

The case-mix of chronic illness hospitalization rates in a managed care population: implications for health management programmes

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Abstract

Objective This paper reports on the case-mix of hospitalized patients based on their health plan enrolment and utilization experience, absent a health management (HM) programme. The implications for achieving targeted reductions in admissions within the context of implementing a population HM programme are discussed.

Study design Descriptive.

Methods Members were identified with asthma, coronary artery disease, congestive heart failure and diabetes. These cohorts were then mapped to disease-specific hospitalizations across a 2-year period (2004–2005). Four distinct case-mix categories were developed. Group 1 comprised members hospitalized for the specific condition in both years. Group 2 comprised all identified members of a disease cohort in 2004 that were not hospitalized in that year but were admitted for the condition in 2005. Members were assigned to Group 3 if they were hospitalized in 2005, did not appear in the 2004 identified cohort but were, in fact, enrolled in the health plan. Group 4 comprised new health plan enrollees in 2005 and were subsequently hospitalized during that year.

Results Of the total admissions in 2005, on average 6.4% came from Group 1, 62.4% came from group 2, 10% from group 3 and 21.2% from Group 4.

Conclusions If an HM programme was to be implemented in this population, the typical identification methods currently used by the industry would have resulted in most hospitalized patients either being initially classified as low risk or going undetected. Improving identification and stratification methods will allow HM programmes to better tailor interventions to impact hospitalization rates for the chronically ill.

Introduction

Medical cost savings from disease management (DM) can only be realized through a significant reduction of hospitalizations in the chronically ill population. In two recent papers, estimates were provided for the number of admissions that would need to be decreased (NND) in order for a DM programme to break even [1,2]. However, those estimates did not suggest that such targets are achievable. To do so, one must understand the case-mix of admissions and the factors that impact it over time. Given that admission rates may be unchanged from year to year, ascertaining the characteristics of hospitalized patients becomes a central issue in predicting the ability of a health management programme to impact acute utilization. This information is equally important for managed care plans and other payers, because the most costly health care services are provided in the hospital. Identifying

opportunities to reduce admissions should therefore should be a top priority at a policy level as well.

Managed-care health plan members who are hospitalized with a chronic illness in any given year fall into four distinct case-mix categories:

- Group 1: those members 'identified' with the condition who were hospitalized both in the prior year and in the current year.
- Group 2: those members 'identified' with the condition who were not hospitalized in the prior year but hospitalized in the current year.
- Group 3: those members who went 'unidentified' with the condition in the prior year and were hospitalized in the current year.
- Group 4: those members who were new to the health plan (or other population under study) in the current year and hospitalized in the current year.

Disease management programmes typically target those in Group 1 with a telephonic nursing intervention and those in Group 2 with quarterly postcard and newsletter mailings. The existence of a Group 3 may be considered a failure of the disease identification process. Although one can argue that conditions such as an imminent heart attack or acute exacerbation of asthma cannot be detected by claims data or predictive models based on those claims, there is a viable alternative. Health risk appraisals or other survey tools can be used to speed up the identification of Group 3 while there is still an opportunity to intervene. In a similar vein, Group 4 can be identified when new enrollees of a health plan are screened as soon as possible to identify those at risk of hospitalization in the near term.

A clear understanding of the case-mix of admissions based on these four groups is crucial to a successful DM intervention. It will assist in assessing how best to allocate human and technological resources to optimize the intervention, and provide a more definitive categorization of admissions to be later used in evaluating programme effectiveness. Furthermore, it clarifies the plausibility of whether a breakeven can be achieved via a reduction in admissions. This paper reports the results of such an analysis conducted on a large health plan population in the north-west USA. The ramifications of these findings for achieving targeted reductions in admissions are discussed. Finally, a conceptual framework for addressing each category of admissions within the context of a population health management approach is discussed.

Methods

Two consecutive years (2004 and 2005) of medical claims data were used in this analysis, representing the entire managed population of Regence Blue Cross Blue Shield. Regence operates health plans in four northwestern states (Oregon, Washington, Idaho and Utah) covering approximately 2 million lives (Table 1).

Members were identified as having coronary artery disease (CAD), asthma, diabetes or congestive heart failure (CHF) with the use of the primary diagnosis field on any medical claim and by matching it to a list of International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes recommended by the Disease Management Association of America [3]. As this methodology was followed for each disease separately, members could be identified with more than one condition. Upon establishing cohorts for each of the four diseases, individuals were then mapped to disease-specific hospitalizations across the 2-year period. Members were purposely categorized by primary condition in order to replicate the method most commonly used by DM programmes and managed care plans.

Members were assigned to Group 1 if they were hospitalized for the specific condition in both 2004 and 2005. Group 2 comprised

all identified members of a disease cohort in 2004 that were not hospitalized in that year but were admitted for the condition in 2005. Members were assigned to Group 3 if they were hospitalized in 2005, did not appear in the 2004 identified cohort but were in fact enrolled in the health plan (verified by membership files). Finally, members fell into Group 4 if they became new health plan enrollees in 2005 and were subsequently hospitalized during that year. This process resulted in a determination of the membership composition of all admissions in 2005 for each chronic condition. No DM programme was implemented during the study period, so these data accurately represent an unbiased population with respect to an intervention effect.

Results

Table 1 provides characteristics of the population under study. As shown, the commercial membership accounted for almost the entire covered population (94%). This explains the relatively low mean age (35 years), and low prevalence of CAD and CHF (1.3% and 0.4%, respectively), which are conditions that are generally found in older adults. Approximately 66% of all persons identified as having a chronic illness were enrolled in the health plan in both periods.

Table 2 presents the breakdown of chronic illness admissions in 2005 by the percentage of members comprising the four case-mix categories. On average, only 6.4% of people admitted in 2005 had

Table 1 Demographics of the study population, 2004–2005

	2004	2005
Lives covered	2 083 580	1 839 855
Mean age (years)	35.4	35.8
Female	55%	55%
Lines of business (%)		
Commercial	94.0	94.0
Medicaid	1.7	1.9
Medicare	4.3	3.9
Prevalence of chronic illness (%)		
CAD	1.3	1.3
Asthma	2.2	2.3
CHF	0.4	0.4
Diabetes	2.9	3.0
Enrolled in health plan in both years (%)		
CAD		64.3
Asthma		70.3
CHF		59.2
Diabetes		63.1

CAD, coronary artery disease; CHF, congestive heart failure.

Table 2 Case-mix of members hospitalized in 2005 by chronic condition (%)

Category (members)	CAD	Asthma	CHF	Diabetes	Mean
(1) Admitted in 2004 and in 2005	5.0	4.9	8.8	11.0	6.4
(2) Not admitted in 2004 and admitted in 2005	69.2	55.7	60.8	36.7	62.4
(3) Members 'undetected' in 2004 and admitted in 2005	9.0	14.6	8.7	12.7	10.0
(4) New members in 2005 and admitted in 2005	16.8	24.8	21.7	39.6	21.2

CAD, coronary artery disease; CHF, congestive heart failure.

Table 3 Case-mix of admissions in 2005 by chronic condition

Category (by admissions)	CAD	Asthma	CHF	Diabetes	% of total
(1) Admitted in 2004 and in 2005	5.7%	5.3%	10.3%	18.3%	8.1%
(2) Not admitted in 2004 and admitted in 2005	68.6%	54.8%	58.4%	33.1%	60.8%
(3) Members 'undetected' in 2004 and admitted in 2005	8.9%	13.5%	8.4%	11.9%	9.7%
(4) New members in 2005 and admitted in 2005	16.8%	26.4%	22.9%	36.7%	21.4%
2004 Admission rate per 10 000 members	27.5	4.6	8.0	5.5	45.7
2005 Admission rate per 10 000 members	26.1	4.8	8.6	5.5	45.0

CAD, coronary artery disease; CHF, congestive heart failure.

been hospitalized in the prior year. Of individuals admitted in 2005, 62.4% were identified as having the chronic condition in 2004 but not hospitalized in that year. Ten per cent of members hospitalized in 2005 were enrolled in the health plan in 2004 but were not identified as having the condition, and 21.2% of hospitalizations came from new health plan enrollees.

Table 3 shows the percentage contribution of each category to the total number of admissions in 2005 for each chronic condition. On average, 8.1% of admissions in 2005 came from those members also hospitalized in the prior year; 60.8% of admissions were from members identified in 2004 with the condition but not hospitalized in that year; 9.7% of admissions were from members enrolled in the health plan in 2004 but were not identified as having the condition; and 21.4% of admissions were from new health plan enrollees. The aggregated admission rate for the four conditions was 45.7 per 10 000 population in 2004 and 45.0 per 10 000 population in 2005.

Overall, there was little or no change in the demographic profile of the health plan population over the observation period. Similarly, the demographic and utilization characteristics of the diseased cohorts under study remained unchanged. This year-over-year stability helps ensure that the results of the present analysis are not anomalous.

Discussion

Individuals who have recently been hospitalized for a chronic illness are typically classified as 'high risk' by DM programmes, and are then targeted with a telephonic nursing intervention. Conversely, individuals with few or no medical claims are considered 'low risk' and may receive little more than quarterly newsletters. The results of the present study indicate that this is a misguided approach. Only 6.4% of all individuals hospitalized in 2005 were hospitalized in the prior year, while nearly three-quarters of all individuals admitted in 2005 were not hospitalized in the previous year (Groups 2 and 3) even though they were enrolled in the health plan during that period. This finding suggests that DM programmes would be better served by allocating more resources to those individuals heretofore classified as 'low risk' while reducing the amount of resources (e.g. costly nursing time) spent on those classified as 'high risk' due to a recent hospitalization.

Perhaps the most significant finding in this study was that, on average, 10% of individuals with a chronic illness go undetected in the 'baseline year', and then are hospitalized in the following year. From a programmatic perspective, this indicates that an identification methodology that relies solely on medical claims has poor specificity for an important outcome [4] (i.e. it will miss people

with the condition who later become hospitalized). This also holds true for new health plan enrollees who have no claims history to be used for identification of a chronic illness. In the current study, on average, 21.2% of admissions in 2005 came from this group. An alternative approach to programme structure that addresses this shortcoming is presented in the following section.

The results also highlight the importance of determining the case-mix of admissions for chronic conditions when evaluating a DM programme's effectiveness. These findings suggest that by using medical claims alone, the 'identified' population in any given year will tend to be over-represented by higher-cost patients (those who were hospitalized) who will have a natural decline in costs during the following programme year, consistent with regression to the mean [5,6]. Advocates of the pre-post study design purport that regression to the mean (RTM) is non-existent when the entire diseased population is used as the unit of measure [3]. However, it was shown that approximately 66% of the chronically ill were present in the population in both periods, suggesting that RTM still represents a real threat to the validity of any study outcomes, even when measured in a fluid population (as opposed to a static cohort).

Finally, the case-mix of admissions for chronic conditions provides guidance when conducting an NND analysis before programme commencement. If a 10–30% reduction of disease-specific hospitalizations in a given year is required to cover programme fees alone [1], a breakdown by case-mix category will elucidate whether attaining that goal is truly feasible. These data show that only 6.4% of admissions come from Group 1, which would have received intensive nursing management had a programme been implemented. Even if it were plausible to completely eliminate admissions from this group, the reduction of such a small per cent of total admissions makes a breakeven extremely unlikely. Furthermore, a significant decrease in admissions from the other case-mix categories would not be expected in the absence of a robust process that detects those individuals at highest risk for a hospitalization, followed by an appropriate intervention.

There may be limitations in generalizing results from this study to other populations. Although the number of lives covered by the health plan in the study period was more than 2 million, the population was relatively young and healthy. This impacted both the prevalence of these specific chronic conditions and their associated hospitalization rates. The 2005 aggregated admission rate of 45.0 per 10 000 population was less than half of the national level in 2003 [1]. It is impossible to know how these lower figures impact the case-mix categories. However, it may be fair to assume that the case-mix would remain stable if population characteristics changed in an unbiased fashion and there were no changes in the

management of these members. In addition, there appears to be a great deal of heterogeneity between conditions across case-mix categories. Again, it is impossible to know whether this is a function of individual disease processes or of particular characteristics in this population. Nevertheless, these data provide a good basis for understanding the case-mix of admissions for chronic conditions and provide a structure for future studies in different populations and settings.

Admissions case-mix and the structure of health management programmes

During the course of the present study no DM programmes were implemented. However, the findings from the current study suggest that, if a DM programme was present, a significant portion of the population would receive little or no intervention because of under-detection. To be effective in reducing admissions, a DM programme would (1) need to correctly identify those with the chronic illness; (2) apply an appropriate intervention to each individual within the identified diseased cohort; and (3) reduce admissions from each case-mix category accordingly. This section provides a framework for establishing a comprehensive programme in which each of these case-mix categories is addressed.

Identification and stratification of risk

The data presented herein suggest that 93.4% of hospitalizations in a given year come from individuals who would typically be classified as low risk because they had no prior hospital admission or would go undetected altogether because they had no medical claims.

Expanding the baseline identification period may increase the likelihood of identifying persons with the disease who had medical claims in a prior period but not in the year immediately before programme commencement. However, individuals who do not regularly seek medical care, who are undiagnosed or who are newly enrolled in the health plan will have no claims data on record and will be missed in the medical claims data analysis. Even when claims data are available, they have been shown to be notoriously inaccurate [7]. The use of a common terminology grouping system may increase the accuracy in identifying chronically ill patients based on claims or medical records. This system creates diagnostic groups based on standard terminology such as local parlance, 'homegrown' diagnosis or billing codes, as well as existing and newly introduced ICD-9 codes [8,9].

Many DM companies and managed care organizations have come to rely on predictive models to assist in the identification of high risk individuals. However, these tools require claims data (with the limitations suggested above), and are extremely inaccurate. A recent study [10] comparing the accuracy of several commercially available tools found that the best model only achieved an R^2 of 32.1% after optimizing it by removing high costing cases (>\$250 000) and including prior year claims. In other words, under the best case scenario, the most accurate predictive model can only explain 32% of the variation in the following year's costs (e.g. risk). Further analyses indicated that these models substantially underestimated costs in those individuals actually found in

the higher cost percentiles and overestimated costs in the lower cost percentiles. These findings are in concordance with results of the current study and illuminate the impact of regression to the mean [5].

Given the limitations of claims-based approaches for identification and stratification, a better suited approach is by administering a health risk survey instrument at the population level that has been proven valid and reliable in predicting future hospital admissions or health care costs [11–13]. Historically, the health care industry has shied away from administering paper-based surveys because of high cost and low response rates. However, with recent advances in interactive voice recognition software and Internet-based computer applications, both survey administration and the intervention itself can be conducted on a large scale at a relatively low cost. Access to laboratory data may further assist in the identification and stratification of persons at high risk of an impending acute event. However, most health plans or DM programmes do not currently collect such data. Given the obvious benefits of collecting such data, organizations should consider this a priority.

Risk-based interventions

The data from the current analysis indicate that only 6.4% of individuals admitted in a given year were admitted in the prior year, and account for only 8.1% of the total admissions in the second period. Thus, the current DM model of providing an intensive nursing intervention to only those patients is misguided. A more robust risk stratification method would allow interventions to be individually tailored. People identified with risk factors for developing a given disease or condition should be provided with access to health promotion or wellness programmes such as health coaching [14], while people at the other extreme with severe physical and mental limitations or at the end-of-life should receive personalized case management services. Moreover, innovative telemonitoring systems can be readily applied to individuals along the risk continuum to ensure that exacerbations of their condition are minimized.

Impact on hospital admissions

Ultimately, a successful health management programme will impact all four case-mix categories. Patients identified with the condition in the previous year but not hospitalized in that year (Group 2) may be the easiest group for a pure DM programme to impact. Given that the disease has already been identified, baseline year costs should be relatively low, and this group accounts for 62.4% of all admissions.

Patients with repeated admissions (Group 1) because of severe illness may be the most difficult category for a DM programme to impact. This category also represents the smallest subset of the overall admission rate, so there may be little statistical power to realize a significant improvement.

Individuals who have gone undetected with the disease or those who are new to the health plan (Groups 3 and 4) can only be impacted if they are appropriately identified. Given that these two categories account for nearly a third of all admissions, health management programmes should devote the necessary resources to identify and intervene upon these groups.

Conclusion

This paper has provided insight into the composition or case-mix of hospital admissions for chronic illness in a health plan population in the absence of a DM programme. The findings suggest that by following the typical identification methods used by DM programmes, most individuals who are hospitalized in a given period either would have been initially classified as low risk or would have gone undetected because of a lack of medical claims information. Moreover, a very small percentage of hospitalizations are attributable to those patients who would have been initially classified as high risk. Improving the methodology by which individuals are identified and risk-stratified will allow a health management programme to better tailor interventions to ultimately impact hospitalization rates for chronic illness and achieve the cost savings necessary for a positive return on investment.

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