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Impact of Mental Health on chronic conditions and cost implications- Leveraging data to predict risk

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Abstract

Background: Value-based care systems are increasingly replacing fee-for-service models, as the latter has proven unsustainable. Mental health and their implications on patients are starting to get significant attention in the past decade. Unrecognized mental illness (MI) and their impact on chronic diseases could have a significant impact on disease progression and cumulative cost to the health system.

Study design: We have analyzed a large cohort of patients using OptMyCare's risk stratification system. Predictive analytics using proprietary algorithms were implemented to estimate cost and disease progression in high-risk patients with and without MHD across the cohort. Cost modeling and outputs are resulted as cost per member across chronic conditions with & without MIs. The members with & without MIs were propensity matched for demographics, disease severity and SDOH.

Key Results: Members with MI in 8 of the 9 chronic conditions demonstrated a significant increase in cumulative cost. There was a 64% mean increase in claims cost per member with MIs.

Conclusion: Utilizing validated algorithms to identify high-risk MI members and implementing disease mitigation strategies targeted at chronic conditions in addition their MI could result in improved clinical outcomes and bend the cost curve.

Introduction

Mental health could impact physical well-being across all age groups[1]. Less is known about the direct impact of mental health problems in patients with chronic diseases. Chronic conditions impact over 120M Americans and many of them have overlapping multiple chronic conditions[2]. Depression and other mental health illness including substance abuse could have a major impact on the severity and progression of chronic conditions[3,4]. Patients with mental health conditions could be underdiagnosed with chronic conditions due to lack of information provided during a regular medical examination as routine exams and annual wellness visits could include a depression screening, however, there are many other MI that would not be diagnosed with screening assessments. Preventive measures, follow-up visits and understanding of disease severity might not be same for age and disease matched non-mental health patients when compared to MI patients. This could result poor outcomes and increased cost for patients with MI and co-existing chronic conditions. Moreover, patients with chronic conditions could develop mental health issues or could exacerbate

current MI disorders due to cumulative stress[5,6]. Patients with diabetes and mental health challenges could affect adherence to administer insulin as prescribed by their physician. This will sometimes cause diabetic ketoacidosis, a complication that will cause blood to produce too many blood acids which will lead to symptoms like nausea, constant thirst and result in hospitalization[7,8]. Other chronic conditions like cardiovascular disorders and arthritis can co-occur with mental health disorders. There is no data in published literature that compares the financial impact of MI across different chronic conditions. We have performed an analysis to review the cost impact of MI on chronic conditions.

Methods

Claims and EMR data from 267,427 patients and 6.42M claims were harmonized into a common format and then analyzed using proprietary algorithms (OptMyCare LLC). OptMyCare's algorithms have been validated across large datasets with > 86% accuracy in predicting cumulative claims[9]. To study the impact of MI disorders on chronic conditions we aggregated all the behavioral health diagnosis and performed multiple regression analysis across chronic conditions like atrial fibrillation, cancer, coronary artery disease (CAD), congestive heart failure (CHF), chronic kidney disease (CKD), Gastrointestinal (GI) disorders, headache, musculoskeletal disorders (MSK) and lung disorders. The members included in the analysis were propensity-matched for demographics, SDOH, chronic conditions, disease severity with and without MI prior to analysis. SDOH parameters like access to care, awareness of health, low income household and food insecurity were included for analysis. Partially supervised ML models (XG Boost, Random Forrest and SVP) were utilized to validate and predict the impact of MI on the severity and cost implications in chronic conditions. Cost prediction model was performed using the XG boost model as it offered the highest accuracy amongst other models. Propensity-matching was performed across each demographic and chronic conditions using logistic regression. All ICD-10 diagnosis that were included under the WHO mental disorders classification was included for analysis.

Results

The mean age of the analyzed cohort is 55+/- 22, and 57% were males.

Claims cost in patients with MH and without MH: After propensity matching members across all cohorts for demographics, SDOH and chronic diseases, the disease severity and cost impact of MH disorders was analyzed across 9 chronic conditions (Table 1). Coefficients were developed using multiple regression models and validated using classification models (XG Boost and Random Forrest). Non-inferiority between the regression models and classification models validated the coefficients were statistically significant on these 9 chronic conditions in high-risk members (Table 1).

Disease prevalence and their severity in patients with and without MI: 14.2% patients in the analyzed cohorts had at least one MI diagnosis recognized as a ICD10 or HCPCS indicator in the high-risk group. The impact of MI was analyzed in patients at high-risk category across the 9 chronic conditions. The cost for patients with MI amounted to 19.8% of the total claims. The cost per member with MI was 64% greater than propensity matched non-MI members across the entire cohort (Table 2 & 3).

Table 1: Demographics

	MH+CC (n=21,014)	CC only (n=87,463)
Men	12819	48,978
Women	8195	38485
Age (mean)	52 (22)	52.4(26)
A.Fib	374	698
Arthritis	1370	6231
Cancer	1853	7732
CKD	1499	7136
CHF	160	184
CAD	1462	7010
MSK	1543	7393
DM	1313	4897
GI	1718	8375
Lung disorders	6955	8813
Headache	79	357
Others	2688	28637

Table 2: Cost differences in patients with CC +MI (chronic conditions and mental illness) compared to CC (chronic conditions without mental illness)

Chronic Condition	CC + MI	CC only	% Change	p value
Diabetes Mellitus	$4628.22	$ 3073.19	66%	<0.01
A Fib	$6,483.46	$4,039.61	60%	<0.10
Cancer	$6,112.13	$5,024.06	22%	NS
CKD	$17,236.49	$9,299.60	85%	<0.01
CHF	$5,626.02	$4,123.31	36%	NS
GI	$2,632.39	$1,613.00	63%	<0.01
Lung	$1,638.00	$582.00	181%	<0.01
Headache	$6,186.00	$836.00	600%	<0.001
CAD	$2,634.39	$3,647.33	-27%	NS
MSK	$1,951.00	$1,614.00	21%	NS
Average	$5,611.10	$3,419.88	64%	<0.01

Table 3: Models with the highest 4 results used for machine learning

Models	Accuracy	Sensitivity	Specificity
Regression analysis	78%	85%	68%
SVP	81%	82%	72%
Random Forrest	84%	83%	88%
XG Boost	87%	86%	85%

Evidence based gaps in care in cohorts with and without MH was comparable and did not correlate with cost differences between the two groups.

Discussion

Mental illness is a risk factor hidden inside other traditional risk factors: Members with MI could be considered to have higher risk for chronic disease progression either due to decreased access to care and/or decreased understanding of the disease process and hence adherence to treatment and follow-up recommendations. With implementation of care management protocols in risk cohorts, there are increased opportunities for closing the gaps in care[10,11,12,13]. Our analysis included patients from value-based cohorts that have care management support to mitigate disease progression. Addressing care gaps have been used to determine Key Performance Indicators (KPI) for at-risk cohorts and payments are made based on successful attainment of these metrics[14,15]. With payment incentives and additional resources allocated for care management to address gaps in care, disease outcomes and its associated cost could be lower in VBC cohorts compared to patients in non-VBC arrangements. Despite these relative advantages in VBC cohorts we have identified significant increases in the total cost of care for several chronic conditions with concomitant mental illnesses.

Chronic diseases could be pathophysiologically of greater severity in patients with MIs and hence could explain the increased care utilization[7,16,17]. These trends were noted across most chronic conditions despite no significant differences care gaps based on key performance metrics. The direct costs related to resource utilization for MI treatment has been accounted for in the cost assessments. One can hypothesize that a detailed review at the patient level on disease specific clinical data and correlations with unique or clusters of MI could elucidate the pathophysiological associations explaining disease severity and increased care utilization.

Fee for service payment arrangements are being gradually replaced with value-based care systems. Payers and provider networks (Risk bearing entities, RBEs) have been actively participating in VBC programs which sometimes requires them to take financial risk with a potential for loss of revenue. Risk Bearing Entities need to pay special attention to their cohorts and diligently identify patients with MI for optimal VBC outcomes. Despite achieving optimal metrics in bridging care-gaps there could be an increased risk for higher disease progression and care utilization in MI patients. Identifying patients with MI and implementing actionable rollouts that includes MI disease mitigation in addition to chronic disease mitigation would be necessary to successfully bend the disease progression curve.

Policy makers should consider identifying patients with chronic conditions with concomitant MI at a higher risk level and reimburse RBEs appropriately so that they can deploy the necessary resources for disease mitigation. A comprehensive approach to thoroughly understand the impact of MI in any chronic disease cohort is essential prior to entering risk contracts[18,19,20]. Since there is sufficient data substantiating the impact of MI on chronic conditions one could make a case for identifying this cohort with high accuracy and setting appropriate cost attribution for at-risk groups.

Limitations

The data do not include groups outside value-based contracts; hence the complete impact of MI cannot be assessed on cohorts that do not have a care management arm. However, fee for service systems are expected to decline and value based care entities are increasing across all 50 states in the United States. The current analysis does not provide the impact of individual MI disorders on chronic conditions, subgroup analysis could be helpful to delineate details on the impact of each MI on chronic conditions and its associated cost. Further analysis might be helpful in healthcare organizations which have longitudinal inpatient and outpatient care within its data ecosystem, especially the ones which also have a health plan as part of its offering.

Conclusion

Recognition and management of MI is being increasingly recognized as a major unmet need. With greater emphasis on addressing MI by the Centers for Medicare and Medicaid Services (CMS), there has been increased interest amongst government and commercial health plans to allocate resources to optimize MI care. Several private-equity backed care management companies supported with digital applications have emerged in the past 5 years to partner with RBEs to tackle this problem. Analytics that are developed with validated AI algorithms are critical in not just identifying and managing prevalent MI members but also in predicting the cost and disease implications of MI in chronic conditions. This study presents the first objective assessment of MI's downstream effects on chronic conditions using highly scalable machine learning algorithms. Further analysis incorporating additional large datasets alongside clinical variables and claims cost would significantly enhance the understanding of individual MI on chronic conditions.

Declaration

The authors have no financial disclosures to declare and no conflicts of interest to report.

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