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The association between health risk status and health care costs among the membership of an Australian health plan

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SUMMARY

Health promotion in Australia has developed into an accepted strategy for solving public health problems and promoting the health of its citizens. However, there are few evidence-based research studies in Australia that measure health risk status or track health changes over time with defined cost outcome measures. Those individuals with more high-risk lifestyle behaviors have been associated with higher costs compared with those with low-risk behaviors. Although intuitively it was believed that the health promotion programs had a positive impact on health behaviors and consequently on health care costs, the relationship between health risk status and health care costs had yet to be tested in the Australian population. Consequently, a verification study was initiated by the Australian Health Management Group (AHMG) to confirm that those relationships between health risks and medical costs that had been published would also hold in the Australian population using Australian private health care costs as the outcome measure. Eight health risks were defined using a Health Risk Appraisal (HRA) to determine the health risk status of participants. Consistent with previous studies, low-risk participants were associated with the lowest health care costs (AU$377) compared with medium- (AU$484) or high-risk (AU$661) participants and non-participants (AU$438). If the health care costs of those at low risk were considered as the baseline costs, excess health care costs associated with excess health risks in this population were calculated at 13.5% of total expenditures. Health risk reduction and low-risk maintenance can provide important strategies for improving/maintaining the health and well-being of the membership and for potential savings in health care costs.

Key words: health care costs; health risk appraisal; health risk status

INTRODUCTION

Over the last two decades, health promotion in Australia has developed into an accepted strategy for solving public health problems and promoting the health of its citizens. While there have been certain successes marked by improvements in the health of the population and the development of an infrastructure for health promotion, there are few evidence-based research studies in Australia that measure health risk status or track health changes over time with defined cost outcome measures (Wise and Signal, 2000).

In the United States, self-insured corporations provide worksite health promotion programs to maintain and/or to improve employee health risk status as one strategy to contain rapidly escalating health care costs. The business strategy justifying health promotion programs stems from a basic relationship between behavioral health

risks and health care costs. Those individuals with more high-risk behaviors have been associated with higher costs compared with those with low-risk behaviors (Yen *et al.*, 1991; Yen *et al.*, 1994; Goetzel *et al.*, 1998). Furthermore, those individuals who change lifestyle behaviors, improving their health status, have been shown to reduce their costs (Edington *et al.*, 1997; Ozminkowski *et al.*, 1999; Pronk *et al.*, 1999; Musich *et al.*, 2000).

In Australia, at least one private health insurance provider [Australian Health Management Group (AHMG)] has implemented a population health management program to improve the health of its members and to reduce costs of illness and disease (Hook *et al.*, 2001). In 1995, AHMG introduced the Health Risk Appraisal (HRA) to their members. The HRA questionnaire was used to generate a customized report for participants that assessed their current health status and suggested ways in which their health could be improved.

Although intuitively it was believed that the program would have a positive impact on health behaviors of their members and consequently on health care costs, the relationship between health risk status and health care costs had yet to be tested in the Australian population. Consequently, a verification study was initiated to confirm that those associations between health risk status and health care costs that have been published would also hold in the Australian population, using Australian health care costs as the outcome measure. Key areas to be investigated were: (i) the measurement of the health risk status of their membership, and (ii) documentation of an association between overall risk levels and health care costs.

METHODS

This study was designed to investigate the association between the health risk status of HRA participants and health care costs at AHMG. AHMG is a private health insurance provider in the Australian market located in Wollongong, New South Wales. In 2000, they contracted with the University of Michigan Health Management Research Center (UM-HMRC) in the United States to conduct an evaluation of their current health promotion program. An integrated database was assembled by the UM-HMRC that contained the following data elements for the study period 1995–1999: membership files, HRA questionnaire responses and health care cost records.

Study population

The selected study population consisted of 11 568 AHMG members who met the following criteria: (i) members of AHMG from 1995 to 1999, and (ii) had completed at least one HRA during the time period. A subgroup of non-participants ($n = 8244$) who were age- and gender-matched to the participants was then randomly drawn from the AHMG membership for comparison. The total study population comprised 19 812 AHMG members. Demographics included age and gender from the membership files obtained from AHMG.

Health risk appraisal

The *Healthtrac* HRA was used as the measurement tool to determine risk status. During this time period, the questionnaire was offered bi-annually to those who participated at the beginning of the program. Non-participants did not receive additional questionnaires if they did not participate initially. All responses were self-reported, with no additional biometric screening.

Eight individual health risks were selected to establish health risk status: smoking, physical activity, alcohol use, blood pressure, cholesterol, weight, absence due to illness and medical problems. The high-risk criteria for the individual health risks are given in Table 1.

Health risk status was determined by counting the number of individual health risks for each participant. Using the distribution of health risks within the population, overall health risk levels was then defined as follows: low risk (zero or one health risks); medium risk (two health risks); and high risk (three or more health risks). The cut-off point for the top 10th percentile of health risks was three risks. For multiple-year HRA participants, the most recent risk indicators were used.

Health care costs

The yearly health care costs used in this study were calculated from the claims charged to the insurance provider, AHMG. The cost data included all the claims handled by the health fund for each member in the study population. Costs included primarily those health care costs associated with in-patient hospital claims, with some claims for ancillary services (except dental). Unlike the US medical system, all outpatient claims including preventive services are covered by a governmental Medicare system. The claims data were received on a 'per claim' basis, and

Table 1: Health risk criteria

Selected health measures	High risk criteria
Lifestyle risks	
Smoking	Current cigarette smoker (≥1 cigarettes per day)
Physical activity	≤60 min/week
Alcohol use	Heavy drinker (more than two drinks per day)
Health/biological risks	
Blood pressure	Systolic blood pressure >139 mmHg or diastolic blood pressure >89 mmHg or taking blood pressure medication
Cholesterol	>239 mg/dl
Weight	Body mass index ≥27.5 [weight (kg)/height (m)^2]
Medical problems	Self-reported heart condition, cancer, diabetes, emphysema or stroke
Absent due to illness	>2 days per 6-month time period
Overall risk levels	
Low risk	0–1 high risks
Medium risk	2 high risks
High risk	3 or more high risks

individual claims were aggregated to determine the total cost per member per year. All costs are given in Australian dollars, with annual costs adjusted to the year 2000 using published medical inflation rates. Average annual health care costs for the 5-year time period (1995–1999) were calculated from the yearly cost data. High-cost status was defined as being in the top 10th percentile of health care costs for individual years and for the 5-year average annual costs. The high-cost cut-off point for the average annual costs in 1995–1999 was $1029.

Since there was a similarity in the plotted distributions of health care costs and health risks, the overlap between the two curves was investigated. The odds of being high cost (in the top 10th percentile of costs) for those who were high risk (in the top 10th percentile of health risks, i.e. three risks or more) was calculated.

Health care costs related to individual health risks

Average annual health care costs were assessed by individual risk status (high risk versus low risk) for each of the eight individual health risks, as reported on the HRA. Each individual health risk was assessed independently without adjusting for other health risks.

Excess health care costs related to excess health risks

The concept of excess health care costs associated with excess health risks is a calculation of the theoretical maximum percent savings for a population, assuming that everyone participates and then reduces to low-risk status and that health care costs follow those changes in health status (Edington, 2001). Average health care costs were calculated for low-, medium- and high-risk individuals, and for non-participants. Health care costs related to excess health risks in the population were defined as excess health care costs greater than the base costs of those members with zero to one health risks (low-risk status). The percentage of total costs attributable to excess risks/non-participation was then calculated.

Statistical testing

Categorical variables were tested for differences using the chi-square test. Health care costs and average age differences were tested using analysis of variance (ANOVA). Because the distribution of health care costs was severely skewed, a log transformation was performed prior to statistical testing. Post-hoc testing of differences in multi-level variables was performed using Tukey's studentized range test.

RESULTS

Demographics comparing the HRA participants and non-participants in the study population are shown in Table 2. HRA participants were more likely to be female (47.2% versus 44.6%; $p < 0.001$), although the average age for the two

Table 2: Characteristics by HRA participation

Demographic measures	HRA participants (n = 11 568)	HRA non-participants (n = 8244)
Gender[a]		
Male	52.8%	55.4%
Female	47.2%	44.6%
Age categories (years)		
<44	40.6%	38.7%
45–54	31.8%	33.2%
⩾55	27.7%	28.2%
Average age (in 2000)	47.7	47.9
Cost		
Average cost (1995–1999)	$435	$438
Percentage high cost	10.0%	10.0%

[a]Chi-square test, $p < 0.001$.

Table 3: Characteristics by HRA risk levels (n = 11 568)

HRA participants	Low risk (n = 7661)	Medium risk (n = 2509)	High risk (n = 1398)
Gender[a]			
Male	49.4%	56.8%	64.5%
Female	50.6%	43.2%	35.5%
Age categories[a] (years)			
<44	44.7%	36.6%	25.1%
45–54	31.3%	32.2%	33.3%
⩾55	24.0%	31.2%	41.7%
Average age (in 2000)[b]	46.5	49.1	52.1
Cost			
Average cost (1995–1999)[c]	$377	$484	$661
Percentage high cost[a]	8.6%	11.6%	14.9%

[a]Chi-square test, $p < 0.001$.
[b]ANOVA (age), $p < 0.05$; low-, medium- and high-risk different.
[c]ANOVA (log costs), $p < 0.05$; low risk different than medium- and high-risk.

subgroups was similar (47.7 years versus 47.9 years). Average health care costs and percentage of individuals in the top 10th percentile of costs indicated no bias in the utilization of medical services between the two groups. When demographics by risk levels were considered, those at low risk were more likely to be younger, female, and to have significantly lower health care costs compared with those at medium- and high-risk (See Table 3).

Risk status

The prevalence of the eight health risks selected from the *Healthtrac* HRA to define risk status are given in Table 4. The percentages of the overall health risk levels in this population were 66.2% low risk, 21.7% medium risk and 12.1%

Table 4: Prevalence of individual health risks and overall risk levels (n = 11 568)

Health-related measures	Members with high-risk status, n (%)
Lifestyle	
Smoking	1156 (10.0)
Physical activity	3712 (32.1)
Alcohol use	1156 (10.0)
Medical/illness	
Absence due to illness	2078 (18.0)
Medical problems	618 (5.3)
Biological	
Blood pressure	1539 (13.3)
Cholesterol	440 (3.8)
Weight	3042 (26.3)
Overall health risk level	
Low risk (0–1 risks)	7661 (66.2)
Medium risk (2 risks)	2509 (21.7)
High risk (⩾3 risks)	1398 (12.1)

high risk. The individual health risks with the highest prevalence were lack of physical activity (32.1%), being overweight (26.3%) and absence due to illness (18.0%).

Distribution of health care costs and number of health risks

The distribution of the average 1995–1999 health care costs among the AHMG population was highly skewed. The median cost was $143; the mean cost was $436. The top 10th percentile of employees accounted for 57.9% of the total average annual costs during the 5-year time period (see Figure 1). For any one year from 1995 to 1999, however, the top 10th percentile of employees accounted for 74–80% of total annual health care costs (1995: 74.1%; 1996: 74.9%; 1997: 78.3%; 1998: 79.4%; 1999: 80.0%).

Likewise, the distribution of the number of health risks among the AHMG population was also highly skewed. The median and mean number of risks were 1.0 and 1.2 risks, respectively. The 90th percentile was three risks and the maximum number of risks for any one individual was seven (see Figure 2). The similarity between the two distributions was apparent. Among those individuals on both curves, 18% of those in the top 10th percentile of costs (greater than $1029) were also in the top 10th percentile of risks (three or more risks). The odds of being high cost for those who were in the top 10th percentile of risks was 1.696 [confidence interval (CI) = 1.443–1.994].

Health care costs by individual health risks

Individuals at high risk for each risk factor had higher costs than those not at risk, with the exception of smokers. The health risks significantly ($p < 0.001$) associated with high health care costs are medical problems, high blood pressure, absence due to illness, high cholesterol levels and being overweight. Contrary to expectations, smokers had significantly ($p < 0.001$) lower costs than non-smokers (see Figure 3).

Excess costs associated with excess risks

Overall low-risk members had the lowest costs ($377) compared with medium-risk ($484), high-risk ($661) and non-participants ($438) (see Figure 4). Compared with the low-risk baseline group, those at medium risk cost $107 more, those at high risk cost $284 more and non-participants cost $61 more. If those costs above the low-risk baseline were defined as 'excess' costs, the total excess health care costs for medium- and high-risk participants and also for non-participants would be $1 168 379 (see calculations at the bottom of Figure 4). Among the HRA participants and non-participants, the total annual health care costs were $8 637 503. The percentage

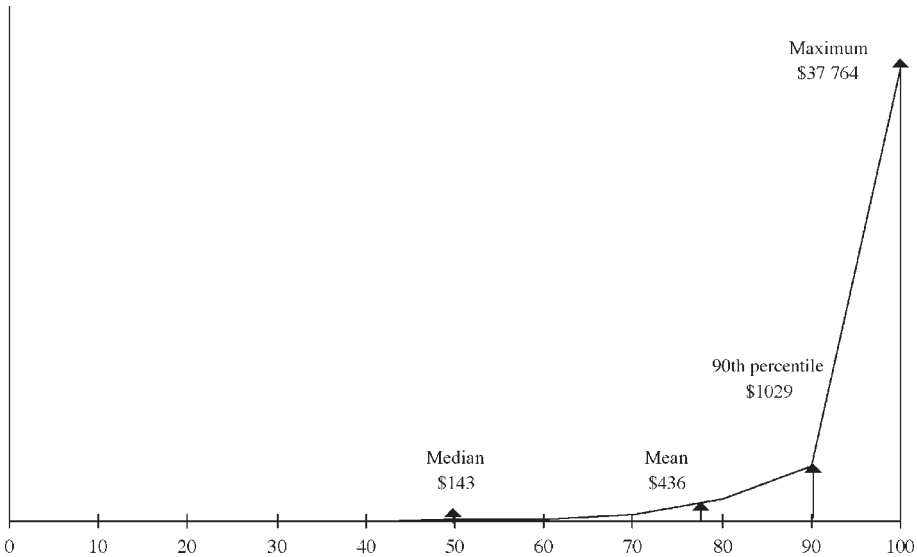


Fig. 1: Distribution of health care costs. Average annual paid amounts (1995–1999) (n = 19 812).

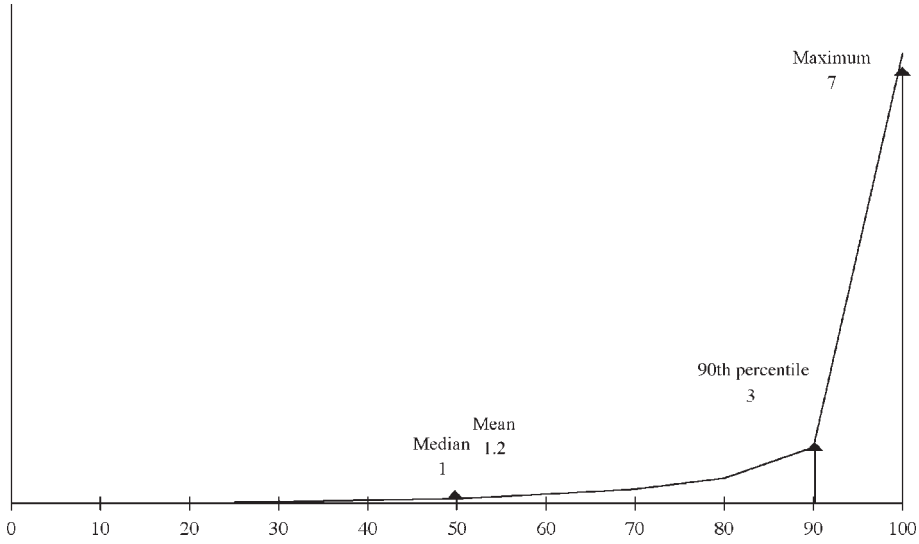


Fig. 2: Distribution of health risks. Average risk factors, HRA participants (n = 11 568).

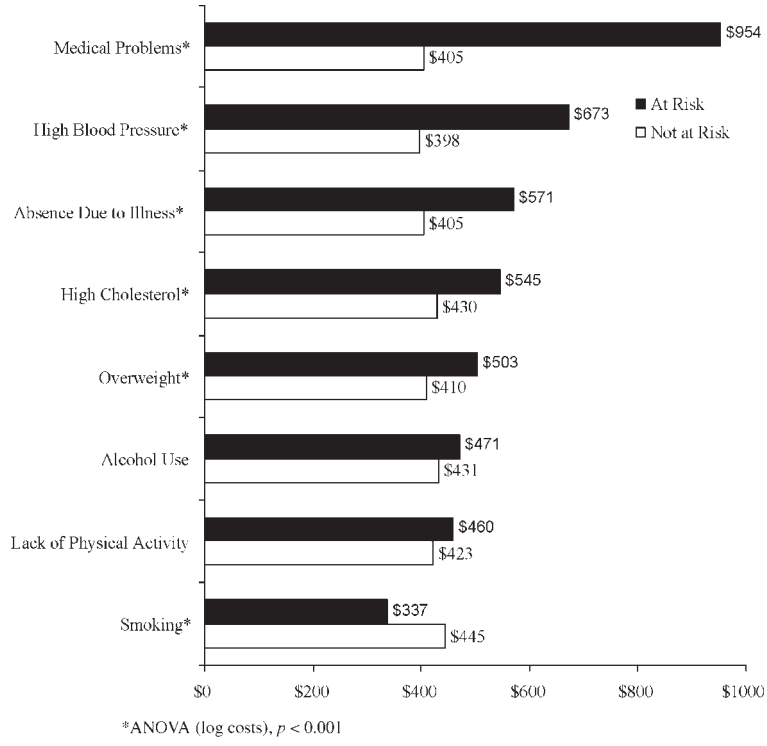
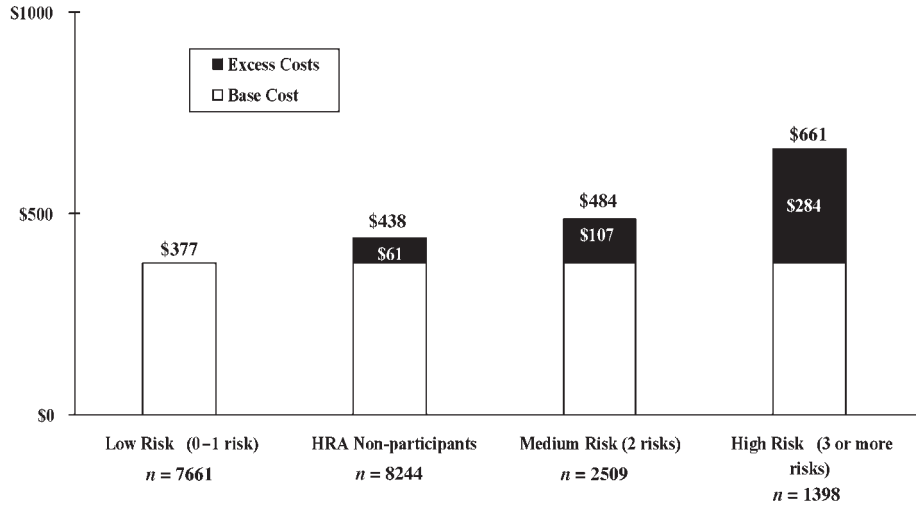


Fig. 3: Cost comparison by individual risk status. HRA participants (n = 11 568) (1995–1999 average paid amounts).



The total annual healthcare costs of HRA participants and non-participants was: ($377 × 7661) + ($484 × 2509) + ($661 × 1398) + ($438 × 8244) = $8 637 503

The total annual excess healthcare costs for medium- and high-risk participants and non-participants was: ($107 × 2509) + ($284 × 1398) + ($61 × 8244) = $1 168 379

The percent of total costs attributable to excess risks is: $1 168 379 / $8 637 503 = 13.5%

This is the theoretical maximum saving in healthcare costs that could be achieved if all participants changed to low risk and costs followed this change in risk.

Fig. 4: Excess medical costs due to excess risks by risk status (1995–1999 average paid amounts). This chart shows that participants with more health risks have higher costs. Those with two risks have costs $107 higher than those with 0–1 risk. High-risk individuals' costs are $284 higher than those at low-risk. Non-participants costs are $61 more than low-risk participants.

of total costs associated with excess risks/non-participation was 13.5%.

DISCUSSION

Consistent with previous studies, individual health risks, as defined from the *Healthtrac* HRA, correlated with Australian health care costs. Those with low-risk status for individual risks were generally lower cost than those with high-risk status. Smoking was the only exception. In this population, smokers were significantly younger than non-smokers (44.4 versus 48.1 years, $p < 0.001$) and were somewhat less likely to be at risk for medical problems (7.8% versus 10.1%, $p = 0.058$), which most likely explains their lower costs. There were no differences in the percentages of males and females who smoked (51.9% males versus 48.1% females, $p > 0.500$). Typically, smokers have higher medical costs than non-smokers (Edington *et al.*, 1997; Goetzel *et al.*, 1998; Anderson *et al.*, 2000; Musich *et al.*, 2000).

Overall, low-risk members had the lowest costs compared with medium- or high-risk participants and non-participants. The percentage of excess health care costs (13.5%) is relatively low compared with the excess costs calculated for US populations. Excess health care costs associated with excess health risks in those studies were relatively consistent at 21–31%, with a mean close to 25% (Anderson *et al.*, 2000; Edington, 2001). The lower percentage of excess costs at AHMG is primarily related to the number of health risks that could be selected from this version of the *Healthtrac* HRA. Notably missing from the list of health risks were any of the psychological risks (stress, perception of health or mental health indicators) commonly included in other studies (Edington *et al.*, 1997; Goetzel *et al.*, 1998; Musich *et al.*, 2000). These data were not available from this questionnaire, but will be collected from the 2000 *Healthtrac* HRA.

The expectation is that by counting more health risks, more individuals will be classified as medium- and high-risk, thus increasing the percentage of those with excess risks/costs.

The distribution of AHMG health care costs was characteristic of medical claims in the US, i.e. highly skewed, with the top 10th percentile of members accounting for a majority (57.9%) of the total annual costs, even when averaged over a 5-year period. For individual years, the top 10th percentile accounted for 74–80% of total annual costs. These percentages are higher than are typical for cost distributions of US claims, where the top 10th percentile accounts for 50–60% of total annual expenditures (Yen *et al.*, 1994). This discrepancy is primarily due to a difference in the nature of Australian claims, i.e. primarily in-patient claims, compared with US medical costs that include both in-patient and outpatient costs.

The distribution of health risks was similar to the distribution of health care costs, indicating two groups of members: the majority with minimal costs/risks, and a minority with costs/risks much greater than the mean and median. Although the individuals were not in the same percentiles on both curves, those who were high risk (three or more risks) were 1.696 times more likely to be high cost than those who were low risk.

Given this association between high risk levels and high costs among their membership, AHMG extended their program offerings in an attempt to reach more high-risk/high-cost individuals. High-risk members (who consented to follow-up) were to be contacted by telephone by health counselors in an attempt to facilitate health behavior improvements (risk reduction). Those members currently at low risk were to receive follow-up HRAs and targeted mailings of health education materials (low-risk maintenance). Tracking health risk status and changes in health risks over time (risk reduction and/or risk maintenance) will be important outcome measures for determining the success of these designated programs.

Since those members in the low-risk category were more likely to be younger females, we considered the influence of age and gender as possible confounding factors in the excess cost calculations. Although not included in the results, the calculated excess cost percentages were similar for males and females within the three age groups ($<$45 years, 45–54 years and $\geqslant$55 years). Excess cost percentages, however, increased for both genders, with the increased numbers of health risks associated with the older age groups. These results suggest that increased health risks were more directly associated with increased health care costs rather than age or gender *per se*, although the influences of age and gender on excess costs/risks need further investigation.

A limitation to the study was that only eight health risks could be selected from *Healthtrac* HRA data. Health risk levels may have been better defined had more health risks been available. Consequently, our results have probably underestimated the impact of excess risks in this population. With recent improvements in the *Healthtrac* HRA system, it will now be possible to include the following additional health risks: high-density lipoprotein (HDL) cholesterol, perception of health, stress, and a measure of mental health. The psychological risks will be an important improvement in evaluating the health of the AHMG members.

The HRA participants may also pose a limitation to the generalizability of the conclusions. Some have suggested that those who participate in health promotion programs may be healthier and use fewer health services than those who choose not to participate (Conrad, 1989). This group of participants, however, showed no difference in their utilization of medical services compared with non-participants, so the bias should be minimal.

CONCLUSIONS

The *Healthtrac* HRA provided a useful tool for measuring the health risk status of the AHMG population. Furthermore, health risk levels correlated with AHMG health care costs. Those members at low-risk status cost less than those at medium- or high-risk or non-participants. Excess health care costs associated with excess health risks or non-participation in this population were calculated at 13.5% of total expenditures. Health risk reduction and low-risk maintenance can provide important strategies for improving/maintaining the health and well-being of the membership, and for potential savings in health care costs.

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