



Institute
and Faculty
of Actuaries

RGA[®]

Reinsurance Group of America, Incorporated[®]

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

RGA

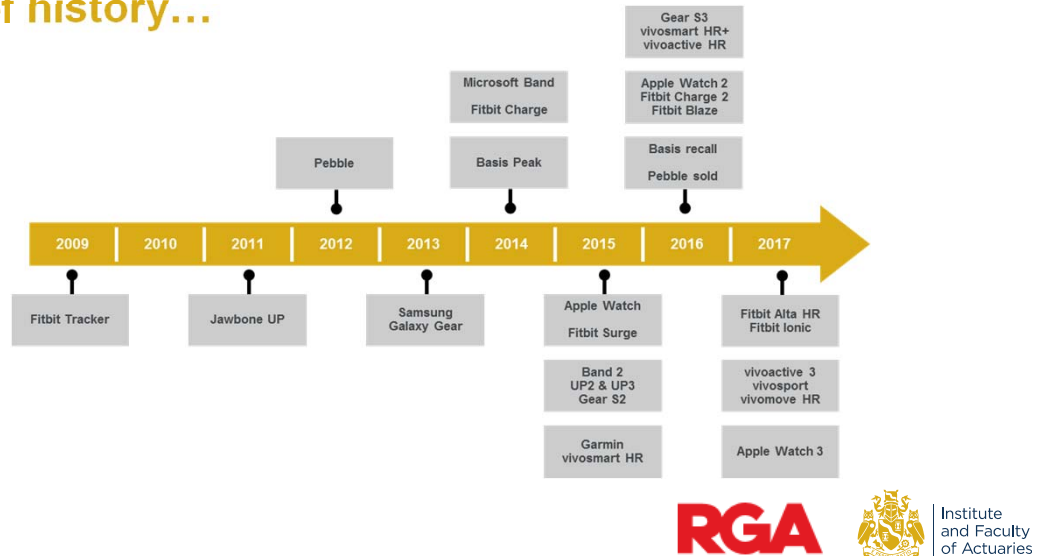


Institute
and Faculty
of Actuaries

23 November 2017

2

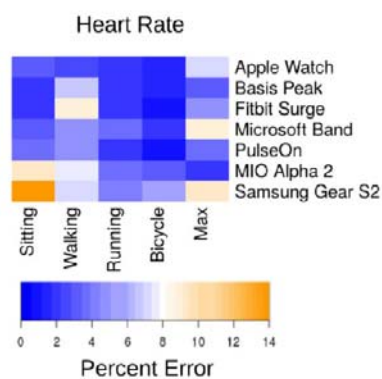
A brief history...



23 November 2017

3

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>

RGA Institute and Faculty of Actuaries

23 November 2017

4

What we're not covering today

- Accuracy
- Engagement
- Influencing behaviour



Institute
and Faculty
of Actuaries

23 November 2017

5

Wearables in Insurance today



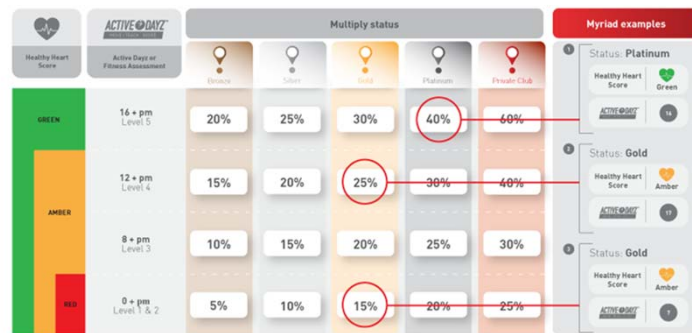
Institute
and Faculty
of Actuaries

23 November 2017

6

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>

RGA



Institute
and Faculty
of Actuaries

23 November 2017

7

MLC On Track

- Life Insurance in Australia
- Garmin Vivosmart HR
- Target 900 points in 160 days
 - 5% discount for 1st and/or 2nd
 - 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

1 Step it Less than 5,000 = 0 5,000 – 6,999 = 1 7,000 – 9,999 = 2 10,000 – 14,999 = 5 15,000 + = 10	OR	2 Move it Less than 20 minutes = 0 20 – 39 minutes = 1 40 – 59 minutes = 2 60 – 89 minutes = 5 90 + minutes = 10
3 Sleep it 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	4 Wear it Less than 18 hours = 0 18 hours + = 2	
Live it 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>)

RGA



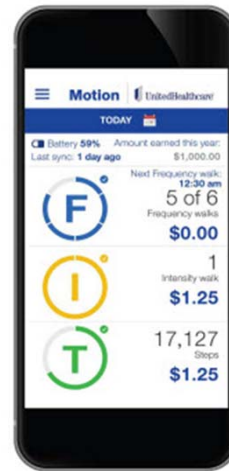
Institute
and Faculty
of Actuaries

23 November 2017

8

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>

23 November 2017

RGA



Institute
and Faculty
of Actuaries

9

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/>

23 November 2017

RGA



Institute
and Faculty
of Actuaries

10

Mainstream metrics in life insurance today

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



Institute
and Faculty
of Actuaries

23 November 2017

11

The science behind these metrics



Institute
and Faculty
of Actuaries

23 November 2017

12

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

RGA



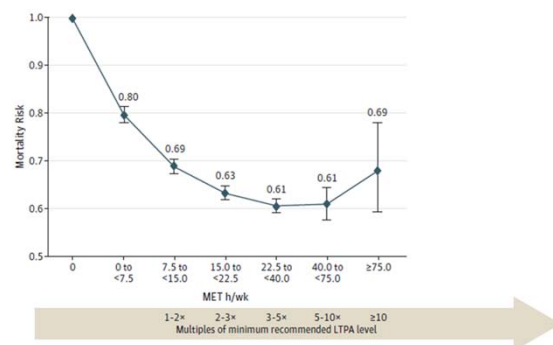
Institute
and Faculty
of Actuaries

23 November 2017

13

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>

RGA



Institute
and Faculty
of Actuaries

23 November 2017

14

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>



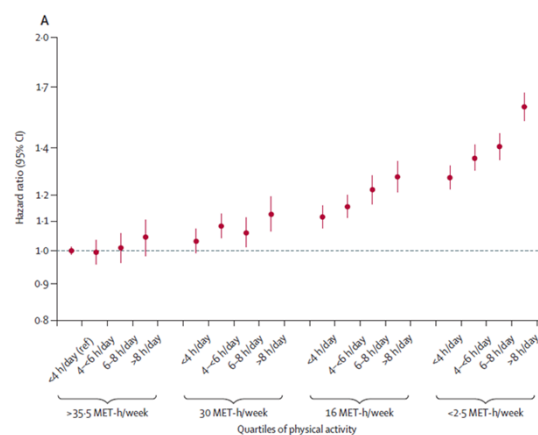
Institute
and Faculty
of Actuaries

23 November 2017

15

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



Institute
and Faculty
of Actuaries

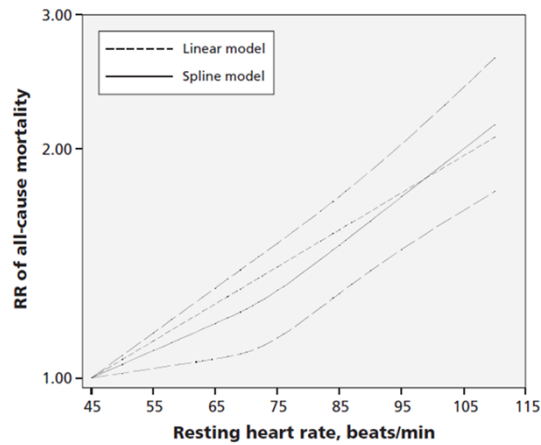
Ekelund et al (2016), [http://dx.doi.org/10.1016/S0140-6736\(16\)30370-1](http://dx.doi.org/10.1016/S0140-6736(16)30370-1)

23 November 2017

16

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>

23 November 2017

RGA

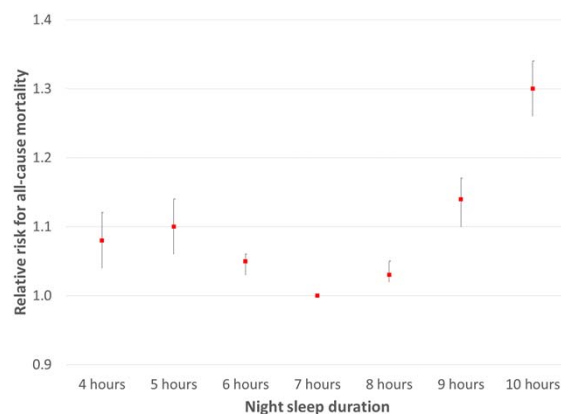


Institute
and Faculty
of Actuaries

17

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.smr.2016.02.005>; own chart

23 November 2017

RGA



Institute
and Faculty
of Actuaries

18

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
- Depending on the characteristics of the insured population, pricing discounts may be substantially lower than this



Institute
and Faculty
of Actuaries

23 November 2017

19

Other mainstream metrics



Institute
and Faculty
of Actuaries

23 November 2017

20

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

RGA



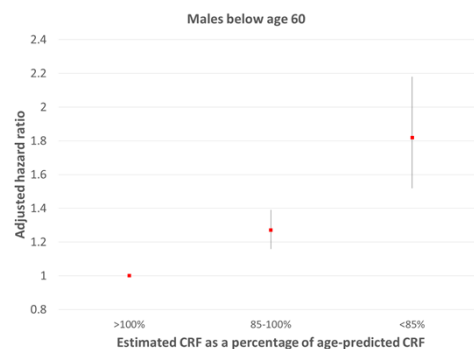
Institute
and Faculty
of Actuaries

23 November 2017

21

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; own chart

RGA



Institute
and Faculty
of Actuaries

23 November 2017

22

Emerging developments



Institute
and Faculty
of Actuaries

23 November 2017

23

Examples of emerging developments

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



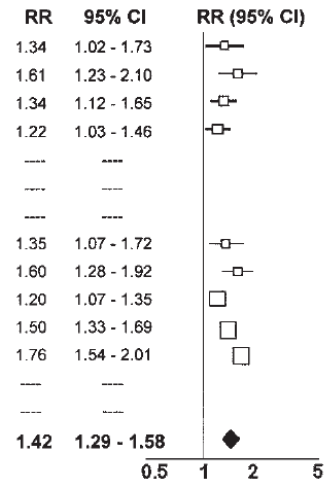
Institute
and Faculty
of Actuaries

23 November 2017

24

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



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

23 November 2017

RGA



Institute
and Faculty
of Actuaries

25

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^{1*}, Jessilyn Dunn^{1,2*}, Denis Salins^{1*}, Gao Zhou¹, Wenyu Zhou¹, Sophia Miryam Schüssler-Florenza Rose^{3,4}, Dalia Perelman⁵, Elizabeth Colbert³, Ryan Runge¹, Shannon Rego³, Ria Sonecha¹, Somalee Datta¹, Tracey McLaughlin⁵, Michael P. Snyder¹

<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>

23 November 2017

RGA



Institute
and Faculty
of Actuaries

26

Insurance applications



Institute
and Faculty
of Actuaries

23 November 2017

27

Possible uses in insurance

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



Institute
and Faculty
of Actuaries

23 November 2017


28

Smoker identification

somatix

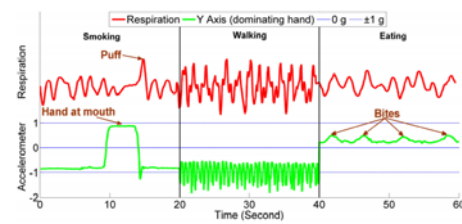
SmokeBeat app main features:

- 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[†], Syed Monowar Hossain*, Hillol Sarker*, Soujanya Chatterjee*, Benjamin Marlin[‡], Emre Ertin[§], Mustafa al'Absi[¶], and Santosh Kumar*



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

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

RGA

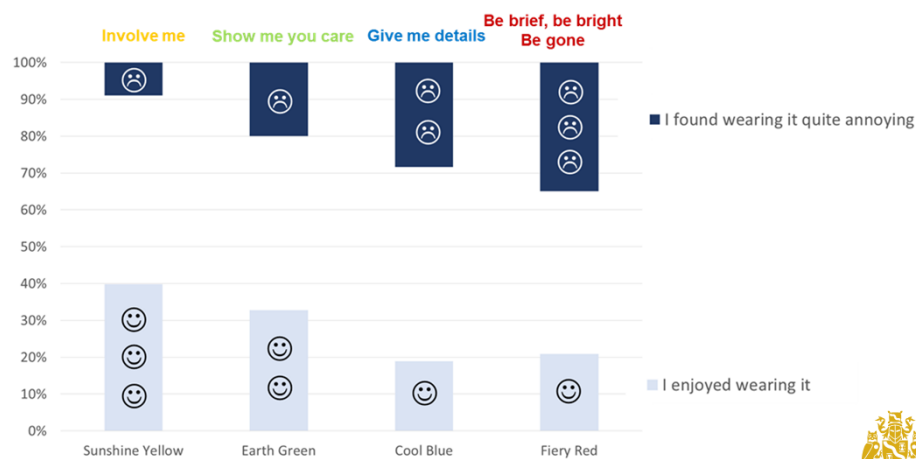


Institute
and Faculty
of Actuaries

23 November 2017

29

Personality and wearables



Institute
and Faculty
of Actuaries

The Four Rs

RGA



Institute
and Faculty
of Actuaries

23 November 2017

31

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 DAVID URBAN, Individually and on Behalf of All Others Similarly Situated,	Case No. 16-cv-36
20		<u>CLASS ACTION</u>
21		<u>CLASS ACTION COMPLAINT</u>
22	Plaintiffs,	<u>DEMAND FOR JURY TRIAL</u>
23	v.	
24	FITBIT, INC.,	
25	Defendant.	

RGA



Institute
and Faculty
of Actuaries

23 November 2017

32

Questions

Comments

The views expressed in this [publication/presentation] are those of invited contributors and not necessarily those of the IFoA. The IFoA do not endorse any of the views stated, nor any claims or representations made in this [publication/presentation] and accept no responsibility or liability to any person for loss or damage suffered as a consequence of their placing reliance upon any view, claim or representation made in this [publication/presentation].

The information and expressions of opinion contained in this publication are not intended to be a comprehensive study, nor to provide actuarial advice or advice of any nature and should not be treated as a substitute for specific advice concerning individual situations. On no account may any part of this [publication/presentation] be reproduced without the written permission of the IFoA [or authors, in the case of non-IFoA research].



Institute
and Faculty
of Actuaries