SuperLife Wellness Program

StatSmart Solutions

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Image: Markevich, 2024

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1. Executive Summary

The implementation of "wellness programs" alongside life insurance products is becoming increasingly popular as the benefits become recognised by insurers and policyholders alike. These programs provide a way for policyholders to reduce their premiums or gain rewards by making healthier choices, and in doing so, decrease mortality risk for insurers and offer a means of attracting new customers.

This report details StatSmart Solution's proposals for SuperLife's wellness program in Lumaria, with actuarial justification and analysis. Our team proposes four main initiatives to reduce expected mortality, increase life insurance sales, add economic value for SuperLife, and incentivise healthy behaviours. These initiatives – namely *Earn* (financial incentives for healthy behaviours), *Screen* (preventative screening incentives), *Prevent* (cancer prevention initiatives) and *Quit* (smoking cessation programs) – will be offered via a SuperLife mobile app. This app will allow customers to log evidence of healthy behaviours, access rewards, and track their progress.

Under StatSmart's proposed plan, we expect SuperLife to have saved Č4.6B if they had implemented this program for the past 23 years. These savings arise from the decreased mortality risk that each program generates, which gives rise to lower benefit payouts and lower liabilities going forwards, as well as income from new policyholders attracted by the wellness program.

A sensitivity analysis shows that the wellness program would have improved SuperLife's economic value with almost 100% certainty. Key risks include participation risk, technology risk, pricing risk and ethical risks, among others. StatSmart has proposed several strategies for mitigating these risks by either reducing, transferring, removing, or self-insuring it.

2. Objectives

2.1. Main Objectives

This health incentives plan aims to benefit SuperLife through five key objectives:

i. Improve policyholder health and wellness through participation in the wellness plan
ii. Decrease expected mortality of policyholders
iii. Increase sales of SuperLife's life insurance products
iv. Add economic value to SuperLife
v. Increase competitiveness and marketability of products.

While all five objectives are fulfilled through StatSmart's proposal, the former three are the primary focus of the program design. The latter two objectives are achieved inherently: our findings show that the benefits of decreased mortality and increased customer base outweigh the program costs, leading to higher overall revenue, thereby providing SuperLife with higher economic value and better competitiveness than if this wellness plan had not been implemented.

2.2. Key metrics & timelines

The success of each incentive, and of the overall program, is primarily measured by the financial savings it would have afforded SuperLife over the past 23 years, relative to the status of no interventions. These savings consist of two parts: increased profits from current policyholders due to lower mortality causing reduced claim frequency, and additional profit from new policyholders joining due to the wellness program offerings. Naturally, the interventions all require cash outflows to fund their implementation and maintenance, but our calculations show that these expenses are outweighed by the savings. Next, timelines can be divided into setup, delivery and evaluation. The set-up of a mobile app to deliver the incentives, as explained in the following sections, will take conservatively 9 to 12 months considering its highly complex features (Srivastava 2023). Each individual incentive is then delivered through the app to the policyholders. Monitoring should be conducted regularly – for example every 3 to 6 months – to ensure that the app is well-used, taking on board policyholder feedback. Updates and general maintenance should occur continuously. The results of the program on policyholder mortality, claim pay-outs and new sales may take 2 to 3 years to be noticed, and even longer, up to 10 or more years, for the full effects to be felt. However, monitoring must still be conducted quarterly or even monthly to ensure assumptions are in line with expectations.

3. Program Design

The StatSmart team have designed a program for SuperLife insurance that encompasses two incentive-based interventions and two mortality-based interventions. To decide on the best interventions, StatSmart performed a cost-benefits analysis on each of the 50 interventions, with the aim of identifying the top 10 interventions in terms of benefits for their respective cost. After selecting the top 10 using the cost benefits analysis, the team utilised the team's exploratory data analysis (EDA) to determine the final four interventions. The final four interventions are outlined below.

3.1. Earn: Financial Incentives for Healthy Behaviour

Leveraging the rising trend of technology literacy in Lumaria, a gamified point system with financial incentives will be integrated within a new SuperLife app to encourage policyholders to live healthier lifestyles. Circulatory diseases are one of the leading contributors to policyholder deaths, responsible for 77% of all non-smoker deaths in the SuperLife dataset. The World Health Organization (WHO) (2015) states that more than 80% of premature heart attacks and strokes are preventable by behavioural choices, including sustaining a healthy diet, regular physical activity, and blood pressure control via check-ups. As such, *Earn* aims to incentivise healthy behaviours to create long-term impact.

Earn will recognise six categories of healthy activities that when tracked and verified, allocates users with points, shown in table below. Each activity has a yearly limit according to the recommended frequency, for example, an annual health screening being sufficient for the general population. However, activities like walking 12,000 steps a day and purchasing fresh foods can be logged every day and every week respectively, as these healthy habits promote lifestyle change and address overall wellness by increasing activity rates and micronutrient intake.

Activity	Points	Yearly Frequency	Maximum Points in 1 Year
Cancer health screening	1000	1	1000
General Practitioner health check	1000	1	1000
Walk at least 12000 steps a day	10	365	3659
Log purchases of 500g of fresh fruits and vegetables	10	52	520
Complete Online Nutrition Assessment	500	2	1000
Read SuperLife articles on Health	1	730	730
Complete BMI test	5	12	60

All users automatically start at the Blue tier, where they can gradually rank up to Platinum, which has a reward worth Č80. At the start of a new year, all users' tiers are reset to Blue, ensuring the maximum monetary reward is capped at Č80 and users are incentivised to complete annual check-ups. The points to Crown conversions were devised to match SuperLife's provided intervention costs, while ensuring the activity effort required is proportional to the awards.

Based on the tier, customers can redeem rewards of a value up to the cost indicted in the table above. These rewards are from partnered businesses, which will initially start with shopping vouchers, wearable device discounts and flight cashbacks. Financial incentives through gamified app scenarios will encourage user satisfaction and participation, as well as improving life expectancy as seen in John Hancock's 'Vitality' program (Vitality, 2018). See Appendix B.2 for more information on partnerships and benefits.

3.2. Screen: Incentives for Preventive Screenings

The majority of the leading causes of death for SuperLife's policyholders such as cancer and diseases of the circulatory system are preventable or can be delayed by undertaking preventive health screenings and check-ups. This is especially true when the factors and symptoms that can lead to disease may not be obvious, spotted early or seen at all until it is too late. Thus, health screenings allow policyholders to identify issues with their health before symptoms develop, to reduce risk (TAL, 2021). General health check-ups often include pathology tests such as blood tests which can also prevent diseases and identify risk factors, allowing doctors to provide advice and improve an individual's health. Discovering diseases early will also increase the quality and length of life.

Thus, one of the activities that is included in the rewards program is undertaking check-ups and preventive health screenings which will ensure a 5-10% reduction in mortality. The number of points awarded when a policyholder does a preventive screening or check-up allows them to automatically move up a tier. This allows them to get better rewards which will encourage participation in this intervention, but costs little to SuperLife as most screenings can only be done once every 2 years or more.

SuperLife will only award points to policyholders if they get a general health check-up or a cancer screening, but only if they meet the criteria outlined in Appendix B.3.2. These screenings are for cervical, bowel, breast, lung and colorectal cancers. Please see Appendix

B.3.1 on explanation as to why these cancers were chosen. Policyholders can gain points and thus financial rewards, by reporting through the app that they have done the preventive screening. This is done by consenting to share their private medical results and uploading documentation or results of their specific health screening. Otherwise, these medical examinations must be done at medical centres that have partnerships with SuperLife to confirm that the policyholders have done the screening in question.

3.3. Quit: Smoking Cessation Programs

Out of all potential interventions examined, the highest improvement in individual mortality arose from a smoking cessation program. Implemented effectively, this can reduce mortality by up to 50%. This program is accompanied by relatively high individual costs, but due to the low proportion of smokers in the policyholder population (on average 7% per year from 2001 to 2023), total costs are not excessive.

In the United States (US), Babb and partners (2017) found that approximately 55% of smokers attempt to quit each year. However, even though quitting unassisted or "cold turkey" is only successful in 7-8% of cases, many smokers do not seek assistance in quitting due to lack of knowledge, high costs and insufficient insurance coverage of cessation programs (Caraballo et al., 2017; DiGiulio et al., 2018). This is where SuperLife can gain a competitive advantage in the Lumarian market: by offering fully covered, comprehensive smoking cessation programs, they will not only be improving the health, and thus mortality risk, of their current policyholders, but will also attract new customers seeking assistance in quitting smoking.

SuperLife's *Quit* will offer three components: counselling, access to medications, and referral to tobacco quitlines. Counselling sessions can be booked through the SuperLife app, along with information on financial coverage for medications that reduce nicotine dependence. The Surgeon General's (2020) report showed that the combination of cessation medications and behavioural therapy through counselling is the most cost-effective method of smoking cessation. SuperLife should also provide policyholders with access to national tobacco quitlines, which are assumed to be offered and funded by the Lumarian government, as in most countries with similar economic standings to Lumaria (WHO, 2024). These quitlines are proven to be effective, and come at no extra cost to SuperLife or their policyholders (Fiore et al., 2008). Further details on *Quit's* offerings and design can be found in Appendix B.4.

3.4. Prevent: Cancer Prevention Initiatives

Cancer is one of the highest contributors to mortality in Lumaria, where 33.47% of all deaths and 48% of non-smoker deaths in the SuperLife dataset can be attributed to cancer (C00-D48 - Neoplasms). To add to this, *Prevent* returned the most profitable numbers in the initial cost-benefit analysis conducted by the StatSmart team. *Prevent* has been designed to maximise participation and potential mortality improvements for SuperLife Policyholders. The StatSmart team designed *Prevent* with two different sections: the initiatives and the resources (to be called the 'Cancer Prevention Hub (CPH)'.

The initiatives will include a cancer fact released weekly with a different theme each quarter. Research conducted by the StatSmart team indicates that the most effective way to deliver this fact will be through a combination of a pop-up and a notification in the new SuperLife app (Appendix B.5). The pop-up will display the fact to the policyholder when they open the app

for the first time since it has been released (once a week), with only the current week's fact being displayed. When each fact is released, it will also send a notification to all policyholders who have the app downloaded, notifying them of the new fact. Included below the fact, will be a link to further resources in the CPH. A similar pop-up technique will also be created in the SuperLife website. An example of a pop up, would be 'Melanoma is the most common cancer among young Australians' (Cancer Institute NSW, 2022). Below this would be a link to multiple different articles put together by SuperLife related to skin cancer and the preventable risk factors behind it. The initiative themes will differ between each of the deadliest cancers in Lumaria and the nine key modifiable cancer risk factors (Appendix B.5). Each quarter, two different initiatives will be created to help the campaign be more targeted, as SuperLife will have the flexibility to adjust the theme based on the demographics of the policyholders.

The CPH will be established by SuperLife in year 1 and then updated yearly with any new information. Articles on new cancer research will also be added to the CPH throughout the year. A summary of all the articles to be included in the CPH can be found in Appendix B.5. Reading these articles will contribute to the point system outlined in the prior interventions.

To bring to life the program outlined above, it would be recommended that SuperLife forms mutually beneficial partnerships within the cancer industry. An example of this would be Munich Re's partnership with GRAIL (2023), where Munich Re helped GRAIL with the clinical testing of the Galleri technology. A similar partnership could be formed by SuperLife, with them getting access to cancer research and statistics in return. Another idea could be to establish a partnership with Lumarian cancer charities and cancer related government organisations.

4. Pricing/Costs

This assessment takes a conservative stance, concentrating solely on mortality savings and excluding potential interest from surplus, to precisely evaluate the effectiveness of interventions on mortality. Key formulas are outlined below, with more detail in Appendix C.5.

$$\boldsymbol{Net\ Savings} = \sum_{All\ Interventions} \Delta\, Benefits\ Paid + \Delta\, Liabilities - Total\ Cost$$

$$\boldsymbol{Benefits\ Paid_{SPWL\ /\ T20}} = \sum_{y=2001}^{2023} v^{y-2023} \sum_{All\ Ages} \Big(\sum_{\substack{all\ policies\ issued \\ at\ Age\ x\ in\ Year\ y}} FaceAmount \Big) \times \begin{cases} A_x \ \ for\ SPWL \\ A^{1}_{x:m\rceil} \ \ for\ T20 \end{cases}$$

$$\boldsymbol{Liabilities} = \Big(\sum_{All\ Active\ Policies} FaceAmount \Big) \times \begin{cases} A_{\bar{x}} \ \ for\ SPWL \\ A^{1}_{\bar{x}:\bar{n}\rceil} \ \ for\ T20 \end{cases}$$

Where:
$\Delta =$ baseline $-$ simulation for each intervention
$m = \min(20\,, 2023 - Issue\ Year\ (y))$
$\bar{x} = average\ age\ of\ the\ group$
$\bar{n} = average\ remaining\ policy\ term$

4.1. Overall Savings and Benefits

The overall savings if the entire program was implemented between 2001 and 2023 would be Č4.6B. These net savings consist of Č6.5B in savings due to mortality improvement, less Č2B in total costs, which includes Č100M for app development (Russell, 2023). See Appendix E.3 and the supporting documents for more details on the full figures and modelling process. This program will also help SuperLife to generate an extra Č94M in savings from a 2% growth in customer base, as new policyholders are drawn by SuperLife's unique and effective wellness program. This new business will be attracted via marketing schemes such as targeted advertisements on social media, referral programs from existing customers and community events with partner companies from the wellness program.

Figure 2 below summarizes the expected mortality savings – in Billion Crowns - from each intervention, in addition to the implementation costs:

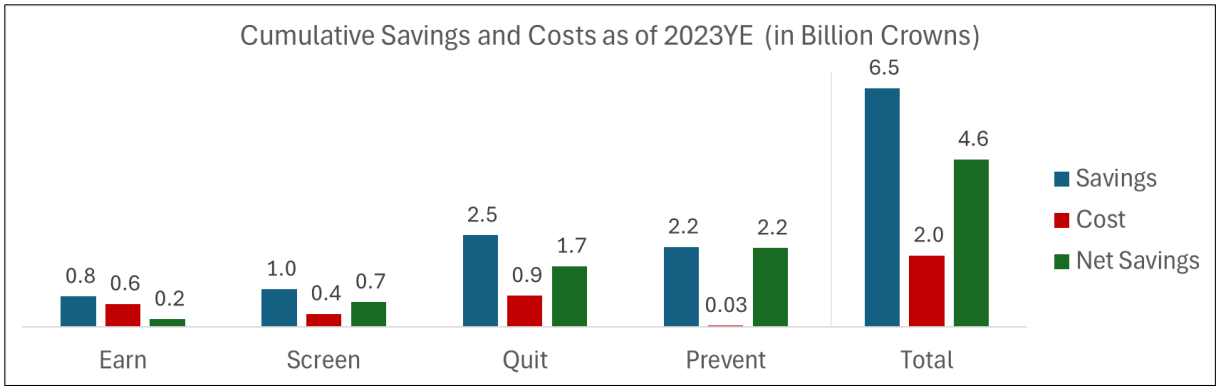


Figure 1: Savings and costs for each intervention

Along with financial savings, this wellness program has several other benefits for SuperLife and its stakeholders. One inherent benefit is the overall health improvement for policyholders, and for Lumarians as a whole. Participating in health screenings, reducing cancer risk factors, decreasing smoking levels and doing healthy activities all promote better lifestyles for policyholders and for their relatives and friends who may also gain awareness of healthy behaviours. Further, this program directly helps SuperLife to practice Corporate Social Responsibility (CSR) by focusing on the needs of its customers (to live longer and healthier lives). This is not only ethical and beneficial to society, but also builds a better brand reputation for SuperLife. Finally, StatSmart's proposed program would also improve employee satisfaction and engagement as they work with the knowledge that their products are helping others to improve their lifestyles.

In the medium to long term, a key factor for SuperLife to consider is whether premiums can be reduced to reflect the improvement in mortality. This may come in the form of overall re-pricing, or of variable premium discounts to policyholders based on their participation in the incentives. While this may reduce SuperLife's premium income, it would likely boost policyholder participation, attract new customers, and improve the company's brand reputation.

5. Key Assumptions

Metric	Assumed Value	Reasoning including analysis
Mortality Adjustment	88% for the general population and 811% when modelling for smokers only	Between 2001 and 2023, the observed mortality was 12% lower than the rates predicted by Lumaria Mortality Table. Consequently, we have recalibrated the mortality rates by applying a factor of 88%, ensuring the mortality table aligns with the empirical data as a baseline before applying any Mortality Improvements. This factor escalates to 811% when only smokers are modelled.
Mortality Improvement	5-10% for Preventive Screening 5-10% for Cancer Prevention 2-5% for Financial Incentives 35-65% for Smoking Cessation	To see the impact of each intervention, we have simulated three scenarios of mortality improvement based on the provided ranges in the Interventions Data file. Note that although the information provided by SuperLife suggests a maximum mortality improvement of 50% for smoking cessation, several studies globally have shown that 50% is in fact an average improvement, supporting our use of this value as a best estimate rather than an upper limit (US Surgeon General, 2020; Pierce, 2022)
Participation Rates	21% for Preventive Screening 45% for Cancer Prevention 37% for Financial Incentives 50% for Smoking Cessation	Based on research indicated in section 3.1 to 3.4 and Appendix B, we have assumed medium participation in each program as a baseline for modelling.
Discount Rate	2.0519%	Utilizing the provided 1-year risk-free annual spot rates from 2001-2023, we derived a single, consolidated discount rate. This rate, weighted by the actual cash flows, effectively replicates the present value that would have been obtained using the variable yearly rates. This approach simplifies modelling and facilitates sensitivity analysis.
App Development and Maintenance Cost	Initial Value = Č 5,000,000 Per year cost = Č 2,000,000 Present Value (2.0519% discount rate) = Č100M	Based on the article from DreamWalk (Russell,2023), the average cost to develop an app was between $45,000 and $240,000. However, it is mentioned that large companies spend millions of dollars a year to develop and maintain apps. Therefore, a conservative estimate of 5,000,000 upfront and 2,000,000 per year was calculated as the cost of the app.

6. Risk and Risk Mitigation Considerations

The program proposed by the StatSmart team offers SuperLife an excellent opportunity to financially benefit themselves, whilst also improving the lives of their policyholders. Despite this, it comes with multiple risks that could impact the overall profitability of the program. After considering these risks, the StatSmart team is almost certain that the proposed program would have lowered mortality over the last 23 years, and even more certain that it will decrease mortality going forward. This is backed up by the research completed by the team where there is no evidence of any similar interventions to the four proposed by StatSmart not decreasing the mortality rate. To add to this, the StatSmart team has also conducted thorough sensitivity analysis to confirm that there is a very low chance that this program does not create economic value for SuperLife. For further information regarding the sensitivity analysis, refer to Section 6.4.

6.1. Ethical Risks

Risk	Description	Mitigation Strategy
Transparency Risk	SuperLife must inform users about how sensitive data is handled, including how the data is collected, used and who has access to it, including third parties. For example, users should be informed about how their data issued if data is shared with partnered companies.	Privacy policies must be transparent, informative, and easily accessible. Policyholders must be made aware of where their data is being used, and whether it is being shared with third parties, to prevent them from unknowingly sharing their data without understanding the implications. SuperLife's legal team can assist with this. Additionally, an ethical framework must be developed to cover this and other ethical risks.
Data Privacy Risk	Sensitive data will be collected from individuals who participate in these programs, such as their medical records used to claim points. Data breaches could lead to fraud, identity theft and other regulatory and ethical issues.	Along with the ethical framework, SuperLife must implement robust security measures to protect sensitive data. Regular tests and checks of this security system must be conducted. Sensitive data should only be accessible for those who require it, and measures should be taken to anonymise and remove or encrypt sensitive information when sharing the data.
Consent Risk	While SuperLife's app aims to encourage healthy habits, policyholders may inadvertently reveal sensitive details about their lifestyle, health conditions, or habits through logging their activities for points. The trends revealed may not align with the terms and conditions of the written consent form they fill out prior to participation.	As with the transparency risk, privacy policies and consent forms must be clear and understandable for policyholders. Policyholders should be fully aware of what they are consenting to, and SuperLife should continually monitor the data they are receiving to ensure that no unnecessary data is collected. Regulatory guidance can also assist in this regard.
Discrimination Risk	SuperLife encourages participation in healthy activities which may not be accessible to certain policyholders like those with health conditions or disabilities. Policyholders with higher socioeconomic status, better access to healthcare and more leisure time for leisure are more advantaged in completing activities and thus financial incentives.	As the wellness program is implemented and further developed, SuperLife can add additional incentives targeted towards these discriminated population groups, such as assistance with chronic diseases. Further, premium discounts (which may be introduced in the future of the wellness program) can make the program more accessible for those with lower socioeconomic status.

6.2. Main Risks

Risk	Description	Mitigation Strategy
Participation risk	The proportion of policyholders who participate in the wellness program is significantly lower than expected.	The inherent design of the program to target several different health-based incentives which can be personalised per policyholder reduces the risk of low participation. The sensitivity analysis shows that profits will still be made even if participation is lower than expected. Data analytics and consumer feedback can be used to improve participation once the program is implemented, if need be.
Mortality Impact Risk	The risk that the mortality impact of the applied interventions is not in line with expectation.	Monitoring mortality changes will allow SuperLife to identify lower-than-expected mortality improvements. Collaborating with doctors, wellness experts and researchers can provide

		additional ideas on how to assist policyholders in reducing their mortality risk.
Pricing Risk	The risk that the prices and costs calculated by the StatSmart team are incorrect.	Consistently (e.g. every quarter) monitor premium income vs cash outflows to ensure expenses and income is in line with expected; re-price if necessary.
Technology risk	The program relies heavily on both the development and ongoing maintenance of the app.	IT specialists within SuperLife will need to focus on ensuring that the app is working smoothly. Several redundancy and backup mechanisms must be in place. In the event of critical system failure, failover mechanisms and recovery protocols must be in place.

6.3. Risk Matrix

As shown in the risk matrix on the right, most main risks have a low likelihood of occurrence but a high impact on the company's performance. Appropriate risk mitigations measures have been implemented to reduce this impact and ensure the company remains in business.

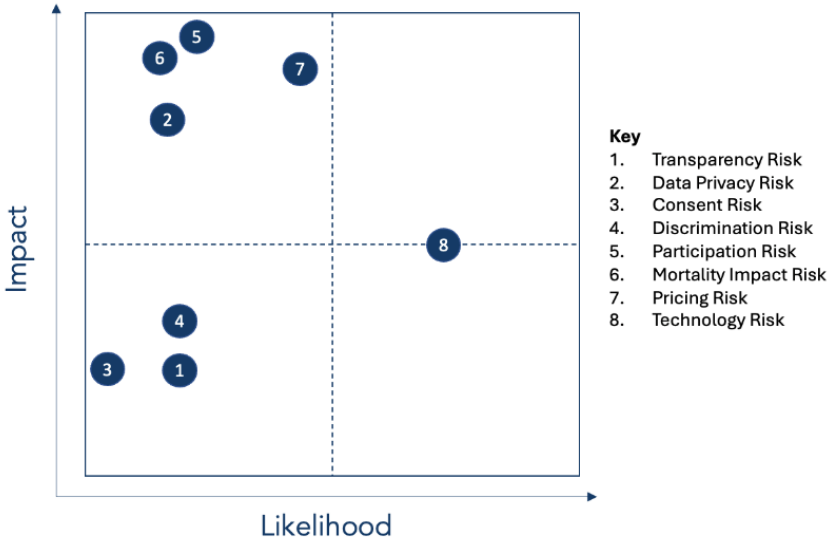


Figure 2: Risk Matrix for all main risks

6.4. Sensitivity analysis

The survival model utilized median scenario assumptions tailored for each intervention in the cost-benefit analysis, detailed further in Appendix C. Below, we present a comprehensive overview of the sensitivity analysis outcomes (full sensitivity analysis in Appendix E.3), focusing on pivotal assumptions that impact Net Savings.

Assumption	Net Savings (000,000's)		Recommended Range
	Min	Max	
Discount Rate	3,981	5,117	The results are desirable for any range of discount rate if the cost and savings are modelled using a consistent discount rate. The min and max scenarios were 1% higher and 1% lower than the provided discount rate (i.e. rates of 1.05% to 3.05%)
Participation Level	3,585	5,801	The results are desirable within all the simulated participation levels, which range from 18% to 60%, if the cost and savings are modelled using a consistent participation level. The participation levels used for this analysis can be found in Appendix E.3.
Ongoing Costs	3,886	5,906	The overall results are desirable within all the simulated cost levels, shown in Appendix C.1-4. However, when evaluating each intervention solely, the cost of the Financial Incentives program will exceed its savings only in the high-cost scenario.

Mortality Improvement	2,405	7,120	The overall results are desirable within the simulated mortality improvement range, shown in Appendix C.1-4. However, when evaluating each intervention solely, only the savings in the low mortality improvement scenario of the Financial Incentives program will be insufficient to cover the program cost.

7. Limitations

Limitation	Description	Impact
Premium Data	Data relating to how premiums were priced, and their prices, was not included.	Assumptions were required to calculate the benefits of our interventions. It was impossible to confidently use premium discounts as an incentive.
Data definitions	Data definitions were not clear, especially in the srcsc-2024-interventions excel document.	The StatSmart team had to use their best judgement to define costs and mortality improvements for their interventions
Cause of Death	Cause of death data was quite broad, and was not specific to the exact illness.	This limited the StatSmart team's ability to completely tailor their solution to the country of Lumaria
Lumaria Encyclopaedia Entry	The Lumaria encyclopaedia entry was not very easy to apply.	There was no simple way to find similar economies to Lumaria. StatSmart used the US as a comparison.
Policyholder Data	There was limited data on the policyholders.	There was very limited data that StatSmart could use to infer the mortality of the policyholders. There was no policyholder behaviour data i.e. how much they used the SuperLife website.
SuperLife data	There was no data on SuperLife	It was impossible to understand SuperLife's full offerings and potential to pair with other products.

Although there are various limitations imposed on our solution as stated above, StatSmart has used appropriate and realistic assumptions to mitigate this limitation and hence, our solution is justifiable and can be used. However, if Lumaria data does exist, StatSmart encourages SuperLife to rerun the model using it to see more accurate results.

8. Conclusion and Next Steps

SuperLife will have an overall mortality saving of Č4.6B if this program was used in the past 23 years. We recommend SuperLife to perform several actions in the future to ensure profitability, attract customers and encourage healthy behaviour. These actions include using premium data to determine and incorporate premium discounts as part of the rewards for health behaviour and customer acquisition. SuperLife should also consider gaining more data on the factors that can affect mortality and use the cox regression model to isolate each covariate's effects on mortality. Finding the exact causes of death will also allow SuperLife to determine a more specific action plan to decrease mortality through the reward program. Ultimately, we believe that our proposed wellness plan will not only benefit SuperLife, but also the community of Lumaria as a whole.

9. Appendix

9.1. Appendix A – Exploratory Data Analysis (incl. Data Quality Check)

Findings:

An exploratory Data Analysis was done to understand the enforce data set prior to designing the program. We created dashboards that were used to slice the data and understand the characteristics of each group of policyholders. Here is a list of key findings:

- Percentage of smokers significantly decreased throughout the Issue years 2001-2023 (T20 from 12% to 6%) and (SPWL from 10% to 0.3%).
- Smokers are mostly Males under T20 Policy & are always classified as moderate or high risk. They mostly die due to Circulatory Systems while Non-smokers mostly die due to Neoplasms.
- SPWL starts from age 35 and is mostly sold through an agent.
- T20 starts from age 26 and is evenly distributed across the distribution channels.
- The data is randomly distributed across all regions. No Region-specific anomalies were found.
- Distribution Channels only correlate with the Type of Policy with no other anomalies.
- Urban VS Rural are randomly distributed.
- Underwriting Class is mostly correlated with Smoking Status, no other anomalies found.

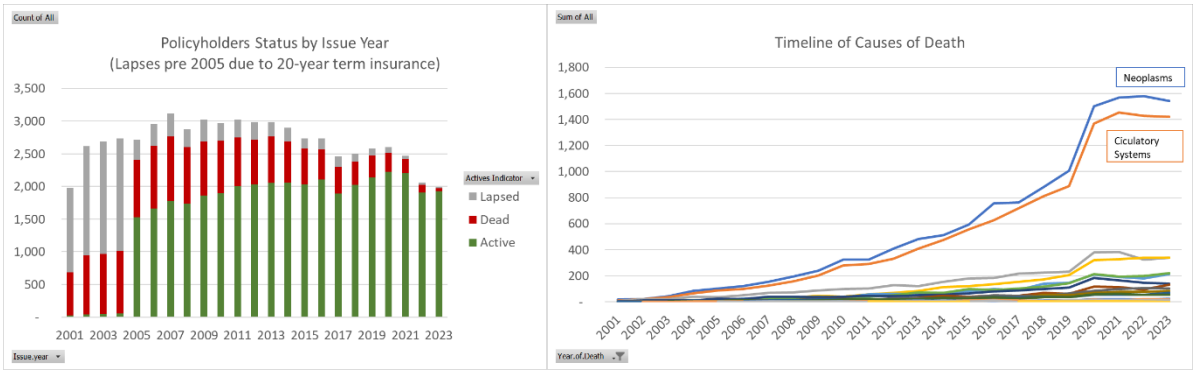
Data Quality Check:

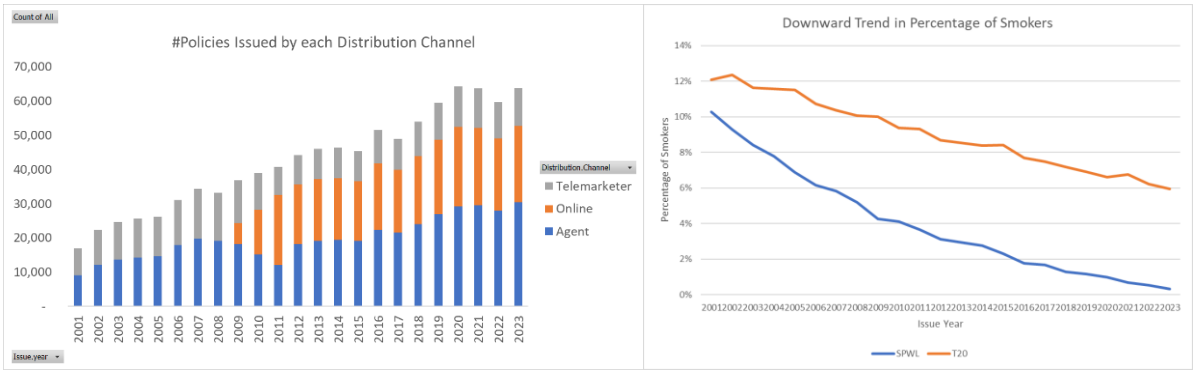
Column Name	Type/ Structure	Data Quality Check
Policy number	123abc456def	No duplicates found
Issue year	YYYY	CLEAN
policy type	(T20, SPWL}	CLEAN
Issue age	zz	CLEAN
sex	{M, F)	CLEAN
Face amount	R	CLEAN
Smoker status	{S, NS)	CLEAN
underwriting class	(very low risk, low risk, moderate risk, high risk}	CLEAN
urban vs Rural	(Urban, Rural)	CLEAN
Region	Z	CLEAN
Distribution Channel	{Agent, Telemarketer)	"Online" was not in the description. It is observed starting from 2009 onwards, in addition to the other 2 channels.
Death indicator	{0, 1}	The data shows NA rather than 0
Year Of Death	YYYY	There are 64,067 blanks, other than the "NA"s

Lapse Indicator	{0, 1}	There are no "0"s. Instead: "Y"s were used for lapses in years 2008 & 2009. "1"s were used for lapses in the remaining years. "NA"s have no lapse years so they mean no lapses.
Year of Lapse	YYYY	CLEAN
Cause of Death	xzz-xzz	16 codes for deaths. There are Blanks for policies of Active/Lapsed/Dead policyholders. There are "NA"s for Active/Lapsed policyholders.

Univariate Analysis:

Multivariate Analysis:





R Code used for the Interventions EDA:

```
# ACTL5100 Case Study
# Kate Jones

setwd("~/Documents/UNSW/ACTL5100/Case Study")
library(data.table)
library(stringr)
library(janitor)
library(tidyverse)
library(ggrepel)

## initial data cleaning and adding relevant cols
interventions <- fread("interventions.csv")
names(interventions) <- make_clean_names(names(interventions))
interventions[, mort_impact_lower := as.numeric(str_extract(approximate_impact_on_mortality_rates, "\\d+"))]
interventions[, mort_impact_upper := as.numeric(str_extract(approximate_impact_on_mortality_rates,
"\\d+(?=%(?!.*\\d+%.*$))"))]
interventions[, mort_impact_ave := rowMeans(interventions[,c('mort_impact_lower', 'mort_impact_upper')])]

interventions[, cost_lower := as.numeric(str_extract(approximate_per_capita_cost, "\\d+"))]
interventions[, approximate_per_capita_cost := gsub(",", "", approximate_per_capita_cost)]  # one cost value has a comma, need
to remove else r won't read full value
interventions[, cost_upper := as.numeric(str_extract(approximate_per_capita_cost, "\\d+(?= per(?!.*\\d+ per.*$))"))]
interventions[, cost_mean := rowMeans(interventions[, c('cost_lower', 'cost_upper')])]

interventions[, row_id := 1:.N]
fwrite(interventions, 'interventions manipulated.csv')
```

9.2. Appendix B – Program Design Appendix

9.2.1. Appendix B.1 – StatSmart Intervention Analysis

The results of the cost benefit analysis completed by the team can be seen in the screenshot below:

intervention_name	mort_impact_ave	cost_mean	cost_per_annum	d Frequency (j	cted Popul	rtality_Imp	Intervention_Payout	Cost per Year	Total Cost	Benefit
Cancer Prevention Initiatives	7.5	52.5	52.5	6	0.7	5.25	28508453077	315	8978.741986	1579615070
Incentives for Preventive Screenings	7.5	52.5	52.5	70000	0.7	5.25	28508453077	3675000	104751989.8	1474872059
Smoking Cessation Programs	50	2177.5	383555214.9	625	0.1	5	28583673269	1360937.5	38792084.67	1465611772
Chronic Disease Management	7.5	522.5	255654547.5	50000	0.9	6.75	28057131920	26125000	744665506	1286279700
Financial Incentives for Healthy Behavior	3.5	52.5	262.5	70000	0.9	3.15	29140302696	3675000	104751989.8	843022439.6
Personalized Health Plans	4.5	217.5	106420792.5	50000	0.7	3.15	29140302696	10875000	309980378.1	637794051.4
Sun Safety Awareness	3	22.5	225	2	0.7	2.1	29456227506	45	1282.677427	631848337
Alcohol Moderation Programs	4.5	217.5	106420792.5	12	0.4	1.8	29546491737	2610	74395.29074	541510993
Holistic Health Assessments	4.5	217.5	106420792.5	70000	0.7	3.15	29140302696	15225000	433972529.3	513801900.1
Well-being Apps	3	22.5	225	70000	0.5	1.5	29636755969	1575000	44893709.93	406427447
Selected										
Backup										

Summary of steps for cost-benefit analysis:

1. Calculate the current amount paid out in the last 23 years to policyholders.
2. For each intervention, estimate the Assumed Frequency (per year) and the Impacted Population (the % of the yearly population impacted).
3. Using the medium value for the mortality improvement, calculate the new value paid out to policyholders over the last 23 years, considering the mortality improvement.
4. Using the medium value for the cost, calculate the total cost of the intervention over the 23 years.
5. Calculate the benefits of the intervention by using the formula below:

$$Benefits = \left(Payout_{original} - \ Payout_{new\ (with\ intervention)}\right) - \ Cost_{Intervention}$$

Python Code used for the Cost-Benefit Analysis:

```
#%%
# Import packages
import pandas as pd
import os
import seaborn as sns
import numpy as np
import math

#%%
# Set working directory
os.chdir("C:\\Users\\231334\\OneDrive - QBE Management Services Pty Ltd\\University")

# Import data
interventions = pd.read_csv("./interventions manipulated - FINAL.csv")
df = pd.read_csv("./2024-srcsc-superlife-inforce-dataset (2).csv",skiprows=3)
econ = pd.read_excel("./srcsc-2024-lumaria-economic-data - Modified.xlsx",skiprows=11)

#%%
# Define the new variables for the inforce dataset (df)
# FIX the Lapse Indicator
df['Lapse.indicator'] = np.where(df['Lapse.Indicator'].isna(),1,0)
df = df.drop(columns=['Lapse.Indicator'])

# Create the active indicator
df["Actives_Indicator_1"] = np.where(df['Death.indicator'] == 1,'Death',0)
```

```
df["Actives_Indicator_2"] = np.where(df['Lapse.indicator'] == 1,'Lapsed',df["Actives_Indicator_1"])
df["Actives_Indicator"] = np.where(df["Actives_Indicator_2"] == 0,'Active',df["Actives_Indicator_2"])
df = df.drop(columns=['Actives_Indicator_1','Actives_Indicator_2'])

# Create the Policy.Age variable
df['Policy.Age'] = 2024 - df['Issue.year']

# Create Age.At.Death
df['Age.At.Death'] = np.where(df['Death.indicator'] == 1,df['Issue.age']+df['Year.of.Death']-
df['Issue.year'],np.nan)

# Age at 2024
df['Age.At.2024'] = np.where(df['Death.indicator'] == 1,'Dead',df['Issue.age']+2024-df['Issue.year'])

#%%
df['Face.amount'] = df['Face.amount'].astype('float')

Results = pd.crosstab(df['Year.of.Death'],df['Face.amount'].sum(),values = df['Face.amount'],aggfunc =
'sum')
Results = Results.set_axis(['Sum of Payouts'], axis=1)
Results = Results.reset_index()


#%%
# Calculating the mortality assumption
interventions['Mortality_Impact'] = interventions['mort_impact_ave']*interventions['Impacted
Population']


#%%
# Calculating payouts with no intervention
M = econ[econ['Year']>=2001]
M = M[['Year','Present Value Factor (End of 2023)']]

Orig_Results = Results.merge(M, left_on = ['Year.of.Death'], right_on= ['Year'])

Orig_Results['PV Results'] = Orig_Results['Present Value Factor (End of 2023)']*Orig_Results['Sum of
Payouts']
Orig_Payout = Orig_Results['PV Results'].sum()


#%%
# Testing for Interventions
# For each intervention, you must define two different factors
# 1. Define the mortality difference and impact on sum of payouts
M = econ[econ['Year']>=2001]
M = M[['Year','Present Value Factor (End of 2023)']]

X = interventions['Mortality_Impact']
```

```
Z = []

for i in X:
    Results_Updated = Results
    Results_Updated['Updated Sum of Payout'] = Results_Updated['Sum of Payouts']*(100-i)/100
    Results_2 = Results_Updated.merge(M, left_on = ['Year.of.Death'], right_on= ['Year'])
    Results_2['PV Results'] = Results_2['Present Value Factor (End of 2023)']*Results_2['Updated Sum of
Payout']
    Y = Results_2['PV Results'].sum()
    Z.append(Y)


interventions['Intervention_Payout'] = Z


#%%
# Now calculating Cost for each of the interventions
interventions['Cost per Year'] = interventions['cost_mean']*interventions['Assumed Frequency (per year)']

X = interventions['Cost per Year']
M = econ[econ['Year']>=2001]
M = M[['Year','Present Value Factor (End of 2023)']]

Z=[]

for i in X:
    M['Yearly Cost'] = i
    M['PV Yearly Cost'] = M['Yearly Cost']*M['Present Value Factor (End of 2023)']
    Y = M['PV Yearly Cost'].sum()
    Z.append(Y)


interventions['Total Cost'] = Z
#interventions['']
interventions['Benefit'] = Orig_Payout - interventions['Intervention_Payout'] - interventions['Total Cost']

#%%
# Picking the top 10
interventions_sorted = interventions.sort_values(by='Benefit',ascending=False)
Final10 = interventions_sorted[0:10]

Final10.to_excel('Final10Interventions.xlsx')

#%%
# Calculate the count of new policyholders by year
X = df['Issue.year'].value_counts()
X = X.sort_values()
# Calculate the count of lapsed policyholders by year
Y = df['Year.of.Lapse'].value_counts()
```

```
Y = Y.sort_values()
# Calculate the count of lapsed policyholders by year
Z = df['Year.of.Death'].value_counts()
Z = Z.sort_values()

# These were then copied to the excel document measuring the costs for each initiative
```

9.2.2. Appendix B.2 – Earn Supporting Analysis

By forging mutually beneficial partnerships with technology companies, major retailers and airlines, *Earn* aims to reward healthy policyholders by giving them the option to convert their earned points into discounts for common lifestyle spendings. Forging such partnerships is highly viable especially for grocers and wearables companies, as partnered firms tap into a health-conscious customer base who track their health, leading to repeat business and loyalty. In Australia, insurer AIA's wellness app AIA Vitality has partnered with over 30 national and multinational corporations, showing the high demand for partnerships for a similar initiative (AIA, 2023).

Using financial incentives to improve mortality has proven highly effective in the US life insurance market, as John Hancock's behaviour change platform 'Vitality' saw participating policyholders living 13-21 years longer than unparticipating insured population, with its extensive lifestyle discount rewards growing its membership base twofold within two years of release (Vitality, 2018). This unwavering participation can be attributed to the app's gamification elements, as points and quizzes are shown to positively influence user behaviour and participation. (Pechenkina et al. 2017)

A similar positive trend can be anticipated for *Earn*, as Lumaria's economy closely follow that of the US, namely the age and income distribution, alongside health, literacy, and mortality rates. Hence, in calculating the total costs required for *Earn*, we assume that the participation rates for SuperLife's app follow that of John Hancock Vitality, but with high and low margins to account for variability.

Reward Tiers and Associated Costs

Reward Tier	Points	Cost (Č)
Blue	0 – 999	0
Bronze	1000 – 1999	20
Silver	2000 – 2999	40
Gold	3000 – 4999	60
Platinum	5000+	80

Timeframe Evaluation

In the short to medium term, SuperLife should monitor the participation rates of the SuperLife app, adjusting the point system to keep a balance of high user count and financial viability of the reward outflows. In the long term, SuperLife should add other activities to the points

system, including mental health check-ups, participation in cognitive programs, and fitness challenges, to make points more accessible to a diverse userbase.

9.2.3. Appendix B.3 – Screen Supporting Analysis

Reason for Screenings Chosen

As cancer is a top killer of SuperLife policyholders, to reduce this and other diseases, SuperLife should encourage policyholders to do preventive cancer screenings and pathology tests during a general health check-up, by rewarding them with financial incentives. Although a screening can provide benefits of early detection, it comes with risks as screening tests can be harmful due to radiation, injury and more (Care, 2019). To determine which screening programs should be accessible to the public, governments use the World Health Organization's population-based screening framework which decides on the criteria to ensure that the benefits of the screening outweighs the risk. These population-based screenings are offered to everyone in a certain group as part of an organised program.

We assume Lumaria's population-wide screening programs to be the common population-wide screening programs implemented by governments around the world (Australia, Canada, US and UK). These are cervical, bowel, breast, lung and colorectal cancers. Other cancers such as ovarian, prostate, thyroid and more have screenings as well but doing such screenings have been found to not reduce deaths or have insufficient evidence to determine the benefits and harms of the screening (Centres for Disease Control and Prevention, 2023).

Criteria for Each Preventive Screening/Check-up

Screening	Criteria
General Health Check Up	All policyholders are eligible
Cervical Cancer	• Age 25-74 • Female only or people with a cervix • Once every 5 years
Breast Cancer	• Age 50 -74 • Female only • Once every 2 years
Bowel Cancer	• Age 50-74 • Once every 2 years
Lung Cancer	• Age 50-74 • Currently smoking or has quit in past 15 years • Have a 20 pack-year or more smoking history • Once every year
Colorectal Cancer	• Age 50-74 • Once every 2 years

Timeframe Evaluation

To evaluate this intervention's performance, SuperLife should monitor the participation rate of each type of screening within the first year to see if it incentivises policyholders to get a screening. In the long run, SuperLife should monitor the participation data and frequency of how often a policyholder gets a specific kind of screening as some screenings can only be tested once every few years. This information will inform SuperLife on how it should adapt the reportable screenings to suit the needs and health of the policyholders.

9.2.4. Appendix B.4 – Quit Supporting Analysis

Program Design & Features

As discussed in the main body of the report, *Quit* will involve three aspects: counselling, insurance coverage of certain medications, and access to the national tobacco quitline. The counselling will take the form of virtual or face-to-face sessions, and can be held privately or in a group setting, as preferred by the policyholder. Policyholders should be encouraged to sign up for a package of counselling sessions, preferably between 6 and 12 total weekly meetings, to avoid the risk of reneging on the program if required to actively sign up every week. The counselling would involve behavioural therapy and strategies on reducing withdrawal symptoms, learning from prior quit attempts, managing cravings and triggers, and maintaining motivation to quit (Fiore et al., 2008). Along with counselling, SuperLife should offer access to medications that reduce nicotine dependence, such as Nicotine Replacement Therapies (NRTs) and non-nicotine-based medications (Lindson et al., 2019). Used individually, these medications are shown, on average, to double quit rates, with even higher success rates when used in combination (Cahill et al., 2013). Insurance coverage of FDA-approved tobacco cessation medication is required in the US and many other countries worldwide, and is found to be highly cost-effective in promoting smoking cessation, thereby demonstrating the importance of SuperLife adopting this approach in Lumaria (Centre for Disease Control, 2021).

Timeframe Evaluation

To evaluate the success of *Quit*, SuperLife should first monitor participation rates of the program and the proportion of smokers in the in-force population, to identify whether participation does indeed lead to success in quitting smoking. This monitoring should be done every 6 months throughout the duration of the program, with adjustments made to the offerings, marketing, and delivery of the program if results are worse than desired. In the medium to long term, SuperLife should monitor the changes in mortality of smokers in their policyholder population, to confirm that mortality is indeed improving. If this is not the case, SuperLife should consider whether this is caused by insufficient knowledge of the program, difficulty in accessing the program's resources, high relapse rates or other reasons. Solutions and adjustments can then be tailored to the underlying issue.

9.2.5. Appendix B.5 – Prevent Supporting Analysis

Timeframe Evaluation

Evaluation of this program should be conducted on an annual basis. This evaluation will be predominantly aimed at testing the uptake of the app (total users), the number of people that read the pop up (specified number of seconds until exited is considered read) and articles for the first five years. After this, it should include looking at both the overall mortality rate and the cancer mortality rate.

Delivery Strategy Research

Delivery Strategy	Advantages	Disadvantages
Email	• Reaches 100% of the policyholders • A newsletter email has just a 1% conversion rate (mailmunch, 2023)	• Very easy for policyholders to ignore • Most likely treated as spam mail
Publications posted on website	• Ability to provide lots of information	• Very low reach percentage • Not easily accessible
Publications on app	• Ability to provide lots of information	• Low reach percentage
Pop up through mobile app/website	• Highest conversion rate of any strategy. According to Optimonk, the conversion rates for a pop up through mobile is 11.07% and the desktop pop up has a conversion rate of 9.69% (Optimonk, 2024) • Higher reach than publications	• Although reaching the customer, it may not be read
Notification to phone	• Higher reach than publications • Higher conversion rate than other strategies	• Very easy to ignore • Policyholders can turn off notifications

Nine modifiable key risk factors from theactuary.com (Schiergens, Smith, 2023):

- Smoking/Tobacco use
- Alcohol
- Nutrition and Diet
- Physical activity
- Obesity
- Diabetes
- Infections e.g. HPV and Hep B/C
- Radiation e.g. sunlight, ionising radiation
- Pollution and environmental risk factors, e.g. exposure to certain chemicals

Five non-modifiable key risk factors from theactuary.com (Schiergens, Smith, 2023):

- Family history and genetics, including random genetic errors
- Hormonal factors
- Sex
- Age
- Race/ethnicity

Program Design – Cancer Prevention Hub

The cancer prevention hub will be designed with a range of resources, a summary of exactly how it will be designed can be found below:

Page Type	Pages	Contents
Cancer	A page for the top 10-20 most deadly cancers in Lumaria	1. Outline of the Cancer 2. Characteristics of people at risk 3. Preventative Measures (incl. explanation) 4. Symptoms (if any) 5. Links to related resources (i.e. specific key risk factors or preventative resources)
Key Risk Factors	One page for each of the nine key modifiable risk factors	1. Outline the key risk factor 2. Explain the impact 3. How to mitigate this risk? 4. Links to resources that help with the actual prevention of these e.g. Smoking Cessation Programs
	One page for each of the five key non-modifiable risk factors	1. Outline of key risk factor 2. Understanding this non-modifiable risk 3. Links to resources that help with discovering susceptibility to these risk factors e.g. Genetic testing
Resources for knowledge of preventing or susceptibility to Key Risk Factors	Modifiable risks	1. Outline a specific method to mitigate the specific risk e.g.. A specific companies weight loss programs
	Non-modifiable risks	1. Outline a specific method to check if you are susceptible to the non-modifiable risk e.g. a specific companies genetic testing.
Articles	All important updates in cancer industry	1. Journal Article on any recent cancer news/research

9.2.6. Appendix B.6 – Evaluation Timeframe

The timeframe below indicates the recommended timeframe for the evaluation of the overall program. For more specific details on the individual interventions refer to Appendix B.

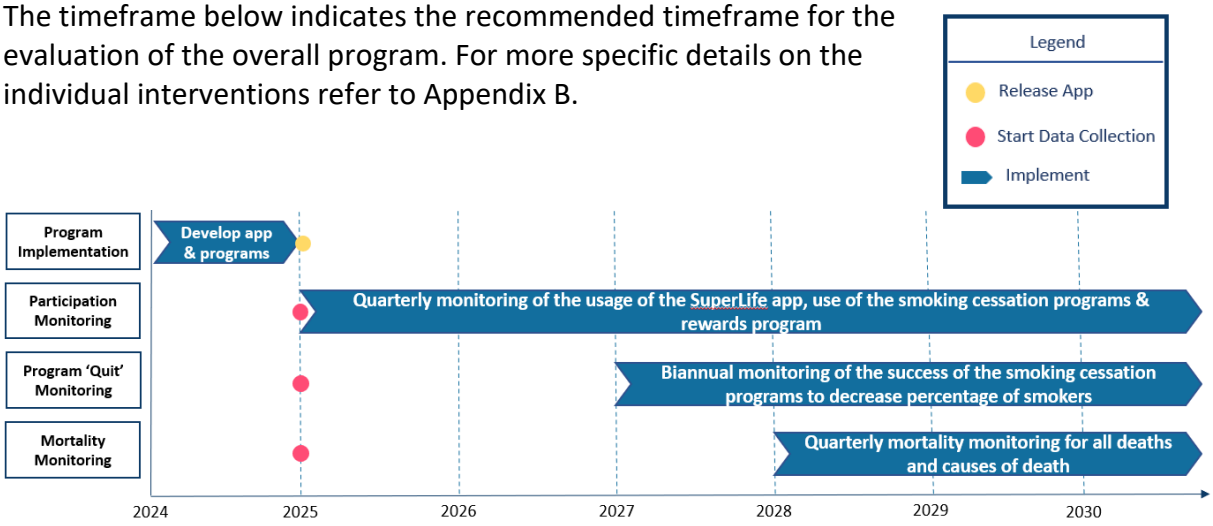


Figure 3: Evaluation timeframe for overall program

9.3. Appendix C – Cost Analysis

9.3.1. Appendix C.1 – Earn Pricing/Cost Supporting Analysis

The Best-Case scenario features high Savings and low Costs, whereas the Worst Case scenario reflects the opposite.

Model output for each intervention		Financial Incentives for Healthy Behavior
Assumptions	Baseline Population	All
	Participation Rate scenario level	Medium
	Participation Rate out of the baseline	37%
	Mortality Adjustment	88%
	Discount Rate	2.05%
	Investment Rate	4.11%
Simulation Results at 100% participation and median assumptions	Assets	241,718,350,621
	Benefits Paid	28,580,508,993
	Liabilities	168,770,153,128
	Surplus	44,367,688,501
Improvements from baseline after adjusting for Participation Rates	Savings in Benefits Paid	356,562,075
	Savings in Liabilities	471,188,776
	Total Savings	827,750,852
Mortality Improvement level	Low	2.0%
	Medium	3.5%
	High	5.0%
Savings: at varying Mortality Improvement levels	Low	471,315,715
	Medium	827,750,852
	High	1,186,790,569
Cost: at varying cost levels	Low	237,885,831
	Medium	624,450,306
	High	1,011,014,781
Net Savings : = Savings - Cost	Worst Case	(539,699,066)
	Expected	203,300,546
	Best Case	948,904,738

9.3.2. Appendix C.2 – Screen Pricing/Cost Supporting Analysis

The Best-Case scenario features high Savings and low Costs, whereas the Worst Case scenario reflects the opposite.

Model output for each intervention		Incentives for Preventive Screenings
Assumptions	Baseline Population	All
	Participation Rate scenario level	Medium
	Participation Rate out of the baseline	21%
	Mortality Adjustment	88%
	Discount Rate	2.05%
	Investment Rate	4.11%
Simulation Results at 100% participation and median assumptions	Assets	241,718,350,621
	Benefits Paid	27,465,023,320
	Liabilities	167,260,495,086
	Surplus	46,992,832,216
Improvements from baseline after adjusting for Participation Rates	Savings in Benefits Paid	439,356,252
	Savings in Liabilities	588,087,217
	Total Savings	1,027,443,469
Mortality Improvement level	Low	5.0%
	Medium	7.5%
	High	10.0%
Savings: at varying Mortality Improvement levels	Low	680,758,592
	Medium	1,027,443,469
	High	1,378,603,245
Cost: at varying cost levels	Low	134,122,868
	Medium	352,072,528
	High	570,022,189
Net Savings : = Savings - Cost	Worst Case	110,736,404
	Expected	675,370,941
	Best Case	1,244,480,377

How to calculate Cost for incentives for preventive screening:

1. Get participation rate of policyholders participating in rewards program
2. Get participation rate for each screening program (bowel, breast, cervical, colon, lung cancer and pathology tests). Average participation rate was used for years with missing participation rate data.
3. Calculate the subset of policyholders eligible (i.e. fit the criteria stated) for each screening program.
4. Multiply the number of policyholders eligible for each screening program with its corresponding participation rate to get the number of screenings.
5. Sum the number of screenings of each screening program to get the total number of screenings for this intervention.

6. Multiply the total number of screenings with the participation rate of policyholders participating in rewards program to get the total number of screenings in the rewards program.
7. Total cost = Sum of the present value of the total number of screenings in the rewards program * cost for each year.

9.3.3. Appendix C.3 – Quit Pricing/Cost Supporting Analysis

The Best-Case scenario features high Savings and low Costs, whereas the Worst Case scenario reflects the opposite.

Model output for each intervention		**Smoking Cessation Programs**
Assumptions	Baseline Population	Smokers Only
	Participation Rate scenario level	Medium
	Participation Rate out of the baseline	50%
	Mortality Adjustment	811%
	Discount Rate	2.05%
	Investment Rate	4.11%
Simulation Results at 100% participation and median assumptions	Assets	19,347,404,631
	Benefits Paid	6,616,311,397
	Liabilities	1,738,097,773
	Surplus	10,992,995,460
Improvements from baseline after adjusting for Participation Rates	Savings in Benefits Paid	1,842,092,568
	Savings in Liabilities	666,018,831
	Total Savings	2,508,111,399
Mortality Improvement level	Low	35.0%
	Medium	50.0%
	High	65.0%
Savings: at varying Mortality Improvement levels	Low	1,660,207,823
	Medium	2,508,111,399
	High	3,477,518,564
Cost: at varying cost levels	Low	251,525,550
	Medium	850,600,742
	High	1,041,597,232
Net Savings : = Savings - Cost	Worst Case	618,610,590
	Expected	1,657,510,656
	Best Case	3,225,993,014

Cost Justification

SuperLife's coverage of these costs, as part of their wellness program, not only reduces barriers for policyholders looking to quit smoking, but also raises awareness of these evidence-

based treatments among Lumaria's general population. This may serve to increase SuperLife's product sales, as well as decrease SuperLife's policyholder mortality, thereby reducing their expected claim payouts. If the average participant in a cessation program signs up for 6 counselling sessions and uses the advised NRTs or other medications, the expected cost for SuperLife is estimated to be between Č2600 and Č3000 per participant over the course of the study period, from 2001 to 2023. This value is estimated using the given interventions information, as well as currency-converted values and data from Levy et al. (2022) in their US-based study.

To calculate SuperLife's overall savings from 2001 to 2023 if they had implemented this smoking cessation program, these estimated costs per participant are multiplied by the expected number of participants per year and then by the relevant interest rates up until the end of 2023. Note that individual costs are estimated to be slightly higher (Č3100) during 2020-2022 to account for the effects on Covid-19 on the procurement of medication, among other impacts. The expected number of participants is estimated using the proportion of smokers in the in-force dataset per year and the total number of active policyholders per year, multiplied by the expected participation rate. The participation rate varies between 50% to 55% over the period, based on data from Babb et al (2017), reducing to 45% during Covid years to capture increased stress levels, lack of motivation to quit and higher rates of relapse (Thai et al., 2023). Along with these costs comes an estimated 50% improvement in mortality, as well as a 2% overall increase in SuperLife's customer base.

9.3.4. Appendix C.4 – Prevent Pricing/Cost Supporting Analysis

The Best-Case scenario features high Savings and low Costs, whereas the Worst Case scenario reflects the opposite.

Model output for each intervention		Cancer Prevention Initiatives
Assumptions	Baseline Population	All
	Participation Rate scenario level	Medium
	Participation Rate out of the baseline	45%
	Mortality Adjustment	88%
	Discount Rate	2.05%
	Investment Rate	4.11%
Simulation Results at 100% participation and median assumptions	Assets	241,718,350,621
	Benefits Paid	27,465,023,320
	Liabilities	167,260,495,086
	Surplus	46,992,832,216
Improvements from baseline after adjusting for Participation Rates	Savings in Benefits Paid	934,787,214
	Savings in Liabilities	1,251,231,567
	Total Savings	2,186,018,781
Mortality Improvement level	Low	5.0%
	Medium	7.5%
	High	10.0%
Savings: at varying Mortality Improvement levels	Low	1,448,401,896
	Medium	2,186,018,781
	High	2,933,156,594
Cost: at varying cost levels	Low	19,946,185
	Medium	28,732,332
	High	40,716,349
Net Savings : = Savings - Cost	Worst Case	1,407,685,547
	Expected	2,157,286,449
	Best Case	2,913,210,409

Cost Justification

The cost justification for *Prevent* can be found in the assumptions (Appendix D.1).

9.3.5. Appendix C.5 – Savings Model

The efficacy of each intervention is measured by examining the difference in benefits paid out from 2001 to 2023, along with adjustments in the insurance liabilities as of the year-end 2023 for the remaining active policyholders. This method intentionally omits considerations related to the asset side of the balance sheet and the potential interest accruing from an increased surplus due to reduced and deferred benefit payments. By adopting this approach, the

methodology ensures a conservative and focused evaluation of the interventions, emphasizing the direct impacts on the insurer's obligations and pay-outs, thereby providing a clear view of the interventions' effectiveness from a mortality improvement standpoint.

The baseline is based on the provided mortality table with mortality adjustments - 88% for the general population and 811% when modelling only smokers – to match the actual experience of Benefits Paid. After that, in the simulation of each intervention impact, we apply a mortality improvement rate to the adjusted mortality table to calculate benefits and liabilities that would have resulted if such intervention has been implemented.

To calculate the savings, there were two separate calculations required: the benefits paid and the liabilities. The formulas used to calculate the benefits paid and liabilities are below; for further details refer to the savings model attached to this report.

$$\boldsymbol{Net\ Savings} = \sum_{All\ Interventions} \Delta\, Benefits\ Paid + \Delta\, Liabilities - Total\ Cost$$

$$\boldsymbol{Benefits\ Paid_{SPWL\ /\ T20}} = \sum_{y=2001}^{2023} v^{y-2023} \sum_{All\ Ages} \Big(\sum_{\substack{all\ policies\ issued \\ at\ Age\ x\ in\ year\ y}} FaceAmount \Big) \times \begin{cases} A_x \ \ for\ SPWL \\ A^1_{x:m\rceil} \ \ for\ T20 \end{cases}$$

$$\boldsymbol{Liabilities} = \Big(\sum_{All\ Active\ Policies} FaceAmount \Big) \times \begin{cases} A_{\bar{x}} \ \ for\ SPWL \\ A^1_{\bar{x}:\bar{n}\rceil} \ \ for\ T20 \end{cases}$$

Where:
$\Delta =$ baseline $-$ simulation for each intervention
$m = \min(20\,, 2023 - Issue\ Year\ (y))$
$\bar{x} = average\ age\ of\ the\ group$
$\bar{n} = average\ remaining\ policy\ term$

The costs for each year for were estimated using the assumptions provided in Appendix D.1. For further information on the costs of each intervention, refer to the supporting documents.

9.4. Appendix D – Assumptions

9.4.1. Appendix D.1 – Other Assumptions

Metric	Assumed Value	Reasoning (incl. analysis)
General Assumptions		
Day of issue	Beginning of year	All policies are assumed to be issued at the beginning of calendar years.
Age rounding	Beginning of year	All ages are rounded down.
Day of payment/death/lapse	End of year	All deaths/lapses/benefits paid in a year are assumed to happen at 31/Dec of that year without rounding up the age of the policyholder to the next year
Allocation to Risk-free assets	70%	We have set this prudent rate to ensure solvency while being able to generate income from deferred deaths (due to interventions)
Investment Rate	4.11%	Assuming a diversified portfolio of 70% in risk-free investments and 30% in Equities. To decipher the exact investment rate, there was a further assumption mentioned below related to the Equity Risk premium.
Equity Risk Premium	7%	Calculated based on the difference between US fed rate and the average of the main three American indexes (the S&P 500, the NASDAQ Composite, and the Dow Jones)
Liabilities	APV (Active Policies)	We assume the company has a liability equal to the Actuarial Present Value (APV) of all active policies. Considering that the purpose of this study is to evaluate the effects of interventions, rather than to serve as a pricing or reserving model, employing a simplified method that calculates liabilities based on average ages and terms is deemed appropriate. This simplification is valid provided that the model maintains consistency with this approach across both the baseline and the simulated scenarios.
Assets	APV (All Policies)	We assume the company has assets equal to the Actuarial Present Value (APV) of each policy sold at issue, invested at the Investment Rate until 2023YE. Assets shall be reduced by the amount of Benefits Paid and Liabilities to find the Surplus.
Lapses	Only by the end of term	Given the historical evidence of a consistent 1% annual lapse rate throughout the 20-year term insurance, we will assume – for simplification- that term policies only lapse by the end of the 20-year term and thus premiums are fully paid at the beginning of the policy period. This simplification is justifiable since the focus of this analysis is on the general impact of interventions on mortality rather than on pricing the product.
Financial Incentives for Healthy Behaviour		
Incentive Cost	Low: Č60 Medium: Č157.5 High: Č255	There are three streams of incentives for the SuperLife points system, being wearable technology companies, major retailers and airlines. The costs correspond to the provided incentive costs multiplied by three.
Participation Rates for Superlife app and incentives	Participation rates follow an extrapolation of John Hancock Vitality's userbase data from 2015 to 2018	John Hancock Vitality is a well-established wellness program that has been operating successfully in the US. A similar userbase trend is likely with SuperLife's launch, as Lumaria's economy closely follow that of the US, namely the age and income distribution, alongside health, literacy, and mortality rates.

Cost for Partnerships with companies	0	Mutually beneficial partnerships create a win-win situation, where partnered lifestyle companies gain access to a new customer base and SuperLife bolsters engagement. Since this partnership involve a large customer base, the cost per customer for SuperLife is minimal. Economies of scale are generated, where bulk discounts are negotiated and extended to policyholders.
COVID assumption	Participation rates from 2020 to 2022 decreased by 10-12% compared to previous years	A lower participation rate is necessary to reflect the overall decrease in access to non-urgent healthcare like general check-ups, physical activities and overall consumer spending and due to restrictions on mobility and economic disruptions in developed countries. (US Bureau of Labor Statistics, 2023)
Incentives for Preventive Screening		
Participation rate data for missing years for bowel, breast and cervical cancer screenings	Maximum of known participation rate values corresponding to each screening. Bowel Cancer: 44% Breast Cancer: 54.5% Cervical Cancer: 68.3%	No trends were found for participation rates across the years for each screening. Hence, to be conservative, the participation rate data for missing years will be the maximum of the known rates for each screening. See Appendix B to see the source and rates for the data.
Missing participation rate data for lung and colorectal cancer screening	Average of known participation rate values	Since Australia only does Bowel, Breast and Cervical screenings, no data can be found for lung and colon screenings which are done in other countries. To ensure that the demographics of the population doing the screenings is the same for the cost analysis, other country data was not used. Furthermore, since no trends found in the participation rates across the years, the participation rate data for each year for both lung and colon screening will the average of known participation rate values in Australia.
COVID participation rate assumption	3% lower than the participation rate in 2019	Amongst the known data, it was found that the participation rate is consistently lower by 3% than the previous year across all screenings during 2020. Thus, if the data in 2020 was missing, it was assumed to have a participation rate 3% lower than the previous year.
Screening Cost	0	Many universal health care systems do include free or heavily subsidized preventive health screenings as part of their services. In our case we will assume that it is either very affordable or free for Lumarian citizens. Thus, screenings are to be paid for by the customers themselves.
Costs to run program	0	It is assumed that the administration of the rewards program, specifically related to the screening, is already included in the Financial Incentives cost analysis.
Incentive Cost	Low: Č20 Medium: Č52.5 High: Č85	The range of costs per incentive provided by the SuperLife interventions data is assumed to be the financial reward that a policyholder will receive for doing a screening or health check-up. The specific value of reward will be dependent on which tier the policyholder is in for the rewards program.
Cancer Prevention Initiative Assumptions		
Fixed Cost	Year 1 = 4,400,000	Due to the low ongoing cost (Č20-85) for each cancer initiative to be released, the StatSmart team decided an investment was

	Years 2-5 = 1,200,000 Years 6 and onwards = 800,000	required to both design, implement and release these initiatives as well as the required resources to support these initiatives. The breakdown can be seen below: • Year 1 – 10 full time staff members to design first 8 initiatives, develop resources for the Cancer Prevention Hub and establish partnerships. Assumed wage of Č 200,000 each. • Year 1 – Upfront cost to add the pop up and resources section to the app (Č 200,000) • Years 2-5 – 3 full time staff members to manage partnerships, update resources for the Cancer Prevention Hub and design initiatives. • Years 6 onwards – 3 full time staff members to manage partnerships, update resources for the Cancer Prevention Hub and update initiatives. • All years – Fixed Costs are multiplied by two to account for all the other staff indirectly involved in the program.
Amount per year	8	It was assumed that there would be a new cancer initiative each quarter. To allow for offering different initiatives to different demographics, two initiatives are to be deployed at once.
Participation Rate	44.79%	The participation rate aligns with the expected participation of people using the app for the financial incentives for healthy behaviour, plus a 5% increase for people using the website.
Partnerships	Mutually Beneficial	It was assumed that partnerships utilised by the Cancer Prevention Initiative team would be mutually beneficial for both SuperLife and the company they engage with.
COVID Assumption	No impact	It was assumed that COVID would have no impact on the costs of the Cancer prevention initiative.
Smoking Cessation Program Assumptions		
Proportion of smokers in policyholder population	Set to the actual proportion of smokers in the in-force data; ranges from 11.7% to 3.1%	It was assumed that the in-force dataset shows the actual, correct proportion of smoking policyholders. In other words, this assumes that no policyholder gave false information about their smoking status, and that new policyholders gained from the wellness program have the same overall smoking demographics as the original population
Ongoing costs (per participant)	Low: Č870 per year Medium: range from Č2600 to Č3100 over the period High: range from Č3485 to Č3750 over the period	The Medium (best estimate) cost assumes that participants undertake 6 counselling sessions and access the advised medications. Higher /lower costs may arise from participants who choose more/less intensive cessation options (e.g. more/fewer counselling sessions). These values are estimated from the given data and Levy et al.'s 2022 study, and are assumed to increase over the years as services and medication costs rise.
COVID assumption	A slight increase in per-participant costs (Č100-150) during 2020 to 2022	During COVID, medications are assumed to be slightly more expensive due to increased shipping and manufacturing costs. The cost of counselling remains the same as sessions can be conducted virtually, and tobacco quitlines are not impacted by COVID, and are funded by the government nonetheless.

9.5. Appendix E – Risk and Risk Mitigations Considerations

9.5.1. Appendix E.2 – Other Risks

The main stakeholders of this project include SuperLife employees and SuperLife policyholders.

Risk	Description	Mitigation Strategy
Covid-19 risk	The Covid-19 pandemic reduced participants' abilities to exercise outdoors, potentially leading to lower exercise levels. Many non-essential shops were shut, limiting access to rewards and thus causing participants to lose motivation. Further, people did not want to visit hospitals or other high-risk areas, causing a reduction in voluntary health check-ups. There is also a risk of the long term effects after recovering from covid which can worsen mortality.	The impacts of Covid-19 have been factored into cost estimations. Aside from long-term health impacts, which would have affected SuperLife's policyholders whether or not the wellness program was in place, Covid's effects have largely died down by 2023. SuperLife should be aware of their experience during Covid-19 to better prepare if another pandemic were to occur.
Third party risk	Sponsors and other businesses with which SuperLife has partnered do not fulfil their duties, which may include offering rewards and discounts for participating members.	Legal, binding contracts should be in place with partners, so that SuperLife can get legal compensation if partners default on their obligations.
Competitor risk	The risk that competitors will adopt similar strategies, decreasing some of the benefits of the designed program.	To reduce the impact of competitors adopting similar strategy, SuperLife should regularly conduct competitive analysis and gain insight into their own customer base to determine their strengths which will allow them to innovate and improve their products.
Longevity risk	Risk of policyholders living longer than expected due to advance in technology, medicine and improvement in lifestyle. While this may reduce or delay benefit payments, it also means that SuperLife holds more reserves than required, preventing them from investing this excess cash.	SuperLife should monitor the payouts and use that data, mortality tables and modelling to estimate life expectancies. SuperLife can also purchase reinsurance agreements or financial hedging strategies to mitigate or transfer this risk.
Fraud risk	Risk of policyholders committing fraud when claiming, getting points or providing medical results for the reward program.	Digital verification mechanisms can be used to reduce fraudulent data from being provided. Partnerships with other parties such as healthcare screening companies and general practitioners will likely reduce the risk of fraud as these companies also have a reputation of professionalism and integrity to uphold. Data analytics and machine learning techniques can also be used to identify anomalies or suspicious patterns.
Regulatory Risk	Risk of regulations changing. As no regulation information was provided about Lumaria, it is unknown if our program design follows the regulations set out by the Lumarian government.	SuperLife must ensure that they are aware of upcoming changes in regulations and prepare and analyse its impact if it changes.
Interest rate risk	Interest rate is lower than expected, meaning that invested premiums grow at a slower rate than expected, which may mean SuperLife's	The sensitivity analysis demonstrates that this program is still profitable even at lower investment rates than expected.

	reserves are not sufficient to pay out all claims. Alternatively, it also impacts the discount rate, which in turn impacts the predicted economic value generated by the project on the provided dataset.	A second sensitivity analysis indicates that the program is still profitable when a higher discount rate is applied.

9.5.2. Appendix E.3 – Full Sensitivity Analysis

The survival model employed optimal or median scenario assumptions for the cost-benefit analysis per intervention. In the following sections, we conduct a sensitivity analysis on the critical assumptions that impact the Net Savings, thereby influencing the effectiveness of the intervention.

Discount Rate:

Intervention	Net Savings at 1% lower discount rate	Net Savings at Baseline	Net Savings at 1% higher discount rate
Smoking Cessation Programs	1,548,707,850	1,657,510,656	1,782,897,118
Incentives for Preventive Screenings	521,808,959	675,370,941	751,207,765
Cancer Prevention Initiatives	1,830,563,484	2,157,286,449	2,318,639,094
Financial Incentives for Healthy Behaviour	80,304,368	203,300,546	264,620,274
Total	**3,981,384,660**	**4,693,468,592**	**5,117,364,251**

Participation Level:

Intervention	Net Savings at low participation	Net Savings at medium participation	Net Savings at high participation
Smoking Cessation Programs	1,155,888,377	1,657,510,656	2,159,132,936
Incentives for Preventive Screenings	521,212,447	675,370,941	829,488,803
Cancer Prevention Initiatives	1,829,310,423	2,157,286,449	2,485,262,475
Financial Incentives for Healthy Behaviour	79,025,145	203,300,546	327,350,401
Total	**3,585,436,392**	**4,693,468,592**	**5,801,234,616**

The participation levels for each of the interventions are:

Intervention	Low Participation	Medium Participation	High Participation
Smoking Cessation Programs	40%	50%	60%
Incentives for Preventive Screenings	18.12%	21.32%	24.52%
Cancer Prevention Initiatives	38.07%	44.79%	51.51%
Financial Incentives for Healthy Behaviour	33.84%	39.82%	45.79%

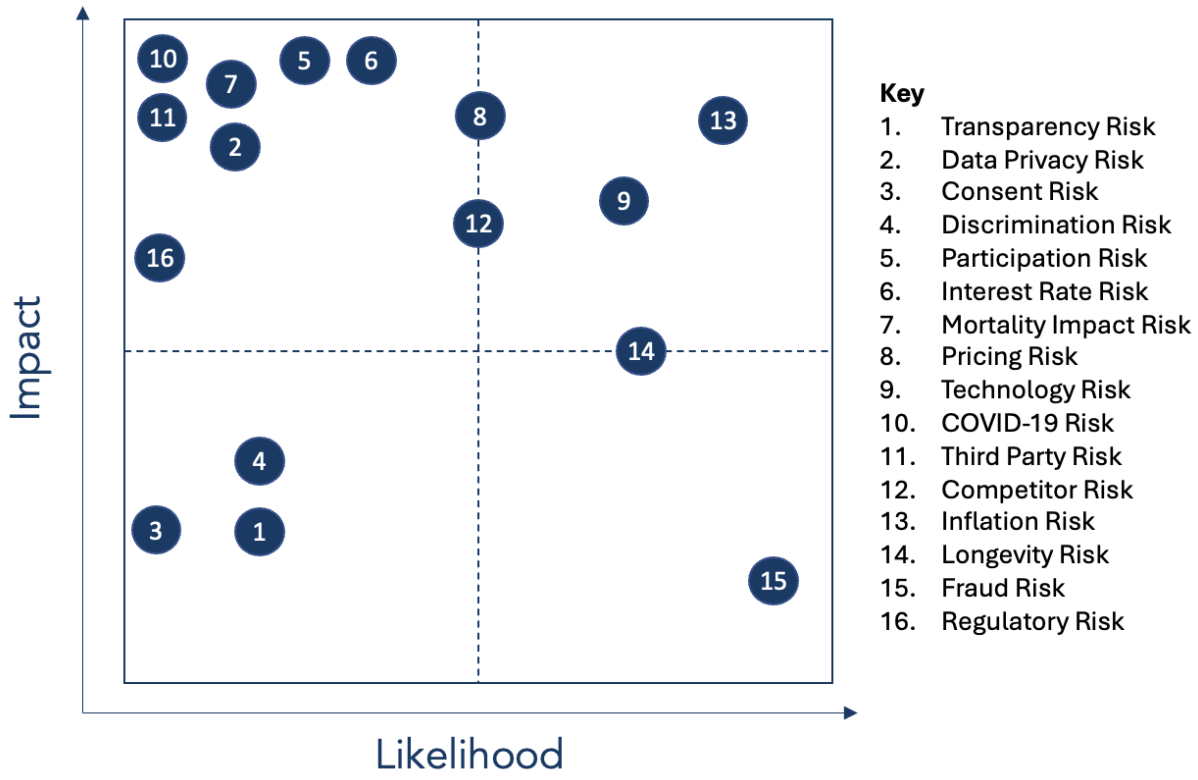
Ongoing Costs:

Intervention	Net Savings at low cost	Net Savings at medium cost	Net Savings at high cost
Smoking Cessation Programs	2,256,585,848	1,657,510,656	1,466,514,166
Incentives for Preventive Screenings	893,320,601	675,370,941	457,421,280
Cancer Prevention Initiatives	2,166,072,596	2,157,286,449	2,145,302,432
Financial Incentives for Healthy Behaviour	589,865,021	203,300,546	(183,263,929)
Total	**5,905,844,066**	**4,693,468,592**	**3,885,973,950**

Mortality Improvement:

Intervention	Net Savings at low mortality improvement	Net Savings at baseline medium improvement	Net Savings at high mortality improvement
Smoking Cessation Programs	809,607,080	1,657,510,656	2,626,917,822
Incentives for Preventive Screenings	328,686,064	675,370,941	1,026,530,717
Cancer Prevention Initiatives	1,419,669,564	2,157,286,449	2,904,424,262
Financial Incentives for Healthy Behaviour	(153,134,591)	203,300,546	562,340,263
Total	**2,404,828,117**	**4,693,468,592**	**7,120,213,063**

9.5.3. Appendix E.4 – Full Risk Matrix



9.6. Appendix F – Data and Data Limitations

9.6.1. Appendix F.1 – Data Sources

Source	Description
S&P, Dow Jones, and NASDAQ Returns	Data was sourced online from macrotrends, more links can be found in the appendix. This data was used to calculate the Equity Risk Premium.
Lumarian Data	This includes the in-force dataset, encyclopaedia entry, mortality table, economic data and interventions data provided by SuperLife.
US Fed overnight rates	The US Fed overnight rate was calculated from bankrate.
Australia Institute of Health and Welfare	Data containing the participation rates for bowel, breast and cervical cancer preventive screening, from Australian Institute of Health and Welfare (AIHW), and data containing the participation rates for pathology tests.

9.6.2. Appendix F.1 – Other Data Limitations

Limitation	Description	Impact
Cause of Death	Cause of death data was quite broad, and was not specific to the exact illness.	This limited the StatSmart team's ability to completely tailor their solution to the country of Lumaria
Lumaria Encyclopaedia Entry	The Lumaria encyclopaedia entry was not very easy to apply.	There was no simple way to find similar economies to Lumaria. StatSmart used the US as a comparison.
Policyholder Data	There was limited data on the policyholders.	There was very limited data that StatSmart could use to infer the mortality of the policyholders. There was no policyholder behaviour data i.e. how much they used the SuperLife website.
SuperLife data	There was no data on SuperLife	It was impossible to understand SuperLife's full offerings and potential to pair with other products.

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