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Cost-Utility Analysis of Extending Public Health Insurance Coverage to Include Diabetic Retinopathy Screening by Optometrists

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ABSTRACT

Background: Diabetic retinopathy (DR) is one of the leading causes of vision loss and blindness in Canada. Eye examinations play an important role in early detection. However, DR screening by optometrists is not always universally covered by public or private health insurance plans. This study assessed whether expanding public health coverage to include diabetic eye examinations for retinopathy by optometrists is cost-effective from the perspective of the health care system. **Methods:** We conducted a cost-utility analysis of extended coverage for diabetic eye examinations in Prince Edward Island to include examinations by optometrists, not currently publicly covered. We used a Markov chain to simulate disease burden based on eye examination rates and DR progression over a 30-year time horizon. Results were presented as an incremental cost per quality-adjusted life year (QALY) gained. A series of one-way and probabilistic sensitivity analyses were performed. **Results:** Extending public health coverage to eye examinations by optometrists was associated with higher costs ($9,908,543.32) and improved QALYs (156,862.44), over 30 years, resulting in an incremental cost-effectiveness ratio of $1668.43/QALY gained. Sensitivity analysis showed that the most influential determinants of the results were the cost of optometric screening and selected utility scores. At the commonly used threshold of $50,000/QALY, the probability that the new policy was cost-effective was 99.99%. **Conclusions:** Extending public health coverage to eye examinations by optometrists is cost-effective based on a commonly used threshold of $50,000/QALY. Findings from this study can inform the decision to expand public-insured optometric services for patients with diabetes.

Keywords: cost-utility analysis, diabetic retinopathy, optometrist, publicly funded eye examination.

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Introduction

Diabetic retinopathy (DR) is one of the leading causes of vision loss and blindness [1]. In Canada, approximately 14% of patients with diabetes (500,000) have some form of DR, and this prevalence is expected to rise in conjunction with the increasing incidence of diabetes [2]. The treatment for DR depends on the disease state. Background retinopathy, a condition whereby the eye's blood vessels are slightly swollen, can be managed with strict control of blood sugar levels and careful regulation of blood pressure and renal function, and more severe vision loss from proliferation of new blood vessels can be managed with a combination of laser photocoagulation, intravitreal injections of steroids, antivascular endothelial growth factor therapy, and/or vitrectomy [3]. Early detection through eye examination allows for timely treatments, which can significantly prevent or delay vision loss [4].

Several clinical practice guidelines highlight the role of primary care physicians in detecting DR and facilitating appropriate referral to an ophthalmologist [5,6]; however, primary care physicians often have limited access to specialized instruments and training to perform the required testing to accurately

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diagnose DR. Despite this, a large proportion of DR screenings are performed by primary care physicians [7]. Optometrists have better training in eye care diagnosis and have the necessary equipment to diagnose eye-related conditions compared with primary care physicians. Although lack of government-insured optometric services for patients with diabetes was found to negatively impact patients' access to health care services and vision health outcomes [8], optometric services are not covered in some provincial health insurance plans in Canada, including those of New Brunswick, Prince Edward Island (PEI), and Newfoundland and Labrador.

Health economic evaluation is a systematic approach that can inform policymakers whether the added benefits of expanding publicly funded optometric services justify their costs. To date, no study has assessed the cost-effectiveness of publicly funded optometric services. Existing studies have shown that a systematic DR screening program is cost-effective compared with opportunistic screening, as in North America and Europe [9] and that DR screening is a cost-effective addition to a national diabetes treatment policy [10].

The objective of our study was to assess whether expanding public health insurance coverage to include eye examinations for patients with diabetes by optometrists is cost-effective from the perspective of the health care system.

Methods

Overview

We conducted a cost-utility analysis of a publicly insured optometric service for patients with diabetes in PEI from the perspective of the health care system. The intervention of interest was a new optometric policy, whereby eye examinations for DR by optometrists are publicly insured. The comparator was usual care, whereby eye examinations for patients with diabetes performed by primary care physicians or referrals to ophthalmologists are publicly insured. We assumed that patients in the usual care group were not screened for DR by optometrists at baseline and that an extended insurance coverage would increase annual DR screening rates.

The diagnostic accuracy of DR screening modalities and the effectiveness of treatment alter the likelihood that patients with diabetes progress through the stages of DR to ultimate vision loss. This means that changes in the screening rate and screening accuracy were the main drivers of difference in DR rates between the usual care (government-insured DR by primary care physicians plus ophthalmologists) and the intervention scenarios (government-insured DR screening by optometrists and primary care physicians plus ophthalmologists).

Setting

PEI is an island province in eastern Canada with a total population of 146,447 (as of 2015), of whom approximately 70,000 are over the age of 44 years. In 2015, prevalence of diabetes among those >44 years of age was just over 11% [11]. Canadian provincial governments bear the primary cost burden for providing health care to their residents and are therefore the primary arbiters for determining what will be publicly covered. Although physician visits (including eye examinations), as well as ophthalmologic DR screening and most treatment, are covered by the PEI provincial health plan, optometric services are not included in the plan.

Study Population

The eligible population was PEI residents ≥45 years of age who had diabetes. The 45-year-old cutoff was used because it was the mean age of patients with diabetes in PEI. Based on PEI's Statistics Bureau [11], a cohort with 7958 patients with diabetes were >44 years of age. Of these 3514 (44.2%) were between 45 and 65 years of age. We used data from the same source to project the future population in PEI. We categorized our target population to two age groups (45–64 years and 65+ years) to account for observed differences in the mortality rates, DR prevalence rates, and screening rates. Given the projected increase in the older age cohort in PEI, it was important to model changes in disease burden and related costs over time. Therefore, each year we added a new cohort of diabetes cases to the Markov model representing the newly 45-year-old population of PEI. The newly added cases were distributed across the stages of DR according to the prevalence rate at 45 years of age [11].

Decision Analytic Model

We used a probabilistic decision analytic model to simulate the long-term costs and outcomes for a cohort of PEI residents living with diabetes. We simulated the natural history of DR among the population with diabetes according to the most recent prevalence and transition probability data by using a Markov chain. The stages of DR used in the Markov chain were as follows: 1) no diabetic retinopathy (NDR); 2) background diabetic retinopathy (BDR); 3) pre-proliferative diabetic retinopathy (PPDR); 4) proliferative diabetic retinopathy (PDR); and 5) end-stage disease—loss of useful vision [12]. Each year individuals may transit through one of the five disease states or death [6], according to annual transition probabilities.

The Markov model estimated the costs and effects over a period of 30 years, since that was the duration of time for which we had population projection data that could be reliably translated into rates of diabetes within our age cohorts. The long follow-up period also allowed us to capture changes in patients' demographics and the incidence rates of diabetes over time. Our patient cohort was expanded to capture new cases of diabetes for each year. We used PEI Statistics Bureau's population projection data to simulate population growth from 2014 to 2044, as the expected change in annual incidence of diabetes [11].

Each year, probability rate of individuals with diabetes being screened was equal to the annual screening rates. Recommended regular screening for DR is once every 2 years. Individuals who did not receive any screening would transit through the Markov chain according to the baseline transition probabilities. For our baseline model, we assumed that the 53% of PEI residents who received DR screening regularly continued going to primary care physicians and ophthalmologists over the 2-year period and that the expanded coverage to optometrists would result in 35% increase in screening. Of those screened in the usual care group, we assumed that 80% of DR screening was performed by general practitioners, who then potentially referred patients to ophthalmologists on the basis of test findings. We varied this share of screenings in a scenario analysis that ranged general practitioner share of screenings from 50% to 100%. For those who were screened, their risk of being diagnosed with DR was estimated according to the incidence of DR and the diagnostic accuracy of the DR screening by an optometrist or an ophthalmologist. The sensitivity and specificity of DR screening was based on a systematic review that included two observational studies in which the true severity of DR was known and several screening approaches and practitioners were provided with the same patient [4]. We assumed that individuals who were diagnosed with DR (whether true or false positive) received a treatment.

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