Reducing disparities in the delivery of primary healthcare – by reducing unnecessary emergency department visits

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BUSINESS CASE

"A closer relationship with your primary healthcare provider leads to a reduction in emergency department visits and subsequent admissions from the emergency department, resulting in better patient outcomes and lower healthcare costs".

Contents

INTRODUCTION

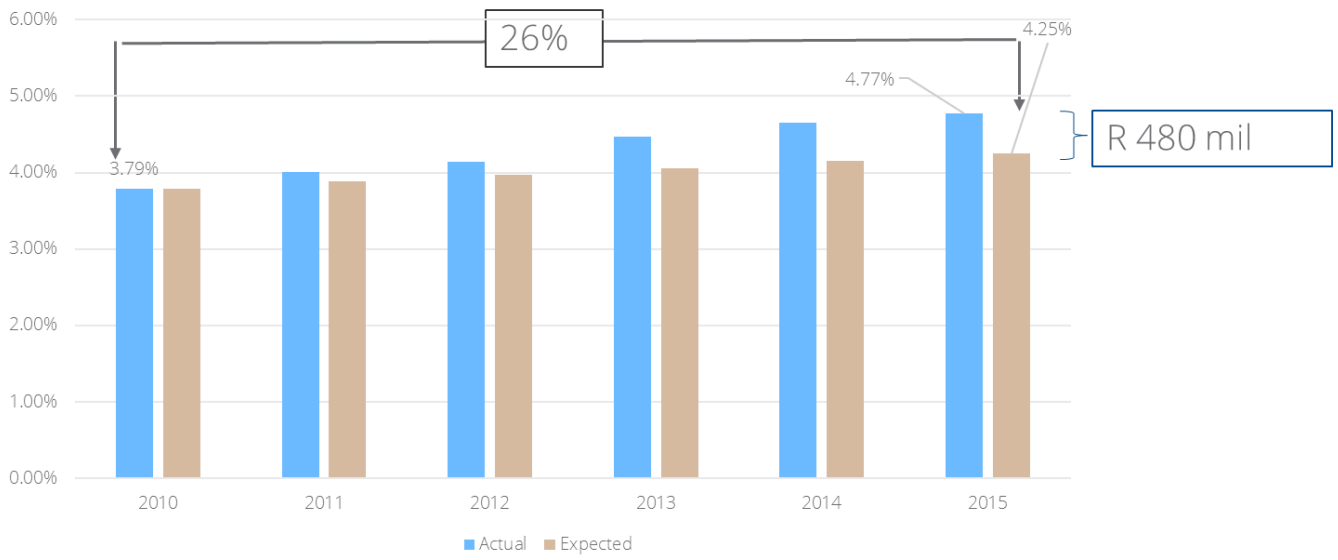
Discovery Health's core purpose is to make people healthier and enhance and protect their lives. To achieve this, Discovery Health seeks to make sure that high quality, cost-effective healthcare is available to all its members. Primary care sits at the centre of all strong healthcare systems and should offer the first point of contact to all of our members.

Over the years, Discovery Health has focused substantial energy on understanding its primary healthcare system. This includes identifying opportunities for partnerships and potential network opportunities that can help strengthen primary care. In the largely fragmented, hospital-centric private healthcare system of South Africa, care is rarely driven by the primary care provider. This not only negatively affects patient outcomes, it also limits the system more broadly in its ability to offer value-based care at an acceptable cost, which maximises quality for all. The use of an emergency department as a first point of care before consulting a primary care provider has been a specific challenge in the South African environment for a while. It seems to be an ever-increasing phenomenon.

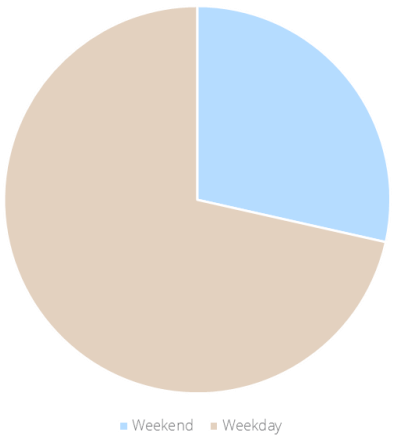
Why is the use of emergency departments as first point of care a problem?

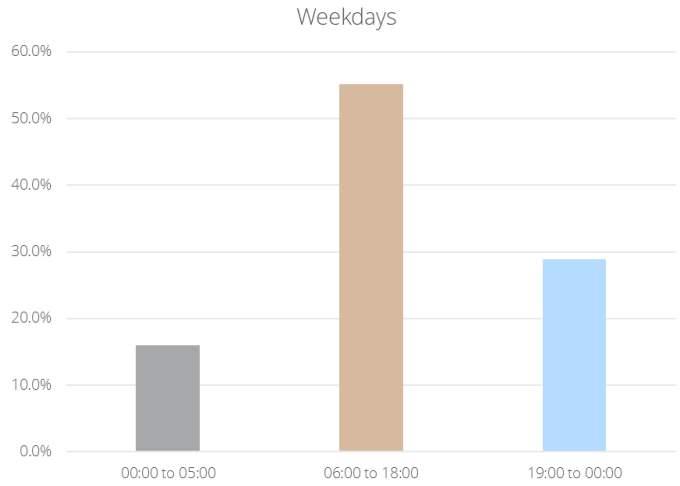
Emergency department visit rates and the consequent hospital admission rate from emergency department visits have been increasing yearly in South Africa. In 2010, 21 out of every 100 hospital admissions came via an emergency department. In 2018, 27 out of every 100 hospital admissions came via an emergency department. This shows an increase of 32% in just eight years.

From 2010 to 2015, there was a 26% increase in hospital admission rates to emergency departments, as evident in the graph below. Fitting a simple model adjusting for age, sex, and the presence of a chronic condition on 2010 data, it is clear that in 2015 there is at least a R480 million residual (meaning there were more admissions than expected in our system). This indicates that there is a potential savings of close to R500 million to be gained if better use of primary healthcare is encouraged.



Most of these emergency department visits with subsequent admissions occur during the week and during normal working hours, as the graph below indicates. This creates a significant opportunity to change behaviour and to encourage better use of primary healthcare.





AIMS

This paper aims to use new insights from the expected emergency department (ED) admission model together with the new emergency department visit classification in the ACG system to demonstrate the impact of improving primary healthcare use trends among Discovery Health Medical Scheme members.

The paper aims to investigate the impact of better use of primary healthcare on healthcare costs in four distinct steps.

1. It will describe how we created a model to calculate the expected admission rate for members visiting an emergency department adjusting for patient multi-morbidity.
2. Using the ACO allocation strengths, it will examine if there is a difference in experience of members with stronger relationships with their primary healthcare providers on emergency department visits and subsequent hospital admission rates from an emergency department.
3. It will then compare the outputs of this model to the ED classification outputs from the ACG system to gain further insights into the reasons patients visit the emergency department and whether these visits are avoidable.
4. The benefits of better relationships with primary healthcare providers and use of primary healthcare will then be determined using two approaches:
    a. Benefit design
    b. Network selection.

Expected admission rate via emergency department methodology

The expected admission rate via an emergency department was calculated using the Johns Hopkins ACG outputs together with additional scheme-specific data as inputs into a distributed random forest model. The data used to generate the expected model is based on all of Discovery Health Medical scheme members who visited an emergency department from 2015 to 2017. The demographic and clinical factors used (listed below) are based on the latest information in the month before the emergency department visits. The train and test set are 70% and

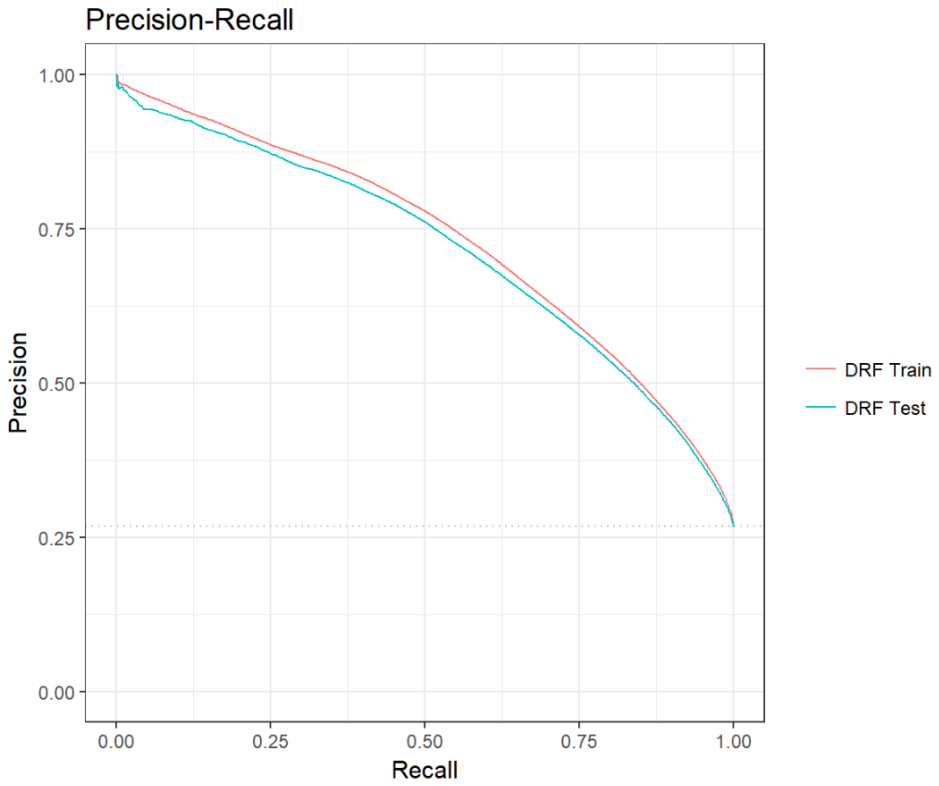
10% of all emergency department visit data from 2015 to 2017 respectively. The remaining 20% of the data was used as the validation set during model fitting.

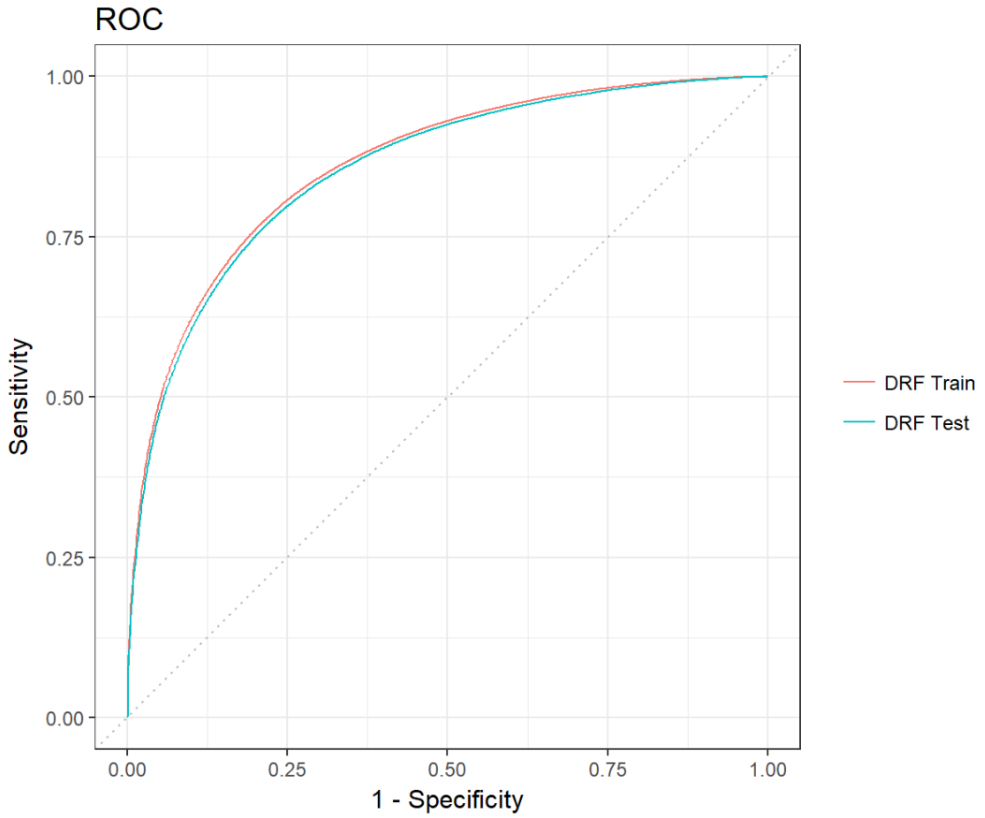
Various demographic and clinical factors were used in the model. The top factors are shown below by variable importance with detailed descriptions of the variables set out in Appendix A.

Variable	Relative importance	Scaled importance
EMERGENCY_DEPARTMENT_CONDITION	8,736,610	100.0000%
ACG_ROLLING_12	2,206,529	25.2561%
RUB_ROLLING_12	1,766,514	20.2197%
EMERGENCY_DEPARTMENT_ICD_10	1,192,864	13.6536%
AGE	512,978	5.8716%
BENEFIT_PLAN	411,116	4.7057%
HYPERTENSION_FLAG	287,883	3.2951%
BENEFIT_PLAN_TYPE	272,938	3.1241%
CHRONIC_CONDITION_FLAG	223,589	2.5592%
BENEFIT_PLAN_OUT_OF_HOSPITAL_BENEFIT_LEVEL	184,716	2.1143%
DIABETES_FLAG	93,885	1.0746%
PREVIOUS_ADMISSIONS_30_DAYS	66,062	0.7562%
CONGESTIVE HEART FAILURE_FLAG	41,210	0.4717%
CHRON_OBSTRUCTIVE_PULMONARY_DISORDER_FLAG	19,468	0.2228%
CANCER_TREATMENT_FLAG	18,793	0.2151%
MEDICAL_SCHEME_DESCRIPTION	16,896	0.1934%
SEX	13,377	0.1531%
CHRONIC_RENAL_FAILURE_FLAG	12,281	0.1406%
EPILEPSY_FLAG	10,119	0.1158%
HIV_FLAG	7,150	0.0818%
BIPOLAR_DISORDER_FLAG	4,661	0.0534%
PERSISTENT_ASTHMA_FLAG	3,714	0.0425%
HYPOTHYROIDISM_FLAG	3,545	0.0406%
PARKINSONS_DISEASE_FLAG	1,446	0.0165%

The Precision-Recall Curve (PRC), Receiver-Operator Curve (ROC) and Area-Under-the-Curves (AUC) indicating the model fit of the expected admissions via an emergency department are shown below. The train and test are referring to the train and test data set defined above.

modnames	dsids	curvetypes	aucs
DRF Train	1	ROC	0.8624409
DRF Train	1	PRC	0.7314132
DRF Test	2	ROC	0.8553142
DRF Test	2	PRC	0.7162763



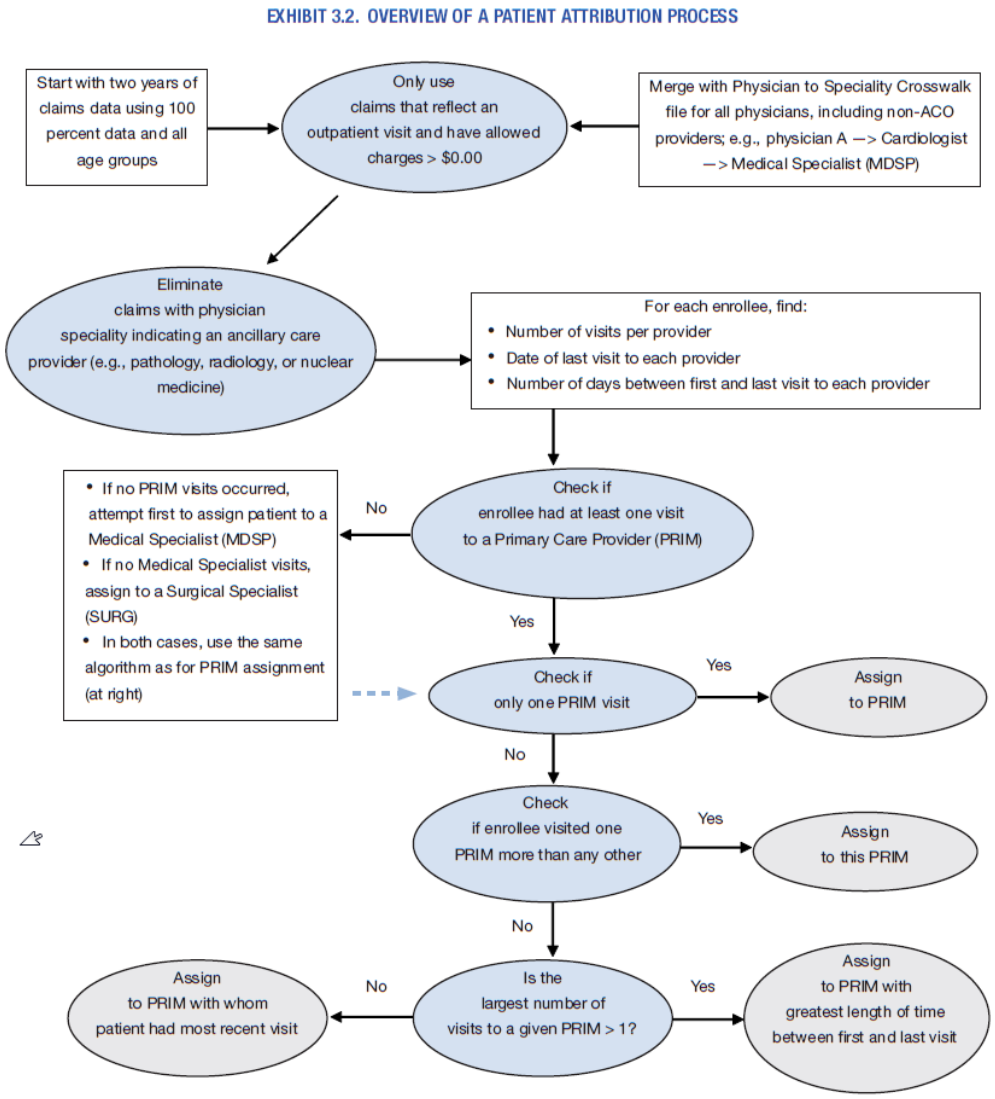


ACO methodology

Claims data corresponding to the 2017 and 2018 calendar years was used for analysing the strength of allocation to a healthcare provider and to evaluate the use of emergency departments and admission to hospital.

1. All members as at January 2017 were allocated to a healthcare provider using the ACO allocation methodology.
2. All member visits to primary care providers and specialist providers out of hospital were extracted for the period from January 2017 to December 2018.

These members were allocated using the rules as described in the figure below:



In phase 1 of the allocation, members were forced to be allocated to a primary care doctor (general practitioner, specialist physician or paediatrician) based on the majority of visits to a provider, given that there were primary care visits to these doctors. Members failing allocation in phase 1 were then allocated to medical specialists based on the same rule of majority visits. Failing to be allocated in phase 2, members were then allocated to surgical specialists.

The strength of allocation was determined for each member in order to characterise the underlying competition between providers for that allocation. The definition for these allocation strengths is described in the figure below.

Strength of allocation	Measures the competition between generalist and specialist (impact of the forced allocation to generalist)	Measures the strength in allocation based on quantity of visits with other generalists or specialists
Strong – Definite	A member would have been allocated to the generalist even when specialists are allowed to compete for the allocation	100% of all OH visits are to the allocated generalist

Strength of allocation	Measures the competition between generalist and specialist (impact of the forced allocation to generalist)	Measures the strength in allocation based on quantity of visits with other generalists or specialists
Strong – Majority	A member would have been allocated to the generalist even when specialists are allowed to compete for the allocation	>50% of all OH visits are to the allocated generalist
Strong – Minority	A member would have been allocated to the generalist even when specialists are allowed to compete for the allocation	<50% of all OH visits are to the allocated generalist
Weak – Definite	A member would have been allocated to a specialist (based on most visits). Since we have forced the allocation to a generalist, the member is instead allocated to a generalist	100% of all OH visits are to the allocated generalist
Weak – Majority	A member would have been allocated to a specialist (based on most visits). Since we have forced the allocation to a generalist, the member is instead allocated to a generalist	>50% of all OH visits are to the allocated generalist
Weak – Minority	A member would have been allocated to a specialist (based on most visits). Since we have forced the allocation to a generalist, the member is instead allocated to a generalist	<50% of all OH visits are to the allocated generalist

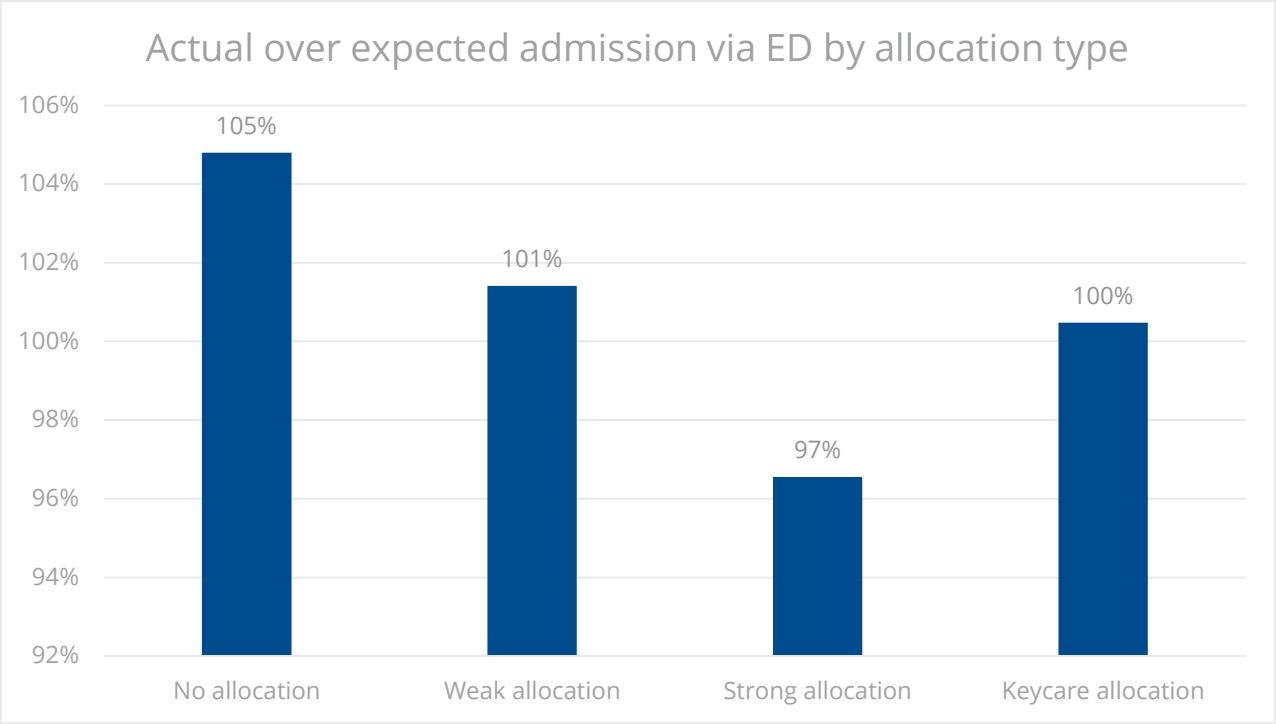
- Low visits – Less than three visits, therefore no allocation should be forced
- KeyCare – KeyCare members are allocated to their KeyCare GP through benefit design

ANALYSIS AND RESULTS

To understand the influence of patient-doctor allocation and the impact of this relationship on emergency department (ED) visits, three questions were posed:

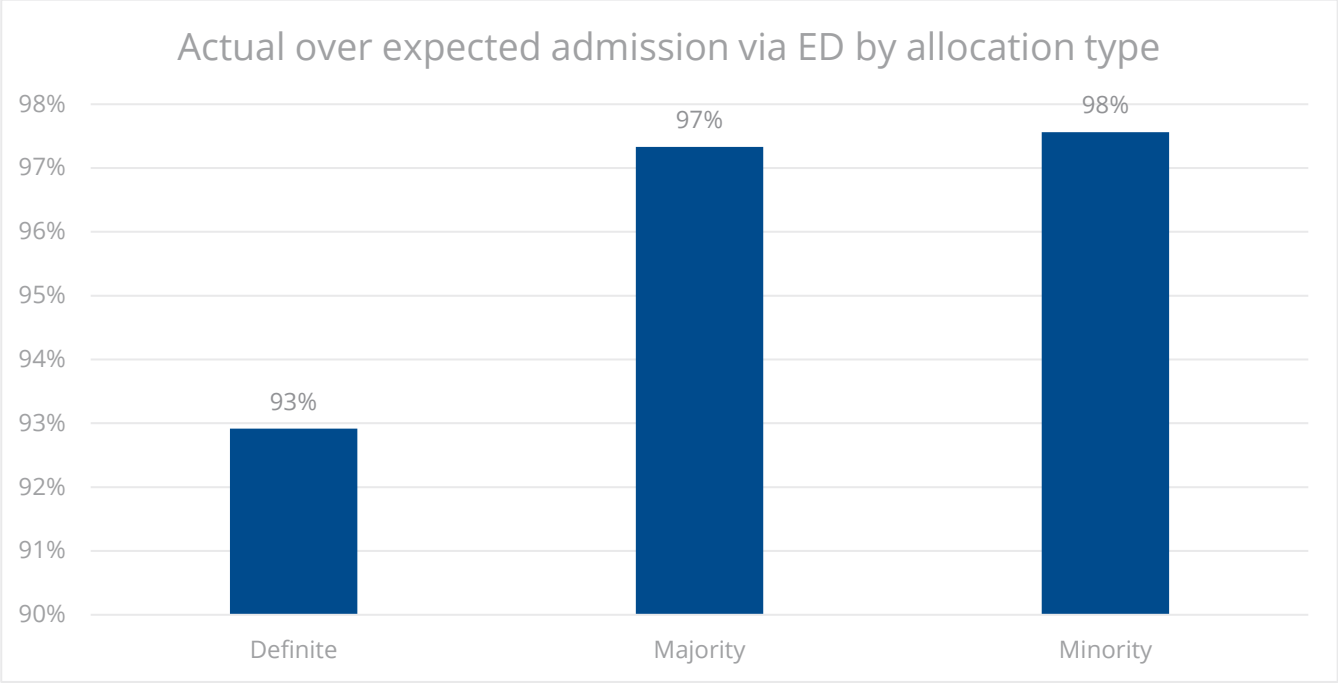
1. Is there a difference in the actual versus expected admission rates via emergency department by primary care provider allocation strength?
2. How does this correlate with the ED visit classification that is outputted by the ACG system? To answer this question, we looked at the **experience of RUB 3 members only** to avoid difference in patient complexity skewing the results.
3. How much variation is there in the environment when it comes to making a decision to admit a patient to hospital from an emergency department?

When we examine the impact of allocation on actual versus expected admission rate via the emergency department in the figure below, we see that members allocated strongly to a GP as well as KeyCare members have a lower than expected admission rate via ED.

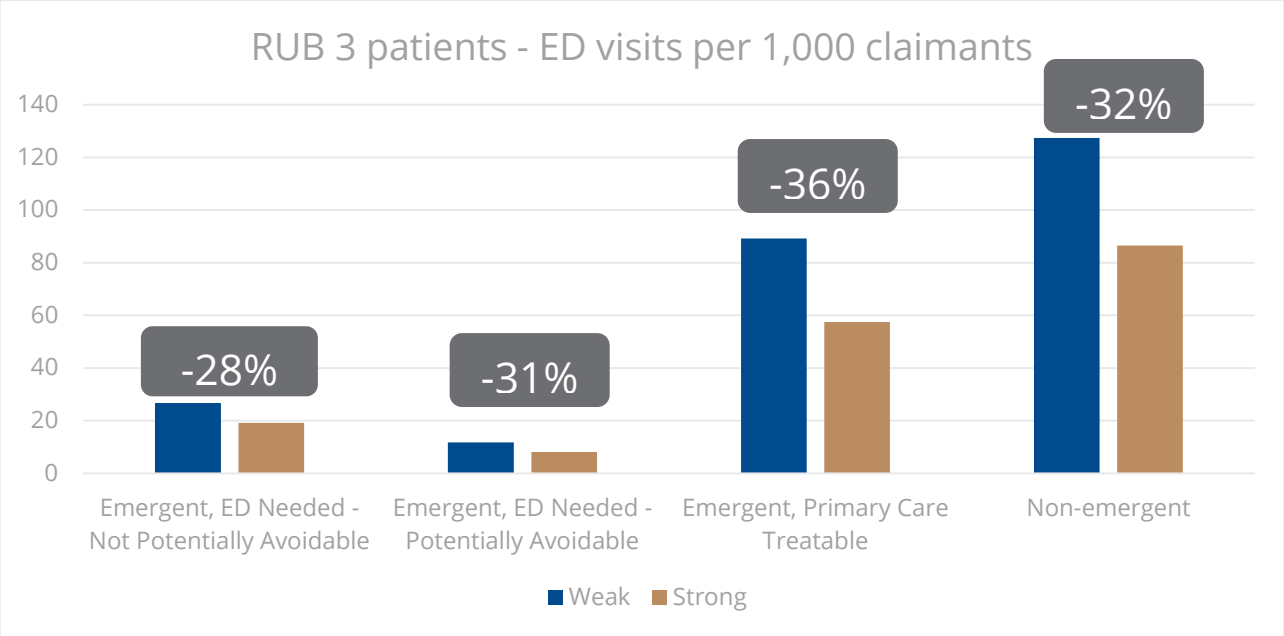


This clearly indicates that having a strong relationship with your primary care provider and using these providers as the first point of entry into the healthcare system has a definite impact on downstream costs and use of primary healthcare.

We also see that the **type of relationship** can improve outcomes even more. Members with more visits to their primary healthcare provider have lower downstream costs and utilisation.



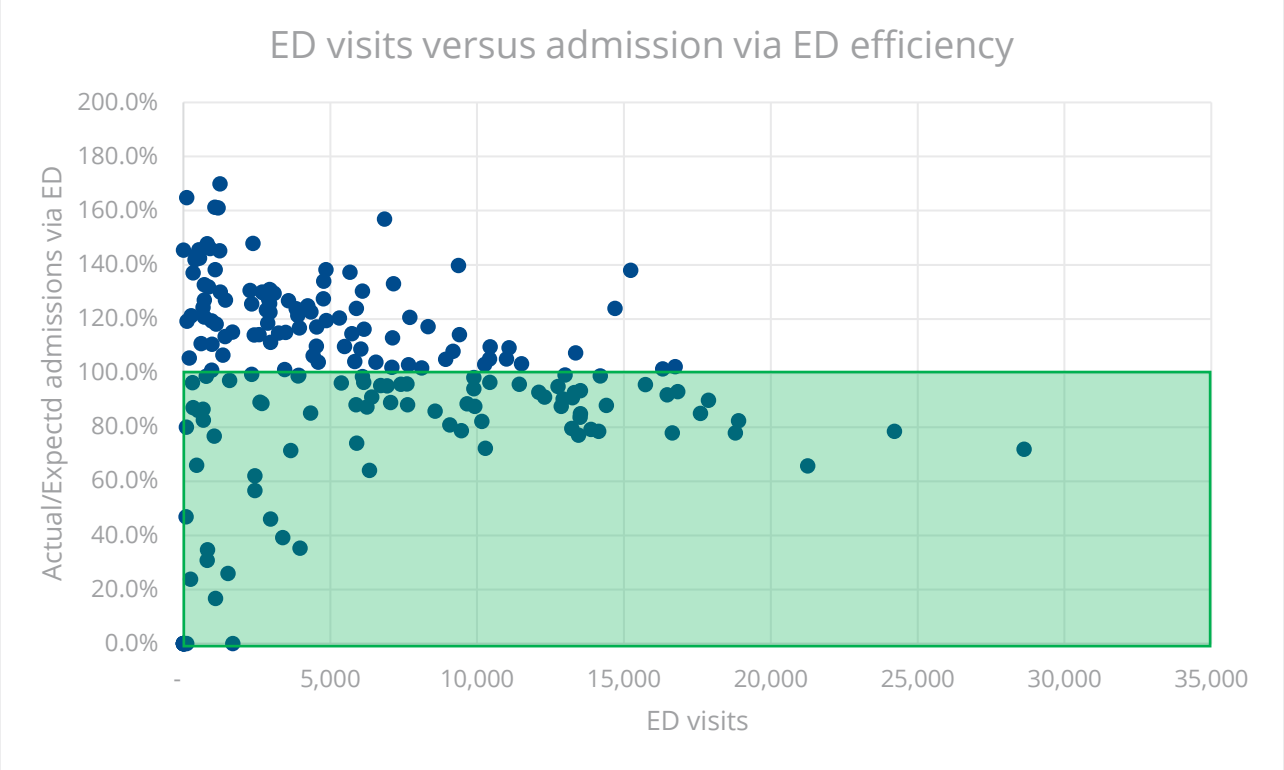
Drilling down into RUB 3 members and looking at the emergency department (ED) classification output from the ACG system for the ED visits for these patients, it is clear that there is a significantly lower amount of ED visits per 1000 claimants for strongly allocated patients compared to weakly allocated patients.



This is evident across almost all 11 emergency department (ED) classifications for these RUB 3 patients with differentials of between 12% and 38%.

Per 1000 distinct claimants	Weakly allocated	Strongly allocated	Differential
Alcohol use	0.32	0.27	-16%
Drug use	0.11	0.07	-37%
Emergent, ED needed - Not potentially avoidable	26.77	19.17	-28%
Emergent, ED needed - Potentially avoidable	11.83	8.11	-31%
Emergent, Primary care treatable	89.17	57.47	-36%
Injury, Non-severe	53.77	47.37	-12%
Injury, Severe	13.45	9.77	-27%
Injury, Severe & in-patient hospitalisation likely	0.47	0.52	10%
Non-emergent	127.44	86.53	-32%
Psychiatric	8.30	5.14	-38%
Unclassified	7.40	4.90	-34%
Total	339.09	239.33	-29%

The following graph shows the number of ED visits on the x-axis, and the efficiency (actual over expected admissions via ED) on the y-axis. Each dot on the graph represents a single hospital facility. From the graph, there is a lot of variation when it comes to admitting patients to hospital from ED. Also, there clearly are some hospital facilities that are much more efficient on admissions via ED to hospital than other facilities.

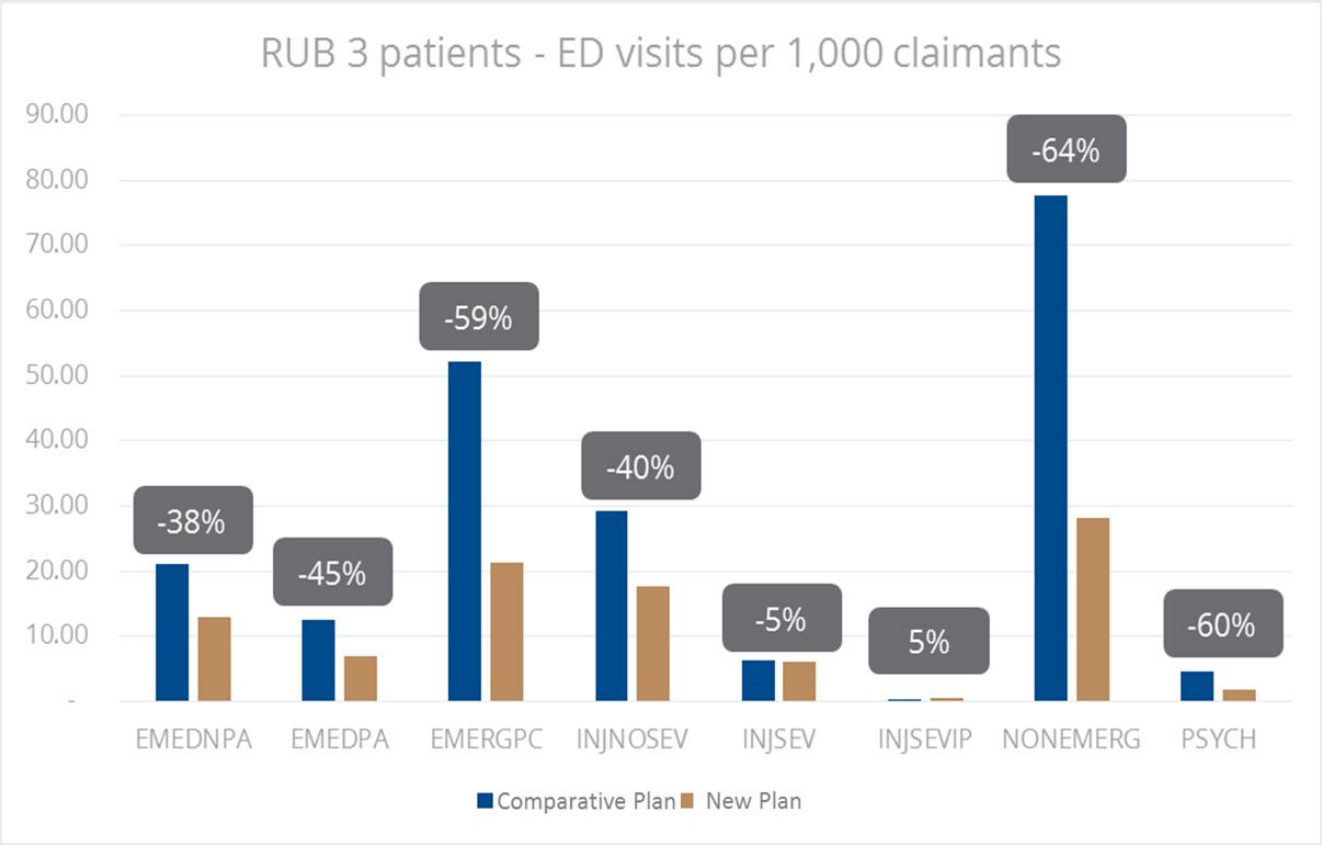


APPLICATIONS

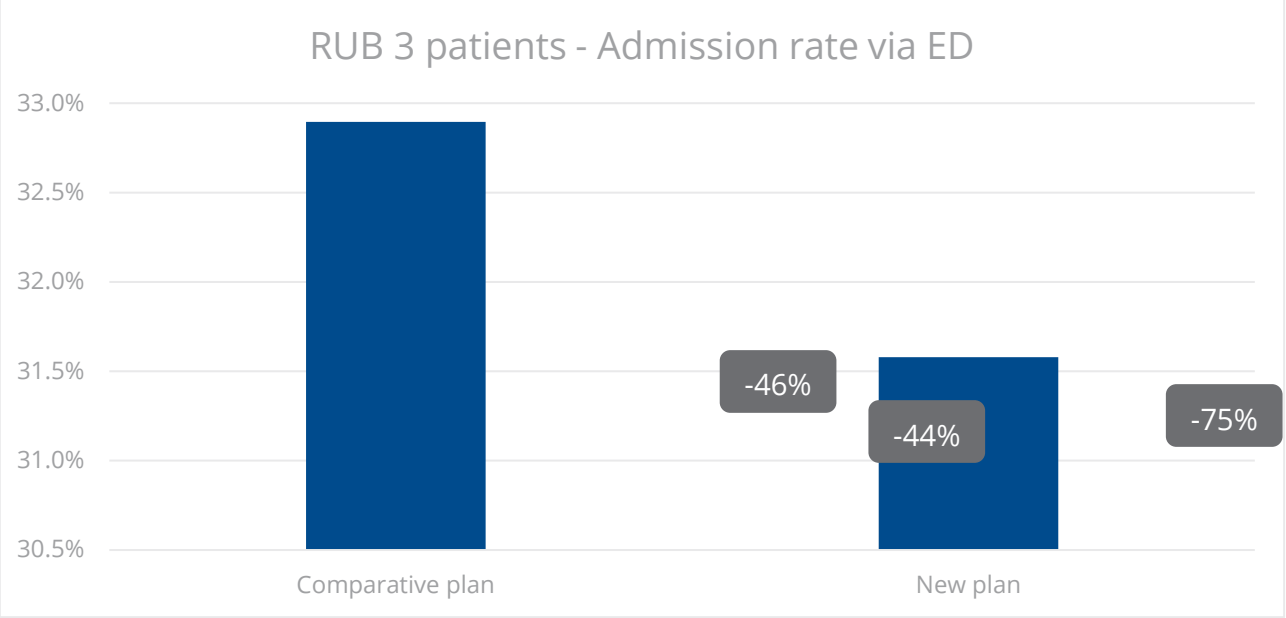
Benefit design

In January 2019, Discovery Health Medical Scheme launched a new benefit plan which was designed around the findings of this analysis. To access this benefit plan, members must have a primary care provider as their entry point into the healthcare system. This means members must see their primary care provider first to unlock any benefits to secondary and tertiary care. Initial analysis shows promising findings around use of emergency departments (EDs) when comparing the new plan to an existing comparative plan (a plan with similar benefits without the need to gain access through a primary care provider).

The graph below shows that in almost all of the categories, there is more than a 40% difference in ED visits per 1000 claimants for the RUB 3 patients on the new plan compared to the comparative plan. This is significantly more than the findings on RUB 3 patients presented above.



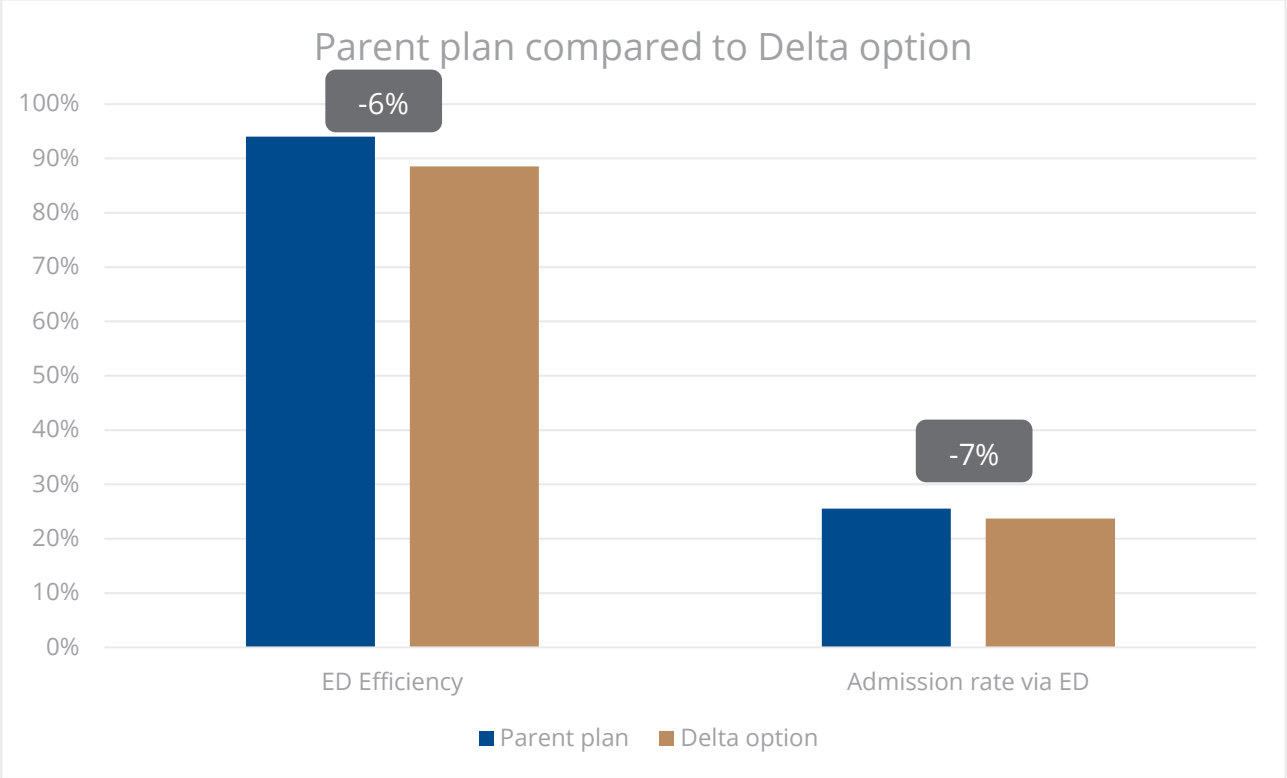
The admission rate via emergency departments (EDs) is also much lower for the patients in RUB 3 on the new plan compared to the patients in RUB 3 on the comparative plan, as is evident in the graph below:



This difference in behaviour in the use of emergency departments and the subsequent hospital admission rate allowed us to decrease the contributions members pay on this benefit plan significantly and to make this plan more attractive to our members. It clearly shows the benefits of better primary healthcare use and the consequent use of tertiary healthcare.

Network selection

Another area in which the findings of this analysis were used was around hospital network selection. In the benefit plans we offer; we can offer the same benefits at a discounted contribution for members who agree to use a healthcare professional from our network of healthcare providers. The Delta plans offer the same benefits as the parent plan. However, members have to use one of the hospitals on the network list for full cover. In selecting the hospitals on the network, we can select the hospitals that are most efficient on cost per admission (adjusted by DRG) as well as hospital admissions from an emergency department visit. This allows us to lower the contributions for our members who agree to use these hospitals, which makes these plans much more attractive. The graph below shows the benefits and outcomes of our Delta option compared to our parent plan on ED efficiency as well as admission rate via ED.



CONCLUSION

This paper has shown the importance of a strong relationship with a primary care provider in managing downstream costs, which leads to improved patient outcomes and lower healthcare costs.

The findings of this paper support the new benefit design path that Discovery Health is on by creating lower costing benefit options where members' entry point into the healthcare system has to be a primary care provider.

The findings also support the creation of more network-based options. This directs members to more efficient hospitals, not only on cost of treating patients in hospital, but also on the decision to admit patients into hospital from an emergency department.

APPENDIX A

Details of variables used in the expected admission rate via emergency department methodology

Variables	Description
EMERGENCY_DEPARTMENT_CONDITION	This is the condition of the emergency department visit as coded by the emergency department.
ACG_ROLLING_12	Rolling 12-month ACG classification starting 12 months before and ending one month before the emergency department visit.
RUB_ROLLING_12	RUB grouping of the ACG ROLLING 12 as above.
EMERGENCY_DEPARTMENT_ICD	This is the primary ICD submitted with the claim from the emergency department. We take GPs' ICD over hospitals' ICD, except when the GP submitted a non-specific ICD. If the hospital also submitted a non-specific ICD, we take the ICD from the admission.
AGE	Age one month before the emergency department visit.
BENEFIT_PLAN	Member's medical aid plan.
HYPERTENSION_FLAG	Whether a member has a flag for HYPERTENSION from the ACG output starting 12 months before and ending one month before the emergency department visit.
PLAN_TYPE_DESCR	Grouping of medical aid plan based on benefit level.
CHRONIC_CONDITION_FLAG	Whether the member is registered for any chronic condition as YES or NO.
BENEFIT_PLAN_OUT_OF_HOSPITAL_BENEFIT_LEVEL	The OH benefit level offered by the plan the member is on.
DIABETES_FLAG	Whether a member has a flag for DIABETES from the ACG output starting 12 months before and ending one month before the emergency department visit.
PREVIOUS_ADMISSIONS_30_DAYS	Whether the member had an admission in the last 30 days.
CONGESTIVE_HEART_FAILURE_FLAG	Whether a member has a flag for CONGESTIVE CARDIAC FAILURE from the ACG output starting 12 months before and ending one month before the emergency department visit.
CHRONIC_OBSTRUCTIVE_PULMONARY_DISORDER	Whether a member has a flag for CHRONIC OBSTRUCTIVE PULMONARY DISEASE from the ACG output starting 12 months before and ending one month before the emergency department visit.
CANCER_TREATMENT_FLAG	Whether a member has a flag for CANCER from the ACG output starting 12 months before and ending one month before the emergency department visit.
MEDICAL_SCHEME_DESCR	The medical scheme that the member belongs to.
SEX	Biological characteristic of the member (male or female)
CHRONIC_RENAL_FAILURE_FLAG	Whether a member has a flag for CHRONIC RENAL FAILURE from the ACG output starting 12 months before and ending one month before the emergency department visit.
EPILEPSY_FLAG	Whether a member has a flag for EPILEPSY as a chronic condition starting 12 months before and ending one month before the emergency department visit.
HIV_FLAG	Whether a member has a flag for HUMAN IMMUNODEFICIENCY VIRUS HIV INFECTION from the ACG output starting 12 months before and ending one month before the emergency department visit.
BIPOLAR_DISORDER_FLAG	Whether a member has a flag for BIPOLAR MOOD DISORDER from the ACG output starting 12 months before and ending one month before the emergency department visit.

PERSISTENT_ASTHMA_FLAG	Whether a member has a flag for ASTHMA from the ACG output starting 12 months before and ending one month before the emergency department visit.
HYPOTHYROIDISM_FLAG	Whether a member has a flag for HYPOTHYROIDISM from the ACG output starting 12 months before and ending one month before the emergency department visit.
PARKINSONS_DISEASE_FLAG	Whether a member has a flag for PARKINSONS DISEASE from the ACG output starting 12 months before and ending one month before the emergency department visit.