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**RGA**<sup>®</sup>

Reinsurance Group of America, Incorporated<sup>®</sup>

## Wearables in life insurance

*The evidence, emerging developments and potential applications*

Chris Falkous  
Biometric Research Actuary, RGA

23 November 2017

### Agenda

- Examples of wearable metrics in life insurance today
- The science behind these metrics
- Other metrics from mainstream devices
- Emerging developments
- Insurance applications
- The Four Rs

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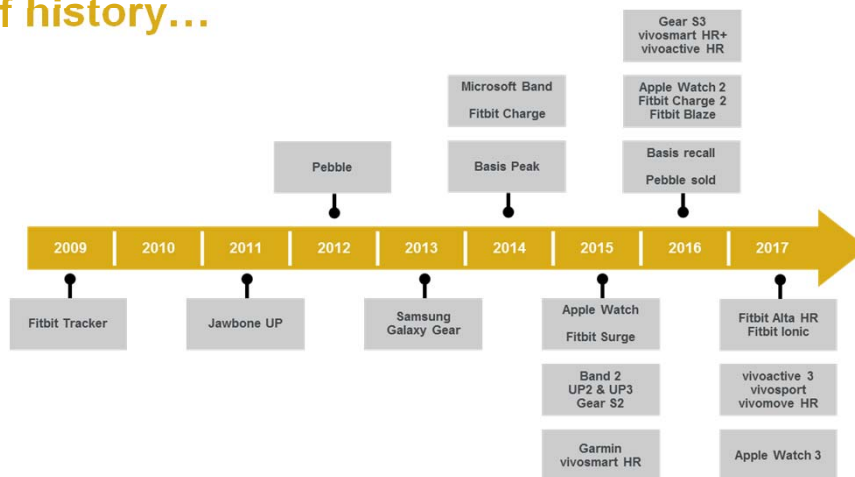


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## A brief history...



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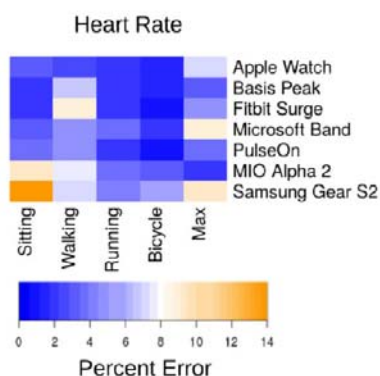


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## Accuracy of wrist-based fitness trackers



Now, we've no reason to query any specific findings based on our real world tests but the problem with lab studies is that they take a while, then the analysis takes a while then publishing takes a while. In short, all these wearables have now been replaced - the Apple Watch has a Series 2 for instance, the Basis and Microsoft Band are pretty much dead and **no-one cares about old Samsungs** or Mio bands and watches.

It's a shame as we need this kind of rigorous testing for metrics like heart rate in which companies often use similar tech but can produce very different results. The next study by this team will take the volunteers out of the lab and walking and exercising in their normal lives. I just hope they can upgrade the tech.

<https://www.wearable.com/newsletter>

Shcherbina et al (2017), J. Pers. Med. 2017, 7, 3; <http://dx.doi.org/10.3390/jpm7020003>;  
<https://www.wearable.com/wearable-tech/the-week-in-wearable-tech-lucky-japan-gets-the-goodies-4558>

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## What we're not covering today

- Accuracy
- Engagement
- Influencing behaviour

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## Wearables in Insurance today

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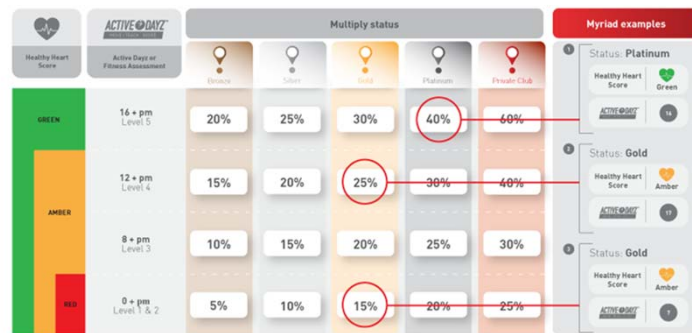
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## Momentum multiply

- Wellness and rewards in South Africa
- Life insurance discount
- Many supported devices
- Active Dayz
  - Going to the gym
  - 10,000 steps per day
  - Activity burning 300 calories
  - Certain qualifying events



<https://www.momentum.co.za/for-you/multiply/premier/myriad>  
<https://www.momentum.co.za/vps/wcm/connect/momV1/1af78e41-2d01-45e8-bfb7-4461d43ac517/HHS+Premier.png?MOD=AJPERES&CACHEID=1af78e41-2d01-45e8-bfb7-4461d43ac517> )

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## MLC On Track

- Life Insurance in Australia
- Garmin Vivosmart HR
- Target 900 points in 160 days
  - 5% discount for 1<sup>st</sup> and/or 2<sup>nd</sup>
    - So 10% if hit target in both periods
- Discount for life of policy

**MLC On Track**  
Target wellness score 900 (within 160 days)

How you can earn your maximum of ten points each day

<b>1 Step it</b> Less than 5,000 = 0 5,000 – 6,999 = 1 7,000 – 9,999 = 2 10,000 – 14,999 = 5 15,000 + = 10	OR	<b>Move it</b> Less than 20 minutes = 0 20 – 39 minutes = 1 40 – 59 minutes = 2 60 – 89 minutes = 5 90 + minutes = 10
<b>2 Sleep it</b> Less than 6 hours = 0 6.00 – 6.59 hours = 2 7.00 – 8.59 hours = 3 9.00 – 9.59 hours = 2 10 hours + = 0		<b>3 Wear it</b> Less than 18 hours = 0 18 hours + = 2
<b>4 Live it</b> Should your resting heart rate be over 85bpm = your points will be divided by 2 at the end of the day.		

[Close]

<https://ontrack.mlc.com.au/welcome> (<https://ontrack.mlc.com.au/resources/img/pointsmlc.png>)

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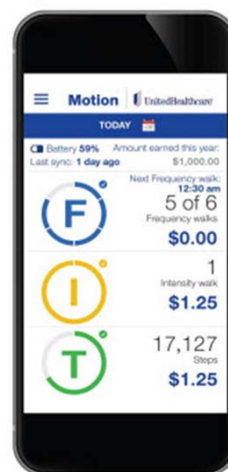
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## UnitedHealthcare Motion

- Corporate wellness program in US
- Various devices including Fitbit Charge 2
- Up to \$4 per day
  - 6x at least an hour apart
- Frequency: 300 steps in 5 mins
- Intensity: 3,000 steps in 30 mins
- Tenacity: 10,000 steps per day



<http://consultant.uhc.com/articleView-18035>

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## Vitality

- Wellness and rewards in UK
- Life insurance
  - Upfront discount with annual increase
- Many supported devices
- Vitality activity points
  - Steps per day
  - Gym visits
  - Activity as % of max HR
  - Activity at calories per hour



Select	2%	1%	0%	-1%*
Healthy	3%	2%	1%	0%
Everyday	4%	3%	2%	1%

<https://www.vitality.co.uk/rewards/partners/activity-tracking/>, <https://www.vitality.co.uk/life-insurance/optimiser/>

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## Mainstream metrics in life insurance today

- Steps
- Activity
- Inactivity
- Resting heart rate
- Sleep



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## The science behind these metrics



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## Steps

- Average daily steps at baseline
- All-cause mortality adjusted hazard ratio 0.94 per 1,000 increase in steps
- Adjusted for
  - Age
  - Sex
  - BMI
  - Energy intake
  - Smoking status
  - Alcohol consumption
  - Education

Baseline steps	Increase	Adjusted hazard ratio
7,000	-	-
8,000	1,000	0.94
10,000	3,000	0.83

Dwyer T, Pezic A, Sun C, Cochrane J, Venn A, Srikanth V, et al. (2015) Objectively Measured Daily Steps and Subsequent Long Term All-Cause Mortality: The Tasped Prospective Cohort Study. PLoS ONE 10(11): e0141274. <http://dx.doi.org/10.1371/journal.pone.0141274>; own calculations

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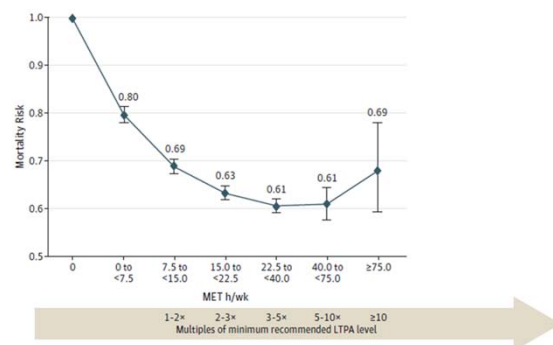
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## Physical activity dose-response curve

- At least 7.5 metabolic equivalent hours per week
  - 150 minutes moderate / 75 minutes vigorous exercise
- Model adjusted for
  - Age
  - Sex
  - Education level
  - Smoking status
  - Cancer history
  - Heart disease
  - Alcohol consumption
  - Marital status
  - BMI



Arem et al (2015), JAMA Intern Med. 2015;175(6):959-967. <http://dx.doi.org/10.1001/jamainternmed.2015.0533>

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## Physical activity and steps

- Low correlation between daily step count and physical activity time
- Independently protective for mortality when included in same model
  - Daily step count
  - 3+ hours of vigorous activity per week

Dwyer T, Pezic A, Sun C, Cochrane J, Venn A, Srikanth V, et al. (2015) Objectively Measured Daily Steps and Subsequent Long Term All-Cause Mortality: The Tasped Prospective Cohort Study. PLoS ONE 10(11): e0141274. <http://dx.doi.org/10.1371/journal.pone.0141274>

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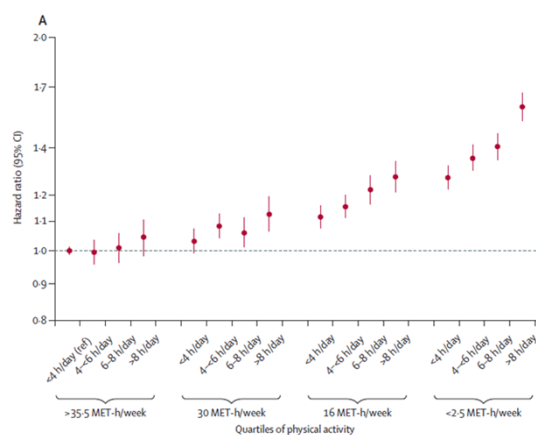
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## Inactivity

- Meta analysis
  - Over 1 million individuals
  - Almost 85,000 deaths
- Examples of covariates controlled for
  - Age
  - Sex
  - Smoking status
  - Alcohol consumption
  - Education
  - BMI
  - Most controlled for health in some way
- Expect to be significantly correlated with steps



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Ekelund et al (2016), [http://dx.doi.org/10.1016/S0140-6736\(16\)30370-1](http://dx.doi.org/10.1016/S0140-6736(16)30370-1)

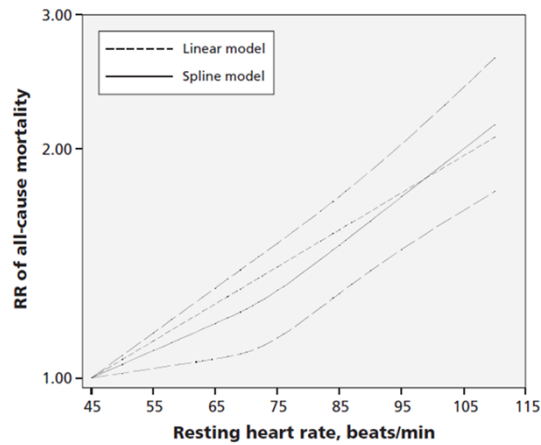
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## Resting heart rate

- Meta analysis
  - Relative risk 1.09 for all-cause mortality
  - 1.12 / 1.07 for <6 / 6+ covariates
  - Blood pressure
  - Smoking
  - BMI
  - Physical activity
  - Serum cholesterol
  - Diabetes
- Evidence of publication bias
  - Correcting for this reduced relative risk to 1.04



Zhang et al (2015), *CMAJ* 2015. <http://dx.doi.org/10.1503/cmaj.150535>

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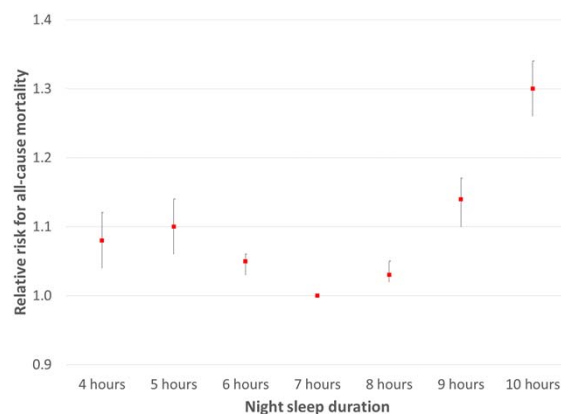


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## Sleep

- Meta analysis
  - 2.2 million participants
  - 271,500 deaths
- Night sleep duration
- Controlled for confounders
- Subgroup mean age under 65



Liu et al (2016), <http://dx.doi.org/10.1016/j.smrv.2016.02.005>; own chart

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## Hypothetical illustration

	Standard	Preferred	Relative mortality
Steps	7,000	10,000	0.83
Activity	0-1x	1-2x	0.86
Inactivity	8+ hrs	6-8 hrs	1.00*
Resting heart rate	70 bpm	60 bpm	0.96
Sleep	6 hrs	7 hrs	0.95
			0.65

- For illustration purposes only
- This simplified approach of multiplying relative mortalities together may not be appropriate
- Actual relative mortality may be higher or lower than shown



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## Other mainstream metrics



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## Examples of other metrics from mainstream devices

- Heart rate (recovery, maximum, minimum, night-time, etc)
- Stress (HRV)
- VO2 max
- Body composition
- Body temperature
- Ambient temperature

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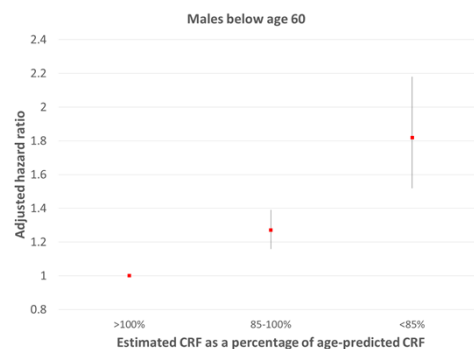
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## VO2 max

- Maximum rate at which oxygen can be used during exercise
- Indication of cardiorespiratory fitness
- Model adjusted for
  - Age
  - Smoking
  - Alcohol consumption
  - Marital status
  - Family history of disease
  - Education



Nes et al (2014),  
[https://www.researchgate.net/publication/260430242\\_A\\_Simple\\_Nonexercise\\_Model\\_of\\_Cardiorespiratory\\_Fitness\\_Predicts\\_Long-Term\\_Mortality](https://www.researchgate.net/publication/260430242_A_Simple_Nonexercise_Model_of_Cardiorespiratory_Fitness_Predicts_Long-Term_Mortality); own chart

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## Emerging developments



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## Examples of emerging developments

- Blood pressure
- Pulse Wave Velocity
- Muscle oxygen levels
- Hydration
- Detecting / monitoring illness
- Emotions



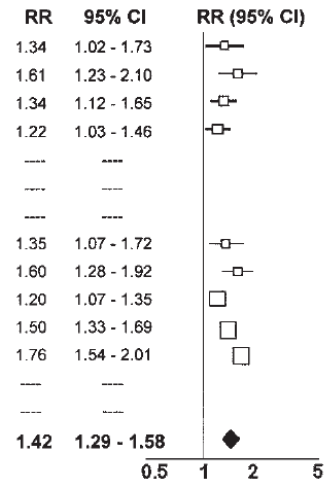
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## Pulse Wave Velocity

- Speed at which pulse wave propagates
- Gives an indication of arterial stiffness
  - Low speed is optimal
  - Indicates low blood pressure and soft arteries
- Meta analysis
- Relative risk for 1 SD increase in PWV is 1.42
- Most studies adjusted for
  - Age
  - Sex
  - Blood pressure



Vlachopoulos et al (2010), <http://dx.doi.org/10.1016/j.jacc.2009.10.061>

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## Detecting / monitoring

**THE VERGE**

**Apple Watch detects heart irregularity with 97 percent accuracy**

*Not good enough for official diagnosis, but useful as a screening tool*  
By Angela Chen | @theverge | May 10, 2017, 10:45am EDT



Photo: Courtesy of Cardiogram

RESEARCH ARTICLE

**Digital Health: Tracking Physiomes and Activity Using Wearable Biosensors Reveals Useful Health-Related Information**

Xiao Li<sup>1\*</sup>, Jessilyn Dunn<sup>1,2\*</sup>, Denis Salins<sup>1\*</sup>, Gao Zhou<sup>1</sup>, Wenyu Zhou<sup>1</sup>, Sophia Miryam Schüssler-Florenza Rose<sup>3,4</sup>, Dalia Perelman<sup>5</sup>, Elizabeth Colbert<sup>3</sup>, Ryan Runge<sup>1</sup>, Shannon Rego<sup>3</sup>, Ria Sonecha<sup>1</sup>, Somalee Datta<sup>1</sup>, Tracey McLaughlin<sup>5</sup>, Michael P. Snyder<sup>1</sup>

<https://www.theverge.com/2017/5/15/15640942/apple-watch-cardiogram-heart-health-artificial-intelligence-monitoring>

Li et al (2017), PLoS Biol 15(1): e2001402 <http://dx.doi.org/10.1371/journal.pbio.2001402>

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## Insurance applications



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## Possible uses in insurance

- Segmentation
- Risk-based pricing
- Post-issue underwriting
- Claims
- Distribution
- Engagement / cross-sell



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## Smoker identification

**somatix**

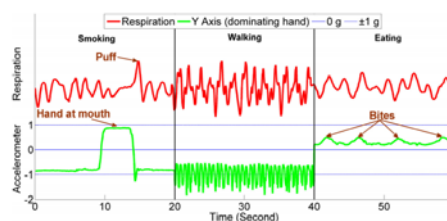
SmokeBeat app main features:

- World's first smoking cessation app using wearables
- Immediate notifications and alerts related to your smoking habits
- Gradual cessation coaching, followed by incentives
- Group support at your fingertips



### puffMarker: A Multi-Sensor Approach for Pinpointing the Timing of First Lapse in Smoking Cessation

Nazir Saleheen\*, Amin Ahsan Ali<sup>†</sup>, Syed Monowar Hossain<sup>†</sup>, Hillol Sarker<sup>\*</sup>, Soujanya Chatterjee<sup>\*</sup>, Benjamin Marlin<sup>‡</sup>, Emre Ertin<sup>§</sup>, Mustafa al'Absi<sup>¶</sup>, and Santosh Kumar<sup>\*</sup>



<http://somatixinc.com/smokebeat/>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4631252/pdf/nihms728785.pdf>

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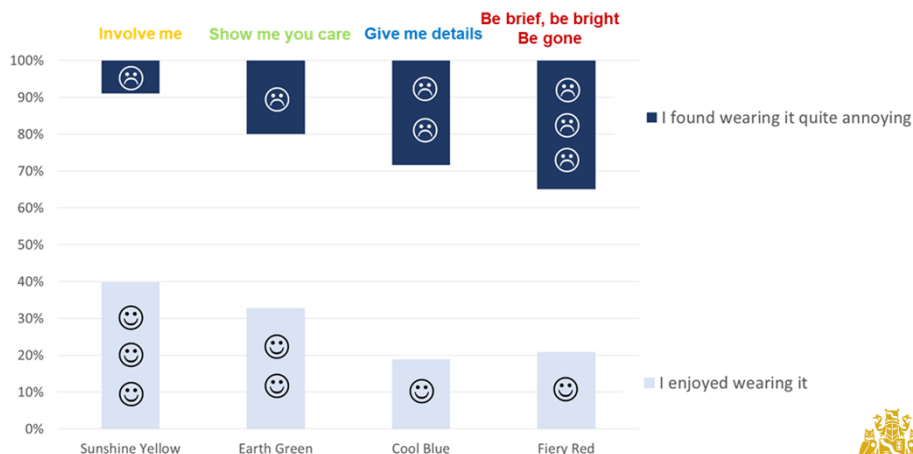


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## Personality and wearables



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## The Four Rs

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## The Four Rs

- Regulations
- Reasonable expectations
- Risks
- Rewards



BASIS

### Safety Recall of all Basis Peak watches

[UPDATE – September 16, 2016]

On June 13 we shared reports of overheating in Basis Peak watches, and we recommended that you stop wearing your Basis Peak watch right away. We had hoped to update the software on your watch to address the problem. Unfortunately, despite our best efforts, we aren't able to develop such a solution without completely compromising the user experience. As a result, we are asking that you return your Basis Peak watch and authorized accessories for a full refund at your earliest convenience. This was a tough decision, but your safety is our top priority.

15	UNITED STATES DISTRICT COURT	
16	NORTHERN DISTRICT OF CALIFORNIA	
17	SAN FRANCISCO DIVISION	
18		
19	KATE MCLELLAN, TERESA BLACK, and	Case No. 16-cv-36
20	DAVID URBAN, Individually and on Behalf	
21	of All Others Similarly Situated,	<u>CLASS ACTION</u>
22	Plaintiffs,	<u>CLASS ACTION COMPLAINT</u>
23	v.	<u>DEMAND FOR JURY TRIAL</u>
24	FITBIT, INC.,	
25	Defendant.	

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# Questions



# Comments

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