# Wearable Technology: Unlocking ROI of Workplace Wellness

An Employer Case Study in Health Care Cost Management

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## An Employer Case Study in Health Care Cost Management

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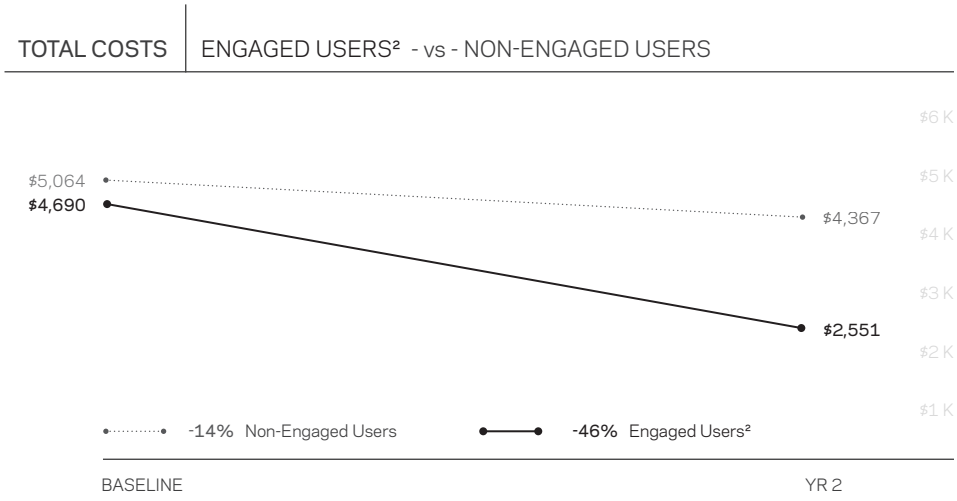
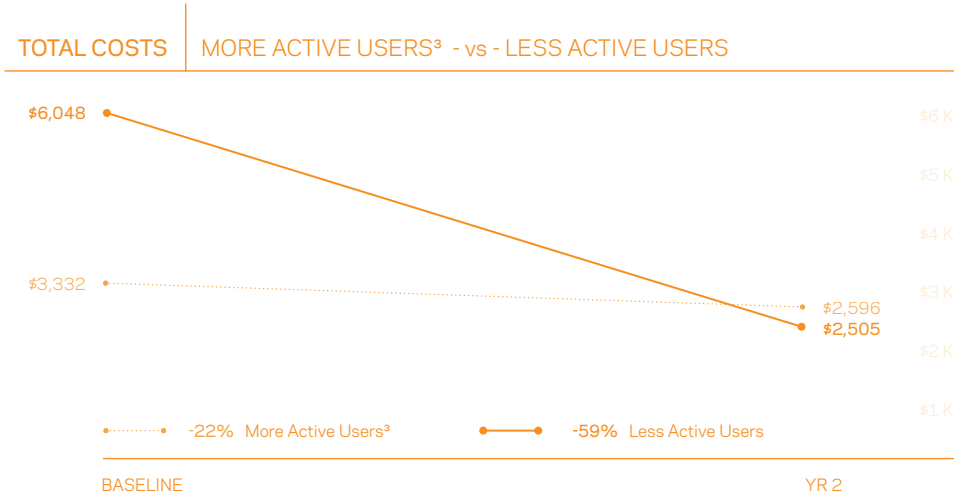
# Summary Findings

This study evaluates health care claims and wearable device data for a self-insured employer over a retrospective three-year period. The Springbuk Health Intelligence platform was used to analyze the impact of wearable technology as part of an overall wellness strategy. The analysis shows that after two years, employees who opted in to the wearable program **cost on average $1,292** less than employees in the control group.[1]

The analysis suggests that connected health and fitness interventions like the wearable program in this study, can promote everyday actions that provide medical cost savings:

— Employees who opted in to the wearable program **cost less than their counterparts**.




— Total costs for **engaged users**[2] **dropped by 46%** over a two-year period, compared to a 14% decrease among non-engaged individuals.

— **Cost reduction is potentially highest** with less active[3] individuals. The total cost for less active users decreased by 59% ($3,543) over a two-year period, compared to a 22% decrease ($736) for those who were more active.

**This study potentially validates what health care leaders and practitioners, policymakers and employers have long believed: wellness delivers a return on investment (ROI).**

[1] The cost difference between these two groups in year three is significant at a p<.03 confidence level.

[2] "Engaged" users defined by individuals who used Fitbit devices for at least 50% or 365 (consecutive or non-consecutive) of the program days over the two-year study period.

[3] "Less active" defined as a median average step count of 6,638; median average step count for "more active" was 10,795.

# Introduction and Purpose of Study

Wearable technology sits at the intersection of consumer excitement for new technology and a workplace ecosystem that turns engagement into measurable improvements in health costs and outcomes. With over half of the non-elderly population[4] covered by employer-sponsored insurance, wearable technology is becoming a tactic of choice for today's employer.

Nearly thirty-five percent[5] of Healthiest Employers® Program Participants include wearable technology in their corporate wellness strategy, and a projected 13 million wearable devices will be integrated into wellness plans offered by businesses in the next five years.[6] With this rapid adoption, today's health and wellness leader faces pressure to measure results of these investments and must ensure that devices produce a lasting return and change in the population.

The complexity of collecting health care claims data has limited employer attempts to link mobile health to improved health outcomes and lowered costs. This study evaluates key cost metrics within a large, self-funded employer.

## Convergence and Transformation

Today, the wearable-to-wellness movement is feeding population health strategies. Four forces are transforming devices from consumer gadgets with broad appeal into the advanced wellbeing sensors that arm today's employer.

### 1 - CLINICAL AND CONSUMER CONVERGENCE

Meeting consumer expectations for consistent and relevant data, today's wearable offers more insights and guidance for lifestyle changes. Wearables are rapidly adopting consumer aesthetics and usability to support improved health awareness, monitoring and self-care.

### 2 - TECHNOLOGY INNOVATION

Social media, mobile technology and advanced analytics have made it easier to aggregate information from diverse sources and form communities of interest. They've also fueled intervention specialists and device manufacturers to explore and adopt new technologies.

### 3 - CONSUMER EXCITEMENT

Wearable device makers shipped nearly 80 million devices in 2015, a clear indication that nothing fascinates consumers more than their own data.[7] Consumers' top priority for wearable use is to make smarter decisions, outranking even "infotainment" and social media features.[8]

### 4 - MOTIVATED STAKEHOLDERS

Wearables continue to garner attention from providers, insurers, policymakers, and employers. Increased need for care, a greater chronic disease load, and an aging population continue to fuel urgency among all stakeholders to address not just health, but escalating health care costs.

[4] "2015 Employer Health Benefits Survey" by Kaiser Family Foundation
[5] Healthiest Employer® 2016 Strategic Wellness Assessment
[6] "Corporate Wellness is a 13 Million Unit Wearable Wireless Device Opportunity" by Allied Business Intelligence, Inc. https://www.abiresearch.com/press/corporate-wellness-is-a-13-million-unit-wearable-w/
[7] "Q4 2015 Worldwide Quarterly Wearable Device Tracker," IDC, 2016
[8] "Consumer Intelligence Series: Wearables Consumer Survey." PWC Health Research Institute, 2014.

> "The days of **one-size-fits-all programming and communication have been replaced** with new age tools."

# More than a Device: Wearables and Workplace Wellness

Faced with double-digit health care cost growth and pressure to increase productivity, it's easy to understand why employer interest in workforce health is gaining steam. In a Rand employer survey, 85% of companies with 1,000-10,000 employees offer a wellness program, and the numbers are on the rise for both large and small organizations.[9] With increased adoption, wellness programs have grown from on-site employee initiatives to more advanced strategies that deploy gamification, spouse and dependent fitness challenges, and team-based campaigns.

In an effort to meet employees "where they are" in their health journey, wellness programs are leveraging wearable technology. In fact, employers account for half of all fitness band sales in the U.S.[10] Employers are not just providing devices to signal an investment in health. The 2016 Healthiest Employers® survey found that they're using wearable data to assess employee population health and to guide strategic planning for new wellness investments.

Employers have changed their approach in both how they engage members, and in how they invest in the asset of employee health. Yesterday's wellness strategies often included newsletters, seminars and "sticks" that missed the individuals in most need of intervention. Today's employers have a greater understanding of how to engage the employee with specific interventions at the individual level.

The days of one-size-fits-all programming and communication have been replaced with new age tools. Wearable technology, advanced analytics, and mobile engagement are transforming how employers think about, and invest in, their population.

## Enterprise Deployment and Connection

Wearables are connecting employees to a broader wellness strategy. A complete view of overall health, step count, heart rate, and sleep show promise for increased engagement toward improved health.

Enterprise deployment is an ideal use case for wearable technology since both the individual and employer share a mutual interest in overall health. Embedding wearable technology in a comprehensive workforce health strategy arms an employer with additional insights to measure and adjust their approach. What's more, this new data set offers a forward-looking view of health that moves beyond the historic nature of claims data alone.

This rich data is available to employers through software provided by wearable technology manufacturers. Health intelligence platforms like Springbuk give employers additional visibility by including medical claims, pharmacy, lab, and clinical data. This connection fosters the measurement of health initiatives in near real-time.

[9] "Workplace Wellness Programs Study" by RAND Health, Sponsored by the U.S. Department of Labor and the U.S. Department of Health and Human Services. https://www.dol.gov/sites/default/files/ebsa/researchers/analysis/health-and-welfare/workplacewellnessstudyfinal.pdf

[10] "Wearables and Company Wellness Programs Go Hand-in-Hand," Computerworld, 2015

## Data-Driven Results

Nearly half (54.6%)[11] of employers surveyed for the "Healthiest Employer" Award Program describe their wellness program as "metric driven." Receiving the data itself has not been the biggest challenge in understanding the impact of wearables or other interventions on employee wellness. Rather, the biggest hurdle has been turning the raw data into intelligence… and ultimately action. As noted digital health care expert Dr. Eric Topol observes, it's the "data analytics and the clinical utility parts that most of the companies haven't figured out yet." [12]

Until recently, inadequate data integration and the complexity of reporting tools limited employer attempts to link mobile health data to improved health outcomes and lowered costs.

Fortunately, that's changing. Employer-facing platforms are going beyond participatory measures: they are seamlessly integrating wearable data with medical claims, clinic, pharmacy and biometric data. This combination of historical and predictive analytics helps identify the most promising opportunities for employers to improve health and cost outcomes.

Cohort analysis uncovers which interventions, from which vendors, for which employee sub-groups will be most effective. This results in the ability to perform precise, targeted engagement. Decision makers can then model the likely results for the broader population across health risk, clinical health outcomes and health care costs.

> "…the biggest hurdle has been turning the raw data into intelligence… **and ultimately action.**"

As the following analysis shows, connected health and fitness interventions can **close the gap** between the everyday actions that change health and drive outcomes for employee health and employer cost.

This study shows that the holy grail of employee wellness is now within reach: the ability to make business and health decisions based on data instead of intuition.

[11] 2016 Healthiest Employer® Strategic Assessment

[12] "Why the FDA Wants More Health Wearables on the Market." Fortune, 2015

# Case Study: **Meet the Employer**

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# Case Study: Meet the Employer

The purpose of this study was to evaluate the impact of wearable devices on health care costs, when part of a worksite wellness program. An anonymous large employer is the subject of the study. With a workforce greater than 20,000 employees, this employer in the health care industry has an active wellness program, which includes the use of Fitbit devices and administrator dashboard. For additional profile information on the employer, see Technical Appendix II: Employer and Study Group's Profiles.

## Integration of Wearables in Overall Wellness Program

For this employer, utilizing Fitbit technology was the first integration of wearable technology as a primary component of their existing wellness program. In 2014, Fitbit became a part of the wellness program that included health screenings, health coaching, a wellness portal, weight loss programs, and tobacco cessation programs. Prior to 2015, the employer's wellness program did not include an activity program. Employees received entry into a raffle-based incentive for achieving pre-defined step goals.

## Employer Offering

Eligible employees were invited to choose a subsidized activity tracker from an e-commerce website, from which Fitbit sent devices directly to individuals. The program included an administrator dashboard that provided opt-in, aggregate data on activity and sleep.

The employer applied a $24 subsidy to the available trackers that ranged in retail value from $59.95 to $99.95. Employees had access to a wellness module that provided detail such as the company's step leader board, team stats, and performance against step goals.

## Benefit Plan Design

This employer offers four health plans: Two different health savings account (HSA) plans, a health reimbursement arrangement (HRA) plan, and a traditional preferred provider organization plan (PPO).

## Employer Profile

Demographics for this employer include:

- 28,921 team members (22,259 studied)
- 75% full-time
- 79% women
- Average age of 46

## Key Metrics for Study

The Springbuk Health Intelligence platform was used to measure the outcomes and correlative effects of wearables. Three years of medical claims, pharmacy, and biometric data were paired with Fitbit device data to analyze correlative effects of wearables within the population. The case study examined employees that voluntarily participated in the Fitbit wearable program (the "Opt-in Group") and those that did not ("the Control Group"). The study was designed to address the financial impact of wearable technology as part of an overall wellness strategy in the workplace.

# Case Study: **Methodology**

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# Case Study: Methodology

The study utilized a robust and well-studied approach to analyzing the impact of the wearable program. The date range, sample size and sampling methods are detailed below. For a full methodology statement, please refer to Technical Appendix 1: Methodology.

For the analysis, Springbuk received the data through a hashing anonymization in two individual data sets. Medical claims, pharmacy, labs and eligibility were provided directly by the employer. Fitbit provided wearable technology usage data. The data sets were combined using a common key to match the users to each other while retaining anonymity.

## DATE RANGE USED FOR STUDY

— Baseline —
(pre-wearable integration)
June 1, 2013 to May 31, 2014

— Year 1 —
(wearable integration, year 1)
June 1, 2014 to May 31, 2015

— Year 2 —
(wearable integration, year 2)
June 1, 2015 to May 31, 2016

Three years of data were used to compare a "before and after" of the introduction of the Fitbit devices. This time period compares the Opt-in Group to a normalized Control Group of those who chose to opt-out of using a device.

## SAMPLING SIZE

22,259 employees

## SAMPLING REDUCTION METHOD

- Nearest neighbor non-greedy optimal matching using age, gender, prior health history and prior medical spend as the determinate matching variables
- Treatment effects in a non-randomized experiment
- Treatment: wellness initiative tied to a BMI/Lab

## NORMALIZED SAMPLE SIZE COHORT

- n = 2,689 employees
- Opt-in Group = 905 employees
- Control Group = 1,784 employees

# Case Study: Financial Impact of Wearables

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# Case Study: Financial Impact of Wearables

Corporate wellness continues to be a strong lever for managing health care costs. Over the last fifty years, annual health care spending per person has climbed to an estimated $10,659.70.[13] This nine-fold increase from 1960 is a major burden to employers.

To illustrate:

— The average employer sponsored plan now weighs in at $25,826.

— Average employer cost increased 4.2% since 2015.

— Only once in the past 10 years have employee costs increased at a lower rate than employer costs. [14]

As employers continue to pay for health outcomes, there is a shift toward investing in preventive measures to reduce cost and the need for care. Our findings suggest a promising opportunity for **wearables as a means to impact future health care**.

## Findings and Results

This study evaluates and compares the health care costs in three distinct areas:

— 1 —
"Opt-in" Group versus the "Control" Group

— 2 —
High Level Activity Group versus Low Level Activity Group

— 3 —
High Step Count Group versus Low Step Count Group

[13] CMS National Health Expenditure Data Fact Sheet

[14] 2016 Milliman Medical Index

## 1 - COST COMPARISON OF "OPT-IN" VERSUS CONTROL GROUP

Financial claims data were used to compare the intervention group of the Opt-in wearable users to the Control Group of non-wearable users in a before and after study. The conclusions suggest a strong correlation. Logic tells us that an active body is a healthy body; **this study suggests a much stronger, quantitative impact from wearable usage** as part of a comprehensive corporate wellness strategy.

Our findings, illustrated in Figures 1a and 1b, indicate an overall impact in both the Control and Opt-in Groups. The costs decreased over the three-year period, with a significant statistical difference by year three. These results imply wearable device usage resulted in lower medical claims.

### Comparison of Medical Claims

| AVG PEPY | Baseline | Year 2 | Difference |
|---|---|---|---|
| Control Group<br>Non-Wearable Users | $4,780<br>n=1,784 | $4,335<br>n=1,784 | -9.3% |
| Opt-In Group<br>Wearable Users | $4,248<br>n=905 | $3,197<br>n=905 | -24.7% |
| $ Change | -$532 | -$1,138 | |
| % Change | -11.1% | -26.3% | p>.05 |

*Figure 1a: Per Employer Per Year (PEPY) Cost Comparison of Medical Claims*[15]

Compared to the expected growth rate in individual health care spending of 5.8% per year[16], the findings are promising. **Medical claims decreased by 24.7% for the Opt-in Group** and 9.3% for the Control Group.

[15] Bounds represent 95% confidence intervals for the estimates
[16] CMS National Health Expenditure Data Fact Sheet

## Comparison of Medical and Rx Claims

| AVG PEPY | Baseline | Year 2 | Difference |
|---|---|---|---|
| Control Group<br>Non-Wearable Users | $5,367<br>n=1,784 | $5,072<br>n=1,784 | -5.5% |
| Opt-In Group<br>Wearable Users | $4,941<br>n=905 | $3,830<br>n=905 | -22.5% |
| $ Change | -$426 | -$1,242 | |
| % Change | -7.9% | -24.5% | p<.05 |

Figure 1b shows the cost comparison for the combined medical and pharmacy claims of the Opt-in and Control Groups. While there is not a statistical difference in the baseline, the difference in year three is statistically significant. **The data continues to suggest that usage of a wearable device supports on overall wellness strategy and may be effective at reducing overall medical and pharmacy costs.**

***Figure 1b:*** *Per Employer Per Year (PEPY) Cost Comparison of Medical and Pharmacy Claims*[17]

[17] Bounds represent 95% confidence intervals for the estimates

## 2 - COST COMPARISON OF HIGH LEVEL ACTIVITY VERSUS LOW LEVEL ACTIVITY GROUPS

While employees can lack interest in traditional engagement initiatives, most have a desire to voluntarily use wearables. On average, 90% of white-collar employees wish their companies would provide wearables and 60% are extremely interested in adoption.[18] They believe that wearable technology will help them be more active.

The findings in figures 2a, 2b, and 2c suggest a financial value of promoting and encouraging activity within an employee population. To evaluate the significance of wearable usage, the study separated the Opt-in Group by activity level.

For the purpose of this study, more than 100 steps is categorized as active for that day.[19] This analysis imposes three different thresholds of user activity:

— 365 days —
of active use

— 272 days —
of active use

— 182 days —
of active use

For the two-year study timeframe, these thresholds represent 50%, 32.5%, and 25% of eligible days, respectively. The goal of this analysis was to assess the relationship between the time that users are active and the total health care costs.

[18] "Wearable Technology in the Workplace Survey," Modis, 2014

[19] A user is considered active on a given day if he or she has logged at least 100 steps that day.

## 365 Days of Active Use

The study evaluated participants who logged at least 365 active days versus those who logged less than 365 active days. For each group, the analysis estimated the difference in costs between 2013 (baseline) and 2015 (year 2).[20]

**The findings suggest that significant cost savings can be realized by sustained active use of a wearable device.** Individuals who logged 365 or more active days in the two-year period are associated with a statistically significant reduction in costs between 2013 and 2015.[21] However, individuals who logged less than 365 days saw a less pronounced reduction in cost between 2013 and 2015.[22] Thus, the significant cost savings of the program can be attributable to individuals who are engaged with the device for a longer period of time.

### Analysis of 365 Days of Active Use

| AVG PEPY | Baseline | Year 2 | Difference |
|---|---|---|---|
| Less Active<br>< 356 days | $5,064<br>n=634 | $4,367<br>n=634 | -13.8% |
| Active<br>> = 365 days | $4,690<br>n=266 | $2,551<br>n=266 | -45.6% |
| $ Change | -$374 | -$1,816 | |
| % Change | -7.4% | -41.6% | |

*Figure 2a: Analysis of 365 days of active use*

[20] Significance of the differences between 2013 and 2015 values analyzed via a paired t-test and Kolomogorov-Smirnov

[21] Paired t-test p=.01

[22] Paired t-test p=.48

## 274 Days of Active Use

The study also evaluated participants who logged at least 274 active days versus those who logged less than 274 active days. For each group, the analysis estimated the difference in costs between 2013 (baseline) and 2015 (year 2).[23]

The findings suggest that significant cost savings can be realized by sustained active use of a wearable device. Individuals who logged 274 or more active days in the two-year period are associated with a significant reduction in costs between 2013 and 2015.[24] However, individuals who logged less than 274 days did not see a significant reduction in cost between 2013 and 2015.[25] Thus, the significant cost savings of the program can be attributable to individuals who are engaged with the device for a longer period of time.

### Analysis of 274 Days of Active Use

| AVG PEPY | Baseline | Year 2 | Difference |
|---|---|---|---|
| Less Active < 274 days | $5,291 n=546 | $4,639 n=546 | -12.3% |
| Active > = 274 days | $4,434 n=354 | $2,582 n=354 | -41.8% |
| $ Change | -$857 | -$2,057 | |
| % Change | -16.2% | -44.3% | |

*Figure 2b: Analysis of 274 days of active use*

[23] Significance of the differences between 2013 and 2015 values analyzed via a paired t-test and Kolomogorov-Smirnov

[24] Paired t-test p=.01

[25] Paired t-test p=.57

## 182 Days of Active Use

The study also evaluated participants who logged at least 182 active days versus those who logged less than 182 active days. For each group, the analysis estimated the difference in costs between 2013 (baseline) and 2015 (year 2).

The findings demonstrate no evidence of significant cost savings at the 182-day threshold.

### Analysis of 182 Days of Active Use

| AVG PEPY | Baseline | Year 2 | Difference |
|---|---|---|---|
| Less Active<br>< 182 days | $5,981<br>n=402 | $4,676<br>n=402 | -21.8% |
| Active<br>> = 182 days | $4,125<br>n=498 | $3,147<br>n=498 | -23.7% |
| $ Change | -$1,856 | -$1,529 | |
| % Change | -31.0% | -32.7% | |

*Figure 2c: Analysis of 182 days of active use*

Driving participation continues to be a popular topic in worksite health, and the data in this **study suggests that the connection between engagement and financial outcomes is real.**

> "A goal of the research was to analyze the correlation between steps and overall claims costs."

## 3 - COST COMPARISON OF HIGH STEP COUNT VERSUS LOW STEP COUNT GROUPS

A goal of the research was to analyze the correlation between steps and overall claims costs. At what point does the number of steps drive a financial impact? To address this question, the study compared Opt-in users with high step counts to those with low step counts. A secondary goal was to analyze the relative movement between these groups to evaluate the financial implications of achieving the popular 10,000 steps a day level.

For this analysis, the study compared two groups:

— 1 —
High and low step counts with >= 365 active days

— 2 —
High and low step counts with >= 274 active days

## High and Low Step Count >= 365 Active Days Comparison

The goal of this analysis was to assess the relationship between steps and total health care costs.

The study evaluated participants who logged at least 365 active days. This group was divided into two subgroups: high steps and low steps. The high steps group is comprised of individuals who took more than the median step count. The low steps group is comprised of those who took less than (or equal to) the median step count. For each group, the analysis estimated the difference in costs between 2013 (baseline) and 2015 (year 2). Average step count among the "low" group was 6,673. Average step count among the "high" group was 10,813.

As shown in Figure 3a, the findings suggest that **cost savings can occur at levels below the well-known 10,000 daily step count.**[26] There is no significant evidence that costs among "high" steppers decreased between the baseline and year three.[27]

Thus, significant cost savings can be realized by sustained wearable usage, and this savings is realized by the significant cost reduction among users who are active for a long period of time, but are not the "super" users achieving 10,000 steps.

### Claims Cost Comparison of High and Low Step Count Users with >=365 Active Days

| AVG PEPY | Baseline | Year 2 | Difference |
|---|---|---|---|
| Low Steps avg 6,673 | $6,048 n=133 | $2,505 n=133 | -58.6% |
| High Steps avg 10,813 | $3,332 n=133 | $2,596 n=133 | -22.1% |
| $ Change | -$2,716 | $91 | |
| % Change | -44.9% | 3.6% | |

*Figure 3a: Claims cost comparison of high and low step count users with >=365 Active Days*

[26] 95% confidence in significant cost difference for the "low" steppers between baseline and year 2 (p = .01)

[27] p-value of .10

## High and Low Step Count >= 274 Active Days Comparison

For the 274 active day range analysis, the average step count among the "low" group was 6,477 and 10,705 among the "high."

As shown in Figure 3b, when using the 274 active day cut-off, the findings suggest that **significant cost savings can occur among users who are not the "high" users achieving greater than 10,000 steps a day**.[28] There is no significant evidence that costs among "high" steppers decreased between the baseline and year 2.[29]

This analysis yields a similar finding: **significant cost reduction can be achieved by users who are active for a long period of time, but are not the "super" users** achieving 10,000 steps.

This study offers promise to worksite wellness. The findings challenge the industry thinking around activity, and points to a daily step count that is achievable by more members of an employee population. For members who view 10,000 steps as unachievable, there is now evidence that **6,477 daily steps offer the greatest reduction** in health care cost. Although the "low" steppers demonstrated a larger amount of medical claims, these findings are actionable for wellness programs to engage members from all points on the activity continuum.

### Claims Cost Comparison of High and Low Step Count Users with >=274 Active Days

| AVG PEPY | Baseline | Year 2 | Difference |
|---|---|---|---|
| Low Steps avg 6,477 | $5,726 n=177 | $2,822 n=177 | -50.7% |
| High Steps avg 10,705 | $3,141 n=177 | $2,342 n=177 | -25.5% |
| $ Change | -$2,584 | -$480 | |
| % Change | -45.1% | -17.0% | |

*Figure 3b: Claims cost comparison of high and low step count users with >=274 Active Days*

[28] 95% confidence in significant cost difference for the "low" steppers between baseline and year 2 (p = .01)

[29] p-value of .06

# The Future is Now.

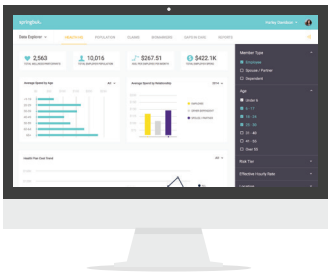
Nearly eighty percent of employers report an inability to measure a ROI, yet 45% are required to report wellness results on a quarterly basis to their leadership.[30] It's increasingly clear that employers are approaching a tipping point where wellness transforms from an altruistic perk into a core, strategic part of operations.

The measurable outcomes in this study offer promise of what all stakeholders crave: a path to better employee health, cost reduction, and better prevention. For this health care system's wellbeing program, wearable technology appears to be a shot in the arm.

As employers traverse rising health care costs, quantifying initiatives is more important than ever. Measuring health impact and reducing costs are no longer bound by intuition and best guesses: health data and analytics are providing unprecedented insight and action.

Imagine a time when employers have the tools to engage their population. Or, one when they can react in real-time to improve health. That time is here. Are you ready?

## Ready to Optimize your Healthcare Dollars?



Get Demo
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[30] Healthiest Employer® 2016 Strategic Wellness Assessment

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## Technical Appendix I: Methodology

The methodology presents a robust and well-studied approach to analyzing the impact of a treatment effect, the wearable program, in the absence of a randomized control population. The methodology first identifies a quasi-control subpopulation: non-participants with similar likelihoods of participating in the wearable program. Next, the quasi-control subpopulation and the wearable subpopulations are compared to identify the impact of the wearable program on health outcomes.

The goal of the propensity score matching technique is to reduce (or eliminate) the relationship between the treatment, wearable users, and employee characteristics that are typically correlated with health such as age, gender, prior health history and medical claims spend. Using these characteristics, employees who participate in the wearable program are matched with the most similar employees who did not participate in the program. The study refers to the employees who participated in the wearable program as the "Opt-in Group", and the non-participating employees as the "Control Group".

The goal of the matching process is to create a subpopulation that looks similar to a randomized control group: the control group. When the post-matching characteristics for the treated and the control groups are similar, the impact of self-selection biases is broken: that is any correlation between choosing the wearable and employee characteristics correlated with health outcomes.

Matching was performed via optimal, or non-greedy, nearest neighbor matching. Nearest neighbor matching identifies most similar individuals across multiple characteristics. Non-greedy is an approach that may result in a single control observation being matched to more than one treatment observation. To overcome potential issues related to overuse of a single observation, treatment observations were matched with two control observations and results show the number of unique control observations (1,784 individuals) is nearly twice the size of the treatment population (905 individuals).

After deriving the control group, the matched data was fed into an additional regression model that differentiated the impact of the wearable program vs. other possible explanatory variables such as historical heath costs.

Data used to perform this analysis included medical claims, pharmacy claims, eligibility, labs and wearable usage.

### CONFIDENCE INTERVAL

The results presented for the quantities of interest below were derived from the matched data. Bounds represent 95% confidence intervals for the estimates. Note: the matched data results estimate the impact of the wearable intervention program for individuals who participated in at least one health screening during the initial 2014 challenge between June 2014 and August 2014.

Measuring the activity and step level results were built upon propensity score matching. Propensity score matching of individuals was used to remove the impact of self-selection bias when comparing the wearable and non-wearable subpopulations. Additional statistical analysis has been performed to consider the values represented through relevant tests such as the unpaired, unequal variance Welch's t-test, paired t-tests, Kolomogorov-Smirnov (KS), and on the distribution of repeatedly sampled sample means.

# Technical Appendix II: Employer and Study Group's Profile

### EMPLOYER DEMOGRAPHIC PROFILE

- 28,921 team members
- 75% full-time
- 79% women
- Average age of 46 years 3 months
- Average age of opt-in wearable user 46 years 1 month
- Average age of non-wearable control group – 46 years 5 months
- Mean step count 8,433, mode 6,194

### OPT-IN GROUP VERSUS NON-WEARABLE GROUP – MEDICAL CLAIMS ONLY

- n = 2,689
- Wearable Users = 905
- Non-Wearable Users = 1,784

### OPT-IN GROUP VERSUS NON-WEARABLE GROUP – MEDICAL CLAIMS ONLY

- n = 2,689
- Wearable Users = 905
- Non-Wearable Users = 1,784

### LESS ACTIVE DAYS (< 365DAYS) COMPARED TO ACTIVE DAYS (>=365 DAYS)

- n = 900
- Less Active = 634
- Active = 266

### LESS ACTIVE DAYS (< 274DAYS) COMPARED TO ACTIVE DAYS (>=274 DAYS)

- n = 900
- Less Active = 546
- Active = 354

### LESS ACTIVE DAYS (< 182 DAYS) COMPARED TO ACTIVE DAYS (>=182 DAYS)

- n = 900
- Less Active = 402
- Active = 498

### COST WITH STEPS AND ACTIVE DAYS >=365 DAYS

- n = 266
- Low Steps (6,673) = 133
- High Steps (10,813) = 133

### COST WITH STEPS AND ACTIVE DAYS >=274 DAYS

- n = 354
- Low Steps (6,477) = 177
- High Steps (10,705) = 177

# About Springbuk

Springbuk is the leading employer-facing health intelligence platform. The software unifies disparate data sources–including medical claims, pharmacy, biometric, lab and payroll–for employers to identify future costs, engage at-risk employees, and measure their health care spending.

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