A Sustainability Model for Small Health Maintenance Programs

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The objective of this paper is to present a theoretical model that can assist community-based health maintenance providers in handling their actuarial risk. It determines the factors and conditions under which the said model can be made financially sustainable. The break-even formulas for some of the parameters are derived. It likewise examines the amount of reserves needed to manage underwriting risk.

Keywords: health maintenance programs, sustainability

1. Introduction

The idea of having a self-managed health maintenance program has been adapted by community-based organizations in the Philippines for many years. It gives these non-profit organizations and its affiliates the opportunity to provide health benefit coverage for its members, and at the same time manage their own resources. The program collects a fixed prepaid fee from a member, which is usually lumped with the organization's annual membership dues, and products are yearly renewable.

In January 29, 2010, the Insurance Commission (IC), together with the Bangko Sentral ng Pilipinas and the Cooperative Development Authority launched the National Strategy and Regulatory Framework for Microinsurance. This national strategy covers all "insurance, insurance-like and other similar activities" (Regulatory Framework for Micorinsurance, 2010) meeting the definition of microinsurance, including health microinsurance products. The IC also has a circular requiring all microinsurance Mutual Benefit Associations (MBA) to have a minimum number of members of 5000, and a minimum capital requirement of 5 Million Pesos (IC Memorandum Circular 9-2006).

In this study, the term "small" means that the scheme was initially formed with a specific market in mind. The market may be the employees of an organization,

or persons who share the same occupation, such as tricycle drivers, farmers or fishermen. Clearly, the minimum capital requirement imposed by the IC will not easily be satisfied by groups such as these. Unfortunately, some of these small community-based programs encountered sustainability issues which lead to their closure. Incorrect premium rates and the absence of regular actuarial valuation may also have contributed to these failures.

The new regulation may be aimed at protecting the policyholders from such failures but it may also lead to the demise of these small health microinsurers. As mentioned earlier, these programs were established to address the needs of the members of a group or an organization. Those who manage the operations of the insurance program are either members or affiliates of these organizations. Contracts are simple and formulated to be easily understood. They have easy access to services and claims.

The objective of this paper is to determine the elements that would make it possible for a community-based health maintenance program to be financially sustainable. It aims to produce a model that will assist these programs to evaluate their actual costs against their current rates. This paper will perform a three-year experience analysis of a small health microinsurer. The study will determine why it suffered losses and how the losses could have been prevented.

It will likewise look into the possibility of relaxing the minimum membership and capital requirements set by the IC. We will present two illustrations of how the break-even values, which may be below the IC requirements, can be computed. The amount of reserves needed to pay for excess claims will also be discussed.

2. Theoretical Framework

The theoretical framework for the model is discussed in this section. The assumptions of the model and formulas for the utilization rates and premiums are presented and the financial projection formulas and the break-even points of some of the parameters are derived. All mathematical expressions were developed using actuarial concepts.

Suppose that a health microinsurance provider offers several health services that are grouped into packages. The services may include hospitalization, annual physical examination, out-patient treatment, dental consultation and procedures, and maternity benefits. For each of the services, a utilization rate per age-group is determined and the annual pure premiums are computed.

Let $u_{i,j}$ denote the utilization rate for service i of age-group j. This is the probability that an enrollee from age-group j makes a claim on service i. It is given by the following formula:

$$u_{i,j} = \frac{a_{i,j}}{e_{i,j}} \tag{1}$$

where

$a_{i,j}$ = number of claims per annum for service i and age-group j,

$e_{i,j}$ = number of enrollees in service i and age-group j.

For each enrollee, the pure premium $\pi_{i,j}$ for service i and age-group j is the amount that covers the pure risk portion of obligations, that is, the cost of absorbing the health risk of the enrollee. It is given by

$$\pi_{i,j} = u_{i,j} \cdot A_{i,j} \tag{2}$$

where

$A_{i,j}$ = average claim amount per service i of age-group j.

Here, $A_{i,j}$ can be replaced by a maximum aggregate amount of availment or "cap" that is set for each service to avoid huge claims.

Let $C_{k,N}$ be the operating expense loading for package k for a program with a total of N enrollees. The total cost C is equal to

$$C = N\sum_k \sum_j (C_{k,N} \cdot f_{j,k}). \tag{3}$$

where

$f_{j,k}$ = percentage of N enrolled in age-group j and package k.

The model assumes that the expense loading per service are equal and $C_{k,N}$ is a function of N and the number of services in the package. The formula is given as follows

$$C_{k,N} = \frac{m_k C}{N\sum_t \sum_j m_t f_{j,t}} \tag{4}$$

where

m_k = number of services included in package k

C = total annual operating expenses

The annual gross premium $G_{j,k}$ for a person in age-group j enrolled in package k is computed as

$$G_{j,k} = P_{j,k} + C_{k,N} \tag{5}$$

where

$$P_{j,k} = \sum_{i \in \text{Package } k} \pi_{i,j} \tag{6}$$

From equation (4), $G_{j,k}$ is also a function of N and is given by

$$G_{j.k} = P_{j,k} + \frac{m_k C}{N \sum_t \sum_j m_t f_{j,t}} \tag{7}$$

This is the amount that should be collected from a member of age-group *j* enrolled in package *k*.

Let *r* be the effective annual rate of interest. Assuming that lapses occur on the average at the middle of the year, the total annual gross premium income *G* at the end of the year is

$$G = N \sum_k \sum_j \left(f_{j,k} \times G_{j,k} \right) (1+r) - \frac{N}{2} \sum_k \sum_j \left(w_{j,k} \times G_{j,k} \right) (1+r)^{1/2} \tag{8}$$

where

$w_{j,k}$ = lapse rate for age-group *j* and Package *k*.

The total expense (*TE*) for the year is the sum of the total benefits paid plus the operating expenses:

$$TE = \text{Total Claims Paid for the Year} + C$$

The surplus for the year, assuming that there are no other sources of income, is

Surplus = Total Annual Gross Premium Income – Total Annual Expenses.
$= G - TE$

For financial projection purposes, assume that the total claims paid is a percentage *u* of the total annual gross income. Then

$$TE = u \cdot G + C. \tag{9}$$

Thus,

$$\text{Surplus} = (1 - u) \cdot G - C \tag{10}$$

Given the formula above, the break-even claims ratio u^*, defined as the overall claims ratio when surplus is equal to zero, is

$$u^* = \frac{G - C}{G} \ . \tag{11}$$

If $u > u^*$, the program will suffer a loss.

For a specific value of *u*, the break-even number of members *N* is

$$N^* = \frac{C-(1-u)\left(\sum_k\sum_j\left(f_{j,k}\times C_{k,N}\right)(1+r)-\frac{1}{2}\sum_k\sum_j\left(w_{j,k}\times C_{k,N}\right)(1+r)^{1/2}\right)}{(1-u)\left(\sum_k\sum_j\left(f_{j,k}\times P_{j,k}\right)(1+r)-\frac{1}{2}\sum_k\sum_j\left(w_{j,k}\times P_{j,k}\right)(1+r)^{1/2}\right)} \quad (12)$$

The Appendix gives the complete derivation of N^*. Note that when $N < N^*$ the surplus becomes negative.

3. Company Profile and Data

For confidentiality, the microinsurance program under study is not named. Established by an NGO, the program offered four types of benefit packages. Table 1 gives a summary of the benefit services covered for each of these packages. It operated as a health maintenance organization (HMO) where a fixed prepaid fee is collected from a member, often on a quarterly basis, and each product is yearly renewable. It is coined as a micro-HMO because of its small staff size (only two permanent employees) and its target market is mostly small organizations. To minimize exposure on big claims, retention limits or caps were indicated in certain services. A cap is the maximum aggregate amount an enrollee can avail for a particular benefit within one year. A primary physician was the first stop for claims. He acted as the gatekeeper to control the flow of claims costs. Health counseling and health education were conducted yearly to push for illness prevention. Apart from the usual annual medical examination and hospitalization in its roster of benefits, it also offered traditional services such as acupuncture and massage. The company believed that the inclusion of these unconventional health procedures set them apart from other HMOs.

Table 1. Benefit Packages

Service	Cap (PhP)	Package 1	Package 2	Package 3	Package 4
Hospitalization	50,000		√		√
Annual Medical Exam	-			√	√
Medical Consultation	-	√			√
Dental	500	√			√
Laboratory Exam	-		√		√
Traditional Medicine	1,200		√		√
Pregnancy	3,000			√	√
ER Consultation	5,000	√			√
Out-Patient Treatment	30,000		√	√	√
Complex Diagnostics	7,000		√	√	√

Each package was priced by age-group, as shown in the following table:

Table 2. Annual Premium per Package

Age-group	Annual Gross Premium			
	Package 1	Package 2	Package 3	Package 4
10-20	1,600	2,950	3,450	7,850
21-29	2,000	2,950	5,000	9,750
30-39	3,450	4,950	6,950	15,000
40-49	4,500	5,400	13,900	21,050
50-59	4,500	5,400	13,900	21,050
≥ 60	4,500	5,400	13,900	21,050

The semi-annual and quarterly fees are simply one-half and one-fourth of the indicated annual gross premiums respectively. About 70% of enrollees are from the National Capital Region (NCR), and the rest are from other parts of the Philippines. Sixty-percent are aged within 30-49, with mean age of 42.

The health care program suffered losses for the three years that it has been in the market. Enrollees were less than a hundred each year. The table below shows their performance for these three years:

Table 3. Financial Performance for Years 1-3

	Year 1	Year 2	Year 3
Number of enrollees	84	89	99
Total premium collected	891,798.79	1,292,145.84	1,319,695.84
Operating Expenses	884,221.39	1,006,179.24	1,011,394.06
Total Claims	158,284.11	365,688.70	361,728.40
Profit (Loss)	(150,706.71)	(79,722.10)	(53,426.62)

4. Results and Discussion

Pricing insurance premiums is not simple. Events and time are essential factors to consider. Unlike life insurance which is contingent to only one event, which is death, and usually of long term duration, health insurance is contingent on several events. This is why health insurance products are typically available for short time periods only, e.g. yearly renewable.

Health companies are exposed to underwriting risk. This arises from incorrect premiums and deviations from claims assumptions. In the next section, we will show the comparison between the existing premiums and what the premiums should have been if these were adjusted based on the previous years' experience.

4.1 Old premium versus experience premium

Using formula (1), the utilization rates per service and per age group for the three years under consideration were computed and shown in Tables 4a, 4b and 4c below. It is evident from the derived values that the annual medical examination was highly utilized. This is expected since the program pushes for illness prevention and healthy well-being. Medical consultation, on the other hand, steadily increased from years 1 to 3. There was also a notable increase in the utilization of laboratory examinations. A sharp increase from 7% and 8% in Years 1 and 2 to 26% in Year 3 was also observed in the availment rate of traditional medicine.

Table 4a. Year 1 Utilization Rates per Service per Age-Group

Age-group	HOSP	AME	MED	DENT	LAB. EXAM	TRAD. MED.	PREG	ER	OP	COMPLX DXTIC
21-29		0.80	0.09		0.17			0.09		
30-39	0.14	0.68	0.25	0.20	0.09	0.09				
40-49	0.03	0.78	0.14	0.17	0.13	0.06		0.03	0.03	0.03
50-59		0.75	0.33		0.15	0.15				
60 up		0.33								
All Ages	0.05	0.73	0.18	0.13	0.12	0.07		0.03	0.01	0.01

Table 4b. Year 2 Utilization Rates per Service per Age-Group

Age-group	HOSP	AME	MED	DENT	LAB. EXAM	TRAD. MED.	PREG	ER	OP	COMPLX DXTIC
21-29		0.56								
30-39	0.15	0.50	0.18	0.24	0.15	0.05	0.19	0.06	0.05	
40-49	0.06	0.89	0.30	0.30	0.24	0.06		0.03		0.03
50-59		0.87	0.29	0.12	0.35	0.15			0.05	0.05
60 up		0.67		0.33		0.33				
All Ages	0.06	0.74	0.22	0.21	0.21	0.08	0.04	0.03	0.02	0.02

Table 4c. Year 3 Utilization Rates per Service per Age-Group

Age-group	HOSP	AME	MED	DENT	LAB. EXAM	TRAD. MED.	PREG	ER	OP	COMPLX DXTIC
21-29		0.71	0.2	0.30		0.14		0.1		
30-39		0.69	0.24	0.14	0.24	0.19	0.19	0.1		
40-49	0.13	0.85	0.23	0.30	0.16	0.31		0.07		0.06
50-59	0.1	0.76	0.41	0.18	0.33	0.33			0.1	0.05
60 up		0.67				0.33				
All Ages	0.07	0.77	0.26	0.22	0.19	0.26	0.04	0.06	0.02	0.03

The average amount of availment for Years 1 to 3 is shown in Table 5. It gives us a picture of how the claim amount per service changed within the three-year period. It also indicates that there were more members hospitalized in Years 2 and

3 as compared to Year 1. Some who claimed this service reached the maximum benefit of PhP50,000 which pulled up the average claim for hospitalization. Aside from hospitalization, the program also experienced higher claims in Year 2 on laboratory examination and out-patient treatment. A sharp increase in claims was also experienced in ER consultation in Year 3 as compared to the previous two years.

Table 5: Average Amount of Availment per Service

Service	Average Amount of Availment per Service (PhP)					
	Year 1	Year 2	Change	Year 2	Year 3	Change
Hospitalization	12,693.22	29,687.31	134%	29,687.31	23,667.98	-20%
Annual Medical Examination	1,287.10	1,713.81	33%	1,713.81	1,255.81	-27%
Medical Consultation	791.38	998.82	26%	998.82	1,074.10	8%
Dental	400	400	0%	400	400	0%
Laboratory Examination	1,308.00	2,954.75	126%	2,954.75	3,019.24	2%
Traditional Medicine	1,116.67	1,322.14	18%	1,322.14	1,154.85	-13%
Pregnancy		2,411.61		2,411.61	1,836.70	-24%
ER Consultation	735	703.5	- 4%	703.5	3,819.38	443%
Out-Patient Treatment	1,200.00	10,585.92	782%	10,585.92	2,850.00	-73%
Complex Diagnostics	8,105.25	6,250.00	- 23%	6,250.00	4,266.67	-32%

Using equations (3) and (4), the expense loadings are figured out for all packages and are given in Table 6. These were computed based on the actual overhead costs that the program incurred. Package C was not included since there were no members enrolled in this package.

Table 6. Computed Cost for each package (PhP)

Package	Yr 1	Yr 2	Yr 3
A	3,490.35	3,731.20	3,612.69
B	5,817.25	6,218.66	6,021.15
D	11,634.49	12,437.32	12,042.29

The next three tables (Tables 7a, 7b, 7c) give the comparison of the gross premium computed from experience against the currently existing premium of the three packages. The gross premium is the sum of the pure premium and the expense loading. (See formulas (5), (6) and (7)). The same values shown in Table 6 are used for the expense loading.

From equation (2), the pure premium is the product of the utilization rate and the cap amount, if it exists, of a particular benefit. The cap amount is used to compute the pure premium to lean on more conservative pricing; to mitigate the

Table 7a. Old Premium versus Computed Experience Premium (Year 1)

Year 1												
Age-group	A				B				D			
	Number of Enrollees	Old Prem	Computed Experi ence premium	Difference	Number of Enrollees	Old Prem	Computed Experi ence premium	Difference	Number of Enrollees	Old Prem	Computed Experi ence premium	Difference
21-29	1	1,600.00	3,579.62	-1,979.62	2	2,950.00	5,938.08	-2,988.08	10	7,850.00	12,281.60	-4,431.60
30-39	1	2,000.00	3,707.85	-1,707.85	3	2,950.00	8,215.73	-5,265.73	19	9,750.00	14,961.42	-5,211.42
40-49	2	3,450.00	3,734.76	-284.76	5	4,950.00	6,525.73	-1,575.73	27	15,000.00	13,754.24	1,245.76
50-59	1	4,500.00	3,816.79	683.21	5	5,400.00	6,045.71	-645.71	8	21,050.00	13,375.65	7,674.35
60 up	0	4,500.00	3,490.35	1,009.65	0	5,400.00	5,817.25	-417.25	3	21,050.00	13,032.83	8,017.17

Table 7b. Old Premium versus Computed Experience Premium (Year 2)

Year 2												
Age-group	A				B				D			
	Number of Enrollees	Old Prem	Computed Experi ence premium	Difference	Number of Enrollees	Old Prem	Computed Experi ence premium	Difference	Number of Enrollees	Old Prem	Computed Experi ence premium	Difference
21-29	2	1,600.00	3,731.20	-2,131.20	2	2,950.00	6,218.66	-3,268.66	9	7,850.00	12,691.88	-4,841.88
30-39	1	2,000.00	4,066.90	-2,066.90	4	2,950.00	9,340.79	-6,390.79	16	9,750.00	16,970.96	-7,220.96
40-49	3	3,450.00	4,149.53	-699.53	6	4,950.00	10,125.78	-5,175.78	27	15,000.00	18,056.92	-3,056.92
50-59	2	4,500.00	4,091.78	408.22	5	5,400.00	8,817.23	-3,417.23	15	21,050.00	17,798.28	3,251.72
60 up	0	4,500.00	3,864.53	635.47	0	5,400.00	6,618.66	-1,218.66	3	21,050.00	14,930.65	6,119.35

Table 7c. Old Premium versus Computed Experience Premium (Year 3)

Year 3												
Age-group	A				B				D			
	Number of Enrollees	Old Prem	Computed Experi ence premium	Difference	Number of Enrollees	Old Prem	Computed Experi ence premium	Difference	Number of Enrollees	Old Prem	Computed Experi ence premium	Difference
21-29	9	1,600.00	4,002.69	-2,402.69	7	2,950.00	6,106.86	-3,156.86	7	7,850.00	12,772.29	-4,922.29
30-39	16	2,000.00	4,172.06	-2,172.06	5	2,950.00	6,498.12	-3,548.12	16	9,750.00	14,334.28	-4,584.28
40-49	27	3,450.00	4,412.69	-962.69	5	4,950.00	8,862.03	-3,912.03	27	15,000.00	16,672.07	-1,672.07
50-59	15	4,500.00	4,154.22	345.78	4	5,400.00	12,503.36	-7,103.36	17	21,050.00	20,196.86	853.14
60 up	3	4,500.00	3,612.69	887.31	0	5,400.00	6,454.48	-1,054.48	3	21,050.00	14,318.96	6,731.04

risk of pricing too low. In the absence of a cap, the average amount of availment for year ($t + 1$) is assumed to be r% higher than that of the previous year t. In this study, we assume a ten percent interest rate.

As seen from the three tables, it is clear that most of the currently used premiums are not enough to cover the claims and costs of the program. Columns under the heading "Old Premium" are the currently used premiums seen from Table 2. Columns under the heading "Computed Experience Premium" are the computed experienced claim costs. Package B is priced way lower than the expected outcome for all age-groups while older age-groups are priced higher than should be in Package D. Since the program had no changes in the premiums from Year 1 to Year 2 and from Year 2 to Year 3, the errors in pricing were repeated in the succeeding business years.

If premiums were corrected in Year 2, that is, the computed experience premium were used rather than the existing ones, the program would not have suffered a loss, as can be seen in the Table 8a. With a premium income of PhP1,417,196.83, there would have been a surplus of about PhP45,000 for the second year.

Table 8a. Income with Corrected Premium for Year 2

If Premiums Computed from Year 1 Experience are Used (in PhP)		
Collection	1,417,196.83	
Expense		1,006,179.24
Claims		365,688.70
Surplus		45,328.89

Similarly, if there was re-pricing of premiums using Year 2 experience and these were used as Year 3's premium rates, the program would have gained over PhP200,000 rather than lose PhP90,000.

Table 8b. Income with Corrected Premium for Year 3

If Premiums Computed from Year 1 Experience are Used (in PhP)		
Collection	1,635,037.02	
Expense		1,009,144.06
Claims		361,728.40
Surplus		264,164.56

An HMO is exposed to pricing risk when one utilizes erroneous prices in its products. In this case, losses were incurred mainly because of mispriced premiums. An experience analysis or morbidity study should have been performed after the first year to evaluate the correctness of the premiums. Loadings were predictable

since there were only two employees involved in the program and minimal costs were efficiently observed. It is the pure premium which has been miscalculated. The company could have avoided negative surplus if changes were made before the second year.

4.2 Reserve requirement

The risk that experience will deviate from the assumptions in the computation of the premiums, e.g. actual claims are more than what is expected, necessitates the set-up of a reserve to protect the program from losses. To manage this risk exposure, a fund is earmarked for these contingencies and this may be computed as a certain percentage of the expected claims. Jay (1998) cited 15% for comprehensive medical packages. This fund should always be accessible to cover for events which may depart from what was assumed.

4.3 Illustrations for break-even values

There is also the issue of affordability and sustainability. The previous section focused mainly on how much should have been collected rather than the marketability of the products. The computed rates may be too costly for some members which will prevent them from buying. Lower premiums can be achieved with higher membership. Higher membership is achieved if products are affordable and coverage is substantial.

To illustrate this idea, we simplify the product into one that comprises only of the following services: hospitalization, annual physical examination, doctors' consultation fees, dental benefit and out-patient treatment. Furthermore, there is only one product for all age-groups. We aim to have a gross annual premium of not more than PhP6000 to make it more affordable to low-income groups. This is also to satisfy the requirement that premiums should not "exceed five (5) percent of the current daily minimum wage rate for non-agricultural workers in Metro Manila" (Microinsurance National Strategy, 2010). For simplicity, we will assume that the interest rate is 0%.

For Illustration 1, we assume the following:

Total Operating Expenses, C = PhP1.2 Million
Claims Ratio, u = 30%
Lapse Rate, w = 15%
Interest Rate = 0%

The table below gives the cap, utilization rate and the corresponding pure premiums for these services.

Table 9. Cap and Pure Premium for Illustration 1

	Hospital-ization	Annual Physical Exam	Doctors' Consulta-tion	Dental	Out-Patient	Total
Cap	20,000.00	1,000.00	1000.00	500.00	2000.00	
Utilization Rate	0.05	0.75	0.20	0.15	0.05	
Pure Premium	1,000.00	750.00	200.00	75.00	100.00	2,125.00

The annual pure premium for this example is PhP2,125.00 and from equation (12), N^* is equal to 308 members. In the table below, we give the gross premium, total annual gross premium income (G), surplus, reserves, and break-even claims ratio u^* which are computed using equation (11), for N^* and for various other values of N.

Table 10. Simulation for Illustration 1

Number of Members	Gross premium	TGI	Claims (30% of TGI)	Admin. Expenses	Surplus	Reserves (15% of Claims)	u^*
N* = 308	6,022.00	1,715,667.80	514,700.34	1,200,000.00	967.46	154,410.10	0.30
350	5,554.00	1,798,107.50	539,432.25	1,200,000.00	58,675.25	161,829.68	0.33
400	5,125.00	1,896,250.00	568,875.00	1,200,000.00	127,375.00	170,662.50	0.37
500	4,525.00	2,092,812.50	627,843.75	1,200,000.00	264,968.75	188,353.13	0.43
750	3,725.00	2,584,218.75	775,265.63	1,200,000.00	608,953.13	232,579.69	0.54
1000	3,325.00	3,075,625.00	922,687.50	1,200,000.00	952,937.50	276,806.25	0.61

For Illustration 2, we use the following assumptions:

Total Operating Expenses, C = PhP1.2 Million
Claims Ratio, u = 70%
Lapse Rate, w = 15%
Interest Rate = 0%

Table 11. Cap and Pure Premium for Illustration 2

	Hospital-ization	Annual Physical Exam	Doctors' Consulta-tion	Dental	Out-Patient	Total
Cap	40,000.00	2,000.00	2000.00	1000.00	4000.00	
Utilization Rate	0.05	0.75	0.20	0.15	0.05	
Pure Premium	2,000.00	1,500.00	400.00	150.00	200.00	4,250.00

Using Table 4, the pure premium is PhP4250 and the calculated value of is 736 enrollees.

Table 12. Simulation for Illustration 2

Number of Members	Gross premium	TGI	Claims (30% of TGI)	Admin. Expenses	Surplus	Reserves (15% of Claims)	u^*
$N^* = 736$	5,881.00	4,003,784.80	2,802,649.36	1,200,000.00	1,135.44	420,397.40	0.70
750	5,850.00	4,058,437.50	2,840,906.25	1,200,000.00	17,531.25	426,135.94	0.70
800	5,750.00	4,255,000.00	2,978,500.00	1,200,000.00	76,500.00	446,775.00	0.72
850	5,662.00	4,451,747.50	3,116,223.25	1,200,000.00	135,524.25	467,433.49	0.73
900	5,584.00	4,648,680.00	3,254,076.00	1,200,000.00	194,604.00	488,111.40	0.74
950	5,514.00	4,845,427.50	3,391,799.25	1,200,000.00	253,628.25	508,769.89	0.75
1000	5,450.00	5,041,250.00	3,528,875.00	1,200,000.00	312,375.00	529,331.25	0.76

From the two illustrations, it is clear that the more members the program has, with administrative costs pegged at 1.2M, sustainability is more probable to be achieved even if the number of members is less than 5000. This is evidenced by the increasing surplus as N increases.

5. Conclusion

The sustainability of a health maintenance program by a community-based organization relies on several factors. Correct premiums, efficient cost management and membership size are major considerations. The company should have affordable products which are actuarially priced dependent on its promised coverage.

It is advised that a morbidity study based on experience should be regularly performed to investigate if existing premiums are still applicable for next year's business. The experience study gives the utilization rates for the computation of the pure premium. Those who have no experience yet may do a market study to obtain these utilization rates.

Indeed, premiums are dependent on the number of enrollees of the program; high membership translates to lower premiums. Affordability of premiums is achieved when risk can be averaged over a large number of policyholders. For cases when membership cannot be increased, sustainability is counterbalanced by the affordability of premiums charged.

The theoretical framework and illustrations discussed in this paper serve as a guide on how pricing and financial projections are done. We hope that this paper would assist community-based organizations offering health microinsurance in evaluating their sustainability position at any time and to help them anticipate and prevent losses.

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Appendix: Derivation of Equation 12

From equation (10), Surplus = $(1-u)\,G - C$. If surplus = 0, then from equation (8),

$$\begin{aligned} 0 = &\left(N\sum_k\sum_j \left(f_{j,k}\times G_{j,k}\right)(1+r) - \frac{N}{2}\sum_k\sum_j \left(w_{j,k}\times G_{j,k}\right)(1+r)^{1/2} \right) \\ &-u\left(N\sum_k\sum_j \left(f_{j,k}\times G_{j,k}\right)(1+r) - \frac{N}{2}\sum_k\sum_j \left(w_{j,k}\times G_{j,k}\right)(1+r)^{1/2} \right) - C. \end{aligned} \tag{13}$$

Using equation (7) which is $G_{j.k} = P_{j,k} + \dfrac{m_k C}{N\sum_t\sum_j m_t f_{j,t}}$, equation (13) becomes

$$\begin{aligned} 0 = &N\sum_k\sum_j \left(f_{j,k}\times\left(P_{j,k} + \frac{m_k C}{N\sum_t\sum_j m_t f_{j,t}} \right)\right)(1+r) - \frac{N}{2}\sum_k\sum_j \left(w_{j,k}\times\left(P_{j,k} + \frac{m_k C}{N\sum_t\sum_j m_t f_{j,t}} \right)\right)(1+r)^{1/2} \\ &-u\left(N\sum_k\sum_j \left(f_{j,k}\times\left(P_{j,k} + \frac{m_k C}{N\sum_t\sum_j m_t f_{j,t}} \right)\right)(1+r) - \frac{N}{2}\sum_k\sum_j \left(w_{j,k}\times\left(P_{j,k} + \frac{m_k C}{N\sum_t\sum_j m_t f_{j,t}} \right)\right)(1+r)^{1/2} \right) - C. \end{aligned}$$

This means that

$$\begin{aligned} C = &N\ 1-u\ \left(\sum_k\sum_j\ f_{j,k}\times P_{j,k}\quad 1+r\ -\frac{1}{2}\sum_k\sum_j\ w_{j,k}\times P_{j,k}\quad 1+r\ ^{1/2} \right) \\ &+\ 1-u\ \left(\sum_k\sum_j \left(f_{j,k}\times\frac{m_k C}{N\sum_t\sum_j m_t f_{j,t}} \right) 1+r\ -\frac{1}{2}\sum_k\sum_j \left(w_{j,k}\times\frac{m_k C}{N\sum_t\sum_j m_t f_{j,t}} \right) 1+r\ ^{1/2} \right) \end{aligned}$$

Since $C_{k,N} = \dfrac{m_k C}{N\sum_t\sum_j m_t f_{j,t}}$, we have the following expression of N^*

$$\begin{aligned} N^* &= \frac{C-\ 1-u\ \left(\sum_k\sum_j \left(f_{j,k}\times\frac{m_k C}{N\sum_t\sum_j m_t f_{j,t}} \right) 1+r\ -\frac{1}{2}\sum_k\sum_j \left(w_{j,k}\times\frac{m_k C}{N\sum_t\sum_j m_t f_{j,t}} \right) 1+r\ ^{1/2} \right)}{1-u\ \left(\sum_k\sum_j\ f_{j,k}\times P_{j,k}\quad 1+r\ -\frac{1}{2}\sum_k\sum_j\ w_{j,k}\times P_{j,k}\quad 1+r\ ^{1/2} \right)} \\ &= \frac{C-\ 1-u\ \left(\sum_k\sum_j\ f_{j,k}\times C_{k,N}\quad 1+r\ -\frac{1}{2}\sum_k\sum_j\ w_{j,k}\times C_{k,N}\quad 1+r\ ^{1/2} \right)}{1-u\ \left(\sum_k\sum_j\ f_{j,k}\times P_{j,k}\quad 1+r\ -\frac{1}{2}\sum_k\sum_j\ w_{j,k}\times P_{j,k}\quad 1+r\ ^{1/2} \right)}. \end{aligned}$$