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A case study: Risk adjustment in the UK PMI market

Joanne Buckle, FIA
Tanya Hayward, FIA
Natasha Singhal

In this case study, we discuss risk adjustment techniques in the context of UK private medical insurance (PMI) and how Milliman's proprietary Chronic Conditions Hierarchical Grouper™ (CCHG) tool has been applied successfully in this environment.

What is population stratification?

Population stratification is the process that allows us to stratify a population by predefined characteristics (e.g., age/sex/clinical condition), where members within a particular population stratification group are considered to have similar risk profiles. For example, in the context of healthcare, we may expect patients within the same group to have similar levels of healthcare resource utilisation. Risk adjustment is the process that allows us to analyse the healthcare resource utilisation of these groups by taking their specific risk profile characteristics into account.

Challenges in the UK PMI market

Traditional risk adjustment methodologies rely on comprehensive and accurate member-level data in order to be effective. Developing a robust population stratification methodology in the UK PMI environment has some challenges which prevent us from being able to develop a complete clinical and claims profile for covered lives. There is limited primary care coverage and limited explicit coverage for chronic conditions or emergency and maternity services. The limited benefit coverage means that there is limited patient information and, consequently, comorbidity profiles are not available. Because UK PMI mainly covers elective services, a large proportion of covered lives will have no claims experience within a year and we are not able to build any expected claims profiles for these members based on claims data alone. There are also data limitations where secondary diagnosis and procedure codes are not always captured.

Can a risk adjustment system do a fair and effective job in population risk stratification, given these data and system challenges, such that we will be able to better understand member risk profiles within the context of UK PMI? To answer this question, we focus on the major conditions covered by the PMI providers (e.g., cancer, musculoskeletal and mental health conditions) and the acute flare-ups associated with chronic conditions, even though the chronic conditions themselves are not covered by PMI.

The four key questions

Before embarking on any population stratification process, we ask ourselves the following four key questions, defined by Lisa Iezzoni in *Risk Adjustment for Measuring Healthcare Outcomes:*[1]

FIGURE 1: THE FOUR KEY QUESTIONS AND EXAMPLE ANSWERS

1. RISK OF WHAT OUTCOME?	High claims experience, mortality, hospital admission or readmission.
2. OVER WHAT TIMEFRAME?	One year, hospital admission or clinical episode.
3. FOR WHAT POPULATION?	Entire membership, clinical definition, regional stratification or member characteristic such as age group.
4. FOR WHAT PURPOSE?	Disease management programme, alternative reimbursement, provider profiling or clinical analysis.

Chronic Conditions Hierarchical Grouper (CCHG) tool

The CCHGs were developed by Milliman in the United States in association with Dr. Michael Chernew, a Harvard University health economist and coeditor of the *American Journal of Managed Care*. The tool assigns individuals to unique categories using a clinically relevant hierarchy based on how healthcare providers make treatment decisions. It considers the entire set of diseases that a member faces and how they interact. All members are assigned to 43 mutually exclusive categories over a 12-month rolling look-back period.[2]

The CCHGs provide a solution that permits:

- Clinicians to evaluate efficiency and effectiveness of treatment patterns for specific populations of clinically similar patients
- Payers to establish healthcare resource utilisation and quality goals for real populations of individuals
- The development of population-based budgets
- Ease of interpretation due to the manageable number of categories
- Capturing 100% of patients and healthcare resource utilisation

[1] Iezzoni, L. (2012). *Risk Adjustment for Measuring Healthcare Outcomes*, Fourth Edition.

[2] More information on the CCHG tool can be found on Milliman's Medinsight website: http://www.medinsight.milliman.com/MedInsight/Products/Medinsight-Tools/?prid=71829.

The 43 CCHG groupings comprise 24 categories for specific conditions (e.g., active cancer and renal failure) and 19 'healthy state' categories, which are divided by age group and gender. Although the tool is a 'chronic conditions' grouper, many of the categories nevertheless relate to conditions covered by PMI providers (e.g., cancer, musculoskeletal and mental health conditions).

Returning to our four questions, CCHGs can be applied in the following way:

FIGURE 2: THE FOUR KEY QUESTIONS AND THE APPLICATION OF CCHGs

1. RISK OF WHAT OUTCOME?	Healthcare resource utilisation.
2. OVER WHAT TIMEFRAME?	Typically one year.
3. FOR WHAT POPULATION?	Can be applied to entire or subpopulation.
4. FOR WHAT PURPOSE?	Disease management, clinical analysis, provider profiling, evaluating treatment patterns, developing population budgets and alternative reimbursement arrangements.

Meaningful results

We used our UK PMI Health Cost Guidelines™ (HCGs)[3] data to conduct a feasibility study and found that the data was of sufficient quality and granularity to apply the CCHG tool.

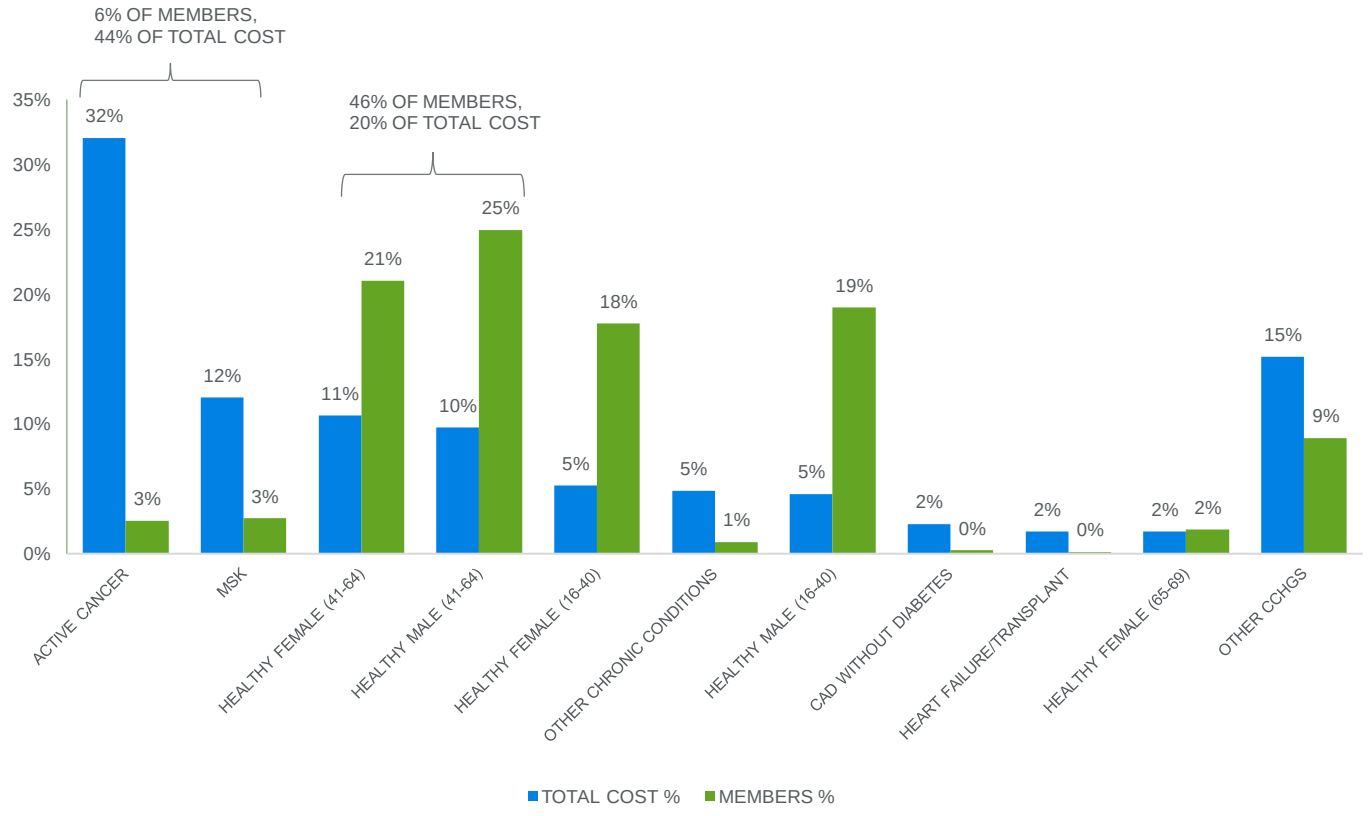
Assessing the distribution of members and cost for the top 10 CCHG categories by annual cost covered by PMI, we see that CCHGs enable us to identify high-resource utilisation members, while identifying each member's most severe condition. Less than 6% of members account for over 44% of total costs, with these members falling into the cancer and musculoskeletal (MSK) categories. Overall, 92% of members are allocated to 'Healthy' CCHG categories and account for 41% of total costs.

The idea of population stratification is to create homogeneous groupings where members within each group have similar levels of healthcare resource utilisation. As such, these CCHG groupings allow us to calculate benchmark per member per month (PMPM) costs within each CCHG category.

Because the active cancer group accounts for 32% of total cost and has a significant level of variability, we stratified this category further. Over a 12-month period, members with one cancer diagnosis were grouped into mutually exclusive categories by description of cancer type while those with more than one cancer diagnosis were allocated to the '2 cancer types' or '3+ cancer types' groups.

From Figure 4 on page 3, we can see that there is significant variation in the calculated benchmark PMPMs within the active cancer CCHG, which demonstrates the necessity to stratify this major category into subcategories.

FIGURE 3: DISTRIBUTION OF MEMBERS AND COSTS BY TOP 10 CCHGs, 2014



[3] Milliman UK PMI HCGs are a tool for modelling healthcare cost and utilisation by service categories based on data we collected from PMI contributors in 2015. This data covers over 6 million life-years for the analysis period (2012-2015).

FIGURE 4: RELATIVE PMPM AND DISTRIBUTION OF LIVES FOR ACTIVE CANCER, 2014

ACTIVE CANCER CATEGORY	PMPM FOR SUBCATEGORY AS PERCENTAGE OF TOTAL ACTIVE CANCER PMPM	PROPORTION OF ACTIVE CANCER LIVES
3+ CANCER TYPES	499%	2.8%
1 CANCER TYPE: OTHER RESPIRATORY CANCER	256%	0.9%
2 CANCER TYPES	209%	13.0%
1 CANCER TYPE: OVARIAN CANCER	143%	1.1%
1 CANCER TYPE: NEOPLASMS	127%	2.5%
1 CANCER TYPE: LEUKEMIAS	126%	0.9%
1 CANCER TYPE: NON-HODGKINS LYMPHOMA	104%	1.9%
1 CANCER TYPE: COLON CANCER	97%	4.7%
1 CANCER TYPE: PROSTATE CANCER	92%	9.2%
1 CANCER TYPE: CANCER OF THE KIDNEY	92%	1.3%
1 CANCER TYPE: HEAD/NECK CANCER	77%	1.2%
1 CANCER TYPE: OTHERS	74%	10.8%
1 CANCER TYPE: BREAST CANCER	71%	19.5%
1 CANCER TYPE: BLADDER CANCER	70%	3.2%
1 CANCER TYPE: OTHER DISEASES OF FEMALE GENITAL ORGANS	40%	3.4%
1 CANCER TYPE: NON-EPITHELIAL CANCER	39%	11.3%
1 CANCER TYPE: SKIN MELANOMA	33%	3.6%
TOTAL ACTIVE CANCER	**100%**	**100.0%**

Goodness of fit

The R^2 measure was used to test the goodness of fit for each population risk stratification methodology. We censored the data using the inter-quartile range method by calculating a censor point for each CCHG. Members with total annual claims costs in excess of the relevant censor point had their costs adjusted downwards (censored) to the censor point.[4]

As shown in Figure 5, CCHGs add significant predictive power compared to only using age and sex as adjustment factors. Including age and sex with CCHGs further enhances the predictive power. Censoring the data improves the goodness of fit for all population stratification methods.

Although a significant proportion of costs are censored for all methods, the associated proportion of members whose costs are censored is approximately 1%, which indicates that a minor proportion of members are responsible for a high proportion of the outlier costs.

Further stratifying the active cancer CCHG category results in further R^2 improvement as well as a reduction in the proportion of costs censored.

The dramatic improvement in goodness of fit from using age and sex with CCHGs indicates a key result:

Two members with the same clinical condition and a different age/sex profile are more similar than two members of the same age and sex with different or no clinical conditions.

FIGURE 5: GOODNESS OF FIT BY POPULATION STRATIFICATION METHODOLOGY, 2014

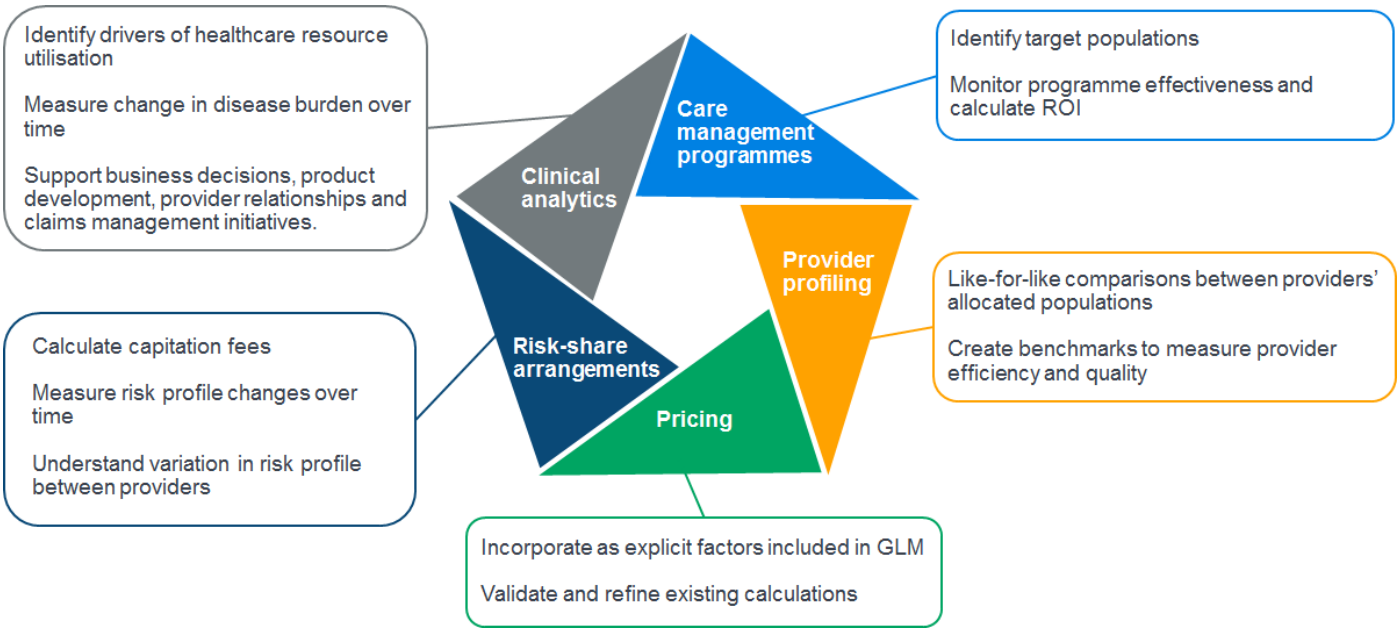
POPULATION STRATIFICATION METHODOLOGY	R2 (NO CENSORING APPLIED)	R2 (CENSORING APPLIED)	PROPORTION OF COSTS CENSORED	PROPORTION OF MEMBERS WITH CENSORING APPLIED
AGE/SEX	2.7%	8.0%	23.7%	1.1%
CCHGs	11.2%	22.3%	19.0%	1.1%
CCHGs AND AGE/SEX	11.8%	23.1%	17.9%	1.0%
CCHGs WITH FURTHER CANCER STRATIFICATION	17.2%	28.8%	13.9%	1.0%

[4] Censor point = 25th percentile + K * (75th percentile – 25th percentile). We found that using a value of K = 3 provided the best balance of proportion of data censored versus goodness of fit.

Applications of population stratification with risk adjustment in the UK PMI environment

Figure 6 summarises the various possible applications of population stratification with risk adjustment in the UK PMI environment.

FIGURE 6: APPLICATION OF POPULATION STRATIFICATION IN THE UK PMI ENVIRONMENT



Conclusion

Being able to stratify a population according to its expected healthcare resource utilisation and calculated risk-adjusted claims cost values can be applied in many contexts and adds tremendous value across multiple business areas. Although there are challenges in developing population stratification methodologies in the UK PMI environment, Milliman's CCHG tool proved to add significant predictive power compared to a more simplistic age/sex adjustment and allows for a more insightful interpretation of results, because the population can be analysed from both a clinical and a financial perspective simultaneously.

Milliman

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CONTACT
Joanne Buckle
joanne.buckle@milliman.com

Tanya Hayward
tanya.hayward@milliman.com

Natasha Singhal
natasha.singhal@milliman.com