The Role of Comprehensive Eye Exams in the Early Detection of Diabetes and Other Chronic Diseases in an Employed Population

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Abstract

Objective: The main objective of this study is to assess the cost benefit associated with comprehensive eye exams as a tool for the early detection of diabetes, hypertension, and high-cholesterol.

Methods: A retrospective, claims-based analysis was performed using U.S.-based employees and spouses from a large, national database. Individuals that received first notification of disease through an eye exam were compared to individuals that did not receive early detection and presumably learned of their condition after further disease progression. Total health plan costs, lost time costs, and termination rates were calculated for the 12-month period after the index date.

Results: A sizeable population first learned of their chronic condition through eye exams as no other claims-based evidence was found to suggest prior knowledge of the condition. All three disease cohorts with early detection during an eye exam had lower first-year health plan costs, missed fewer work days, and were less likely to terminate employment than the respective comparison groups.

Conclusion: As employers strive to better manage health and business outcomes, comprehensive eye health exams can provide opportunity for early disease detection and associated cost savings through referral to primary care providers and condition management programs. (Population Health Management 2010;13:xx–xx)

Introduction

As health care costs continue to rise at alarming rates and businesses are left with shrinking profit margins during an unsure economy, employers are actively seeking new solutions to the health care cost and quality problem. Early disease detection has long been proposed as part of this solution, but traditional condition management interventions typically get involved significantly after the onset of symptoms. Accordingly, opportunities to improve outcomes are limited since much of the associated risk has already manifested itself in terms of poor health outcomes and high costs. This study will evaluate the role of comprehensive eye exams as a potential tool for more focused and proactive chronic disease detection that allows intervention further upstream in an individual’s disease progression.

In addition to eye-specific diseases, routine eye exams are capable of early identification of conditions such as diabetes, hypertension, and high cholesterol levels. Literature suggests the early identification of all three of these diseases can lead to better management of conditions, avoid related complications, and reduce costs. As such, comprehensive eye exams have the potential to play a significant role in health care cost management strategies.

For the purposes of assessing the benefit of early disease detection through eye exams, a group of individuals that first learned of their disease through a comprehensive eye exam provided by an optometrist was evaluated against a comparison group of like individuals who learned of their disease through other means. Again, the study focuses on three specific diseases that are identifiable through routine eye exams: diabetes, hypertension, and corneal arcus (an indication of high cholesterol).

Methods

Data

A retrospective study was performed using the Human Capital Management Services’ Reference Research Database (RRDb). The RRDb contains demographic, employment, compensation, medical claims, pharmacy claims, disability,
workers’ compensation, and absence data sources from numerous large employers throughout the United States. To supplement data already available in the RRDb, vision claims data were provided by VSP Vision Care (VSP).

Population

The following parameters were used to define the analysis populations:

- The Study Group: Includes employees and spouses with a comprehensive eye exam that identified the presence of diabetes, hypertension, or high cholesterol for the first time. As part of the eye exam process, doctors can explicitly identify the presence of a given disease by checking the appropriate box on a screening form that accompanies the billing form used by the insurance company. Alternatively, as screening forms are not consistently provided by all eye doctors, this study also attempts to include individuals with an early disease detection even if the accompanying form was not filled out. To this end, individuals who enter the medical system for a given disease shortly after an eye exam are included in this cohort under three assumptions:
  1. If the disease was diagnosed through traditional methods within a short period of time following an eye exam, early evidence of the disease would have been noticeable at the time of the eye exam.\(^{30,31}\)
  2. The eye exam itself was likely the catalyst for the individual to learn of the disease and to enter the medical system.
  3. As such, individuals with a medical or pharmacy claim for a given disease within 180 days of an eye exam are included in the study group. The length of this window was based on the median time to enter the medical system for those individuals where a screening form was available.
- The Comparison Group: Includes employees and spouses with a new onset of diabetes, hypertension, or high cholesterol with no evidence of an eye exam that could have led to the identification.
- Index Date: The first indication of disease found in vision, medical, or pharmacy claims data. For individuals in the study group, the index date represents the date of an eye exam. For individuals in the comparison group, the index date represents the date of a medical or pharmacy claim for the given disease.
- Exclusions: Individuals who were over the age of 65 were excluded, as Medicare data was not available for this population. Additionally, individuals with over $400,000 in total health plan cost (medical cost + pharmacy cost) were also excluded based on an outlier analysis.
- Time Period: The study includes individuals with an index date between July 1, 2006 and June 30, 2007. Individuals must have been enrolled in a health plan for the 6-month period preceding the index date. Similarly, for health plan and lost-time outcomes, individuals must have been enrolled for the full 12 months following the index date. For analyses related to termination, only six months of enrollment was required after the index date.
- Wash-Out Period: All cohorts are subject to a 6-month wash-out period before their index date as the study is designed to capture new disease onset. Individuals with data-based evidence of the disease prior to the index date are excluded.
- ICD-9 codes used for disease definition:
  1. Within the medical claims data, the presence of a disease was measured with the presence of a disease-specific primary, secondary, or tertiary ICD-9 code from the *International Classification of Diseases, 9th Revision*.
  3. Hypertension: ICD-9 codes of 401.xx–405.xx and 437.2x.
- NDC codes used for disease definition:
  1. Within the pharmacy claims data, the presence of a disease was measured with the presence of a disease-specific drug class based on the National Drug Classification (NDC) code.
  2. Diabetes: Drug classes containing insulin, alpha-glucosidase inhibitors, antidiabetic combinations, meglitinides, miscellaneous antidiabetic agents, non-sulfonylureas, sulfonylureas, and thiazolidinediones.
  3. Hypertension: Drug classes containing antihypertensives, alpha agonists/alpha blockers, beta blockers, calcium channel blockers, ace inhibitors, and diuretics.
  4. High cholesterol: Drug class containing hyperlipidemia.

Analytic questions

Three primary comparisons are made in the study and replicated for each disease cohort:

1. Evaluation of the study group (with early disease detection through an eye exam) against a comparison group in terms of first-year health plan spending following disease identification. Medical and pharmacy costs for the disease of interest are considered along with medical and pharmacy costs for co-morbid conditions.
2. Evaluation of the study group against a comparison group in terms of lost time cost due to short-term disability, long-term disability, and workers’ compensation episodes. Both long-term disability and workers’ compensation costs include costs paid-to-date plus reserved costs expected to be paid in the future on claims that remain open. Short-term and long-term disability costs represent income replacement costs paid to workers when they are unable to be on the job. Workers’ compensation costs include both medical and income replacement costs. Only employees are included in this analysis as lost time data was only available for the employee population.
3. Evaluation of the study group against a comparison group in terms of termination rates following disease onset. Again, only employees and not their spouses are included in this analysis.

Statistics analysis

Data analysis was generated by the SAS software platform Version 9.1.3. For the comparison of health plan costs addressed in Analytic Question 1, a two-part regression technique was used to estimate disease-specific medical
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Costs, co-morbid medical costs, and drug costs for the study and comparison groups.

Health plan cost data is typically right-skewed with a large proportion of valid zeroes. As such, the two-part regression model approach was chosen and is commonly used for health plan data modeling.12,13 The first part used a logistic regression model to predict the probability that cost was greater than zero. The second part used a generalized linear model (GLM) with a log link and a gamma distribution to conditionally predict cost for those with cost greater than zero.

A dichotomous variable was created to distinguish between the study group and the comparison group. Various sets of model-appropriate control variables were constructed to adjust for differences in the groups not explained by the group indicator variable. These include age, gender, indicator for employee or spouse, company, Charlson co-morbidity score,14 prior and concurrent medication utilization (when predicting nonpharmacy medical costs), and the number of unique medical providers (when predicting pharmacy costs).

Lost-time costs, as described in Analytic Question 2, were also estimated with the same two-part regression approach as outlined above.

To assess the difference in termination rates for each group as described in Analytic Question 3, a Kaplan–Meier survival curve approach was used to adjust for censored observations. Using available termination dates in the data, the time in days to termination (or end of available data for those still employed) from the individual’s first disease detection date was calculated. A Kaplan–Meier curve was then derived for both the study group and the comparison group. The estimated termination percent were compared between groups at time equal to 365 days. The nonparametric log-rank test was used to assess statistical difference between the two survival curves.

Results

Analytic Question 1

Total health plan costs (disease specific medical + co-morbid medical cost + pharmacy cost) were consistently lower for the study group across all three disease cohorts. The diabetes cohort displayed the greatest cost savings ($6465 vs. $7251, Table 1). The hypertension ($5829 vs. $6015, Table 2) and high cholesterol ($4147 vs. $4192, Table 3) co- morbids also exhibited positive findings.

Analytic Question 2

All three disease cohorts exhibited lower lost time costs due to short-term disability, long-term disability, and workers’ compensation in the study group, suggesting that detection of the disease during the eye exam potentially leads to fewer lost work days. The high cholesterol cohort showed the greatest cost savings ($256 vs. $320, $P = 0.04, see Table 3), while the diabetes ($449 vs. $459, $P = 0.91, see Table 1) and hypertension ($548 vs. $555, $P = 0.91, see Table 2) cohorts displayed smaller positive, but insignificant results.

Analytic Question 3

Using the Kaplan–Meier estimate of the survival function, the hypertension cohort displayed the greatest statistically significant difference in termination rates within one year of disease detection between the two groups (9.5% vs. 13.4%, $P < 0.005, see Table 2). Similarly, the diabetes cohort (8.5% vs. 11.5%, $P = 0.31, see Table 1) and the high cholesterol cohort (8.5% vs. 9.8%, $P = 0.06, see Table 3) had positive results for the study group, but sample sizes were not large enough to suggest a statistical difference in the survival curves of the study group and the comparison group.

Limitations

Significant effort was made to control for confounding factors and differences between groups; however, it is possible that some of the effect is driven by variables not available in the study. It is also possible that individuals in the study group are inherently earlier in their disease progression than individuals in the comparison group. While getting to individuals as early as possible is a positive outcome in itself, a follow-up analysis with more longitudinal data may be able to confirm that the cost differences seen in this study persist into future years and are not an artifact of this particular study design.

Finally, since the screening form for early disease detection was not consistently available, the study had to use claims-based criteria as evidence of early disease detection in many cases. These criteria logically link claims activity to an eye exam, but may not be precise in every circumstance.

Discussion

Individuals who receive an early detection of their chronic disease through an eye exam exhibited lower total health plan costs, lower costs due to lost-time, and a lower rate of termination during the 12 months following the first evidence of the disease. These results were consistent for all three disease cohorts.

As seen in Table 4, after totaling the per-person savings for the entire study group, a savings of roughly 4.5 million dollars was observed. To put this number into perspective, the total eye exam fees for all covered members (including

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those with and without an early disease detection) during this time period was approximately 4.8 million dollars. So, in addition to the core benefit provided in terms of vision improvements, the eye exams returned approximately $0.94 for every $1.00 spent from the benefit of early disease detection. The $0.94 return is composed of $0.18 due to health plan cost reductions, $0.03 for reductions in lost-time, and $0.73 for reductions in termination rates. The termination rate estimate was converted to a cost using a wage replacement value of 60% of base salary based on J. Phillips’ Investing in Your Company’s Human Capital. The cost savings found in this study were made possible by comprehensive eye exams that are typically not available through traditional health insurance, but instead as an add-on benefit largely funded directly by employees themselves. Competitive market environments, as well as the direct purchase nature of eye exam services, strengthen consumer engagement and discretionary participation in preventive services in a way not seen with traditional medical insurance coverage.

## Conclusion

This analysis gives evidence that early detection of chronic disease through comprehensive eye exams can lead to lower health plan costs, fewer lost work days, and lower rates of termination. In fact, cost savings almost completely offset the fees of the eye exams. As such, employers should consider eye exams as part of their overall health strategy and should seek eye care providers who offer eye health exams in a broad and effective manner, and who are capable of referring cases of early detection to primary care and condition management. Emerging research suggests that primary care, as opposed to specialty care, can provide higher quality and more cost effective care for those in the beginning stages of chronic disease.

Finally, despite chronic disease screenings being available inside traditional insurance coverage, these tools are underutilized by patients and doctors in the formal setting. The cost savings found in this study were made possible by comprehensive eye exams that are typically not available through traditional health insurance, but instead as an add-on benefit largely funded directly by employees themselves. Competitive market environments, as well as the direct purchase nature of eye exam services, strengthen consumer engagement and discretionary participation in preventive services in a way not seen with traditional medical insurance coverage.

## Author Disclosure Statement

No competing financial interests exist.

## References


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AU1: Is Disclosure Statement accurate? If not, please amend as needed.