MILLIMAN REPORT

The role of wearables in private medical insurance

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1. Executive Summary

Mass market wearable technology is relatively new, and it has evolved dramatically in recent years. Ever since the rollout of electronic devices capable of measuring and recording various types of health data, private medical insurers have been carefully eyeing the potential usage of these devices. In this paper we discuss the implementation and practical uses of wearables in the private medical insurance market. We review why insurers are considering using wearable devices and how these devices might benefit insurers' business models, as well as some of the pitfalls to consider.

Wearables provide real-time data points that we expect to be detailed and accurate. However, is this really the case? We look at the reliability of real-time data, potential areas of fraud and abuse and whether wearables' data can really be considered reliable. We also look at funding considerations when incorporating wearables into an insurance product, alongside other key considerations for the use of wearables data. We found that, whilst wearables data can help insurers gain additional insight into the general fitness levels of its policyholders, the additional data collected might not necessarily improve upon existing claims cost prediction techniques.

As part of our research, we conducted a market survey designed to understand consumer opinions on their interaction levels with wearable devices and their thoughts on the use of wearables in insurance. We share the findings of our market research and discuss some of the key conclusions. An interesting outcome from this research was that even though a significant proportion of our respondents regularly tracked their health data, and worked within the insurance industry, views on the role of wearables data within insurance varied quite widely. We consider the range of devices used by survey participants, the type and frequency of activity captured and their views on the use of this information in determining the premium level for their insurance policies.

Finally, we consider whether the types of data available from wearables really provide predictive value in healthcare. As most health risk assessments (HRAs) are generally accepted to be evidence-based in their scoring, we conducted a sensitivity analysis on HRA data elements that are parallel to the types of data that could be obtained through wearables (e.g. tracking exercise and activity levels). We varied the different input metrics in three independent HRAs to see which metrics had better predictive value for the overall outcome. We use these findings to assess whether corresponding measurable data provided from wearable devices are likely to enhance the pricing methodologies of private medical insurers significantly. Our findings indicate that, although wearables may encourage members to increase their activity levels, many of the key factors that influence HRA scores (and hence members' overall health levels) are not captured by wearables.

2. Why are insurers thinking about implementing wearables?

The use of wearables in insurance is typically centred around three main objectives:

1. **Improve claims cost prediction**
    a. Insurers can use wearables data to supplement their underwriting processes and pricing models.
2. **Make people healthier and reduce healthcare claims costs**
    a. Increased awareness about healthy lifestyle behaviours and increased physical activity is expected to improve members' health and eventually reduce overall healthcare claims costs.
3. **Strengthen competitive position**
    a. As the popularity of wearables increases, insurers may be required to offer them as part of their regular wellness offerings to remain competitive.

Although these objectives sound reasonable, it is important to question whether wearables do in fact add power to claims cost prediction beyond what traditional and other big data measures contribute, and if wearables are in fact capable of making people healthier.

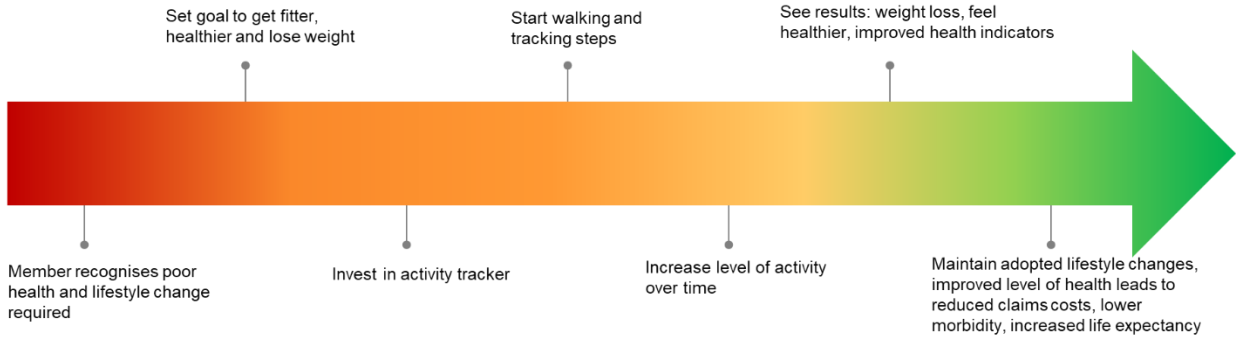
Offering wearables to insurance policyholders certainly presents new opportunities not previously available to insurers. However, these opportunities are not without their pitfalls, as shown in Figure 1.

FIGURE 1: OPPORTUNITIES AND PITFALLS OF USING DATA FROM WEARABLES

Capability	Opportunities	Pitfalls
 **Collect real-time data**	▪ Large amounts of real-time data to track activity and health indicators of individuals	▪ Storing, processing and creating business value can be tricky. ▪ Risk of collecting incorrect or misleading data. ▪ Regulatory and data protection concerns.
 **Pricing rating factors**	▪ New rating factors not otherwise available. ▪ Enhance predictive power.	▪ Complex 'black box' pricing models. ▪ May not provide additional insights compared to traditional methods because the underlying science is still not clear (i.e., we don't know which factors are most predictive of morbidity with any real level of precision). ▪ Potentially expensive to incorporate.
 **Underwriting using additional data**	▪ New underwriting criteria not otherwise available e.g. having credible and reliable wearables data may be a useful source of information when classifying policyholders as a standard or substandard risk.	▪ Potential for fraudulent methods used to achieve high activity levels. ▪ Discrepancy between devices may produce different conclusions for different measures. ▪ Lack of evidence that high levels of activity recorded by wearable devices can be associated with better risks.

The expectation is that insurers can positively impact their members' lifestyle behaviours with wearables, which should result in improved health and lower healthcare claims costs. Figure 2 illustrates a potential pathway of a member's journey along a positive lifestyle behavioural change journey.

FIGURE 2: THE IDEAL OUTCOME FROM IMPLEMENTING WEARABLES ON POLICYHOLDERS



However, actual experience could turn out quite differently from the expectation. A study by Rand Health on US wellness programmes in 2013[1] found that, while it is possible that the use of wearables can improve health and claims experience, further considerations are required to incentivise members. Two major findings from the study included:

1. Take-up rates for wellness tests are less than half for eligible employees and that less than a fifth of employees provided with follow-up actions carry them out.
2. When wearable technology is used in conjunction with loss-framed incentives, there are lower activity levels and higher financial costs to members. Conversely, gain-framed incentives can lead to higher activity and greater discounts for members with no additional financial costs incurred.

It is important to recognise that the use of wearable technologies alone is unlikely to be sufficient to drive real change in lifestyle behaviours and impact members' health. A comprehensive wellness programme that focuses on additional health-related activities with appropriate incentive structures is more likely to achieve the desired effects. In a separate Milliman publication, we discuss the considerations for implementing and evaluating wellness programmes.[2]

2.1 RISKS TO STAKEHOLDERS

For wearables to be integrated into a viable insurance product, risks faced by key stakeholders need to be addressed to achieve stakeholder alignment.

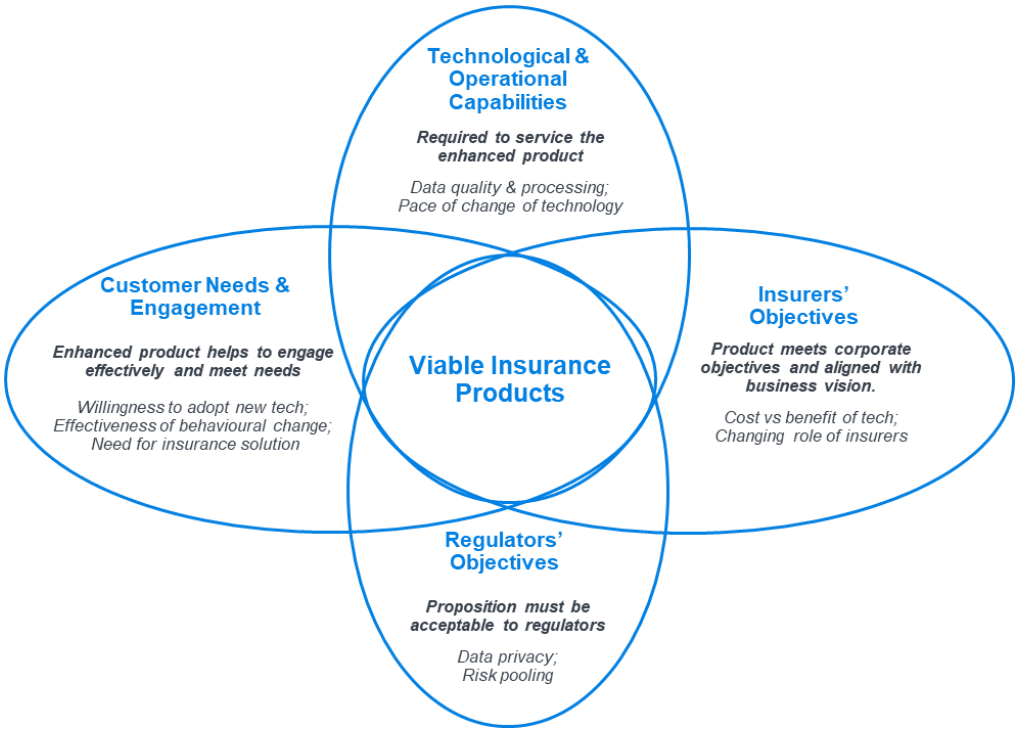
As shown in Figure 3, for insurers to achieve alignment with the relevant stakeholders, they will need to consider their own objectives, as well as those of the stakeholders and regulators. They will also need to consider the needs of their customers and identify their operational and technological capabilities to ensure that they can create a viable insurance product. Figure 3 is taken from the Institute and Faculty of Actuaries (IFoA) presentation 'Wearables and the Internet of Things.'[3]

[1] Mattle. S. et al. (2013). Workplace Wellness Programs Study. RAND Health. Retrieved 3 March 2020 from https://www.rand.org/content/dam/rand/pubs/research_reports/RR200/RR254/RAND_RR254.pdf.

[2] Beveja, L. et al. (December 2019). How to Implement a Wellness Programme. Milliman Report. Retrieved 3 March 2020 from https://www.milliman.com/insight/how-to-implement-a-wellness-programme.

[3] IFoA Wearables and Internet of Things Working Party (18 June 2018). Wearables and the Internet of Things: Working Party Update. Retrieved 3 March 2020 from https://www.actuaries.org.uk/practice-areas/health-and-care/disbanded-research-working-parties/impact-wearables-and-internet-things.

FIGURE 3: STAKEHOLDER ALIGNMENT FOR VIABLE INSURANCE PRODUCTS[4]



2.2 INSURANCE FIRMS ALREADY USING WEARABLES

Many insurers are already making use of the technology in their insurance and wellness programme offerings. Figure 4 includes examples of how some insurers are using the technology to incentivise policyholders.

FIGURE 4: EXAMPLES OF CURRENT USE OF WEARABLES IN INSURANCE

Aditya Birla Health Discounts for policyholders who record a specified number of steps using an activity tracker or attend gym sessions or have a health assessment.	The Vitality Programme Vitality members earn points and achieve a higher Vitality status when they undertake activities that are assumed to impact on health status. Higher Vitality statuses unlock higher rewards for benefits such as gym, travel and other discounts.	AXA Offers a free Withings Pulse fitness tracker. Participants receive discounts of over $100 on their insurance policies, as well as discounts off any Withings product purchases when they complete a certain number of steps.
Oscar Rewards customers who track their fitness data gift cards when they reach their step goals.	United Healthcare Rewards users with healthcare credits for reaching daily fitness goals.	Qantas Assure Policyholders receive Qantas frequent flyer points if they lead more active lifestyles.
Aetna Monitors daily activity and provides assistance in achieving personalised health goals. The app also provides recommendations, nudges and rewards.	Esurance SavorBand devices are offered which can capture information on food consumed, including recipes, cooking tips, and purchasing discounts along with other data.	Beam Technologies Uses Bluetooth-enabled toothbrushes to reward good brushing habits with discounted insurance premiums and other rewards.

[4] Ibid.

3. What do 'consumers' think? Our survey results

3.1 SURVEY OBJECTIVES

We conducted a survey, shared on LinkedIn, to investigate what our contacts think about wearables in insurance in the context of their role as 'consumers' by asking questions relating to:

- Demographic profile
- Current use of wearables
- Opinions on sharing wearables data with insurers
- Opinions on fairness of using wearables data for premium calculations
- Opinions on the use of discounts for using wearables on insurance policy renewal

We gathered 70 responses from this survey. Highlights from our survey results are discussed in the sections that follow.

3.2 DEMOGRAPHICS

We asked our respondents about their age bands, genders and job types. That information is presented in Figure 5.

FIGURE 5: POSSIBLE RESPONSES TO DEMOGRAPHIC QUESTIONS

AGE BAND	GENDER	JOB TYPE
<18	Female	Actuarial
18 – 24	Male	Data science
25 – 34	Prefer not to answer	Clinical practice
35 – 44	Other (please specify)	Strategy
45 – 54		Finance
55 – 64		Other (please specify)
65+		

Figure 6, Figure 7 and Figure 8 summarise the demographic information of our respondents. Approximately 41% of our respondents were female, 57% were male, and the remainder chose not to answer. Our most frequent type of respondent was a young adult in an actuarial, strategic or financial role based in the United Kingdom (UK). This was largely due to the fact that our survey was shared on LinkedIn and captured the responses of many of our LinkedIn contacts.

FIGURE 6: DISTRIBUTION OF RESPONSES BY AGE BAND

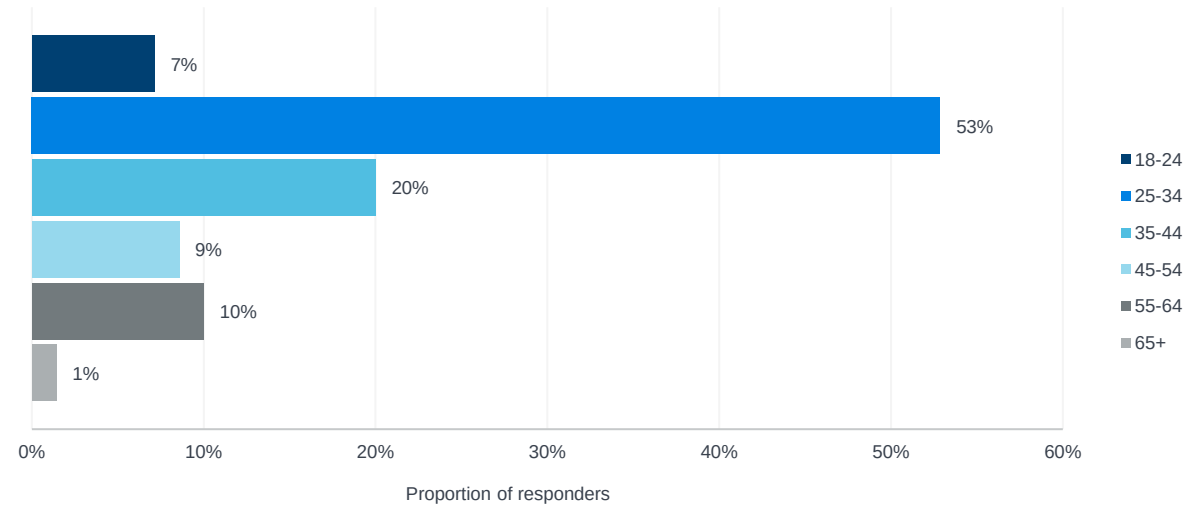


FIGURE 7: DISTRIBUTION OF RESPONSES BY JOB TYPE

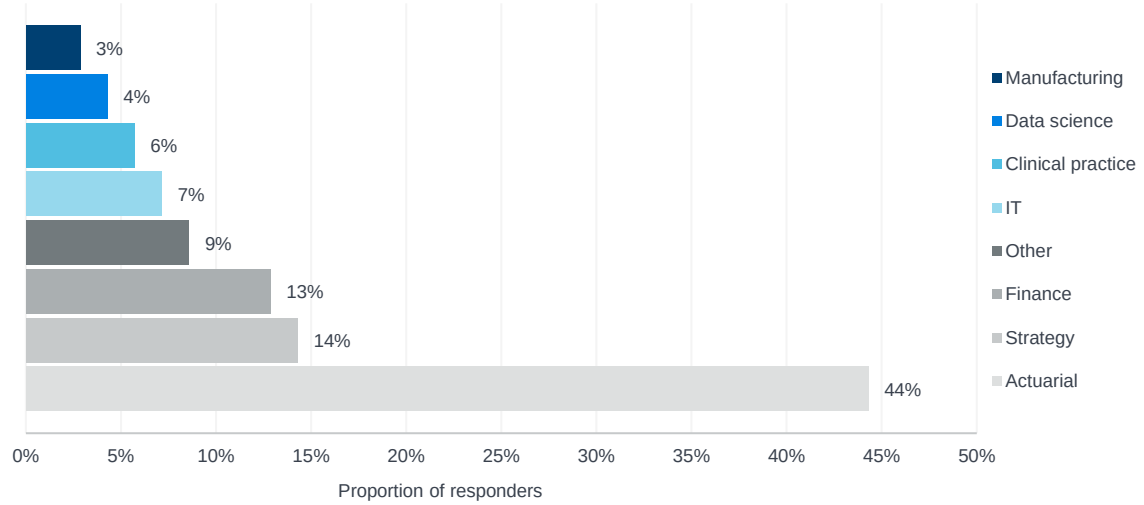
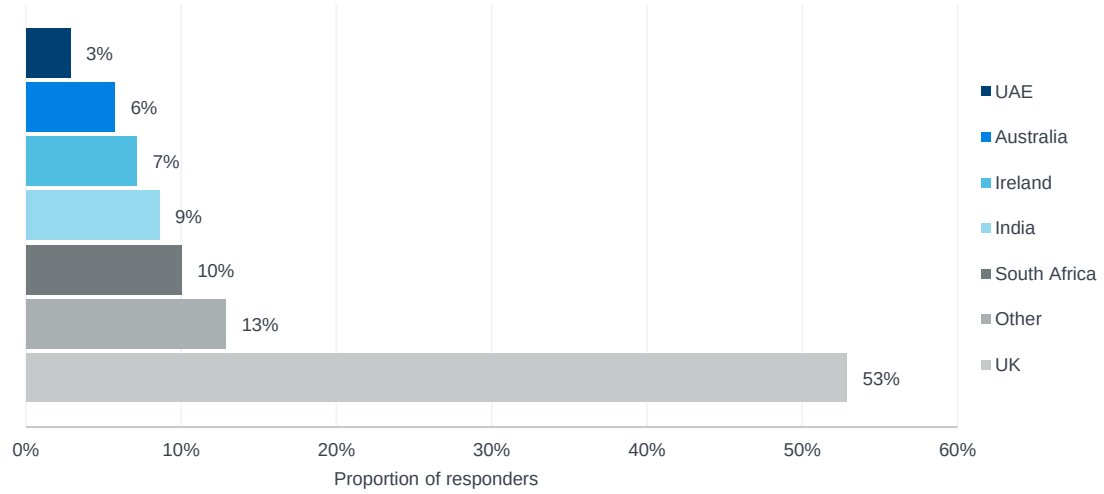


FIGURE 8: DISTRIBUTION OF RESPONSES BY COUNTRY



3.3 DEVICES, TRACKING ACTIVITIES AND STEPS

We asked our respondents what devices they use as their primary source for tracking their health data, and what activities they track.

FIGURE 9: SURVEY INSTRUMENT

WHAT IS THE MAIN DEVICE USED TO TRACK YOUR HEALTH AND FITNESS ACTIVITY?	WHAT ACTIVITY DO YOU TRACK? (SELECT ALL THAT APPLY)
▪ Apple watch	▪ Steps
▪ Fitbit	▪ Sports and/or exercise
▪ Garmin	▪ Distance
▪ Misfit	▪ Speed
▪ Polar	▪ Flights of stairs climbed
▪ Smartphone	▪ Sleep
▪ Smartwatch with Wear OS by Google	▪ Heart rate
▪ Other (please specify)	▪ Nutrition
▪ I do not track my activity	▪ Time spent being active
	▪ Other (please specify)

Figure 10 and Figure 11 summarise the responses we collected. The smartphone was the most used device, with just over half of the respondents using this as their primary tracking device. This is not surprising as most smartphones have inbuilt apps (such as Apple Health, Samsung Health and Google Health) that automatically record metrics such as sleep, steps and distance. Interestingly, 56% of our respondents used either a Fitbit, Garmin, Apple Watch or other smartwatch to actively track their data, which suggests that there is a large proportion of people actively choosing to use these devices to pursue their tracking goals.

Just over 21% of people said that they do not track any data at all. The most common activities that people tracked were steps and distance (84% and 64%, respectively). This is most likely because most devices fitted with GPS and accelerometers are capable of measuring these activities. Only 2% of our respondents track calories burned, even though the metric is displayed in various health apps.

FIGURE 10: DISTRIBUTION OF RESULTS BY SMART DEVICE USED

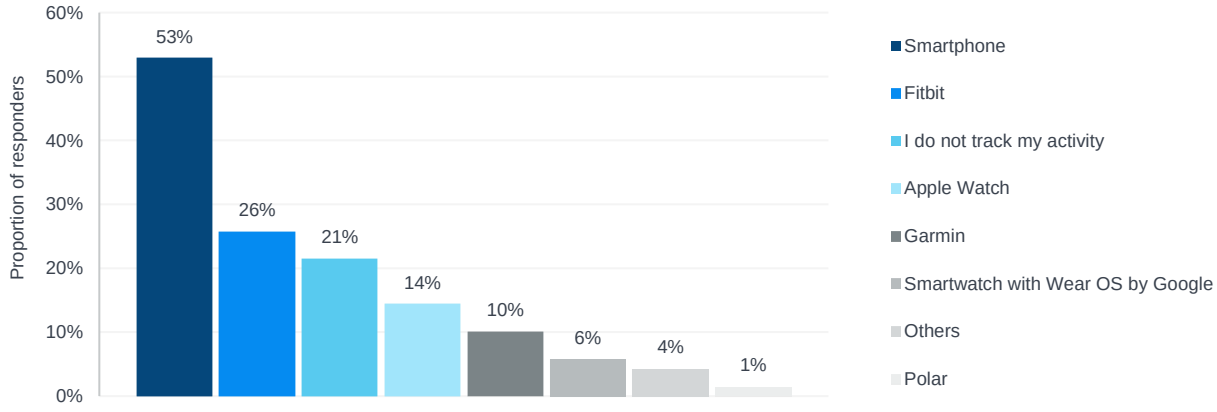
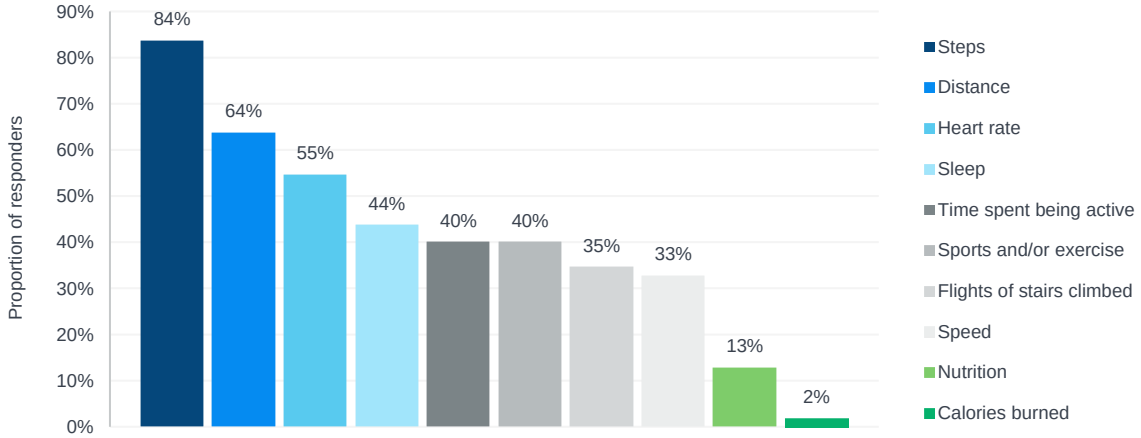


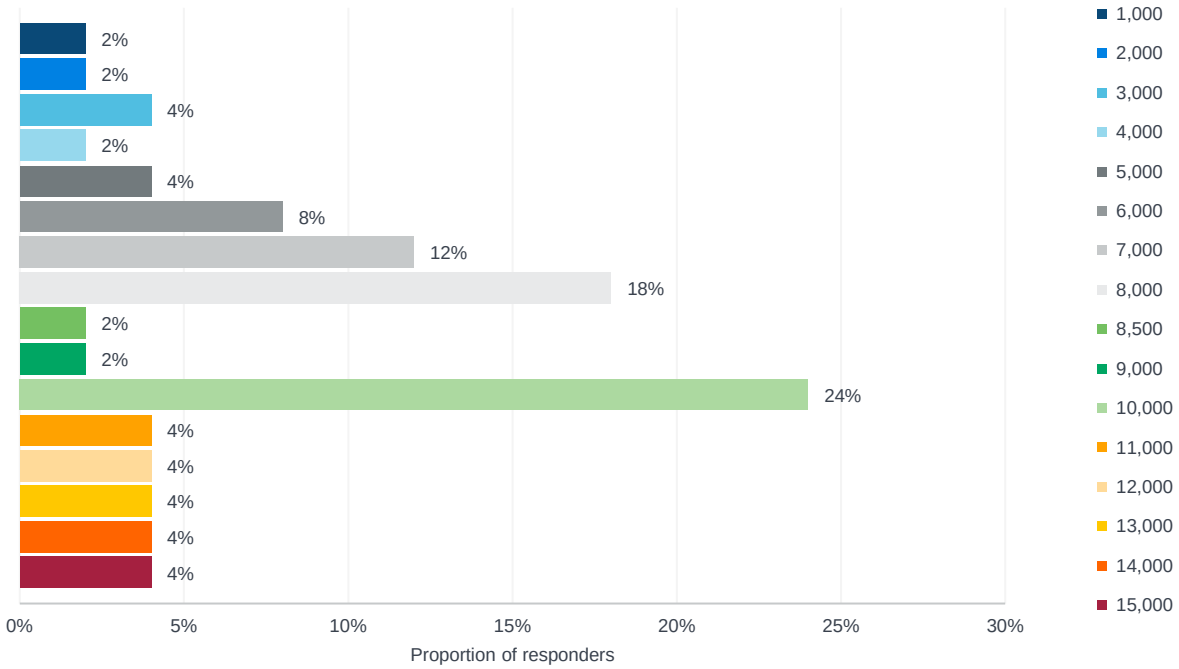
FIGURE 11: DISTRIBUTION OF RESULTS BY TRACKED ACTIVITIES



3.4 STEP COUNT

Figure 12 shows the distribution of average daily step count for our respondents.

FIGURE 12: DISTRIBUTION OF RESPONSES FOR AVERAGE STEPS COVERED PER DAY



Interestingly, 66% of our respondents claimed that they complete an average of 8,000 steps or more per day. This is relatively high considering that most respondents work in financial services or other corporate roles that typically involve more than 35 hours of sitting per week. This could suggest that our respondents are aware of their inactivity during the workday and are taking action to be active during other parts of the day.

We acknowledge that these results may have a bias as people who responded to our survey may be more likely to make use of wearables and be interested in being active and tracking their activity. Additionally, because the data is self-reported it may also not reflect respondents' actual step counts. For example, there were three members who stated that they do not track their activity with any wearable device but also gave a high estimate (over 7,000) of the number of steps that they complete per day.

3.5 SHARING PERSONAL DATA WITH INSURERS

We asked our respondents how they feel about sharing their wearables data with insurers, as shown in Figure 13.

FIGURE 13: INTEREST IN SHARING ACTIVITY DATA

WOULD YOU BE WILLING TO SHARE YOUR ACTIVITY TRACKING DATA WITH YOUR HEALTH OR LIFE INSURER?

- I would be willing to share this data with my health insurer
- I would be willing to share this data with my life insurer
- I wouldn't be willing to share this data with any insurer

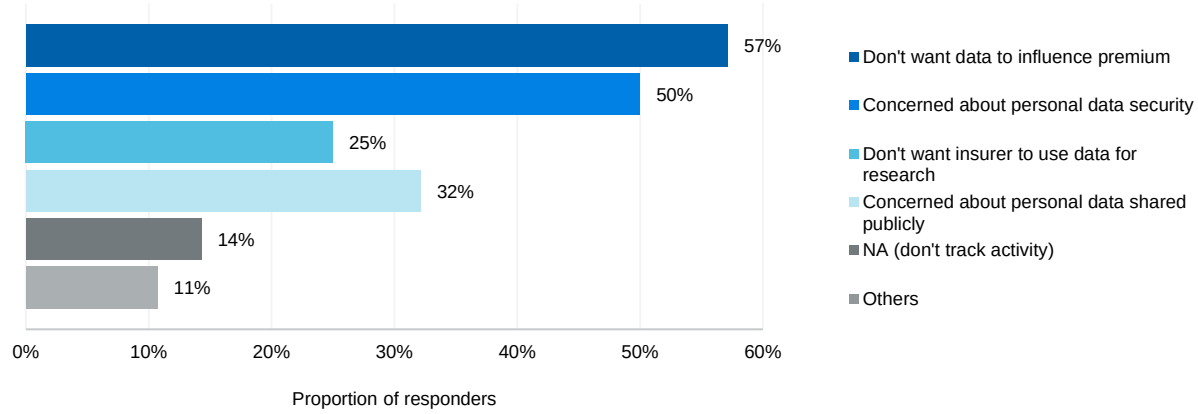
IF NO, WHAT ARE THE MAIN REASONS?

- I do not want this data to influence my premium
- I am concerned about the security of my personal data
- I do not want my insurer to use my data for research purposes
- I am concerned about my data being shared publicly
- Other – please specify

Among our respondents, 51% were willing to share any health tracking data with their health insurers and only 43% would be willing to share their data with their life insurers. The main concerns of our respondents seem to be that wearables data may influence their premiums or the security of their personal data.

Figure 14 presents the reasons for these responses.

FIGURE 14: DISTRIBUTION OF RESULTS BY OPINION ON INSURERS TRACKING WEARABLES DATA



We also asked respondents, as shown in Figure 15, what they thought about premium loading at various stages throughout the contract and if being provided with a free wearable device by their insurer would increase their likelihood of renewing their policy. Results are shown in Figure 16.

FIGURE 15: USE OF WEARABLES FOR PREMIUM LOADING AND INCREASING LIKELIHOOD OF RENEWAL

Do you think it is fair for wearables data to be used to set premiums at the start of the insurance contract?

- Yes
- No
- Please add any comments you have

Do you think it is fair for wearables data to be used to set premiums during the contract term?

- Yes
- No
- Please add any comments you have

if your insurer offered you a free wearable device annually, would it make you more likely to renew your policy?

- Yes
- No
- Please add any comments you have

FIGURE 16: RESPONSES ON THE 'FAIRNESS' OF PREMIUM LOADING WITH WEARABLES DATA DURING THE TERM OF A CONTRACT

3.6 INFLUENCE OF WEARABLES ON ACTIVITY AND HEALTH

We asked respondents about the changes to their activity levels since they began tracking their activity and health information, as shown in Figure 17.

FIGURE 17: WEARABLE IMPACT ON ACTIVITY LEVEL

HOW HAS YOUR WEARABLE DEVICE INFLUENCED YOUR LEVEL OF ACTIVITY?

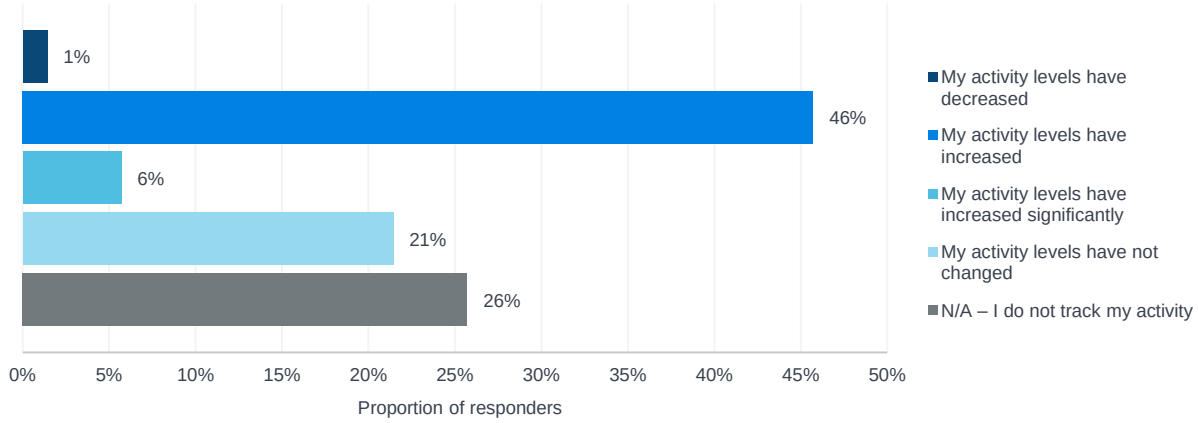
- My activity levels have decreased significantly
- My activity levels have decreased
- My activity levels have not changed
- My activity levels have increased
- My activity levels have increased significantly

SELECT THE MEASURES THAT YOU THINK HAVE IMPROVED AS A RESULT OF TRACKING YOUR ACTIVITY

- BMI
- Body fat percentage
- Waist circumference
- General level of fitness
- Heart rate
- Blood pressure
- Cholesterol
- Blood glucose levels
- Mental well-being
- Other – please specify
- Please add any comments you have

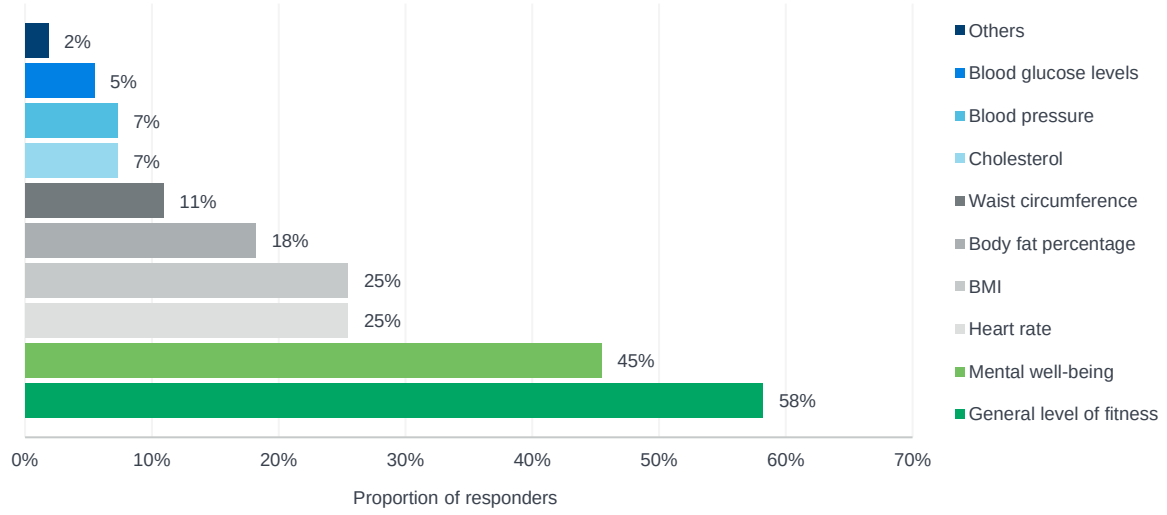
Overall, people thought that tracking health information helped improve their activity levels, with 52% of respondents reporting an increase in activity levels. However, 22% of people stated that their activity levels had either not changed or decreased since they started using wearables.

FIGURE 18: DISTRIBUTION OF RESULTS ON THE IMPACT OF WEARABLES ON GENERAL ACTIVITY LEVELS



Almost 60% of respondents stated that their general level of fitness has improved due to activity tracking while 45% of respondents claim that their mental health has improved, as shown in Figure 19.

FIGURE 19: DISTRIBUTION OF RESULTS ON THE PERCEIVED MEASURES IMPROVED AS A RESULT OF ACTIVITY TRACKING



3.7 FEEDBACK FROM USERS

We have compiled some interesting responses from the survey where respondents provided their thoughts and opinions on various topics, shown in Figure 20, Figure 21 and Figure 22.

FIGURE 20: FEEDBACK FROM RESPONDENTS ON SHARING OF DATA

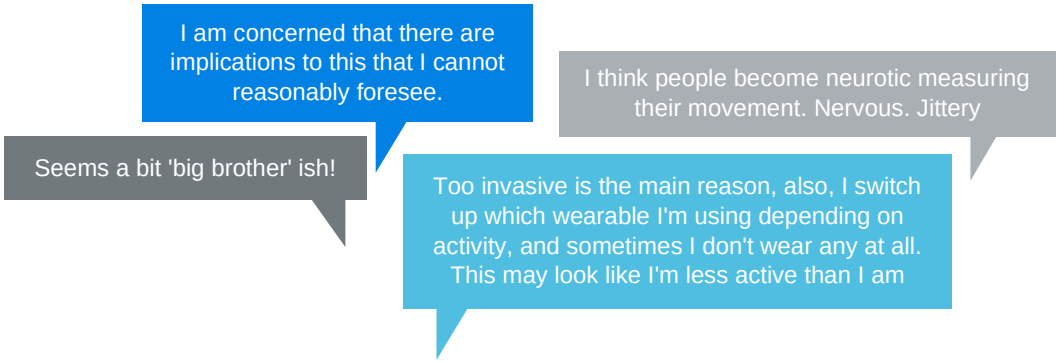


FIGURE 21: FEEDBACK FROM RESPONDENTS ON 'THE FAIRNESS OF USING WEARABLES TO INFLUENCE PREMIUMS'

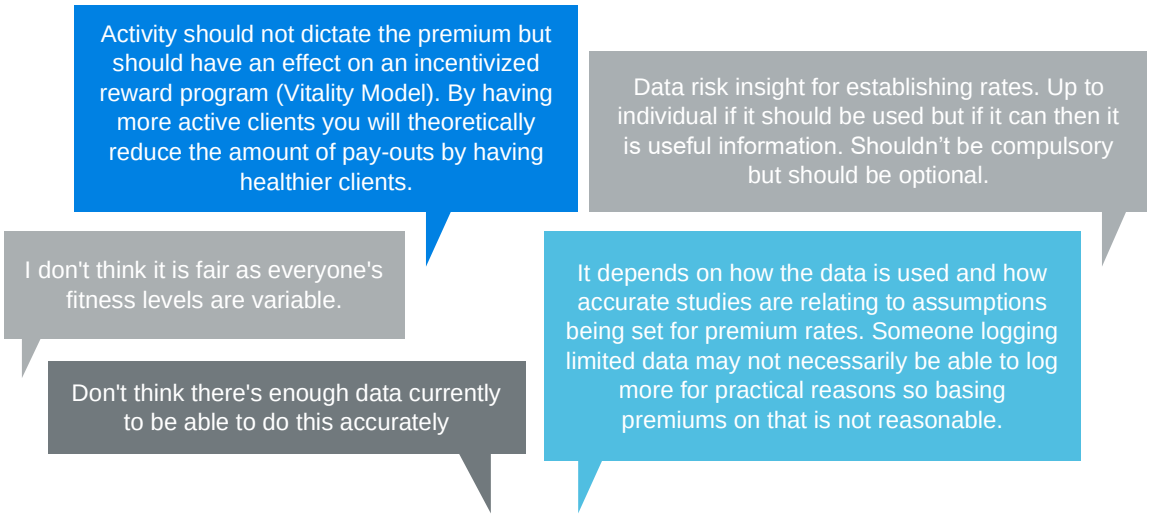
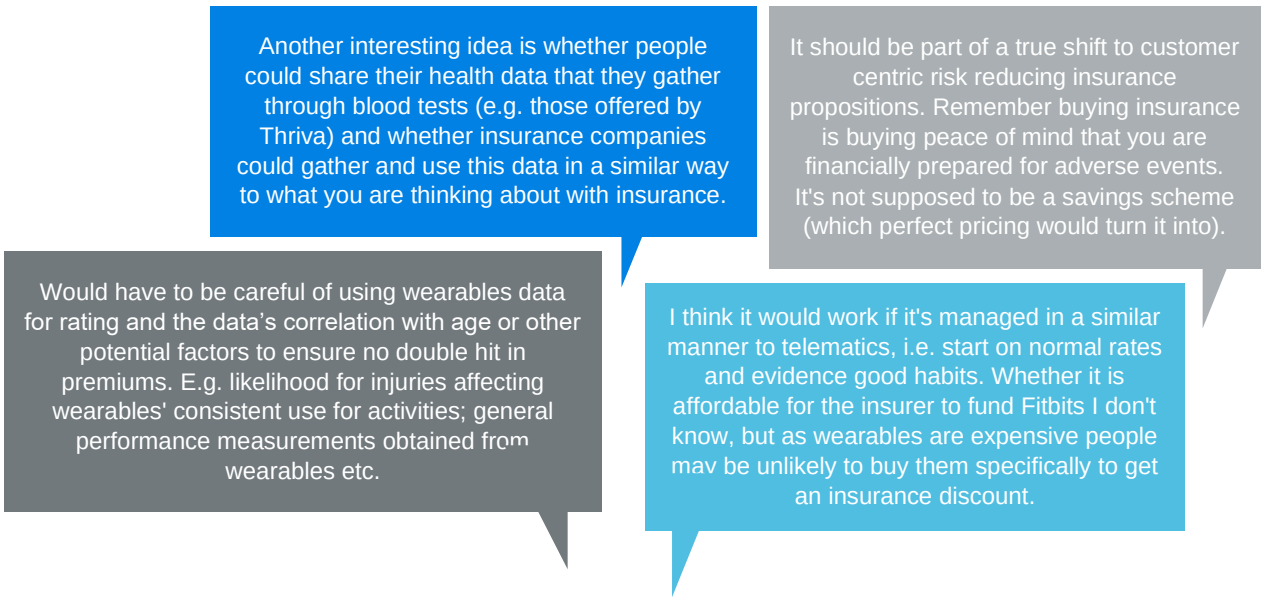


FIGURE 22: OTHER COMMENTS PROVIDED BY RESPONDENTS ON THE SURVEY



4. How reliable is real-time data?

The proliferation of wearables and the data that they generate have some benefits to insurers. However, the potential for fraud will need to be managed and the accuracy of the collected data will need to be assessed.

4.1 FRAUD AND ABUSE

The use of wearables opens up many opportunities for members to commit fraud, with new ways to game the system being invented continuously. If insurers track data in real-time and use this to influence members' benefits, they will need to develop methods to guard themselves against new types of fraud that will arise. For example, devices to help members fabricate their levels of activity are widely available for members to purchase.

The introduction of games and insurance products that offer rewards for step counts has created a market for tools that simulate steps. To prevent this type of fraud from occurring, insurers could consider using combinations of biometric data such as heart rate combined with steps or distance covered with steps.

4.2 FUNDING CONSIDERATIONS

To develop an insurance product that incorporates the use of wearables, the insurance firms designing such products will need to weigh the costs and benefits of the various fitness devices available on the market. As seen inFigure 23, prices can range from £31 to £429 and yet key fitness metrics are quite similar across the entire range. However, insurers will also have to consider wider features of the products that are not so measurable. For example, the strength of the Apple brand may make an expensive Apple Watch more attractive to customers than cheaper products with similar features.

FIGURE 23: A COMPARISON OF THE FEATURE OF TOP-RATED FITNESS TRACKERS, 2019[5]

Device	Inbuilt GPS?	Heart Rate Tracker?	Activity Tracking?	Sleep Monitoring?	Water-proof?	Max battery life in days (with GPS off)	Highest Price (on Amazon UK)
YAMAY Fitness Tracker	No	Yes	Yes	Yes	3m	7	£31
Honor Band 4	No	Yes	Yes	Yes	50m	14	£35
Moov Now	No	Can pair with monitor	Yes	Can pair with monitor	50m	180	£55
Huawei Band 3 Pro	Yes	Yes	Yes	Yes	50m	12	£56
Amazfit Bip	Yes	Yes	Yes	Yes	3m	45	£63
Fitbit Inspire HR	No	Yes	Yes	Yes	50m	5	£70
Garmin Vivofit 4	No	No	No	Yes	50m	365	£86
Samsung Galaxy Fit E	No	Yes	Yes	Yes	50m	7	£89
Garmin Vivosmart 4	No	Yes	Yes	Yes	3m	7	£99
Garmin Vivosport	Yes	Yes	Yes	Yes	50m	7	£100
Fitbit Charge 3	No	Yes	Yes	Yes	50m	7	£119
Apple Watch Series 4	Yes	Yes	Yes	No (can use an app)	50m	0.75	£429

[5] Peckham, J. Best Fitness Tracker 2020: The Top 10 Activity Bands on the Planet. TechRadar Retrieved 4 March 2020 from https://www.techradar.com/uk/news/wearables/10-best-fitness-trackers-1277905.

4.3 ACCURACY OF RESULTS

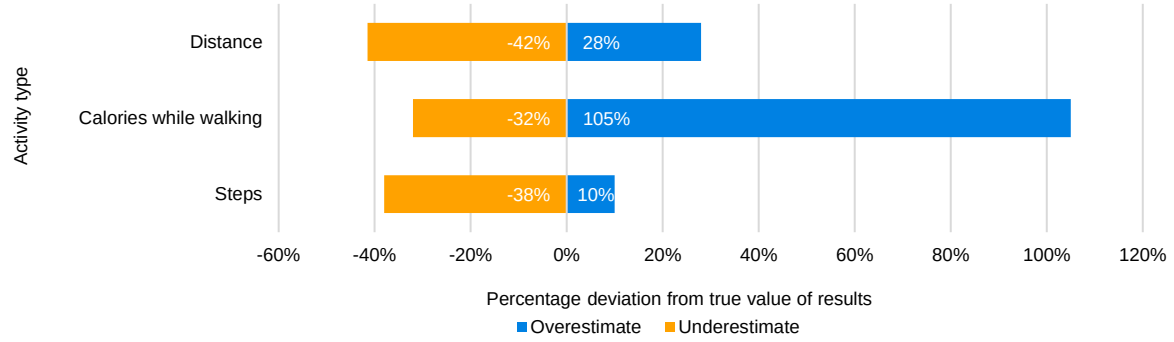
Currently there seem to be discrepancies among the results recorded by different types of devices, which brings the accuracy of these devices into question. Devices tend to consistently overestimate or underestimate the true value of each metric they capture. In addition to accuracy, the precision of each device varies largely across each brand and model. Accuracy is defined as how close a measurement is to its true value whereas precision is defined as how consistent results would be if the measurements from a device are repeated.

The UK consumer watchdog 'Which?' tested the consistency of results produced by over 100 wearable wrist devices by considering a range of metrics for all of these devices. Which? found that there was significant variability in the results among devices.

These discrepancies mean that policyholders could be unfairly rewarded or penalised depending on the device they use.

Figure 24 shows the results of using various wrist devices alongside a chest strap to monitor heart rates. This shows that some devices are much worse than others in terms of providing accurate results.

FIGURE 24: WHICH? MAGAZINE'S FINDINGS ON ACTUAL VS. RECORDED MEASURABLE DATA



4.4 CONSIDERATIONS FOR USE OF WEARABLES DATA

Insurers will also have to consider how to they collect, store, analyse and use the data generated by wearable devices. Figure 25 highlights key considerations for insurers in this context.

FIGURE 25: CONSIDERATIONS FOR USE OF WEARABLES DATA

What influences health?	It is unlikely that wearables alone can influence health and reduce claims costs. The overall effectiveness of most comprehensive wellness programmes in motivating healthy behaviors is unclear, so it is highly unlikely that wearables alone will achieve lower claims costs.
Regulation	Insurers will need to consider the relevant insurance and data protection regulation in their regions.
Engagement levels	Only some policyholders will be willing to share their data and insurers will need to consider how to design benefits that are fair to all. For example, can you penalise those who share data but not those who do not?
Data interpretation	The type and frequency of data being captured may make it challenging to derive any meaning from data analysis. (Additional data does not necessarily give rise to improved claims cost prediction).
Absolute improvement vs. trend	How do you reward both those who are making improvements to their health (e.g., move from 3,000 to 8,000 steps per day) and those who are already at a high level (e.g., 15,000 steps per day).
Costs	There will be significant costs associated. For example: ▪ Funding/subsidising wearable devices ▪ Infrastructure (e.g., cloud storage, computing power) ▪ Staff hiring and training
Measures captured	What measures are being captured and used, and what are the challenges associated with this? For example, if distance is a measure of interest, what about the scenario where someone runs on a treadmill for an hour and logs 0 km.

5. Wearables and HRAs

Many health metrics considered in health risk assessments (HRAs) overlap with those tracked by wearable devices. Consequently, we have investigated the impact of the activities that HRAs measure on overall reported HRA health scores. This has helped us to understand the influence that activities measured by wearable devices may have on overall levels of health, based on how significant the HRAs consider these activities to be.

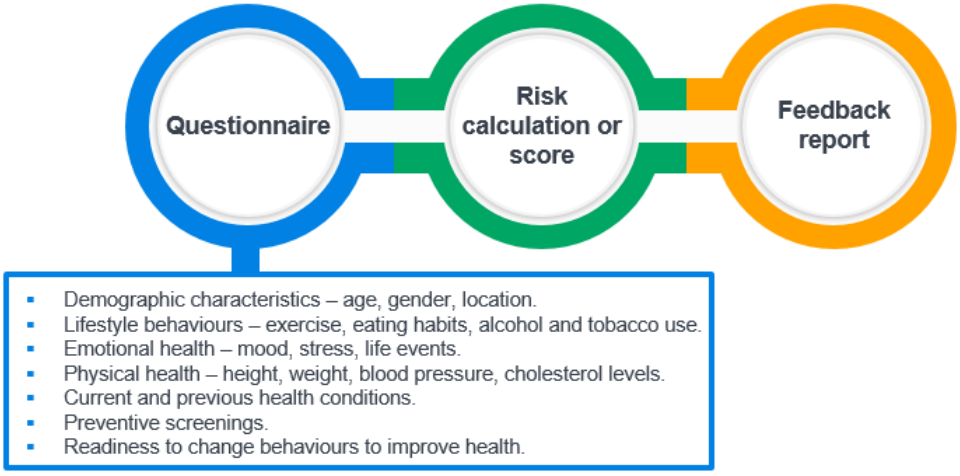
5.1 HEALTH RISK ASSSEMENTS

The US Centers for Disease Control and Prevention (CDC) has defined an HRA as the following:

'A systematic approach to collecting information from individuals that identifies risk factors, provides individualised feedback and links the person with at least one intervention to promote health, sustain function and/or prevent disease.'

HRAs typically incorporate three key elements, as shown in Figure 26.

FIGURE 26: TYPICAL HEALTH RISK ASSESSMENT PROCESS



We have tested the consistency among three HRAs and the relative weightings that they give to metrics in terms of predicting overall health levels. We have compared the questions and results for publicly available HRAs from Vitality and the heart risk assessment of the English National Health Service (NHS) as well as the Rapid HRA tool developed by Milliman. Figure 27 shows there is a substantial overlap in question types for Vitality and the Rapid HRA while the NHS HRA has a narrower focus.

Each HRA also has a different type of output. The Vitality HRA produces a 'Vitality Age' which should be interpreted relative to the member's age. A Vitality Age higher than the member's actual age signals that a member's health status is worse than expected based on the demographic profile, and vice versa. The NHS HRA produces a similar output but with a focus on 'heart age.' The Rapid HRA produces a score out of 100 where a score of 100 signals that the member is in perfect health.

FIGURE 27: THE MAIN QUESTION GROUPS WITHIN EACH TYPE OF HRA

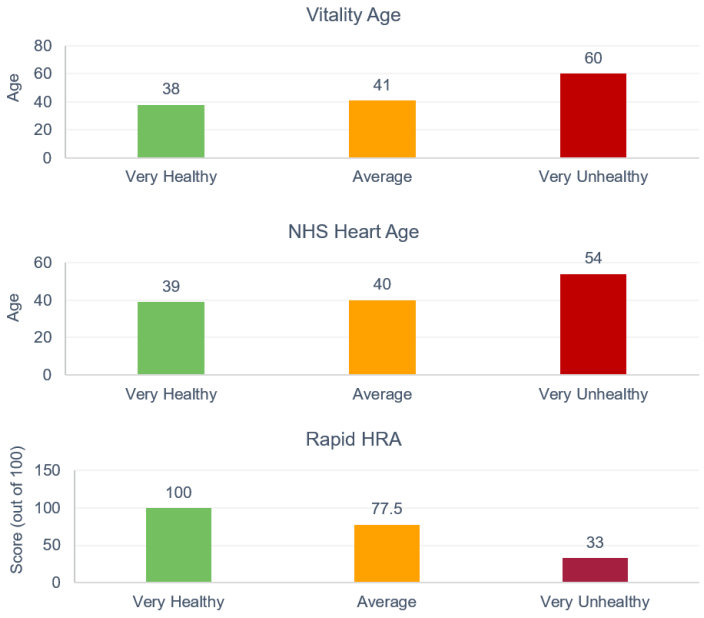
Question types	HRA tool		
	Vitality	NHS (UK)	Rapid HRA developed by Milliman
Demographic features	✓	✓	✓
Lifestyle behaviours	✓		✓
Emotional health	✓		✓
Physical health metrics	✓	✓	✓
Current and previous health conditions		✓	✓
Preventive screenings		✓	✓
Readiness to change behaviours			✓
Output	Vitality Age	Heart Age	Health score out of 100

We defined a base case for a male member, aged 40 with the health and demographic characteristics described in 8 representing the 'average' scenario. We also defined 'very healthy' and 'very unhealthy' scenarios for the member aged 40 by varying the base case inputs to test the impact on the HRA outputs. We used the base case scenario to test the sensitivity of each HRA's output metric to the input measures that wearables are able to capture. This is discussed in more detail in Section 5.2 below.

FIGURE 28: AN EXAMPLE OF THE BASE CASE MEMBER AND WHAT IS CLASSED AS HEALTHY OR UNHEALTHY IN TERMS OF HEALTH SCORE OR AGE

Base case/Average

Age	40
Gender	Male
Height	5' 7"
Weight	64 kg
Waist circumference	30 inches
Exercise	5 hours per week
Blood pressure	120/80 mmHg
Glucose	4.5 mmol/L
Cholesterol	5.0 mmol/L
Pre-existing conditions	None
Food	Average fruit and veg intake
Smoking	Never
Alcohol	3 drinks per week
Mental health status	Normal levels of stress and tiredness

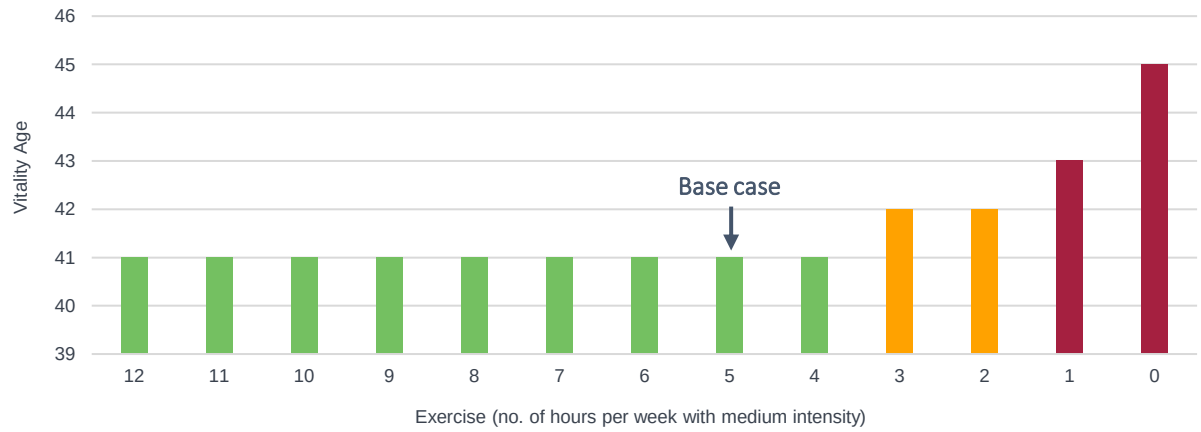


5.2 HEALTH RISK ASSESMENTS AND WEARABLES

The wearable devices of today only measure a limited amount of information, and insurers can only use the data that is made available from each device. For this research, we tested the sensitivity of the HRAs to the metrics that wearables measure, and compared it to other component metrics. This gives us some additional insights into how HRAs and wearables interact with one another as well as the value that HRAs place on selected lifestyle behaviours.

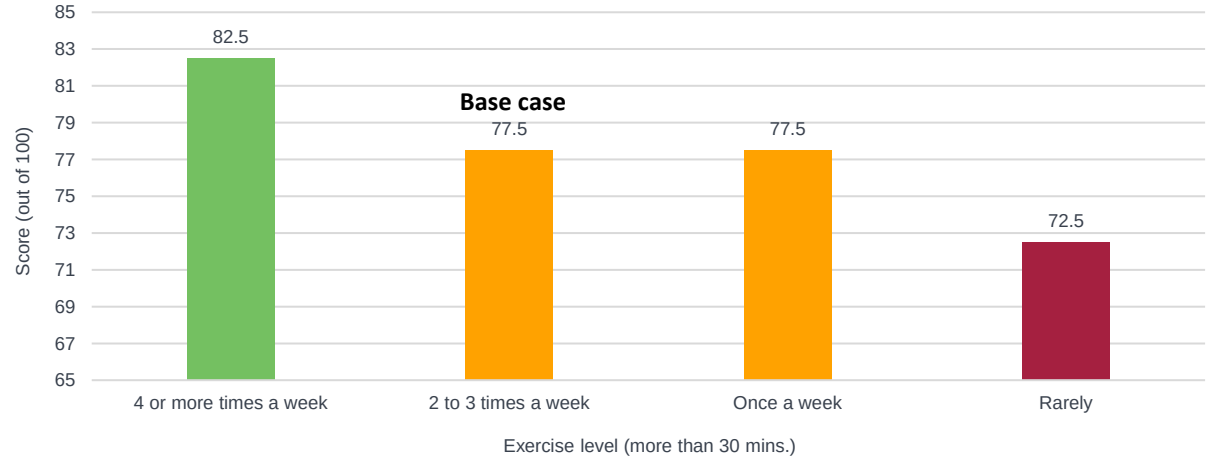
Our research showed that, in the case of the Vitality Age, there is no marginal benefit from exercising more than four hours per week. However, exercising less than four hours per week has a negative impact on the member's Vitality Age.

FIGURE 29: THE IMPACT OF ACTIVITY LEVELS ON HEALTH AGE (VITALITY HRA)



In the case of the Rapid HRA, we saw that increasing activity levels from the base case can improve the overall health score significantly. Additionally, reducing activity levels has a negative effect on the health score, as shown in 0.

FIGURE 30: THE IMPACT OF ACTIVITY LEVELS ON HEALTH SCORE (RAPID HRA)



Another area we assessed was the impact of a changing body mass index (BMI) against the overall health score or health age.

We found that, in the cases of the Vitality HRA and the Rapid HRA, any BMI value that moved further away from the 'healthy' range[6] had a significant impact on the overall health score or age. The NHS HRA is less sensitive to changes in BMI, with a step change only occurring at a BMI of 30.

[6] A BMI of between 19 and 25 is typically considered a healthy range.

FIGURE 31: THE IMPACT OF BMI ON HEALTH AGE (VITALITY HRA)

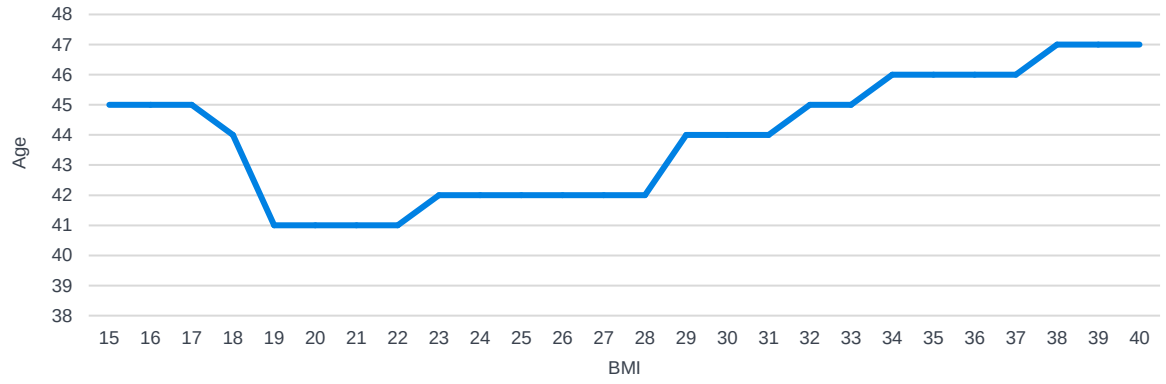


FIGURE 32: THE IMPACT OF BMI ON HEALTH AGE (NHS HRA)

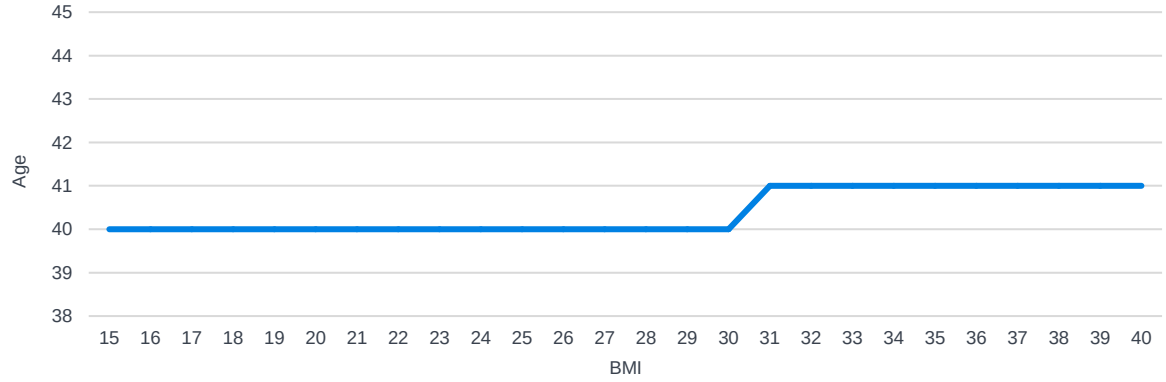
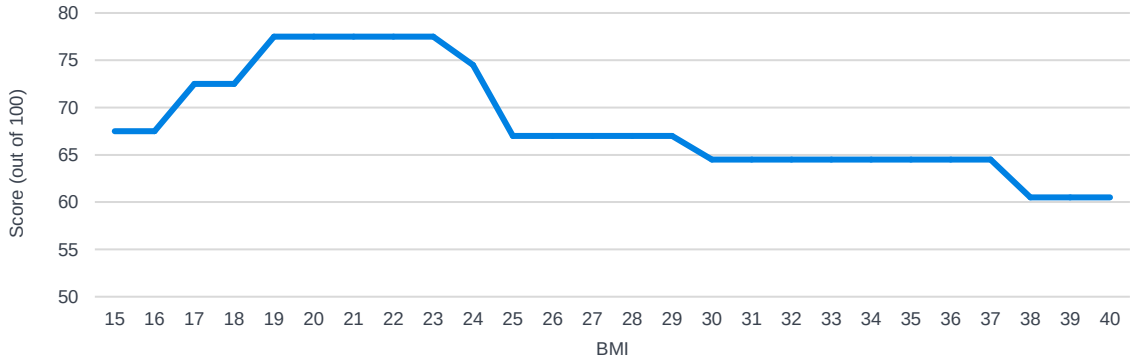


FIGURE 33: THE IMPACT OF BMI ON HEALTH SCORE (RAPID HRA)



Finally, we looked at the sensitivity of HRAs to some key health metrics. We looked at the effect on the health age or score after varying each metric to 'good' and 'bad' values from the base case. For the NHS HRA, we found that it was not possible to improve the heart age by improving on particular factors, but worsening on particular factors could result in a deterioration of the heart age. For the Vitality HRA, it is only possible to improve the Vitality Age by improving cholesterol and eating habits from our defined base case and, for the Rapid HRA, it is possible to improve the overall health score by improving on various factors.

While we found that *not* exercising has a negative impact on the health score, it was not always the most important health factor. As seen in Figure 34, Figure 35 and Figure 36, metrics such as cholesterol, smoking and BMI can all have a higher impact on a member's health score or Vitality/Heart Age.

FIGURE 34: SENSITIVITY TESTING RESULTS OF EXISTING QUESTION GROUPS ON VITALITY HEALTH AGE

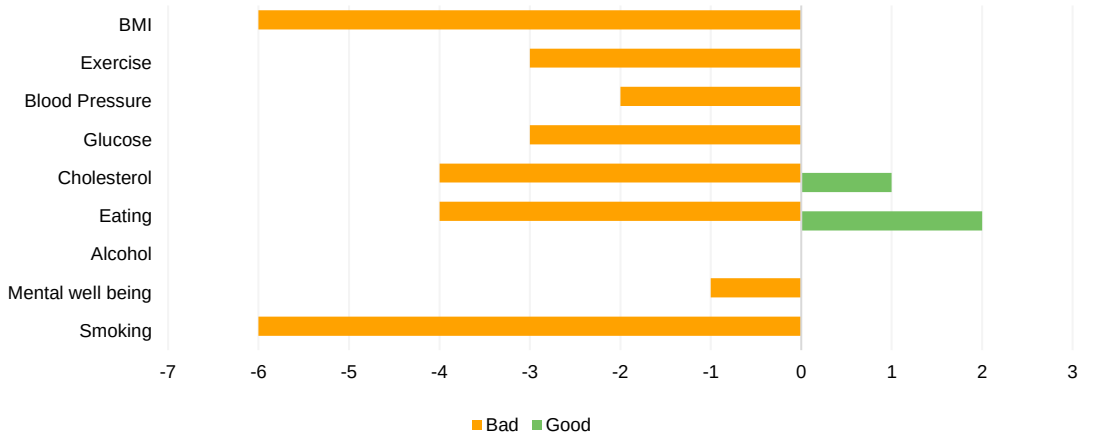


FIGURE 35: SENSITIVITY TESTING RESULTS OF EXISTING QUESTION GROUPS ON NHS HEALTH AGE

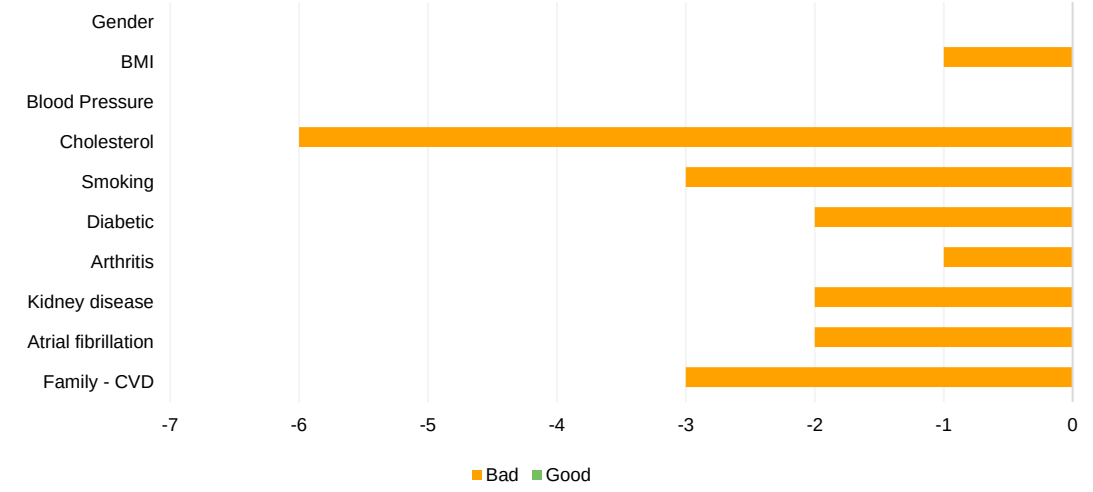
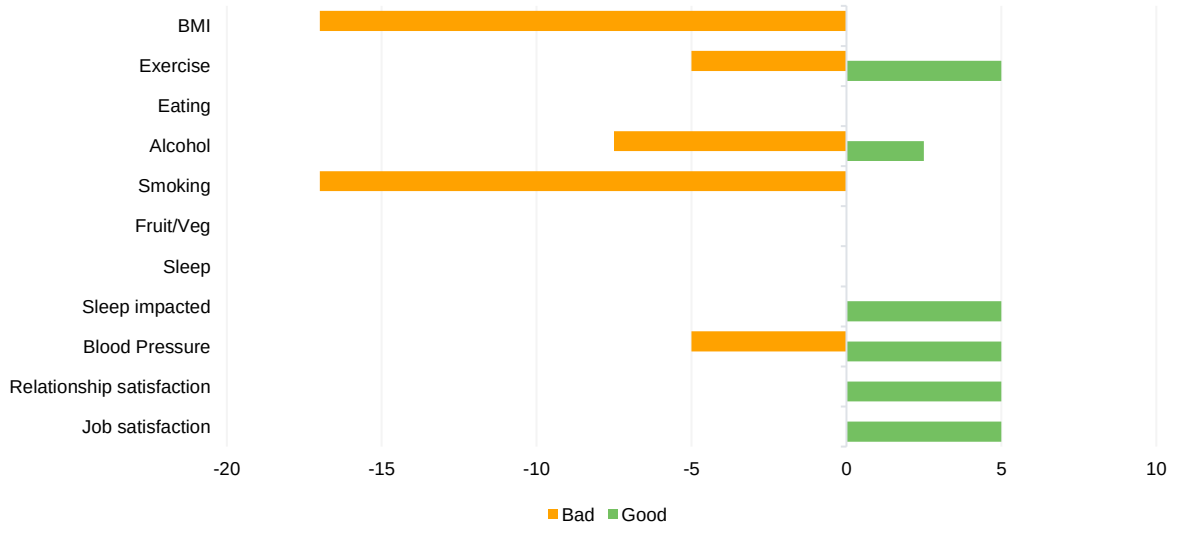


FIGURE 36: SENSITIVITY TESTING RESULTS OF EXISTING QUESTION GROUPS ON RAPID HRA HEALTH SCORE



6. Conclusion

The stated use cases of wearables in medical insurance focus primarily on improving claims cost predictions, making members healthier and reducing overall claims frequency and amounts, while at the same time strengthening an insurer's competitive position.

However, currently there is limited evidence that wearables can change the long-term behaviour of policyholders. There is also limited evidence that metrics captured by wearables today are strong influencers of long-term health and it is important to recognise that wearable technologies alone are unlikely to sufficiently drive real change in lifestyle behaviours and impact members' health statuses.

While wearable technology provides a stream of health-related data and hence, potential additional rating factors to use for pricing and underwriting purposes, each stated benefit comes with potential pitfalls and the additional complexity of incorporating these data elements may not be warranted. Potential risks, such as tracking unreliable information or manufactured data, must be addressed. Further, the variability in the data coming from different devices is problematic.

Our research among our contacts on the use of wearables in insurance highlighted that our respondents were fairly engaged with wearable technology, with nearly 75% of all respondents tracking their activity in some form and almost 60% stating that their general level of fitness had improved due to activity tracking. The most interesting finding is that even within the cohort of our respondents (who were typically actuaries or analysts) there were widely varying views towards the use of wearables in the insurance market, with different levels of understanding of the wearables landscape, the use of wearables in insurance and a range of attitudes towards insurers using their wearables data. This may indicate that in the wider population there is likely to be a very wide range of acceptance of the use of wearables in insurance decisions.

Our review of the factors that influence health risk assessments (HRAs) indicates that, although wearables may encourage members to increase their activity levels, the implementation should be considered as part of a comprehensive wellness offering because many key factors that influence HRA scores, and (by implication) health status, are not captured by wearables.

Finally, even though real-time data is an exciting big data opportunity, its use needs to be carefully considered with high potential for fraud, high potential costs for insurers, questionable accuracy of the data and considerations around fairness in how this translates into pricing and underwriting decisions that affect individual members.

How Milliman can help

Milliman has a vast and deep technical knowledge of understanding global healthcare systems, as well as significant experience working with health insurers, employers and government organisations. Whether you want to understand more about the interaction of wearables with insurance products, technical tools and data, or how to set up an evaluation framework for implementing wearables, we can bring our global experience of best practices combined with local knowledge.

If you have any questions or comments on this paper, or on any other issues associated with the roles of wearables in insurance, please contact any of the consultants below or your usual Milliman consultant.

Caveats and limitations

In carrying out our analysis and producing this research report, we relied on the data and information provided in the responses from our shared survey. To collect the data, the authors of this article shared the survey with their associated contacts on LinkedIn. Due to the limited sample size available, the results may not be fully statistical credible and we acknowledge that given our range of contacts the results will contain bias and need to be interpreted in this context.

This research report is intended solely for educational purposes and presents information of a general nature.

This report is not intended to guide or determine any specific individual situation and persons should consult qualified professionals before taking specific actions.

Milliman is among the world's largest providers of actuarial and related products and services. The firm has consulting practices in life insurance and financial services, property & casualty insurance, healthcare, and employee benefits. Founded in 1947, Milliman is an independent firm with offices in major cities around the globe.

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