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1. Objectives of Analysis

1.1 Main Objectives

Aligned with SuperLife's key objectives, Cardinal Consulting has developed a proposal focused on achieving three core principles:

- **Turning the tide on premature goodbyes:** This health incentive program entitles policyholders to live longer, healthier lives. By implementing the interventions laid out in the program, SuperLife will see significant reductions in policyholder mortalities.
- **Building stronger communities:** By strategically investing in interventions that extend their impacts beyond just the individual, policyholders and SuperLife will reap numerous benefits. Creating healthier and happier communities will increase policyholder wellbeing. In addition, SuperLife's brand image will also have better visibility across Lumaria, helping bolster marketability, public perception, and future sales.
- **Gaining deeper insights into policyholders:** Through a combination of savvy incentives and integrated data collection methods, this program will allow SuperLife to cultivate a comprehensive understanding of insured demographics and behaviors, enabling data-driven insights for future decision making.

1.2 Key Metrics for Reporting

Key metrics, such as **participation rates**, **health outcomes**, and **cost savings**, must be diligently recorded during the program's implementation period to assess its success. To gather reliable data, Cardinal Consulting recommends a one-year pilot program in the urban areas of Region 3 in Lumaria. This region is not as small as regions 4 through 6 but will not be as expensive to run as programs in the two largest regions. Centering the program in an urban area will allow for the full suite of interventions to be tested. This focused approach will allow precise monitoring of the key metrics during the implementation period. Measuring participation rates ensures the credibility of mortality savings, while monitoring health outcomes ensures consistency between predicted and actual reductions in mortality. Additionally, tracking spending on interventions and incentives is crucial to evaluate the program's effectiveness in achieving cost savings. After a successful one-year pilot program, nationwide reviews after five, ten and twenty years are recommended to see where cost adjustments are needed and examine any unforeseen long-term trends that arise. Over five and ten years, SuperLife can assess lapse rates, sales changes, and initial costs. After twenty years, losses can develop, providing more credible mortality rate data.

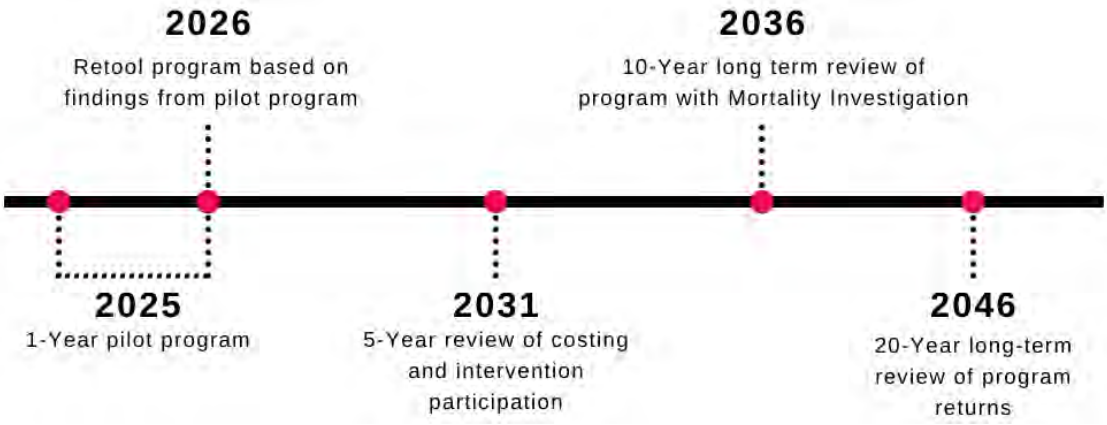


Figure 1.1: 20-year Review Plan

2. Program Design

2.1 Program Overview

The program's core interventions are strategically aligned with corresponding incentives to optimize engagement. A tailored mobile application streamlines user access and maximizes program utilization. The interventions and incentives were meticulously selected to ensure their effectiveness and value while aligning with SuperLife's primary objectives.

2.2 SuperLife Companion App

The center piece of this program is the development of a comprehensive digital solution to modernize SuperLife. The introduction of a user-friendly web platform and dedicated mobile phone application will allow users to gain access not only to the program interventions, but other quality of life improvements for their policy. The key features of the companion app include:

Effortless Autopay: Eliminate lapses and simplify billing with seamless in-app premium payments. Scheduled automated payment options and easy billing reports give users more control over the financials of their policy.

Empowering Data Insights: Utilize user generated data for future product development. By gathering data provided by users as they sign up for the program and utilize the interventions, SuperLife will be able to harvest plenty of data on their policy holders and their tendencies with intervention usage, incentive motivation, and many other data points.

Personalized Intervention Hub: Access a dedicated portal within the app showcasing available interventions and corresponding incentives. Users can sign up, track progress, and claim rewards. Personalized interventions can even be recommended to users to maximize their participation.

SuperCoins: A rewards program that rewards healthy living. SuperCoins are virtual rewards points that are earned by participating in the interventions outlined in this program. Each SuperCoin is set to a monetary value, simplifying program costing, and enabling policyholders to estimate their earnings. SuperCoins can be redeemed as direct Crown transfers or for discounted rewards including but not limited to spa vouchers, gym memberships, and event tickets.

AI-powered chatbot: Users can get instant answers and personalized guidance for the program and their policy at anytime and anywhere with the help of AI-powered chatbots. These chatbots can answer policy questions, recommend interventions, and help with any billing questions among with many other uses to take some stress away from customer support.

2.3 Interventions

2.3.1 Causes of Death Exploration

To determine which interventions will be the most impactful and cost effective, an investigation into the risk factors associated with the leading causes of death within the Lumarian policyholders is needed. As shown in Figure 2.1, the two predominant causes of mortality are **neoplastic** and **circulatory** diseases. These specific causes of death constitute 64% of all policyholder fatalities from 2001 to 2023.

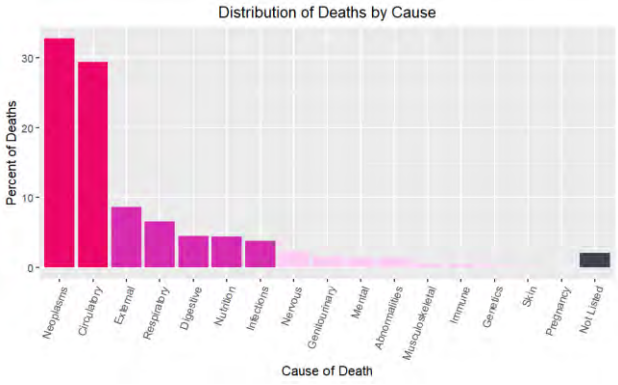


Figure 2.1: Distribution of Deaths by Cause

By meticulously examining the underlying causes of these diseases, appropriate interventions can be selected for the program. According to statistics from the Centers for Disease Control and Prevention[3], 80% of deaths within the circulatory disease category can be attributed to heart attacks and strokes. These causes of death can be linked to an individual being diagnosed with diabetes or the presence of high cholesterol and high blood pressure as well as smoking, secondhand smoke inhalation, obesity, unhealthy dieting, and physical inactivity[3]. From the proportions shown in Figure 2.2, a significant portion of the policyholder deaths from circulatory causes involve smokers. Reductions in the number of smokers can be achieved by implementing smoker cessation programs. Paired with more interventions focused on the other risk factors of heart attacks and strokes, this wellness program can effectively reduce the expected deaths by circulatory causes.

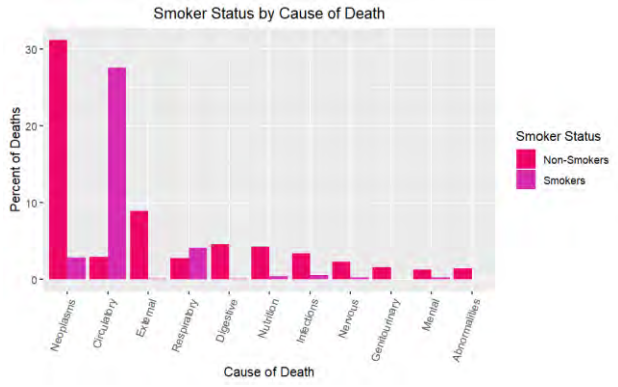


Figure 2.2: Smoker Status by Cause of Death

Neoplasia occurs when cells rapidly proliferate in a way that is not consistent with surrounding cells. When these cells continue to grow and divide without dying, they are labeled as malignant or cancerous. According to the World Health Organization[23], the most common causes of cancer deaths in 2020 include deaths from cancer of the lung, colon/rectum, liver, stomach, breast, and prostate with common risk factors including smoking, excessive drinking of alcohol, obesity, poor dieting, physical inactivity, and family history. Tailoring interventions to combat these risk factors will be the most effective in reducing the number of deaths from neoplasia.

2.3.2 Intervention Design

Resulting from the findings on the main causes of deaths, Cardinal Consulting has determined unhealthy dieting, physical inactivity, and smoking to be common risk factors between the leading causes of death. Tailoring interventions to address these factors offers a significant opportunity in mitigating economic losses for SuperLife and bettering the public's health. Listed below are the interventions included in the program proposal with their respective estimated reduction in mortality and participation rates among policyholders. More details on eligibility and procedures of the intervention programs can be found in Appendix A.

Intervention Type	Estimated Reduction in Mortality	Estimated Participation Rates
Community Gardens	2—4%	0.25% of urban population[5, 9, 10]
Alcohol Moderation Program	3—6%	2.8% of general population[1]
Weight Management Programs	5—10%	5% of general population[21, 22]
Active Aging Programs	3—6%	13% of population aged 50+[16]
Fitness Tracking Devices	3—6%	6% of general population purchase the device[19] 90% of those who purchase the device utilize it
Hiking and Outdoor Activities	3—6%	24.2% of general population[12]
Annual Checkup	5—10%	45% of general population[7]
Heart Screening	5—10%	8%[2] (only able to participate once every 4 years[17])
Smoking Cessation Program	10—50%	7.5% of smokers[4]

Payment structures and average total annual costs of the programs have been designed to maximize the participation rates of each individual program. Most interventions' rewards are structured such that an initial sign-up benefit is offered to incentivize new participants into the program, and follow-up enrollment benefits are offered throughout the year to maintain participation to reach the desired reduction in mortality. The average total annual cost of incentive rewards was determined by using the table in Appendix B of estimated savings per participant as a budget for how much to offer in incentives. The community garden intervention is not listed in the table below as the incentive for them is free access to policyholders with non-policyholders paying small fees to offset yearly maintenance costs. More information on the community garden and other intervention payment structures can be found in Appendix A.

Intervention Type	Payment Structure	Average Total Annual Cost
Alcohol Moderation Program	Initial sign-up benefit with follow-up enrollment benefits	Č100
Weight Management Program	Initial sign-up benefit with follow-up enrollment benefits	Č150
Active Aging Program	Initial sign-up benefit with follow-up enrollment benefits	Č152.5
Fitness Tracking Devices	Offer upfront partial payment of allowed devices	Č50
Hiking and Outdoor Activities	Provide portion of yearly pass for national parks and follow-up usage-based payments	Č120
Annual Checkup	Benefit payment completing the checkup	Č100
Heart Screening	Benefit payment for completing the screening, only available once every 4 years.	Č150
Smoking Cessation Program	Initial sign-up benefit with follow-up enrollment benefits	Č2177.5

2.3.4 The Holistic Heroes

Holistic Heroes have been curated by Cardinal Consulting as marketing characters to be used alongside the intervention programs. The Holistic Heroes concept for the SuperLife campaign has numerous benefits. It resonates with the current emphasis on overall wellness, and the

superhero theme perfectly captures the engaging and aspirational tone, while also appealing to a younger audience which likely has never heard of SuperLife. Focusing on a team of heroes allows SuperLife to showcase the different aspects of health (heart and liver health, fitness, and nutrition) in a fun and positive manner. This approach provides flexibility to tailor messaging for specific demographics while maintaining a cohesive brand identity under the Holistic Heroes umbrella. There is even the opportunity to include Holistic Heroes branding and merchandise as rewards redeemable for SuperCoins, allowing entire families to pursue healthy living.

Figure 2.3: The Holistic Heroes[a]

3. Pricing/Costs

3.1 Mortality Savings

The implementation of the previously highlighted intervention programs and their respective incentive programs was evaluated using a simulation. This simulation follows a subset of policyholders throughout their life to better reflect the interaction of interventions on individual policyholders. For more information, see Appendix E.

The results of this simulation are listed in the table below. The mortality reduction over the past 23 years would have been 7.78%.

Estimated Mortality Savings for Past 23 Years					
Base Deaths	Program Deaths	Death Reduction	Base Mortality	Program Mortality	% Reduction
37,604	34,753	2,851	0.00426	0.00393	7.78%

3.2 Total Program Savings

The simulation results also provide an estimate of the overall savings from the past 23 years.

Simulation Summary (All Values are in Millions)					
Base Benefit Payouts	Simulation Benefit Payouts	Benefit Payout Savings	Program Cost	Total Savings	Annual Savings
Č 24,250	Č 22,547	Č 1,704	Č 975	Č 728	Č 32

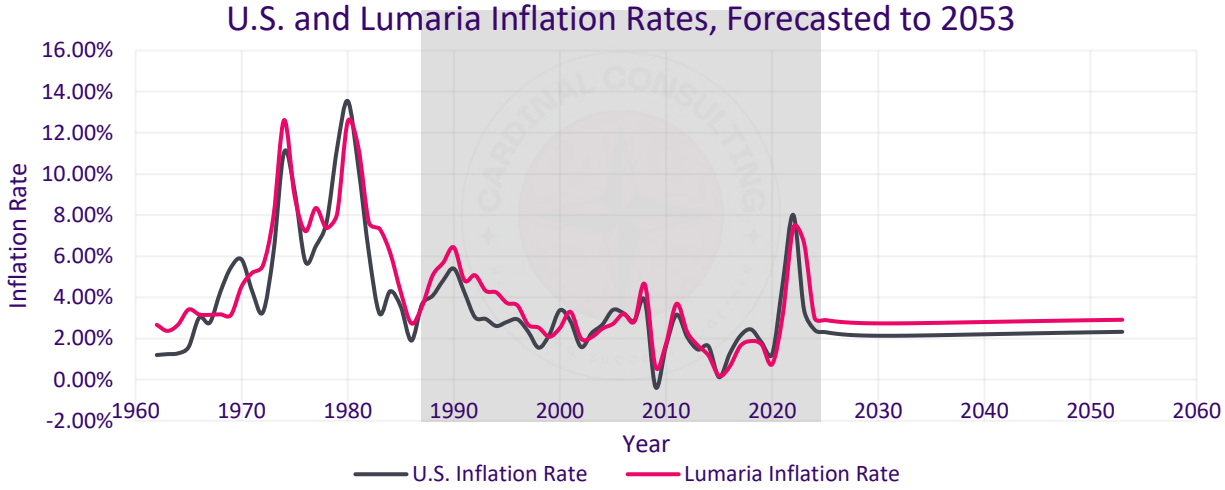
With expected annual savings of Č32 million each year, there is an opportunity to put that money back into the development and upkeep of the application to use as part of the proposed program. Initial costs of creating a web and mobile phone application vary widely depending on the use of the app and number of users. Maintenance costs also vary widely depending on whether the

[a] These images were generated using Microsoft Copilot Designer AI[11]. More information on AI usage can be found in Appendix F.

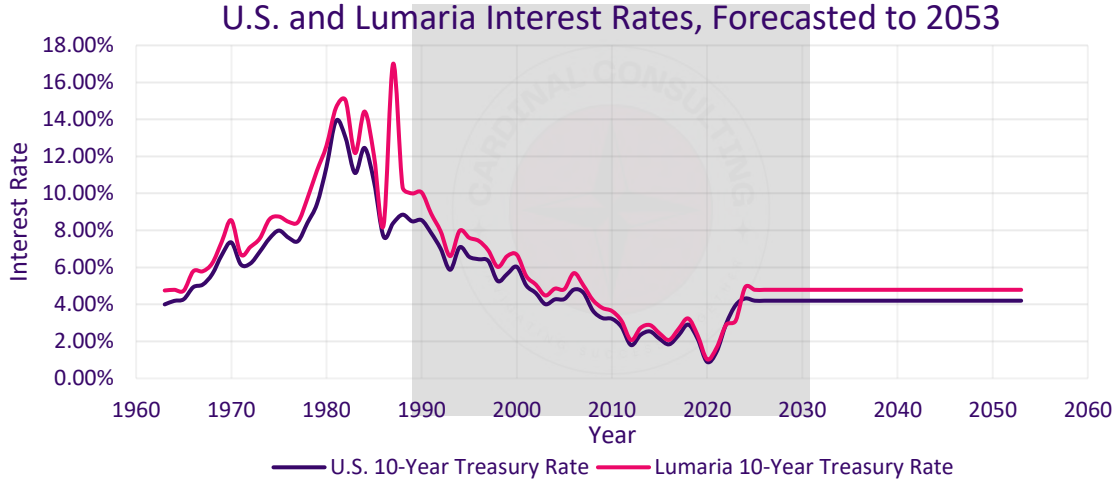
applications will be maintained within SuperLife or outsourced to third parties. An estimated cost of Č2 million per year has been formulated with an average healthcare application building cost, employment of software engineers, server costs, and costs associated with administering the rewards program[18].

3.3 Inflation and Interest Rate Projections

The figure below shows that Lumaria's inflation rate is expected to fall in the short term before settling around 2.75% to 2.9% in the long-term, following the American inflation rate trend[6] despite a somewhat higher topline. For more detailed information on how projections were calculated, see Appendix D.



The graph below shows the projected Lumarian 10-year spot rate, which settles at about 4.79%, higher than the expected future U.S. spot rates[15], since in general the Lumarian rates outpace U.S. rates. For more detailed information on how projections were calculated, see Appendix D.



3.4 Analysis of Economic Value

3.4.1 Future Projections

Projections into the future have been made to continue the observed trends in new policies, policy type, sex, smokers, age group, and face amount. These projections were then used to generate a set of expected policies in line with the trends to maintain the ratio of these factors. These policies were then run in the simulation detailed in Appendix E to estimate the savings this program would have in the next 23 years based on the implementation schedule.

3.4.2 Future Program Savings

Based on the simulation results, implementing the intervention programs would result in the following future savings.

Estimated Mortality Savings for Past 23 Years					
Base Deaths	Program Deaths	Death Reduction	Base Mortality	Program Mortality	% Reduction
223,552	211,474	12,079	0.00669	0.00631	5.69%

Simulation Summary (All Values are in Millions)					
Base Benefit Payouts	Simulation Benefit Payouts	Benefit Payout Savings	Program Cost	Total Savings	Annual Savings
Č 125,850	Č 119,139	Č 6,711	Č 2,975	Č 3,736	Č 162

3.5 Proposal of Pricing Changes

3.5.1 Optimizing Sales

One option to optimize sales is to offer bundled programs to combine payment of loans or mortgages to target young people without policies currently but are considering purchasing a policy. The type of young people who are most likely to purchase a life insurance policy are those who have a family, and considering the rising costs of raising a family, those who can purchase a life insurance policy in addition to these other formidable costs are disproportionately likely to have either student loans or down payments on a mortgage. For this subset of prospective policyholders, offering these bundles will both attract new customers and incentivize timely payment of their premiums.

3.5.2 Optimizing Policy Values

A general strategy to pursue is to improve underwriting by gathering more information about policyholders. More data on prospective policyholders will ensure that SuperLife correctly understands and prices their risks, reducing the losses it takes on currently through subpar underwriting. SuperLife can also offer a potential reduction in premium for people who opt in for a medical examination. Healthy individuals will be more inclined to take this option because policies will be more accurately underwritten, and they may receive a premium reduction. People who know they are less healthy will be inclined to not take this option because their premium might be higher. Those who do not take the health examination will have a slightly higher premium by default to combat the higher density of high-risk individuals.

4. Risk and Risk Mitigation Considerations

4.1 Key Risks

Cardinal Consulting has determined and ranked key risks that may impact this program. The rankings of the key risks are listed in the risk matrix in Figure 4.1. Risks are ordered according to their expected frequency and severity.

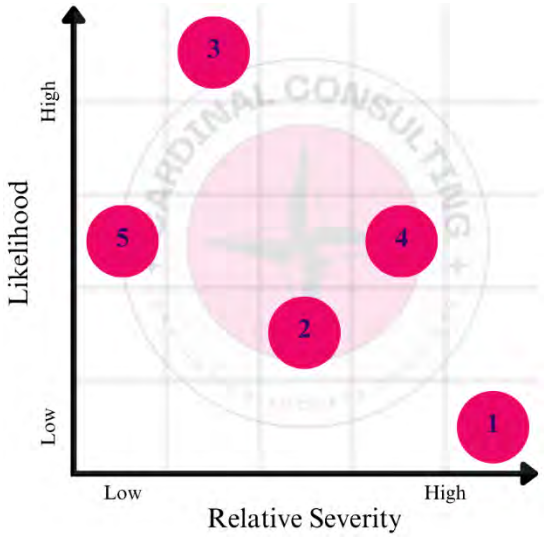


Figure 4.1: Risk Matrix

1. **Excess Mortality:** Events in which significantly higher than expected mortalities occur. Examples include war, pandemics, and natural disasters.
2. **Inflation and Interest Rates Risk:** Economic uncertainty resulting in the assumptions for inflation and interest rates not being accurate.
3. **Moral Hazard:** Policyholders being dishonest about participating in interventions to receive benefits from incentive payouts.
4. **Cyber Risk:** Bad actors infiltrate electronic systems of SuperLife to unlawfully access data or other protected assets.
5. **Decreased Sales Risk:** Future sales and growth are lower than expected due to less individuals seeking life insurance or losing potential clients to other life insurance companies.

4.2 Risk Mitigation

To mitigate potential risks from excess mortality whilst expanding coverage for higher policy values, SuperLife should utilize reinsurance. This would also help in warding off some other catastrophic risks, such as a natural disaster or a pandemic.

In addition to standard cyber insurance to protect against potential cyber-attacks, SuperLife should also implement some form of cyber insurance related to the app revolving around incentives, as data relating to policyholders would be put into the app to distribute incentives and track progress.

Moral hazard will always be a concern for any intervention that needs truthful participation data to distribute its incentive rewards. SuperLife can mitigate these exposures by increasing oversight of policyholder engagement. One way to monitor moral hazard would be to have a system in place that could detect an abnormal increase in Super Coins over a day or week. Another option would be to ask permission for the app's users to provide location data to SuperLife, so that they can verify that policyholders are actively engaged with its programs.

4.3 Sensitivity Analysis

To gauge the sensitivity of each program to small changes in input characteristics, the simulation was run with updated values for mortality reduction, participation reduction, and incentive amounts. It was run for each program individually updating the respective input value up and

down by a percentage amount. The resulting ranges of total cost by program and variable are shown in the following table.

Range of Total Cost Percent Change			
Intervention	30% Mortality Change	20% Participation Change	10% Incentives Change
Alcohol Moderation	0.17%	0.06%	0.38%
Weight Management	0.38%	0.15%	0.28%
Hiking and Outdoor	0.10%	0.21%	0.23%
Annual Checkup	1.50%	0.86%	0.53%
Fitness Tracking	0.37%	0.23%	0.10%
Active Aging	0.52%	0.09%	0.10%
Heart Screening	0.91%	0.03%	0.21%
Smoking Cessation	1.26%	0.06%	0.30%

The most notable data from this table are the higher relative change of annual checkups and smoking cessation with a change in mortality and annual checkups with a change in participation. These high ranges mean that the program is the most sensitive to a given percentage change in program characteristics. This result is to be expected because the programs of smoking cessation and annual checkups are the programs that provide the most savings, and therefore changing the characteristics will have the most impact on the result.

Two other notable results from the above table are the heart screening program with respect to a change in mortality and the alcohol moderation program with respect to a change in incentives. A program being sensitive with respect to mortality changes means that if the true reduction in mortality is more or less than the assumed reduction, there will be a relatively high change in the overall program savings compared to other programs.

4.4 Degree of Certainty

Reduction in Mortality

Based on the values of number of deaths and number of policies from each simulation run, the aggregate expected mortality reduction and its sample variance were calculated. Summing the lower bounds of a one-sided confidence interval based on reduction in mortality for individual programs provides a minimum overall mortality reduction. Setting this value to zero gives the degree of certainty that the reduction in mortality will be positive. That degree of certainty was calculated to be 99.99995% confidence that the implementation of this program would have reduced the mortality rate for the past 23 years.

Savings

A confidence interval was created accounting for fluctuations in each individual program's performance by adding up total savings resulting from simulations run with only one program in place at a time. Based on results from the simulation, there is a 90.14% chance that the overall benefits of the health incentive program outweigh the program costs and total savings over the past 23 years are positive.

5. Data and Data Limitations

5.1 Data Observations

In the dataset, there is a clear separation in the number of policyholders by their age at the issue of the policy. There are distinct groups, having stark jumps between the ages of 34-35, and 55-56 as seen in Figure 5.1. Along with the division by age, term and whole life policies are sold only to select groups. The only term policies are among the younger two age groups, and whole life policies only pertain to the older two age groups.

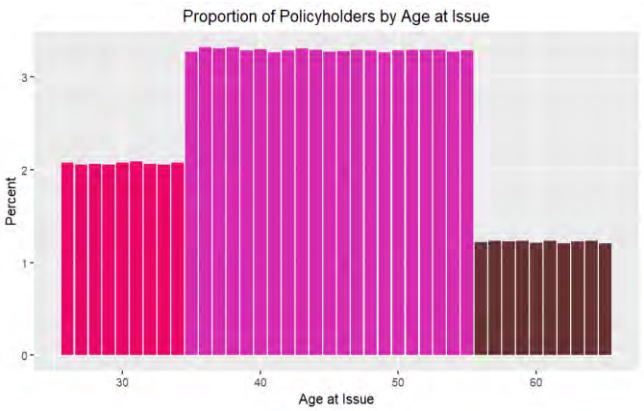


Figure 5.1: Age Groups

Life expectancy at birth is 78.4 as given in the encyclopedia data about Lumaria, but only 4% of the population is over 65 years old. It would make sense to have more people older than 65 to drive the value up higher. It is possible there was a recent decline in the elderly population due to COVID. This reasoning is not substantiated as respiratory rates of death do not spike around this year as would be expected from the COVID pandemic. However, there was a general increase in mortality in the year 2020, with the elderly population's mortality rate significantly increasing as shown in Figure 5.2.

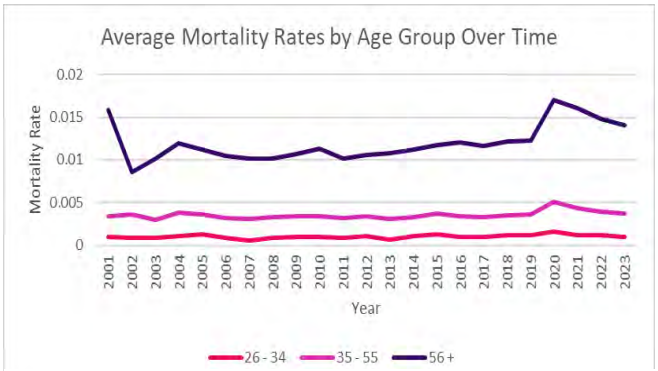


Figure 5.2: Mortality by Age Group

5.2 Data Limitations

The amount of data that was given in relation to each policy individually is small. There are not many lifestyle characteristics about the policyholders to model what policy traits cause the main deaths among policyholders. Because of this, the general risk factors will be targeted based on the main causes of death regardless of individual policyholders' personal risk factors. In addition to lacking policy information, underwriting data provided fails to accurately capture the true relative mortalities of each risk class. This reflects poorly on the underwriting at SuperLife because the same insights about a policyholder's risk can be acquired from the smoker data.

5.3 Assumptions

The following assumptions were necessary to evaluate the performance of the proposed program.

Assumption	Rationale
Mortality rates are constant over time	The trend of overall mortality over time is weak
Participation rates are independent of previous participation or incentives	Participation rates would likely increase because of incentives, so this assumption allows more confidence that the program performs well
Lapses only occur at the end of the year	Policyholders would likely wait until the end of the year to lapse to get the most out of their policy
Lapse rates are constant by policy year	Policyholders tend to lapse more towards the end of the term

6. Appendix

Appendix A: Intervention Reasonings and Procedures

Community Gardens

The community gardens will be built by SuperLife and will include SuperLife branding. The gardens will serve as a loss leader in the intervention program, as the reduction in mortality and participation rates of the community gardens are not of the same magnitude as other interventions. However, being able to display SuperLife branding around the cities of Lumaria is an important marketing strategy and will allow SuperLife the ability to strengthen their relationships with urban populations. These gardens will encourage healthier eating, reduce crime, elevate property values, and foster social communities. By promoting healthier lifestyles and social engagement, participation in community gardens may contribute to increased longevity and healthier aging.

SuperLife will purchase small plots of land across Lumarian cities. Initial costs for the land plots and cleaning of land plots vary. To cover yearly maintenance costs, SuperLife can charge non-policyholders a small fee for use of the gardens. Policyholders will receive free use of the gardens, thus creating a small incentive for those who do not have policies with SuperLife to purchase a policy if they are already using the gardens. Depending on the Lumarian legislature, SuperLife could also apply for federal or municipal loans to cover the construction and maintenance costs of the gardens if they are made free for use for everyone.

An estimation of Č10-35 per garden per plot with 20 plots per garden are used in the garden cost calculation.

According to the Lumarian encyclopedia page the population of Lumaria is around 92 million. Using the urban population field of the inforce dataset, 63.4% of the policyholders are in urban areas, which corresponds to approximately 58 million Lumarians living in urban areas.

Using an assumption of 30 individuals per community garden and a random sample of 10 of the 100 largest cities in the US, an assumption of participation rate of urban population was calculated to be 0.12%. The calculation details are found below.

A random sample of the 100 largest cities in the US, along with their 2022 population and number of community gardens listed within their city limits, is found below:

- #88: Chandler, Arizona: 261,149 – 1 garden
- #57: Aurora, Colorado: 379,312 – 20 gardens
- #33: Milwaukee, Wisconsin: 590,157 – 20 gardens
- #83: Toledo, Ohio: 272,778 – 11 gardens
- #27: Oklahoma City, Oklahoma: 655,158 – 28 gardens
- #86: Fort Wayne, Indiana: 262,907 – 9 gardens
- #72: Pittsburgh, Pennsylvania: 300,281 – 19 gardens
- #40: Kansas City, Missouri: 495,278 – 19 gardens
- #70: Cincinnati, Ohio: 303,954 – 18 gardens
- #23: Nashville-Davidson, Tennessee: 692,587 – 15 gardens

Note that population data was sourced from Data Commons[5]. The amount of community gardens was collected by utilizing Google Maps[9] and manually counting the amount of community gardens within city limits.

With the 0.12% participation rate of urban population, one can conclude that around 70,000 people participate in the gardens per year. From the SuperLife policyholder statistics, 620,468 urban policy holders multiplied by 0.12% determines that 745 policyholders will use the gardens at the beginning of the program.

Using the 30 people per garden found on gitnux.org[10], the total number of gardens needed across of all Lumaria is $\frac{70{,}058}{30} = 2335.3$ gardens. Using the 20 plots per garden and average cost per plot of Č22.50, a total of Č1.05 million can be expected for yearly maintenance costs. If fees for non-policyholders are set at Č15 per year, that would offset the costs per year.

Alcohol Moderation Program

Partnering with reputable alcohol moderation programs across Lumaria ensures that policyholders have access to credible resources for addressing drinking problems. The program should have a track record of success in helping individuals moderate their alcohol consumption. SuperLife can enter "good faith" agreements with the alcohol moderation program administrators in which by increasing the number of their participants by recommending them as "preferred" institutions, in turn the administrators will assist in collecting attendance records of the SuperLife policyholders who participate in the program.

SuperLife can select alcohol moderation programs across Lumaria and deem them as "preferred programs". The policyholders can select which one they would like to attend; the institutions will then record attendance of policyholders who opt to go.

Incentives include paying an enrollment benefit along with follow-up benefits. This ensures that the policyholder has incentive to remain in the program in order to receive the mortality benefits.

A study published in the *Alcohol and Alcoholism* journal[1] found that the brief intervention rate with a general practitioner for alcohol consumption was 2.8%: this was chosen as the alcohol moderation program participation rate.

Weight Management Program

Weight management programs are a popular way for individuals to maintain a healthy weight. In conjunction with the nutritional counseling services, policyholders can have access to weight coaching services that will set healthy and obtainable weight goals to reduce mortality in overweight individuals.

Like the alcohol moderation program, SuperLife will partner with weight management organizations across Lumaria and advertise them as "preferred" institutions, then have the institution record attendance of policyholders who opt to go.

The incentive structure will be like the alcohol moderation program's incentives, where enrollment benefits along with follow-up participation payments will be made to incentivize remaining within the program.

For the participation rate regarding the weight management program, the rate was calculated by taking the total amount of participants enrolled in the largest weight management program in the world (WeightWatchers), and dividing it by the total population in each nation that the program was offered in. The population data was gathered from the World Bank[22]. The number of enrollees in WeightWatchers was given from an article posted by WeightWatchers[21].

Active Aging Program

It is important to stay active at an elderly age to remain healthy. Active aging programs ensure that senior citizens have groups to perform physical activities in a safe and enjoyable space while being considerably cost effective.

SuperLife will partner with various active aging programs in Lumaria and direct their senior policyholders (50+) to these programs. These institutions will record and provide attendance of the fitness sessions to see which policyholders are attending them and how many they go to per year.

It is important to note that SuperLife should not pay for membership fees to these programs but pay participation rewards instead to incentivize policyholders to attend many sessions. An enrollment benefit should be paid to offset some of the membership fee cost, but other incentives should be paid out as they attend more sessions.

A Canadian Health Measures Survey[16] found that 13% of older Canadian adults exercised for at least 150 minutes per week; this is used as the active aging program participation rate.

Fitness Tracking Devices

Fitness tracking devices can be provided to policyholders. By having a fitness tracker, individuals can get reminders when they are not active or have a better understanding of their daily physical fitness goals and whether they are achieving them.

To administer the program, SuperLife will create a list of accepted fitness tracking devices. If policyholder purchases one of the selected devices, a set number of Crowns will be refunded. Refunds for purchasing new devices will be limited to one refund for every four years to discourage policyholders from buying a new device every year at a discount.

Pew Research[19] found that 22% of Americans use smart watches or fitness trackers; this was used for the yearly fitness tracking device participation rate.

For the fitness tracking device purchase, participation rates were found for every four years, but the simulation uses a yearly participation rate because of the yearly participation evaluation. For the four-year rate found for fitness tracking devices, the equation $p + p(1-p) + p(1-p)^2 + p(1-p)^3 = 0.22$ was used, where p is the annual participation rate. This equation accounts for the compounding effect on policyholders who did not already purchase a fitness tracker. Solving this equation results in a value of about 0.06, so the annual rate for purchasing fitness tracking devices is 6%.

Hiking and Outdoor Activities

Lumaria has many natural wonders. Getting outdoors in nature and exploring is a great way to get active and improve mental and physical health. By providing policy holders with incentives to get out and visit national parks we can increase the number of policyholders who are staying physically active.

SuperLife can partner with the Lumarian national parks service to offer discounted annual passes to policyholders. Additionally, if the policyholder registers their hiking trips within the app and fitness tracking device, they can receive SuperCoin payments as an incentive for physical activity.

Data from the National Health Interview Survey[12] found that 24.2% of adults met guidelines on aerobic and muscle-strengthening activities, so this was chosen as the participation rate for the hiking and outdoor activities program.

Annual Checkup

Annual checkups are essential in identifying changes in one's physical wellness and recording changes in overall health. These changes could inform the patient about any ailments or diseases that they could be at risk for. Encouraging SuperLife policyholders to participate in annual checkups by offering SuperCoin reimbursements is one way to reduce mortality.

Due to Lumaria's universal healthcare system the annual checkups should be free for the public to receive, so it is just a matter of retrieving the confirmation of the policyholder's confirmation that they received an annual checkup.

Depending on data Lumarian privacy laws, SuperLife can gather checkup reports or require the policyholder's checkup report in exchange for incentive payouts. However, if this were the case this intervention would be subject to adverse selection as the policyholder would not want to submit their report if their checkup was not favorable.

An Ipsos poll[7] found that 45% of Canadians regularly go for checkups; this rate was used as the participation rate, given that both Canada and Lumaria have universal healthcare.

Heart Screenings

Heart screening tests play a crucial role in pinpointing cardiovascular diseases by uncovering potential risk factors within an individual's heart. The screenings would include blood work, physical examinations, and imaging tests. Due to Lumaria's universal healthcare system the heart screenings would be minimal cost to the public.

SuperLife may partner with health providers around the country to send in confirmation that policyholders received screenings. Limiting incentive payments to once every 4 years would reduce costs for this intervention program. This is also in line with cardiologists' recommendations[17] on performing regular screenings "every 2 to 4 years".

A Health Affairs study[2] found that only 8% of U.S. adults age 35+ had received all of their necessary screenings; to be conservative (since this is the only screening of the suggested interventions), this was used as the participation rate for the heart screenings program.

Smoking Cessation Program

Smoking cessation programs will be vital in decreasing the smoking percentage of the policyholder population. Giving smokers the resources to help them quit will not only impact their mortality but also the mortality of others around them due to second-hand smoke[20].

Similar to the other interventions within the plan, SuperLife will be able to partner with various smoking cessation organizations throughout Lumaria. They will be able to direct policyholders to these institutions that have been deemed as preferable and suitable with existing results in helping individuals quit. By providing more clients to the institutions, SuperLife may enter into a good-faith agreement for the institution to record attendance of policyholders who opt to go. The average cost was calculated as Č2177.50 from the data supplied by SuperLife.

Creamer, Wang, Babb et. al found that the successful smoking cessation rate was 7.5% among American adults[4]; this was used as the smoking cessation program's participation rate.

Appendix B: Mortality Savings

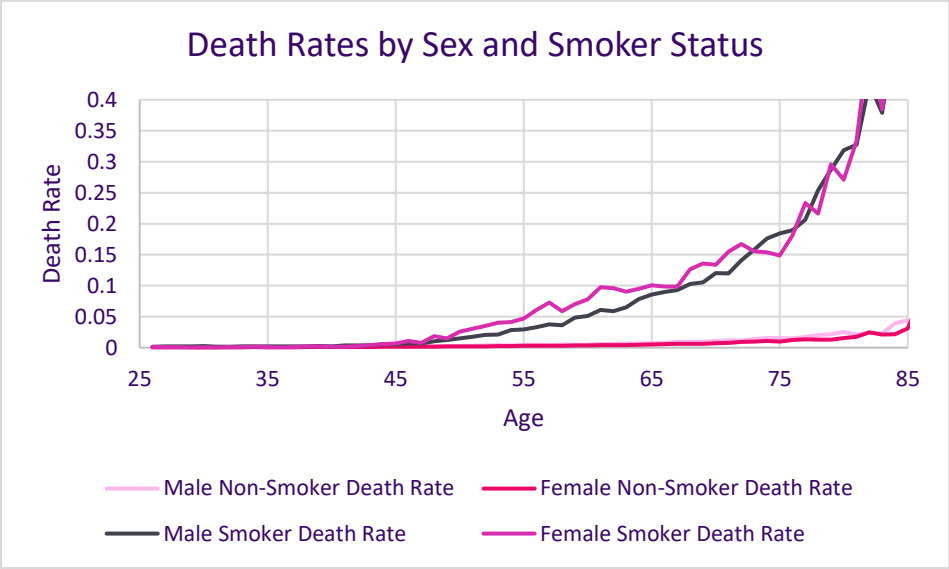
Preliminary mortality savings were calculated as aggregate reductions over the 23 years of given policy data. Calculations followed the assumptions of uniform participation across policyholders and a single reduction in mortality based on year of participation. These preliminary values are shown in the following table in white. Estimated savings per participant were used to come up with initial incentive costs to input into the simulation detailed in Appendix E. The corresponding values from running the simulation are in gray. Community gardens were not included in the simulation because of its low participation rate and resulting low impact to mortality. Most programs had a lower result in savings per participant than initially expected, but smoking cessation had much increased savings. This is likely due to the impact of the program on the rest of the policyholder's life that the initial estimation was not able to capture.

Intervention	Estimated Reduction in Deaths		Estimated Reduction in Benefit Payouts (Values shown in millions)		Estimated Savings Per Participant (Per Year)	
Community Gardens[b]	2		Č 1		87	
Alcohol Moderation Program	50	53	Č 31	Č 20	124	82
Weight Management Programs	147	111	Č 92	Č 56	206	127
Active Aging Program[c]	170	200	Č 110	Č 55	203	94
Fitness Tracking Devices	96	114	Č 60	Č 49	124	105
Hiking and Outdoor Activities	428	247	Č 268	Č 163	124	76
Annual Checkup	1328	1,066	Č 831	Č 701	206	175
Heart Screening	236	159	Č 148	Č 18	206	29
Smoking Cessation Program[d]	277	864	Č 170	Č 423	3,536	15,252

[b] The community gardens calculation only considers the benefit to the policyholders who are living in an urban setting.
[c] The active aging calculation only considers the policyholders above the age of 45; this accounts for some policyholders that will age to be 50+ during the term of their policy.
[d] The smoking cessation calculation only considers the policyholders that smoke initially.

Calculating the same table through simulation instead of estimating based on assumptions yields the following table. The community gardens intervention was not included in the simulation because it does not have a significant reduction in mortality due to low expected participation.

Appendix C: Mortality Table Calculation



Mortality rates are roughly similar among smokers and non-smokers until age 40, when the mortality rates of smokers begin to increase exponentially compared to an almost constant mortality rate for non-smokers. This separation creates a clear divide between the mortality of smokers and non-smokers. There also exists a difference between male and female policyholders, female policyholders having lower mortality rates. These factors created a natural division of policyholders into four groups for the purpose of mortality modeling.
Given the assumption of constant mortality over the 23-year period, the mortality table provided from 2010 can be combined with the mortality rates from the dataset to create a master mortality table for each of the four groups listed.

The values from the 2010 mortality table were combined and smoothed with calculated mortality rates giving more weight to the ages with more policyholders in the dataset. The combination of the mortality rates allows for the scaling of all 120 years to values consistent with life expectancy and infant mortality rates. For ages below 26 and above 74, there were less than 20,000 observations, so the 2010 mortality rates were scaled directly. Scaling was calculated using linear interpolation so that the age 1 mortality rate was equal to the infant mortality rate given of 0.43%, the mortality rate at 120 stays at 100%, and life expectancy is 78.4 years.

With the overall mortality table done, individual group mortality tables were calculated. Between the ages of 26 and 85, there was enough data to calculate and smooth mortality rates for male

and female non-smokers, and male smokers. The category of female smokers was lacking in data, so the ratio or male to female non-smokers was used to extrapolate the female smokers' mortalities. Extending the ages of each group to be a full mortality table from age 1 to 120 was done in various ways. Linear interpolation was used before the age of 26 to achieve the same 0.43% infant mortality rate, reflecting the fact that smoking should not affect the mortality of infants. For non-smokers, the mortality rates scaled proportionally to the overall mortality rates from the age of 86 until reaching 100% at age 120. For smokers, a logistic regression was utilized between age 81[e] and 120 because of the rapid increase seen in the data.

Appendix D: Future Projections

Inflation and Interest Rate Projection

Lumaria's inflation rate was compared to countries like the U.S., Germany, Japan, India, and the U.K. Lumaria's inflation rate was highly correlated with the U.S. inflation rate, with a correlation coefficient of 0.9125. Using the Cleveland Fed's inflation expectations[6], forecasted to 2053, a linear regression was fit using the 1962-2023 data. With an R^2 of 0.8183, it seems reasonable to extrapolate future inflation rates in Lumaria from those in the U.S.

Lumaria's 10-year spot rate is directly comparable to the U.S. 10-year Treasury spot rate. When comparing the two rates, the correlation was 0.9602. Given the high correlation, it seems reasonable to utilize the projected future U.S. 10-year Treasury rates to predict the future Lumaria 10-year spot rate. Using a simple linear regression, the R^2 was 0.922, which gives credibility to the belief that these rates trend similarly. Swiss Re published an Economic Insights article[15] in December 2023 which stated that they expect long-term 10-year rates to reach 4.2%, so these projected U.S. rates were used for 2025 and beyond.

Future Policyholder Trend Projections

For the purposes of simulating future policyholders' outcomes, certain characteristics were trended out to 2046, using historical data as a predictor. These characteristics were the total number of new policyholders, age (young, middle-aged, or old), smoking status, sex (male or female), type of policy (term or whole life), and face value amount (Č50k, Č100k, Č250k, Č500k, Č1m, and Č2m, conditioned on their age group). Listed below are the methods and rationale for each specific trend.

Analyzing the number of new policyholders from 2001-2023 indicates that SuperLife's growth rate is almost perfectly linear. A simple linear regression on new policyholders using the years as input resulted in an R^2 of 0.976. Using this model to project new policyholders out to 2046, it predicts an increase in new policyholders of 2086 per year; by 2046, this results in an expectation that SuperLife will add 113,458 new policyholders, nearly twice the number of new policyholders in 2023.

For age projections, historical data was accumulated using the categories of "young" (ages 26-34), "middle-aged" (ages 35-54), and "old" (ages 55+). The percentages for these categories were calculated from 2001-2023. From this data, it is clear that, over time, the percentage of

[e] Age 81 was chosen for smoothing purposes. Additionally, there was sparse data for ages older than 81, so the values were not credible.

policyholders that are young is declining (from 24.2% in 2001 to only 14.9% in 2023). Conversely, the middle-aged and old policyholder shares have increased steadily since 2001.

Applying a simple linear regression to the number of young policyholders by year yielded a model with an R^2 of 0.890, indicating a strong positive trend of roughly 237 new young policyholders each year. This same process was carried out for middle-aged policyholders (with an R^2 of 0.977 and a yearly trend of 423 additional middle-aged policyholders) and old policyholders (with an R^2 of 0.975 and a yearly trend of 1426 new old policyholders). These projected raw age totals were then converted to relative percentages for 2024-2046. While all age groups see increases, the larger magnitude of new old policyholders means that, as a portion of the entire population, the old policyholder share is expected to increase slightly from 16.2% to 17.3% in 2046, while the young policyholder share slightly declines from 14.9% to 14.1% and the middle-aged policyholder share barely moves at all from 68.9% to 68.6%.

For smoking status projections, the number of smoking and non-smoking policyholders was collected from 2001-2023. Analyzing historical trends, the raw number of non-smoking policyholders followed a positive linear regression almost perfectly (with an R^2 of 0.979), and so the non-smoking policyholder trend was extrapolated out to 2046. The historical trend of number of smoking policyholders was much vaguer, increasing slightly from 2001 to 2010 before leveling off and declining somewhat from 2020 to 2023. As a result, the smoker to non-smoker ratio was calculated for the historical period and analyzed as well to see if any trends in this statistic were evident.

It turns out that the smoker to non-smoker ratio behaves quite similarly to a linear or an exponential regression. The linear regression was unsuitable primarily because it would have outputs that were negative, which make no sense in the context of a ratio. Thus, an exponential regression of smoker to non-smoker ratio by year was conducted: with an R^2 of 0.991, the model seems to be an excellent fit. Once this ratio had been obtained, the number of smokers was calculated as the product of the smoker to non-smoker ratio and the projected number of non-smokers. Finally, these raw population numbers were converted to percentages. The model projects that the percentage of smokers in the new policyholder group will decline from 3.12% in 2023 to 0.80% in 2046; this reflects the general trend of smoking rates decreasing while not being completely eradicated.

Sex projections were fairly straightforward. The historical period (2001-2023) was compiled into male and female categories, and the trends in both male and female policyholders was strongly linear. A simple linear regression was fit to the male policyholders and female policyholders separately; the male policyholder regression produced an R^2 of 0.964, while the female policyholder regression had an R^2 of 0.981. The projected increase in male policyholders per year is 1015 compared to 1070 for female policyholders, so the expected percentage of female policyholders (as contrasted to male policyholders) should rise in the future. The projected percentage of new female policyholders will uptick slightly from 47.7% presently to 48.6% in 2046.

The policy type projections were similar to the sex projections in that each of the two categories (term and whole life) exhibited strong linear trends from 2001-2023, confirmed by extremely high values of R^2 (0.886 for the simple linear regression for number of term life policies and 0.976 for the simple linear regression for number of whole life policies). While the share of term policies as a percentage of all new policies has declined from over 80% to 50% in 2023, it is expected to mostly hold steady in the next 23 years, very slowly declining to 46.6% by 2046.

The face amount projections, conditioned on the age group of the policyholders, was the most complicated of the characteristic projections, due to the additional complexity of analyzing policyholder subgroups for discernible patterns. In general, different age groups do purchase different percentages of the available face amount values, and so it was unwise to apply a general percentage to new policyholders of all ages. For the young and old age groups, the historical period did not indicate any changes in the relative percentages; the data showed little variation from a general equilibrium and the resulting correlations were low.

As a result, all but one of the face values (Č250k for the young age group and Č100k for the old age group) were set to remain constant for the period 2023-2046: this constant, for the five face values, was the average percentage from the historical period. The face value with the largest observed variance of the six possible face values was assigned the complement of the sum of the other five percentages, so that the total percentages would sum to 1. The reasoning behind choosing based on the largest observed variance was that, assuming the values were remaining flat, lower variances would indicate a better fit to a constant percentage, and so assigning the five best-fitted face values would produce the most accurate model.

Unlike the young and old age groups, the middle-aged age group showed quite clear trends in the percentage of policies of different face values. The Č50k trend was almost perfectly linear (with an R^2 of 0.982), and while the other five face value trends showed more noise (R^2 values of 0.518, 0.472, 0.822, and 0,537 for the face values of Č100k, Č250k, Č1m, and Č2m respectively), they did all indicate a possible linear trend from the historical period data. Again, one face value was excluded from the simple linear regression, and this time the worst fit was the Č500k face value trend, which basically exhibited no trend and had an R^2 of 0.047. The model projects that, as a share of new middle-aged policyholders, the percentage of Č50k will decrease, but the percentages of the other five face values will increase. This seems believable, since general price level increases in the next 20 years may push those who otherwise would choose a lower face value to choose a higher face value, absent changes in the possible face values offered.

All of the percentages listed above were then utilized directly by the simulation (described in detail below) in order to assign characteristics to new policyholders and calculate future economic value.

Appendix E: Simulation Explanation

Overview of Simulation

The simulation created to evaluate this program is based on the concepts of a Monte Carlo simulation which relies upon randomness and many runtimes to achieve an expected value for a complex process. This simulation follows a representative subset of 1% of policyholders over their time as a policyholder and simulates their interaction with the incentive programs. The same policyholders were input into the simulation each time it was run to reduce extraneous variation. This method allows a fine-tuning of the impacts of interventions on individual lives more accurately than the estimations of reductions in deaths and savings in payouts calculated in Appendix B.

The policy characteristics that are considered throughout the simulation are policy type, issue year, issue age, sex, smoker status, and face amount. The simulation starts each policy by assigning its characteristics, and a mortality table according to the sex and smoker status. The policies are then evaluated year by year to simulate participation and its effects on mortality, then it is checked if they die that year or lapse for term policies.

For consistency, the simulation was run with all participation rates at 0% to calculate the base benefit payouts. All values have been brought to present value using the provided 10-year spot rate and inflation rate. Incentive costs were calculated generously by assuming the participants of programs with progressive rewards would max out the incentive limit each year they participate. This slight overestimation of likely costs gives more confidence that the program will perform as well as is expected.

The same simulation was updated to be used to estimate the mortality and costs savings for the future using projections detailed in Appendix D. Policyholders from the dataset provided were included and aged to the present year in this simulation if they were still alive and had not lapsed. Future policies were included based on the projected number of new policies each year. Policy characteristics were then assigned to these policies according to the distribution of trends in each individual policy characteristic calculated in Appendix D.

Appendix F: AI Usage

AI technologies were used while creating this report. Google Gemini and Chat GPT were used to enhance the wordage of the report. Microsoft Copilot Image generator was used to create the images used for the Holistic Heroes.

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