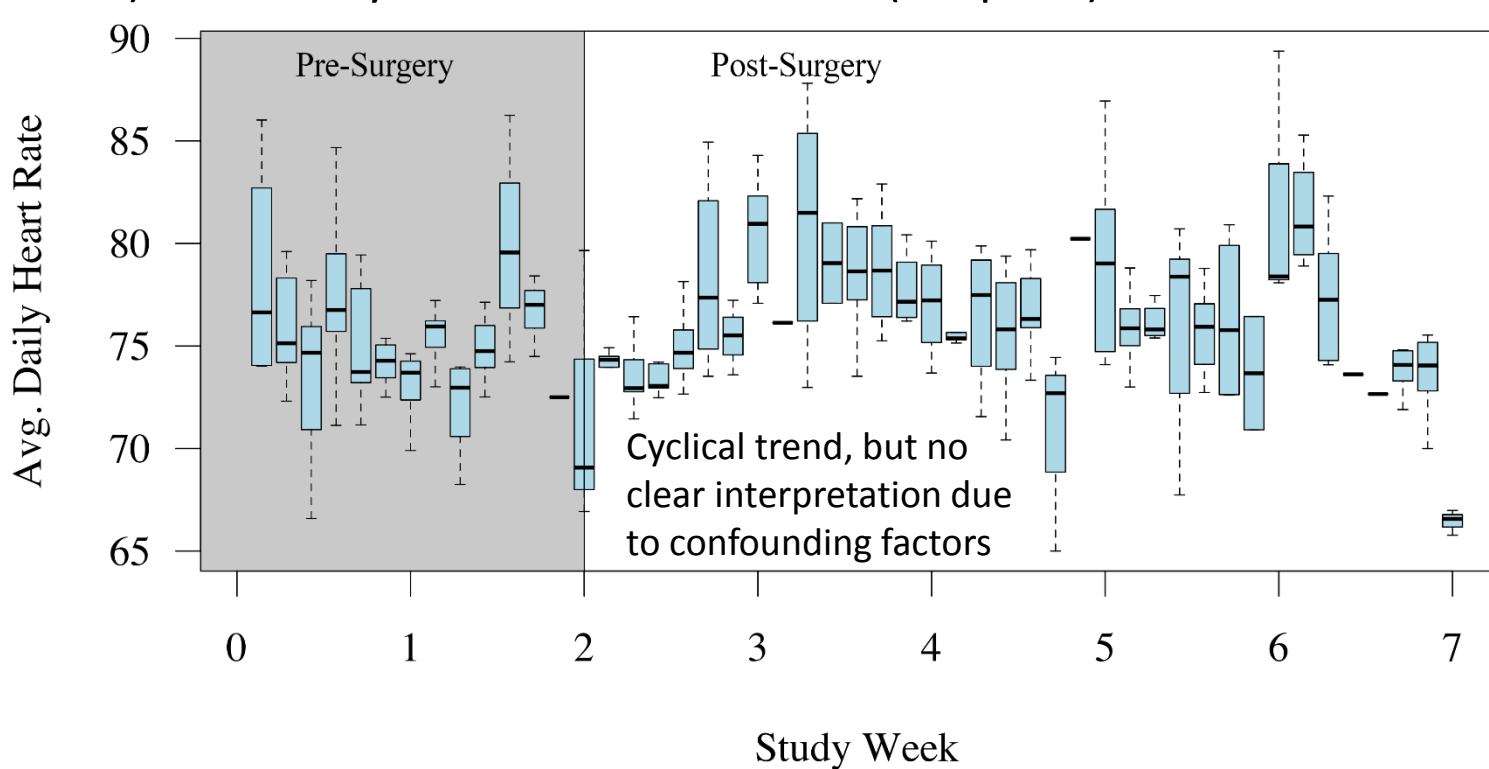
Steps – Measured by total daily steps



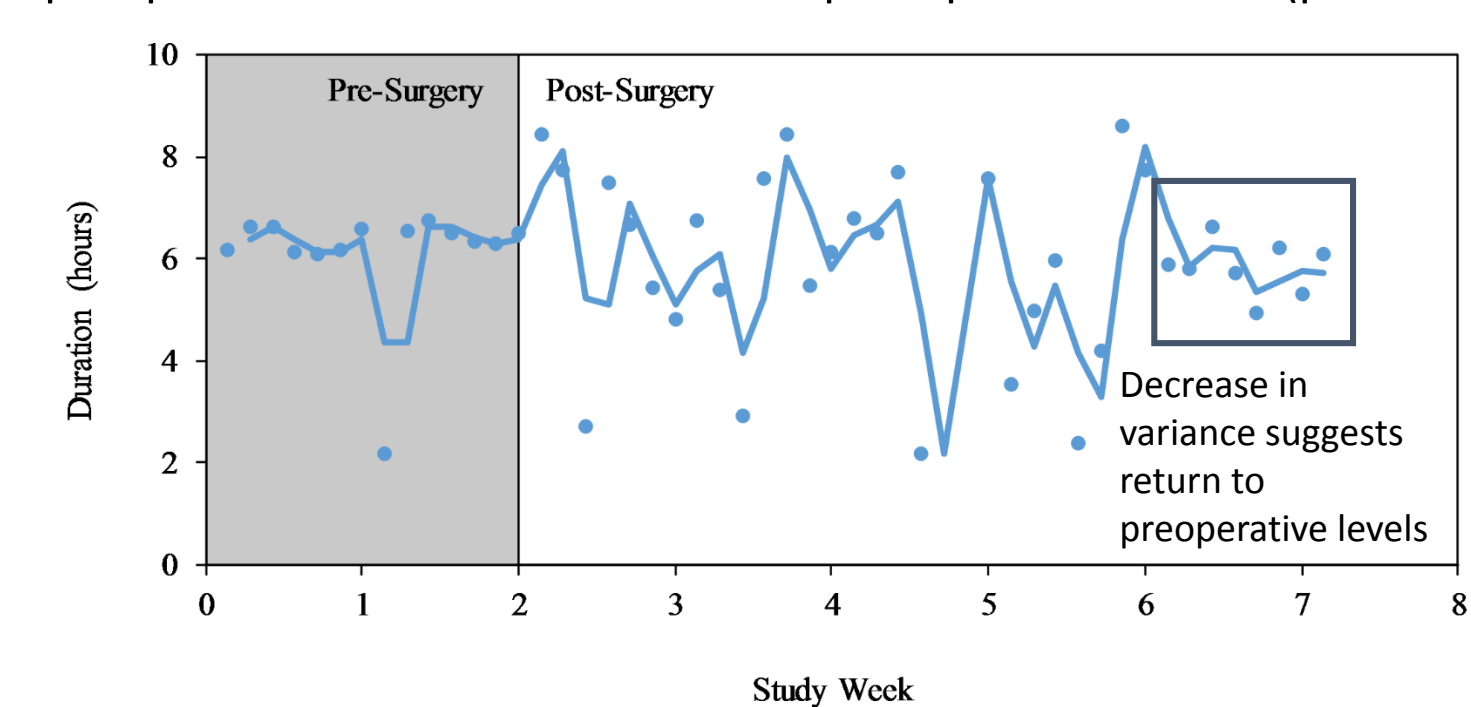
Mobility – Calculated by an activity index which is a weighted average of the variance in x, y, and z accelerometer directions



Heart Rate – Measured by mean daily heart rate (center black lines) and hourly variation in heart rate (boxplots)



Sleep – Analyzed through sleep duration variance, which is a key predictor of recovery, and increases significantly from the two preoperative weeks to the first four postoperative weeks (p=0.021)



Future Work

Feasibility

- Pilot study to assess the feasibility of monitoring and analyzing patient recovery experiences
- Proved successful in providing a better understanding of the recovery process for implant and flap reconstruction surgeries
- Analysis between pre and postoperative data revealed a significant difference in patient steps, mobility, and sleep

Design Improvements

- Include self-report data on sleep, pain, and mood
- Consider new devices to ensure patient comfortability, extended battery life, and granular data collection
- A longer postoperative data collection period would allow for an in-depth study of the course of recovery and follow-up of each surgical option

Long-Term Goals

- Inform patients of their expected recovery for different reconstruction surgical choices based on their patient profile
- With continued analysis, models will be developed to estimate recovery times based on patients' current health and lifestyles, further empowering patients with better-informed decision making