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Original article

Estimation of mortality savings due to a national program for diabetes care

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Abstract

Background: Diabetes-related complications can be reduced by better control of glycemia, lipid abnormalities and blood pressure. In recent years, efforts at improving diabetes care in Israel have been made. This study aims to estimate mortality savings related to a national program for diabetes care in Israel.
Methods: Total population data for Israel was projected to 2020. Current diabetes prevalence and disease management data were obtained from a national program of diabetes care. Projections of the program's effect were based on two models: improvement in glycemic control, reflected in Hb A1c levels, and improvement in overall diabetes care, reflected in the percentage with LDL<100 mg/dl, a proxy for multi-factorial control. Potential years of life lost (PYLL) and quality-adjusted life years (QALYs) saved were calculated.
Results: A drop in average Hb A1c values from 8.13% at baseline to 7.36% in 2020 is expected, and as a result 4216 deaths from diabetes will be prevented over the period 2001–2020, saving around 47,773 life years or 34,342 QALYs. Overall diabetes care, reflected in improving the control rate of LDL levels to <100 mg/dl from 36% in 2000 to 58% in 2020, is estimated to prevent around 4803 deaths from diabetes over the period 2001–2020., so the program will save around 47,127 PYLL or 32,862 QALYs.
Conclusions: A nationwide program of diabetes care is estimated to result in significant reductions of overall, as well as CHD-related, mortality.

Keywords: Diabetes mellitus; Managed care; Quality of care; Quality indicators; Evaluation

1. Introduction

Diabetes mellitus has been described as "an ideal condition for evidence-based disease management" [1]. The progression of microvascular complications can be slowed, but probably not stopped, with interventions such as aggressive control of glycemia, laser therapy for retinopathy, and angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers for nephropathy [2]. Emerging evidence suggests a correlation between higher levels of cardiovascular disease and chronic hyperglycemia [3–7]. Some studies [3,4] show that cardiovascular events and all-cause mortality are correlated with hemoglobin A1c (Hb A1c) blood levels. A meta-analysis of 13 prospective cohort studies showed that for every 1% increase in Hb A1c, the relative risk for any cardiovascular event was 1.18 (95% confidence interval [CI]:1.10–1.16) [5,6]. Even among people without diabetes, a 1% increase in Hb A1c (above 4.6%) was associated with a relative risk of 2.36 (95% CI:1.43–3.90) for a cardiovascular event [7]. In the United Kingdom Prospective Diabetes Study (UKPDS), a 1% fall in Hb A1c was associated with a 35% reduction in microvascular end

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points, an 18% reduction in myocardial infarction, and a 17% reduction in all-cause mortality [8,9].

The most effective approach for prevention of both micro- and macro-vascular complications appears to be multi-factorial risk factor reduction (control of glycemia, aggressive blood pressure control, treatment of dyslipidemia, stopping smoking and daily aspirin). In the UKPDS [10], the long term benefit of intensive glycemia control on fatal and nonfatal heart disease and stroke has been demonstrated (a reduction by 57%). ACE inhibitors therapy was associated with a decrease in all-cause mortality and cardiovascular mortality [11].

Despite extensive data suggesting real benefit from preventive and therapeutic measures in diabetes, there has been little improvement in diabetes management in the United States in terms of Hb A1c and blood pressure control, while an improvement was seen in the percentage with low-density lipoprotein (LDL)<130 mg/dl [12].

In Israel, four health maintenance organizations (HMOs) supply primary care services for the majority of the population, and bear the responsibility for the quality of care given to enrollees, as the National Health Insurance Law of 1994 guarantees uniform delivery of a "basket" of medical services to all citizens. It also dictates evaluation of medical services in Israel. A system of quality indicators for primary care in Israel has been developed by a coordinated effort of all four HMOs [13]. These quality indicators deal with various fields of primary care, including diabetes management. The goal of the current study was to estimate mortality savings related to this national evaluation program of quality indicators for diabetes management, using projections of current improvement trends in diabetes control.

2. Methods

2.1. Data sources

Data regarding patient care were anonymously reported by the four HMOs in Israel and were based on the entire population of enrollees. To rule out coding, registration or analysis errors, an external audit was regularly performed. Data regarding diabetes care were available for medically treated patients (both type 1 and type 2) — about 85% of all diabetes patients. Therefore, patients with diabetes were defined as those purchasing medications for diabetes through at least 3 prescriptions in a single year. Parameters available include the prevalence of diabetes mellitus, Hb A1c measurement, control of glycemia, performance of a lipid profile, control of LDL levels, rate of fundus examinations, screening for microalbuminuria, influenza vaccination, blood pressure measurement, and blood pressure control. In this report, we focus on the effect of two interventions, which reflect two possible ends of a spectrum: a narrow view of diabetes care which focuses on glycemic control only, versus a wider look at diabetes control, including glucose levels, blood pressure and LDL levels, with some overlap between these interventions. Therefore, the interventions assessed include the effect of glucose level control (reflected in Hb A1c) on overall mortality and the effect of the control of LDL levels (as *a proxy* for multi-factorial control) on cardiovascular mortality [14,15].

2.2. Modeling

Total population data by gender for Israel from 1980 to 2006 was projected to 2020 [14]. Gender-specific death rates from diabetes were calculated using gender-specific mortality data from diabetes from 1980–2003 as reported to the World Health Organization (WHO) [17].

Diabetes prevalence and disease management data by age and gender reported for 2001–2005 was obtained from the national evaluation program of quality indicators for diabetes management. We intentionally assumed that the prevalence of diabetes is projected to rise in parallel with the increasing trend in mortality rates from diabetes (i.e. case fatally rates are assumed to remain constant), in order to produce *conservative* estimates of utility, although obviously the prevalence is expected to increase.

In the "limited care" model, Hb A1c was the main input used. Trends in Hb A1c testing and control observed in 2001–2005 were projected to 2020. Data reported to the program classify patients as having "poor", "intermediate" and "good" control of glycemia (Hb A1c levels below 7%, 7–9% and above 9%, respectively). Since individual data for Hb A1c were not available, average baseline Hb A1c levels were calculated based on data from Clalit Health Services, the largest HMO in Israel, that showed an average value of 6.36% for patients with good glycemia control, 7.85% for those having intermediate control of glycemia, and 10.63% for patients poor control. We assumed that the small "untested" population would have the same distribution of Hb A1c as those who were tested.

Estimates for the expected mortality rate in the absence of the national quality indicators program were based on projections of the trend in gender-specific mortality rates from diabetes. Next, estimates as to life years saved as a result of the program were made for each year from 2001 to 2020 based on the assumption that a 1% average decrease in Hb A1c levels will cause a 16% decrease in diabetes mortality [8,9] adjusted to take into account the lagged effect of the intervention over future years. Details of the calculation are given in Appendix A.

For the second model, trends in LDL control to less than 100 mg/dl observed in 2000–2005 were projected to 2020. We assumed that 65% of diabetes deaths are attributable to coronary heart disease (CHD) [18,19]. Next, estimates were made for mortality rates in 2001–2020 in the absence of the program, as before.

Estimates as to life saved as a result of the program were made for each year from 2001–2020. These based on the assumption that a multi-factorial intervention (including blood pressure control, ACE inhibitor therapy, and lipid-lowering drugs, *reflected* by LDL levels less than 100 mg/dl) will cause a 53% decrease in CHD mortality [20–22] in those patients. The decrease in mortality was adjusted to take into account the lagged effect of the intervention over future years, See Appendix A for details of the calculation.