Epidemiologic Projections of Diabetes and Its Complications:

"*Forecasting the Coming Storm*"

James F. Blanchard, MD, MPH, PhD

with

Andre Wajda, Chris Green

Objectives

- To describe a model for predicting the future prevalence of diabetes and its complications.

- To use this model to predict the future shape and magnitude of the diabetes epidemic using empiric data from Manitoba.

Outline

- Methodology Overview:
  - Basic principles for projection models.
  - Data sources.
  - Application of our model.
- Results:
  - Future trends in the prevalence of diabetes.
  - Future implications for diabetes complications and health care costs.

Background

- The prevalence of diabetes is rising in most populations worldwide.
- Health care personnel are aware of an increasing demand for a variety of diabetes-related services:
  - Diabetes education.
  - Hospital services.
  - Renal dialysis.

Motivation

- There is an increased emphasis on regional, “needs-based” planning of health services.
- We are usually resigned to planning our health services based on no data, or data that is at least a few years old.
- The epidemiology of diabetes is dynamic, so current estimates of need are likely to underestimate the future reality.
- We now have the empiric data that permits projections.

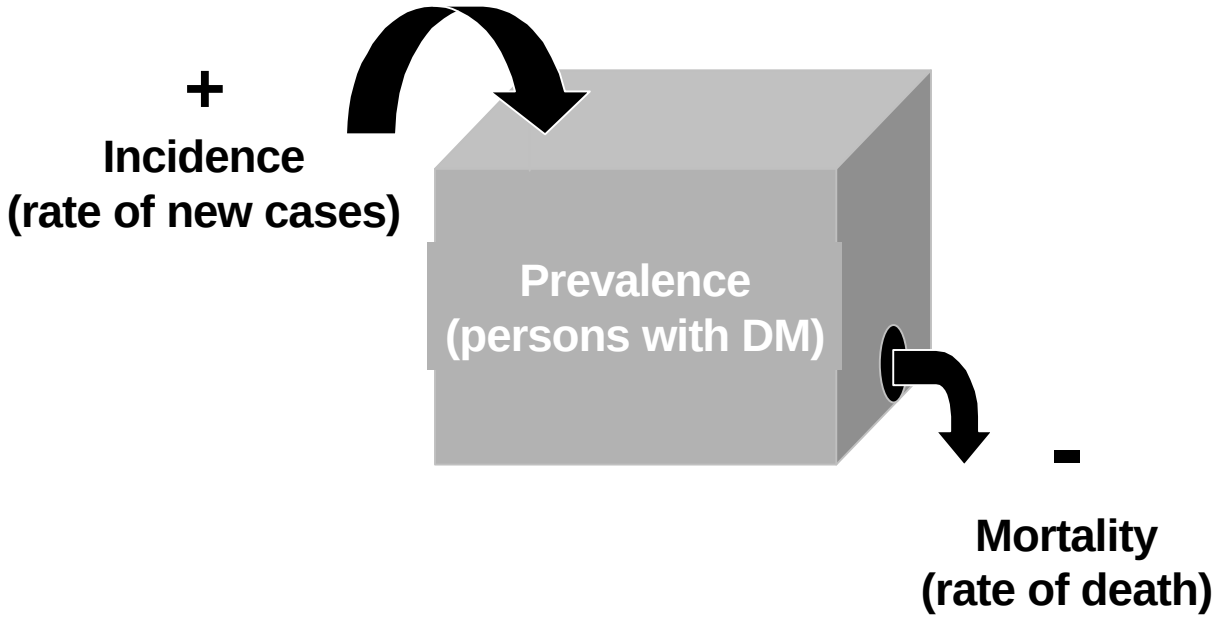
Methodology

- Epidemiologic Principles:
  - Relations between incidence, mortality and prevalence.
  - The nature of chronic disease epidemics.
- Elements of the Manitoba Diabetes Database and Population Registry.
- Our “Projection Model”.

Key Definitions

- Incidence rate - the number of new cases among those who don't already have the disease… expressed as *new cases/population/year*.
- Mortality rate - the number of deaths in the population… expressed as *deaths/population/year*.
- Prevalence - the proportion (%) of the population living with diabetes at a given point in time.

The Relations Between Incidence, Prevalence and Mortality



Factors Influencing the Prevalence of Diabetes in a Population.

- Age-specific incidence rates.
- Age-specific mortality rates.
- Age distribution of the population.
- (Age-specific migration rates of persons with diabetes).

Developing the Projection Model

- STEP 1 - Determine the population by age, gender and Status (i.e. Status Indian).

- STEP 2 - Determine the number of persons with diabetes for each age, gender, and Status grouping.

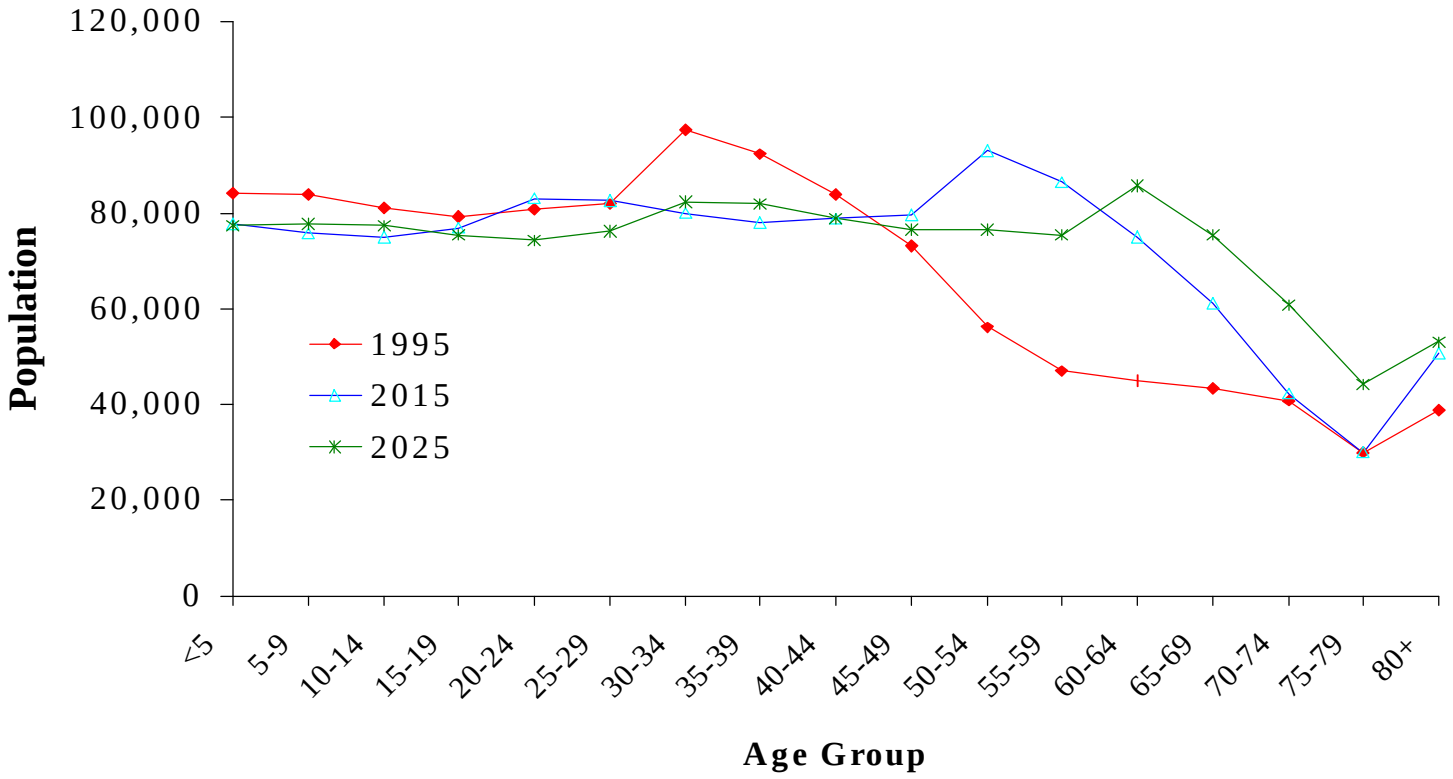
Data Sources

- Manitoba Health Population Registry:
  - Current population distribution.
  - Age-specific fertility rates.
  - Age-specific mortality rates.
- Manitoba Diabetes Database:
  - Current prevalence of diabetes.
  - Incidence rates of diabetes.
  - Mortality rates among persons with diabetes.
  - Complication rates and direct health care costs.

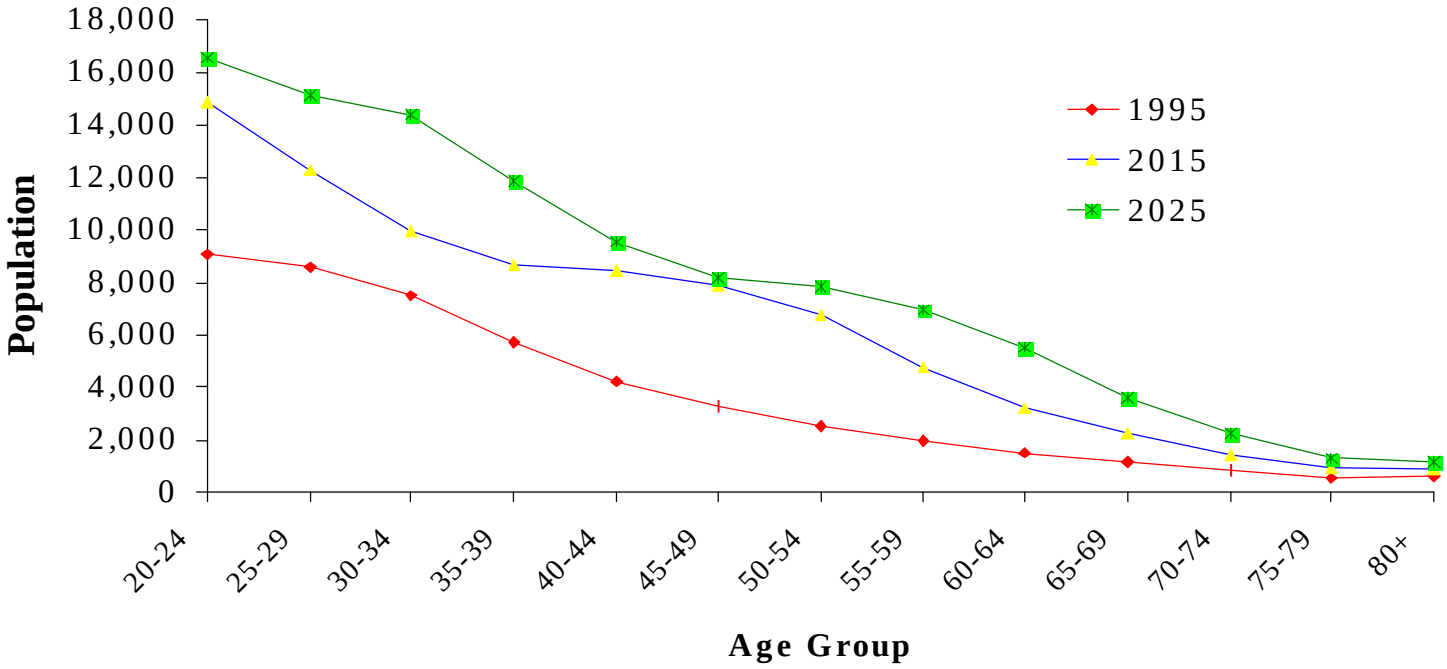
The Diabetes Projection Model: Methodology

- **STEP 1:** Determine the population by age, gender and Status:
  - Each year, add new births based on the current age- and Status-specific fertility rates.
  - Each year, subtract deaths based on current age-, gender-, and Status-specific mortality rates.
  - Each year, “age” the number of survivors by one year.

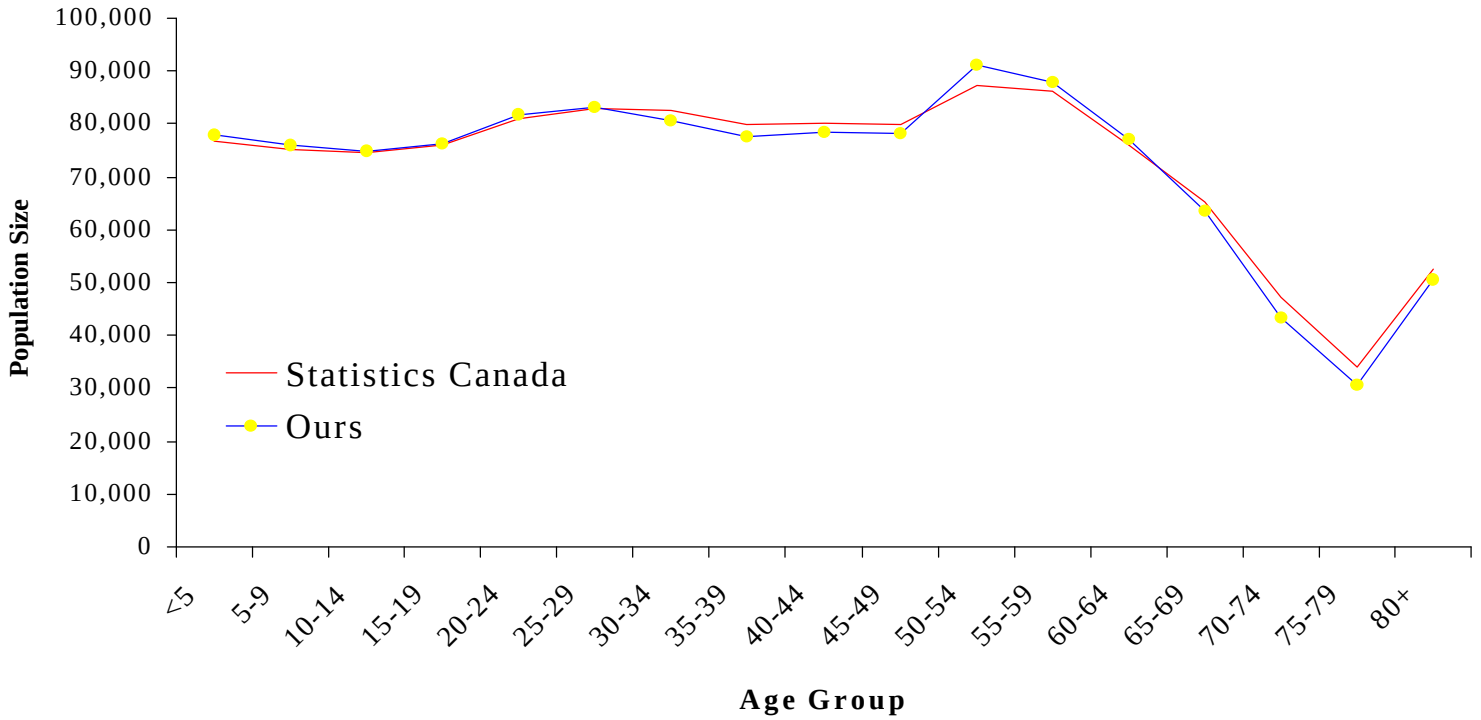
Manitoba Population Age Distribution
1995, 2015 and 2025



Population Age Distribution, Status Indian 1995, 2025 and 2025



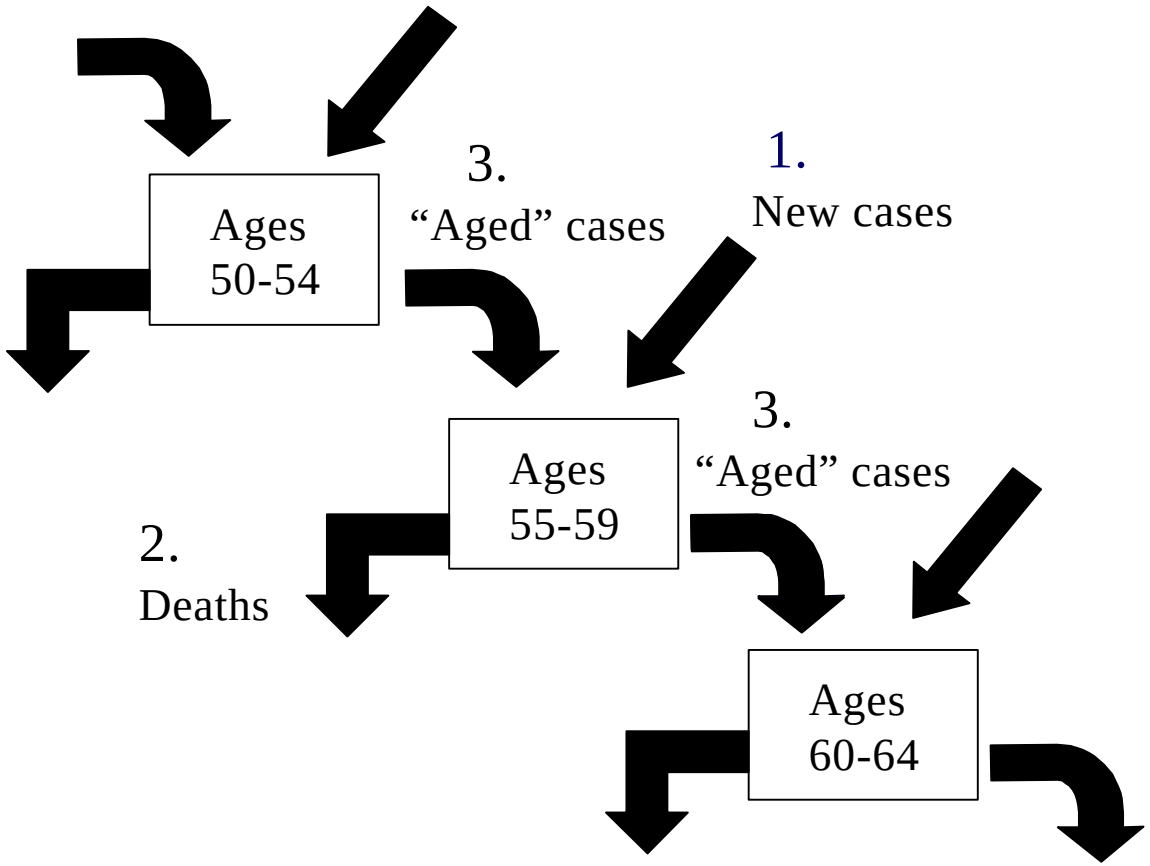
Comparison with Statistics Canada Population Projections for Manitoba, 2016



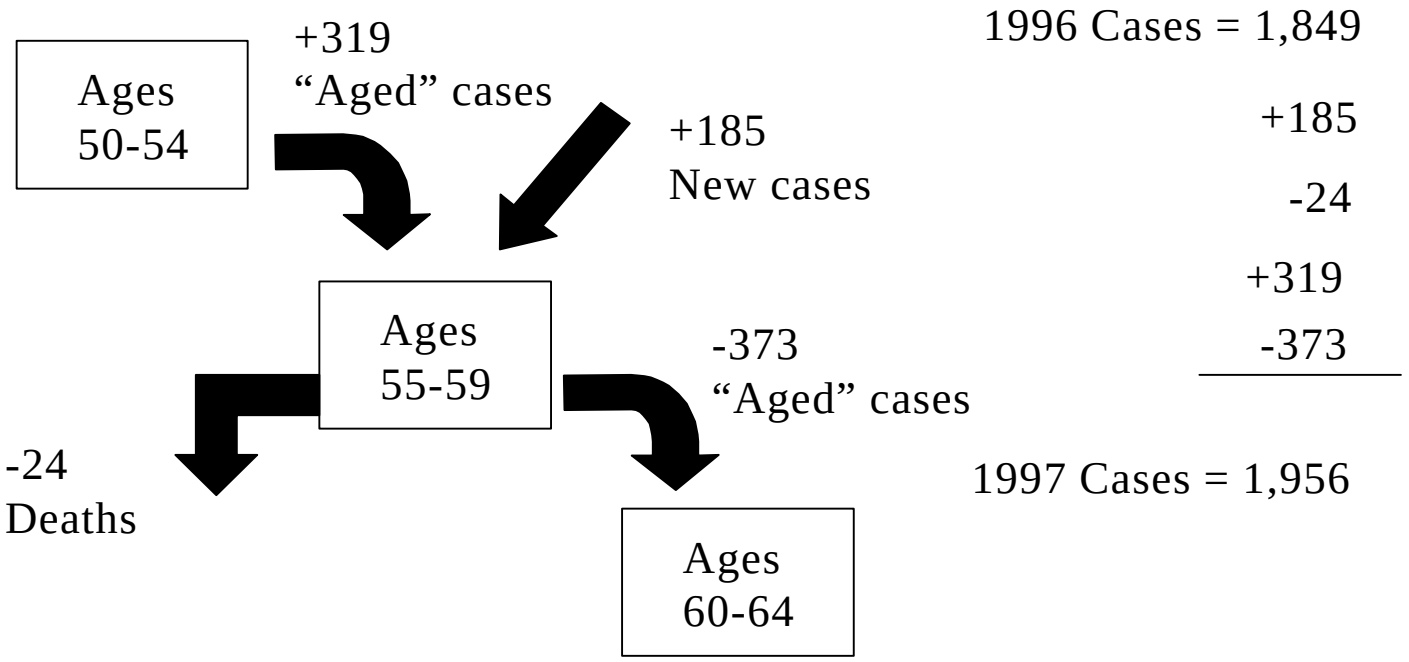
The Diabetes Projection Model: Methodology

- **STEP 2:** Determine the number of persons with diabetes for each age, gender, and Treaty status grouping:
  - Determine the number of new diabetes cases (based on the incidence rate).
  - Determine the number of deaths among those with diabetes (based on the mortality rate among those with diabetes).
  - Each year, age "surviving" persons with diabetes by one year.

Components of the Diabetes Projection Model



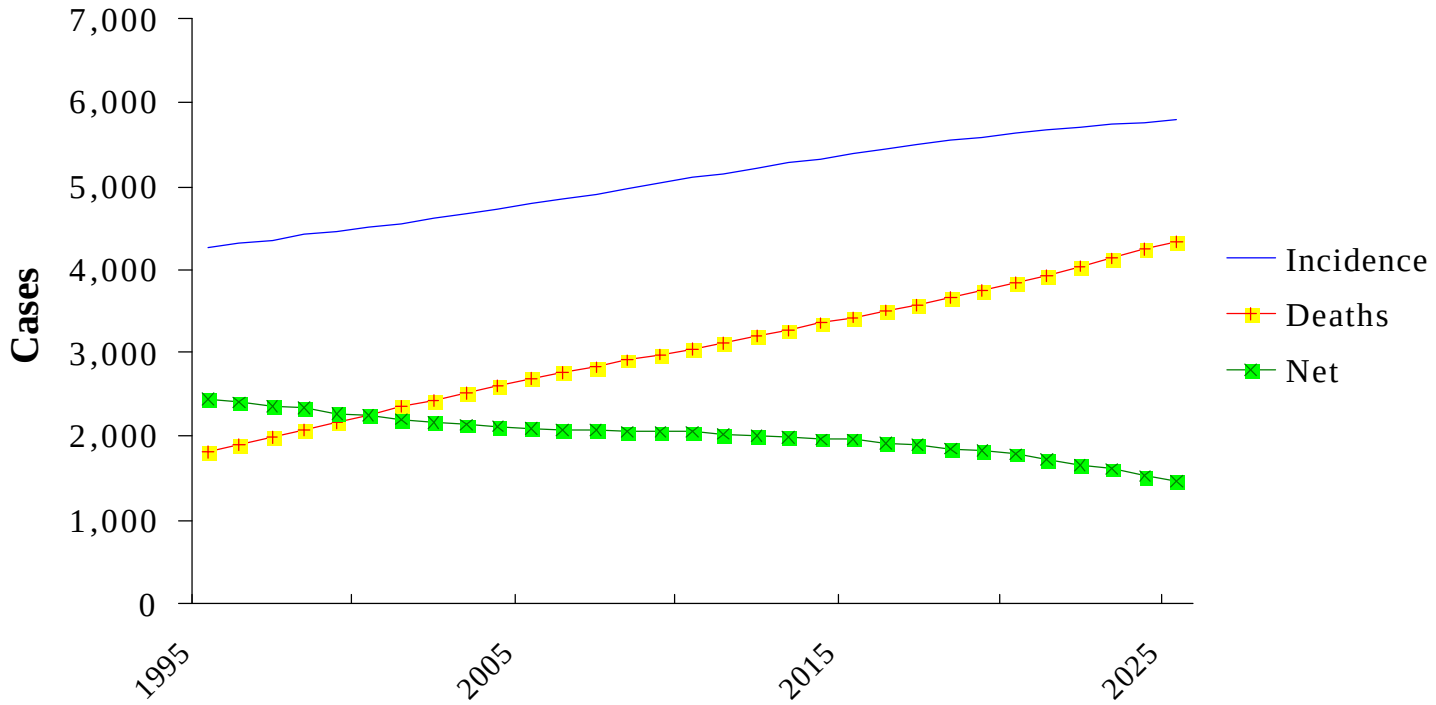
Application of the Model to Non-Status Women Aged 55-59, 1996 to 1997.



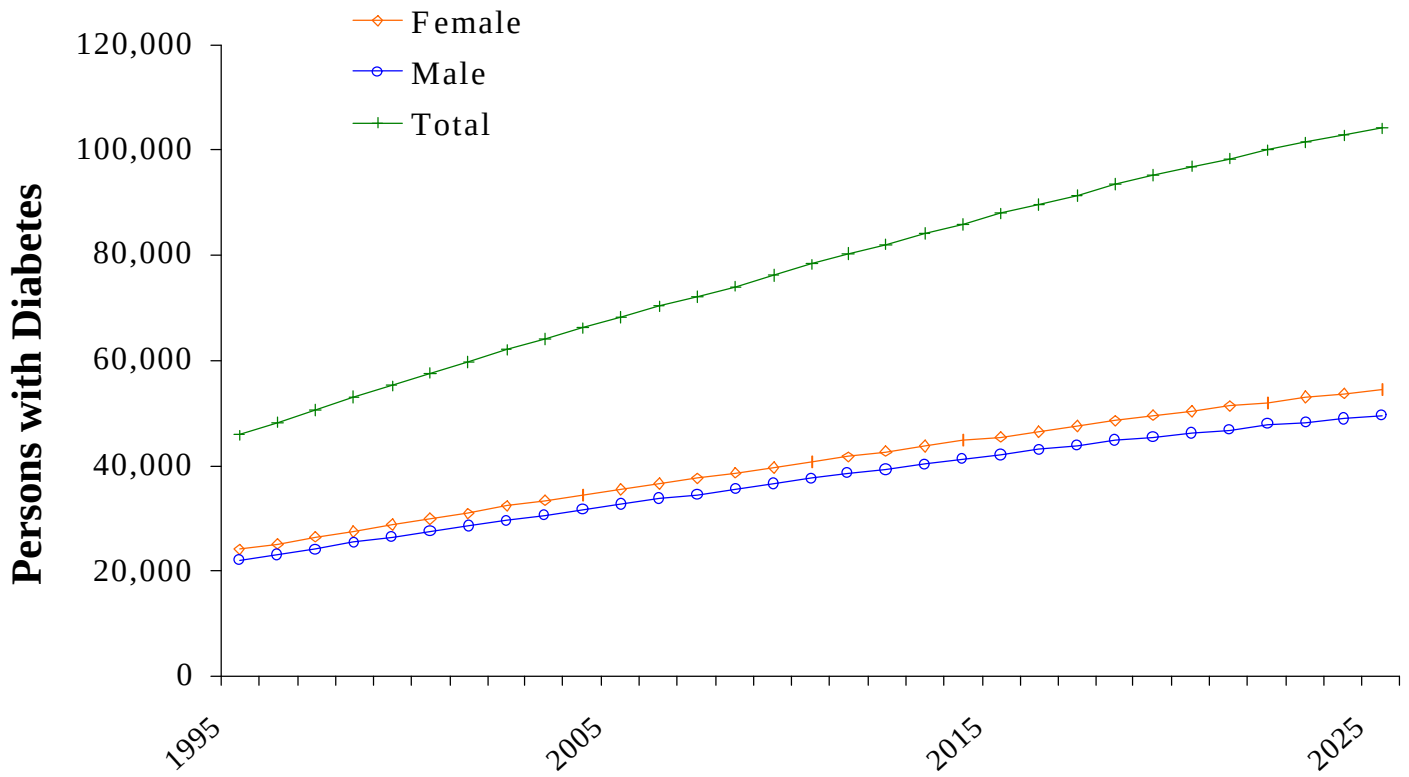
Results I

Trends in the Prevalence of Diabetes

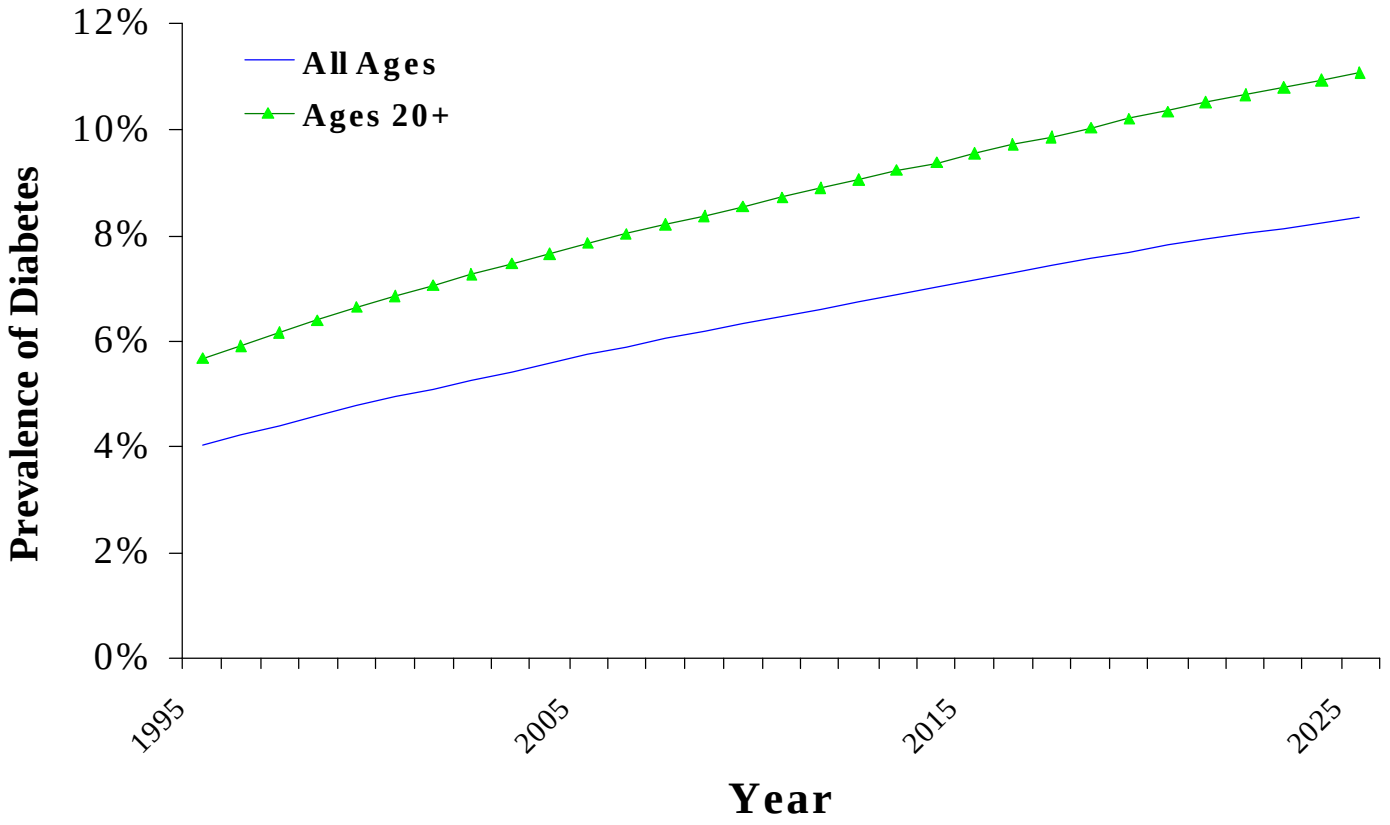
Projected Number of New Cases, Deaths, and Net Growth for Diabetes, All Manitoba 1995-2025



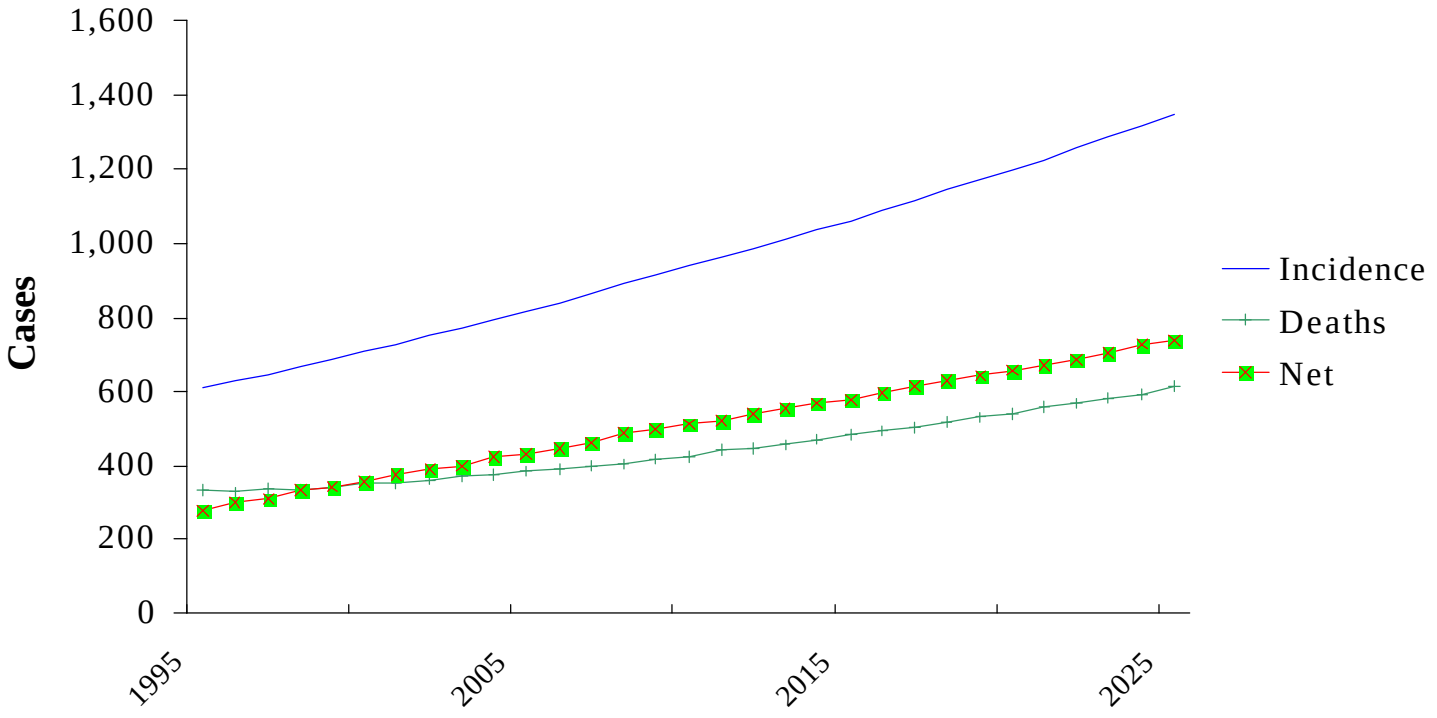
Projected Number of Persons with Diabetes in Manitoba, By Gender, 1995-2025



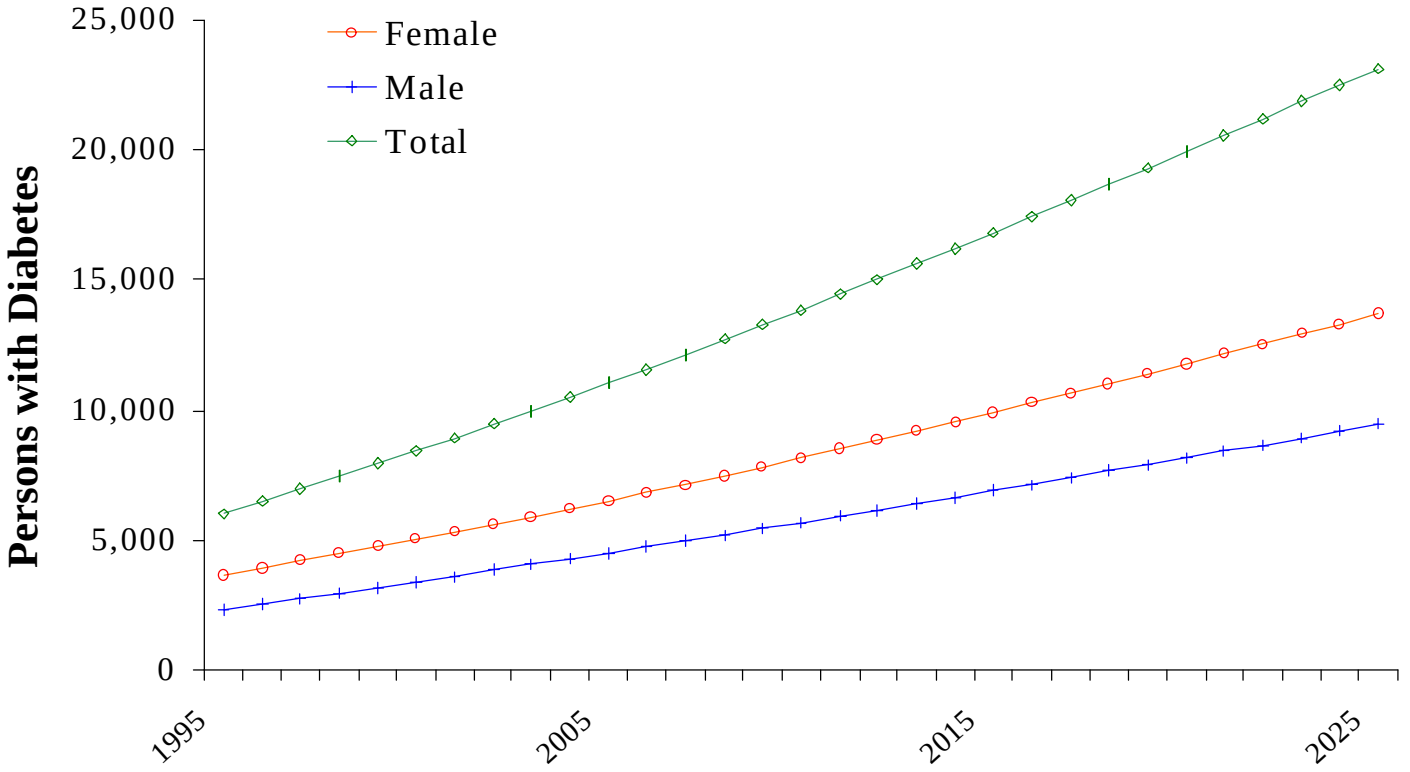
Projected Prevalence of Diabetes in Manitoba, 1995 to 2025



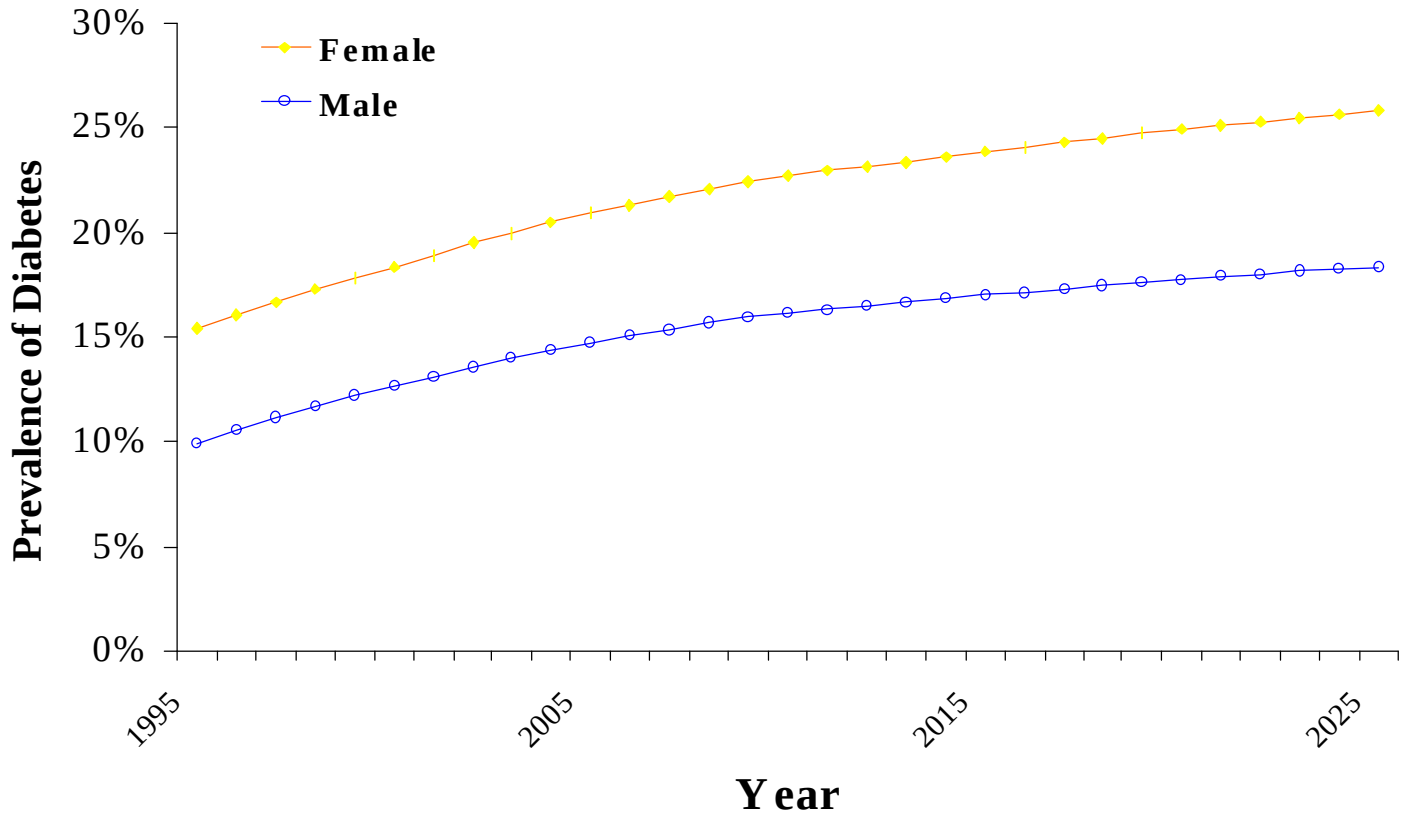
Projected Number of New Cases, Deaths,and Net Growth for Diabetes, Status Population, 1995-2025



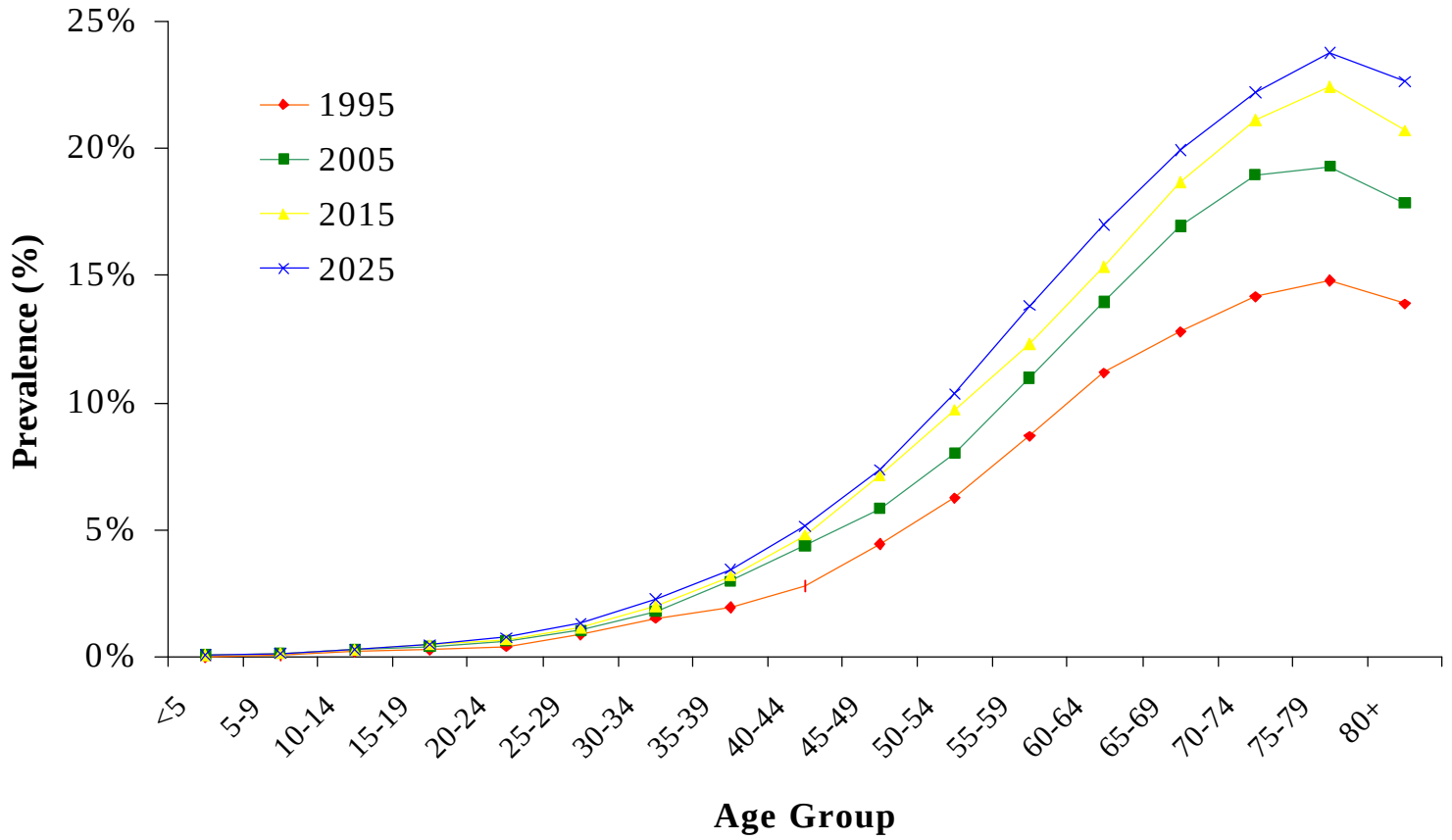
Projected Number of Persons with Diabetes Manitoba Status Indian, Ages 20+, 1995 to 2025



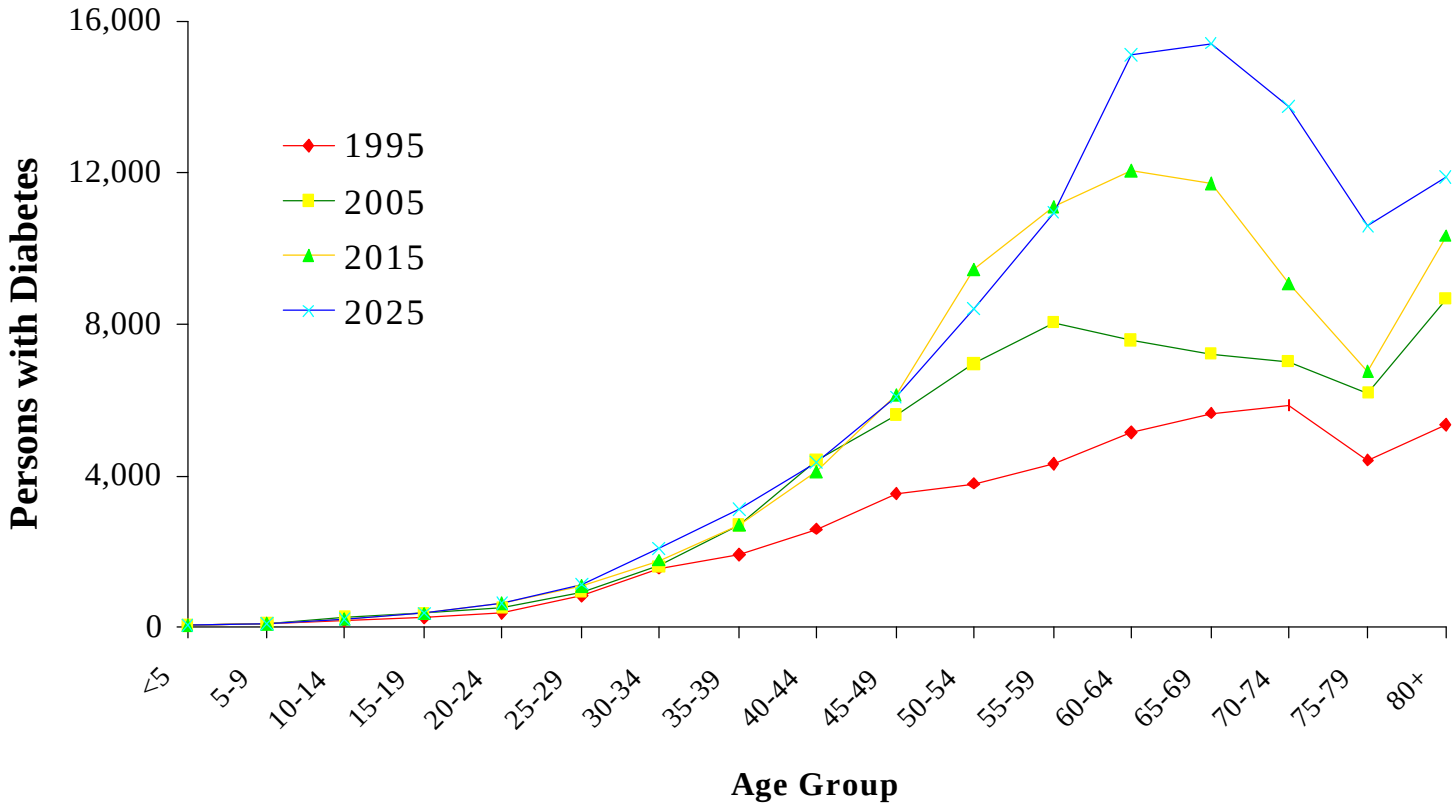
Projected Prevalence of Diabetes in Manitoba, Status Indian, Ages 20+, by Gender, 1995 to 2025



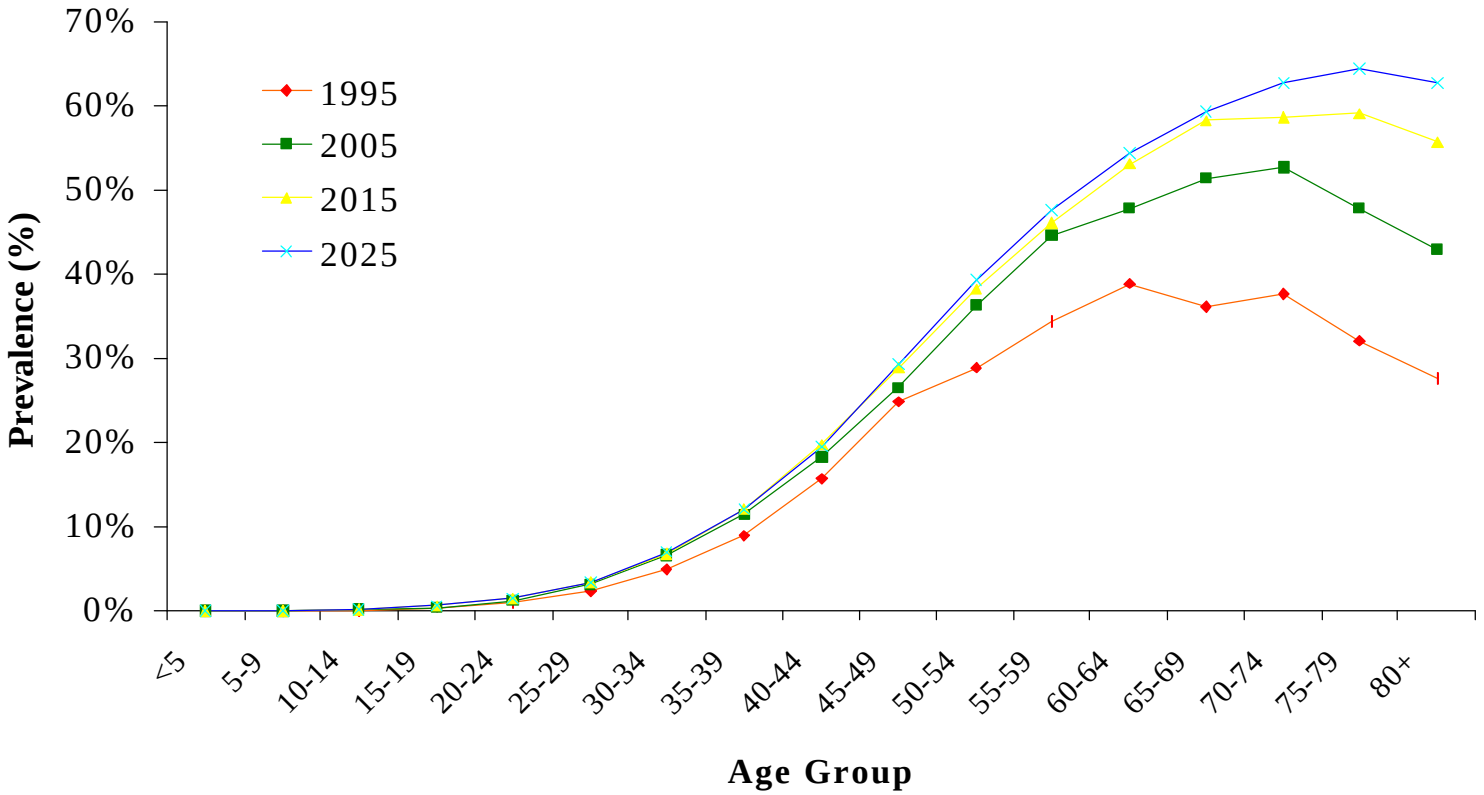
Age-specific Prevalence of Diabetes, All Manitoba: 1995, 2005, 2015, 2025



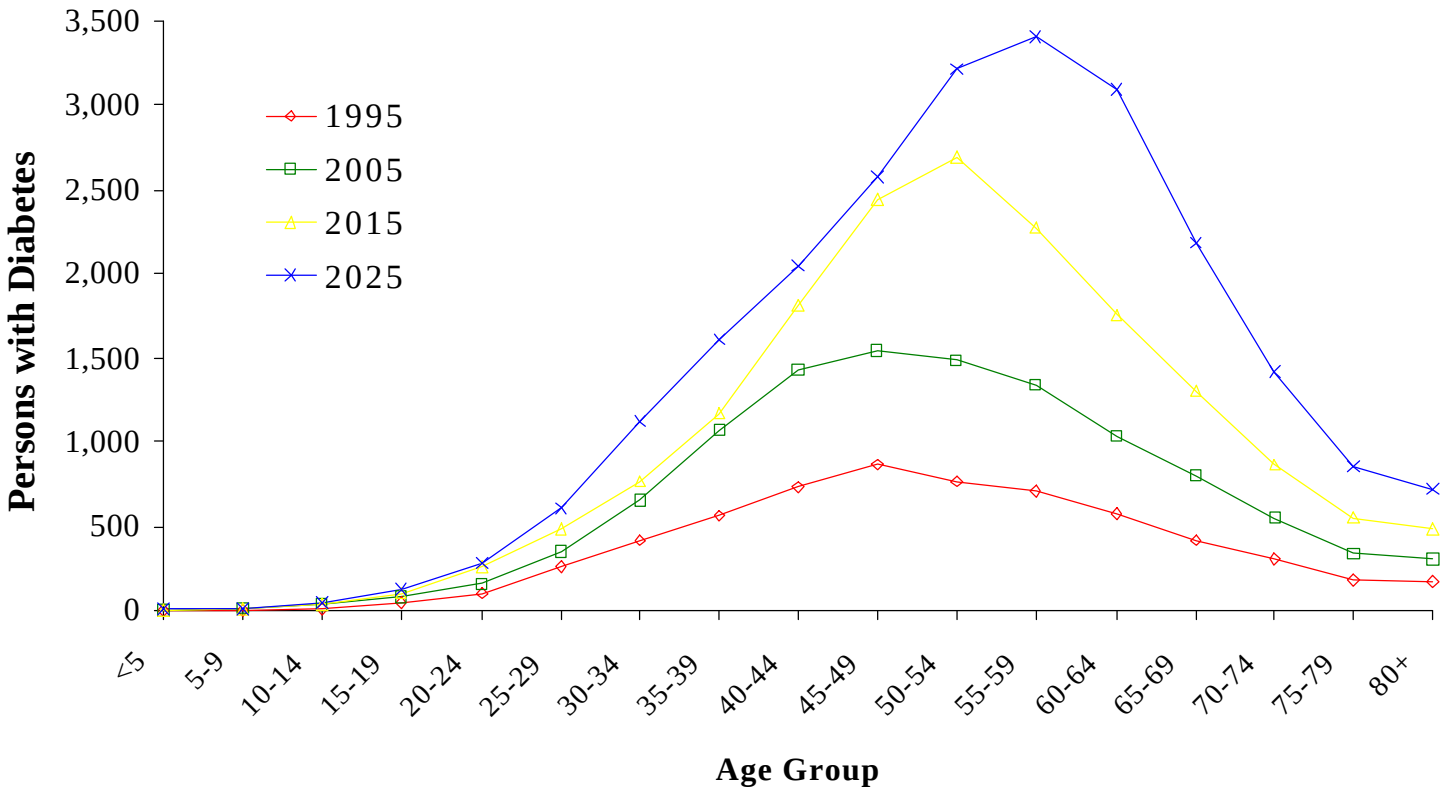
Age Distribution of Manitobans with Diabetes 1995 to 2025



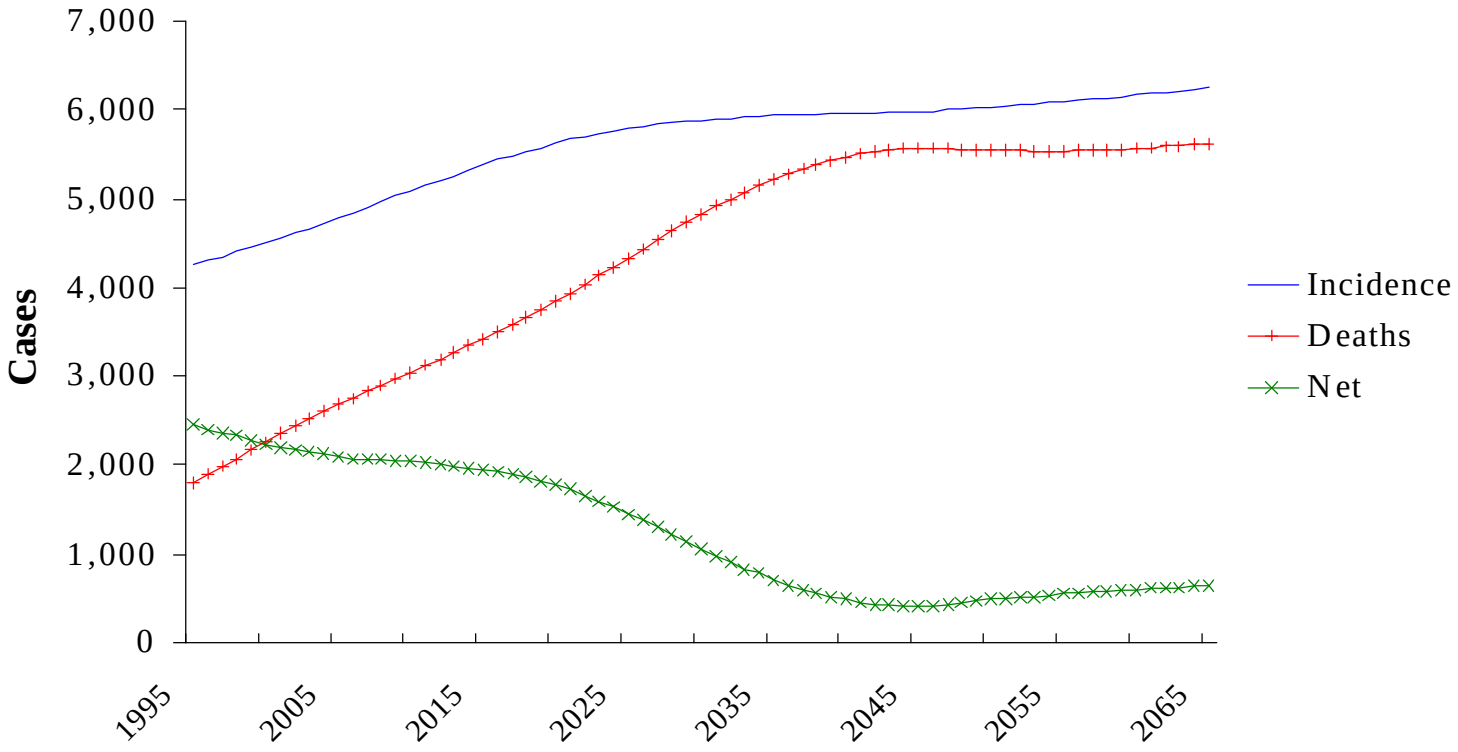
Age-specific Prevalence of Diabetes, Status Indians: 1995, 2005, 2015, 2025



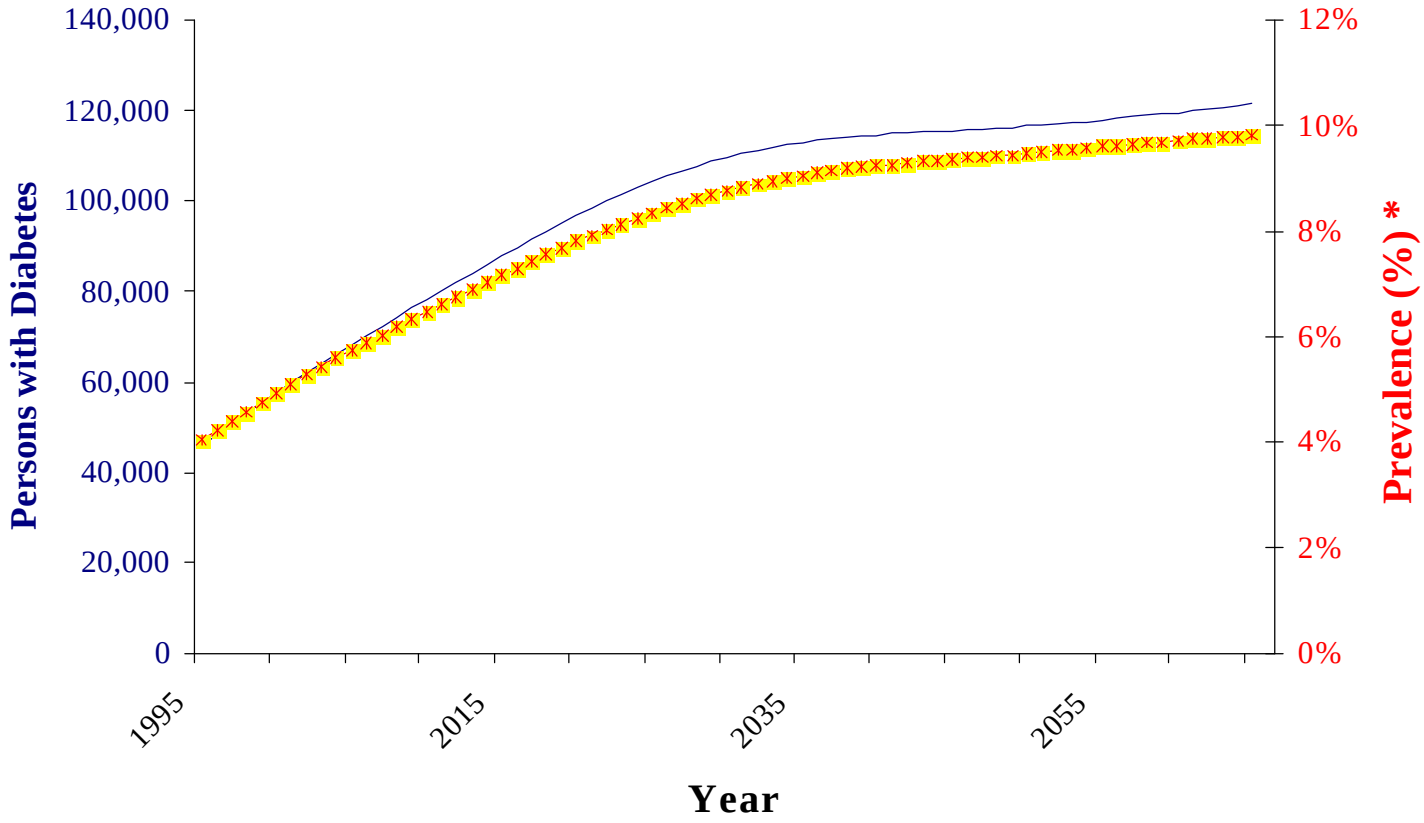
Age Distribution of Manitoba Status Persons with Diabetes, 1995 to 2025



Projected Number of New Cases, Deaths, and Net Growth for Diabetes, All Manitoba 1995-2065



Projected Prevalence of Diabetes in Manitoba, 1995 to 2065



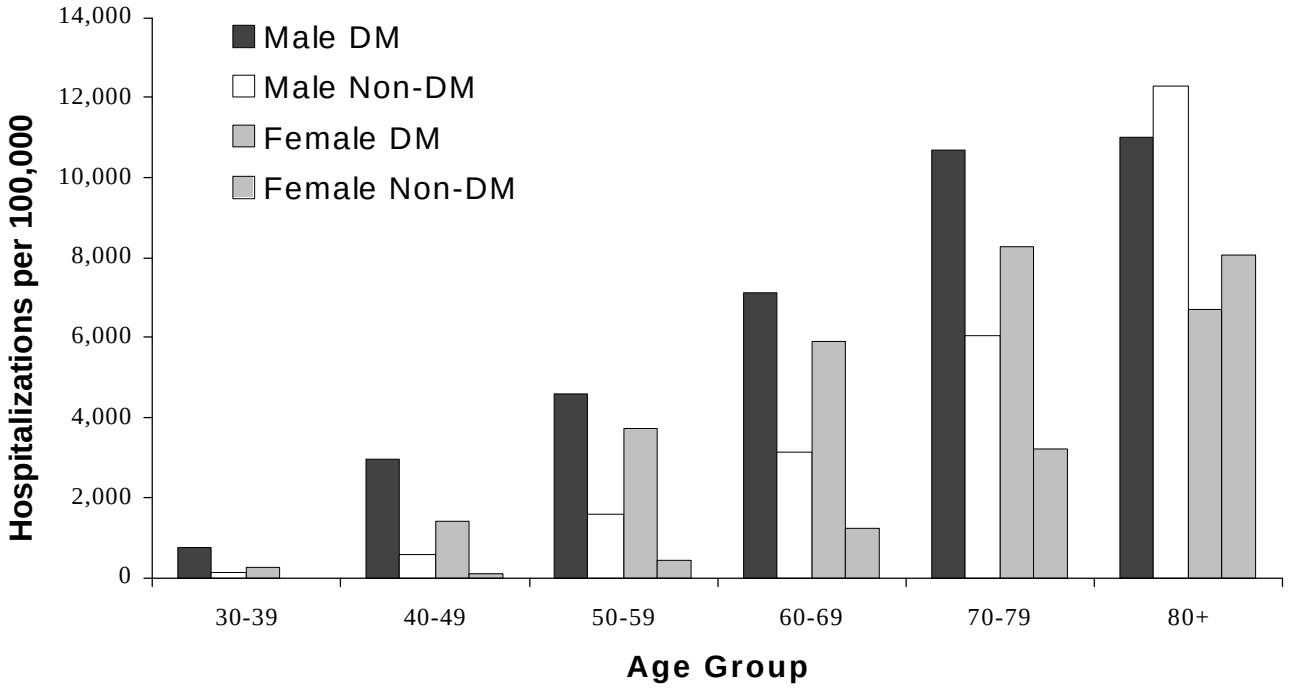
RESULTS II

DIABETES COMPLICATIONS AND HEALTH CARE COSTS

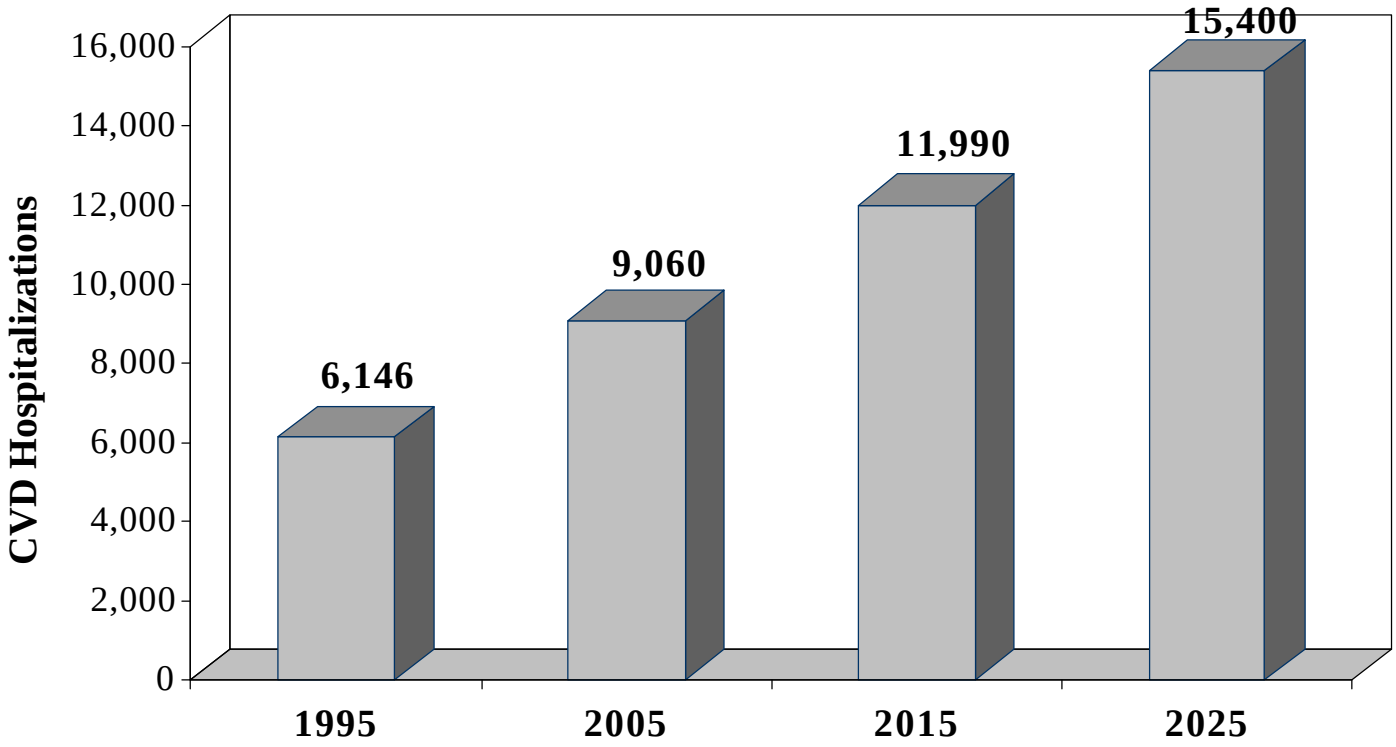
Methods for Complications

- Focus on three measures of complications:
  - Cardiovascular disease hospitalizations.
  - Lower limb amputations.
  - New persons on renal dialysis.
- Projection methods:
  - Calculate the current incidence of complications by age, gender, and Status.
  - Apply current rates to the projected diabetic population.

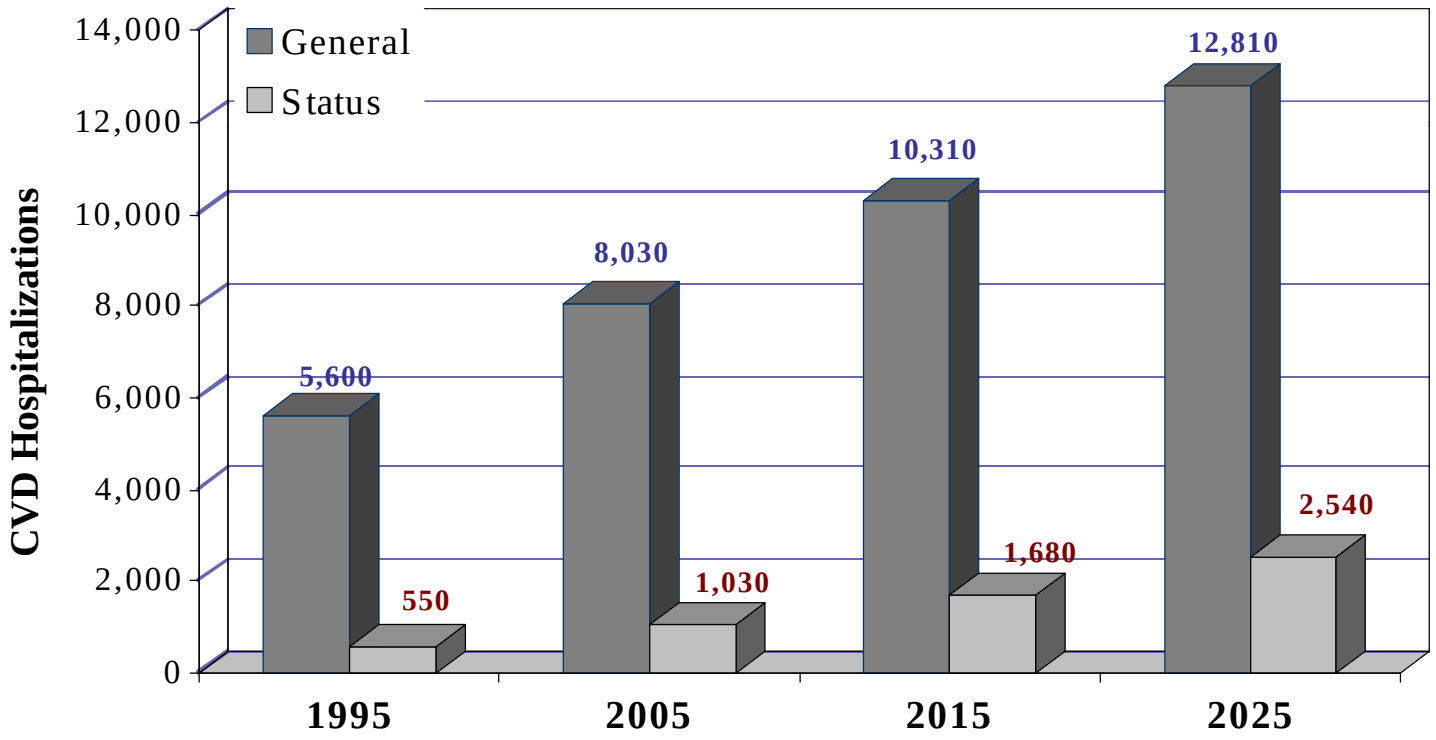
Cardiovascular Disease Hospitalization Rates by Diabetic Status, Age, and Gender



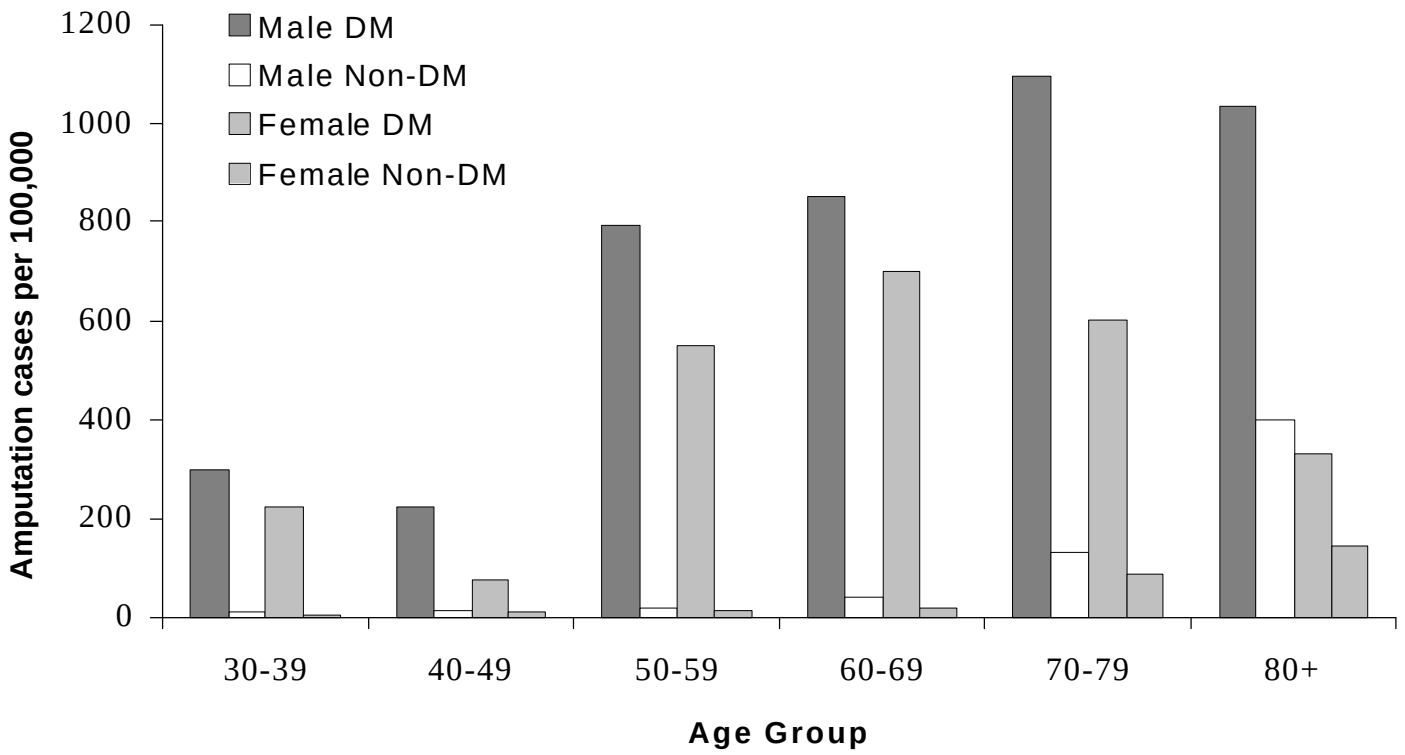
Projected Number of Cardiovascular Disease (CVD) Hospitalizations Among Persons with Diabetes



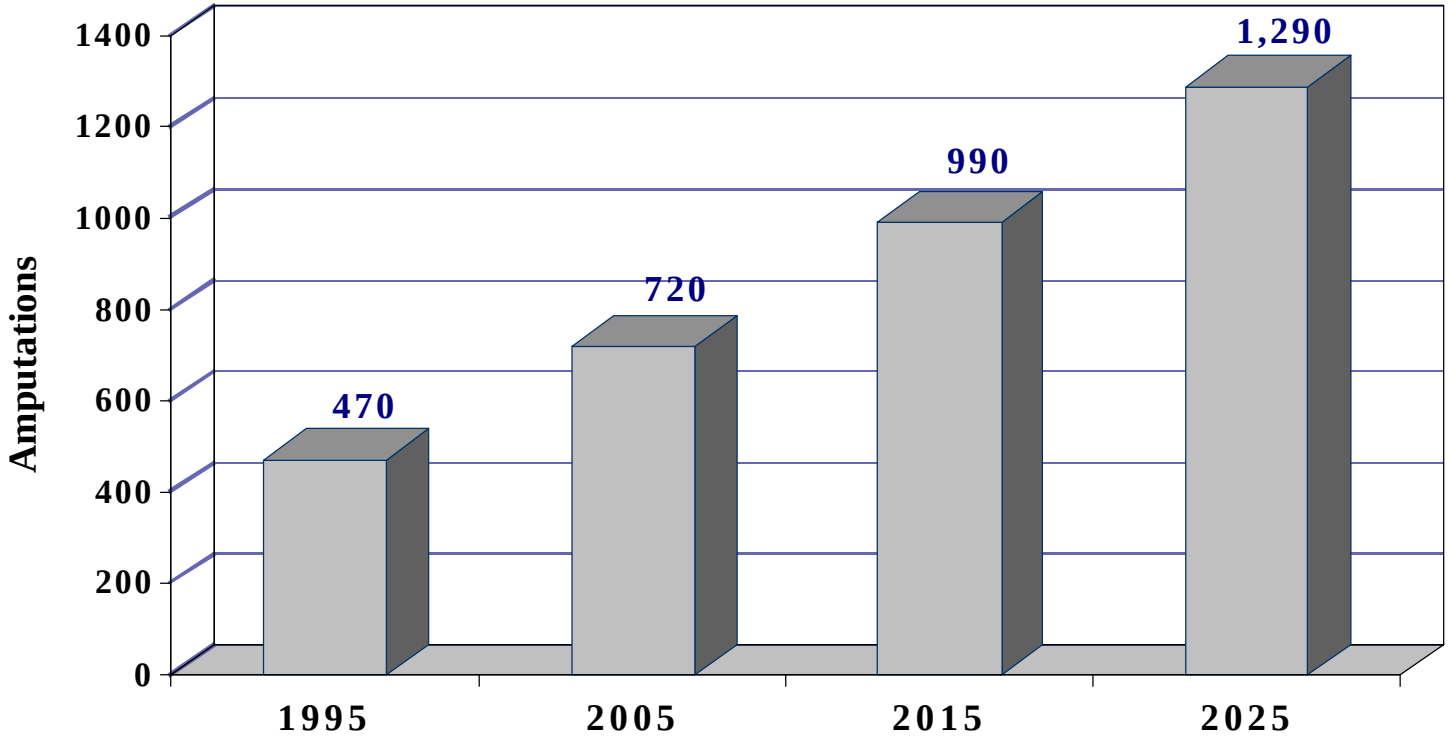
Projected Number of Cardiovascular Disease (CVD) Hospitalizations Among Persons with Diabetes, By Status



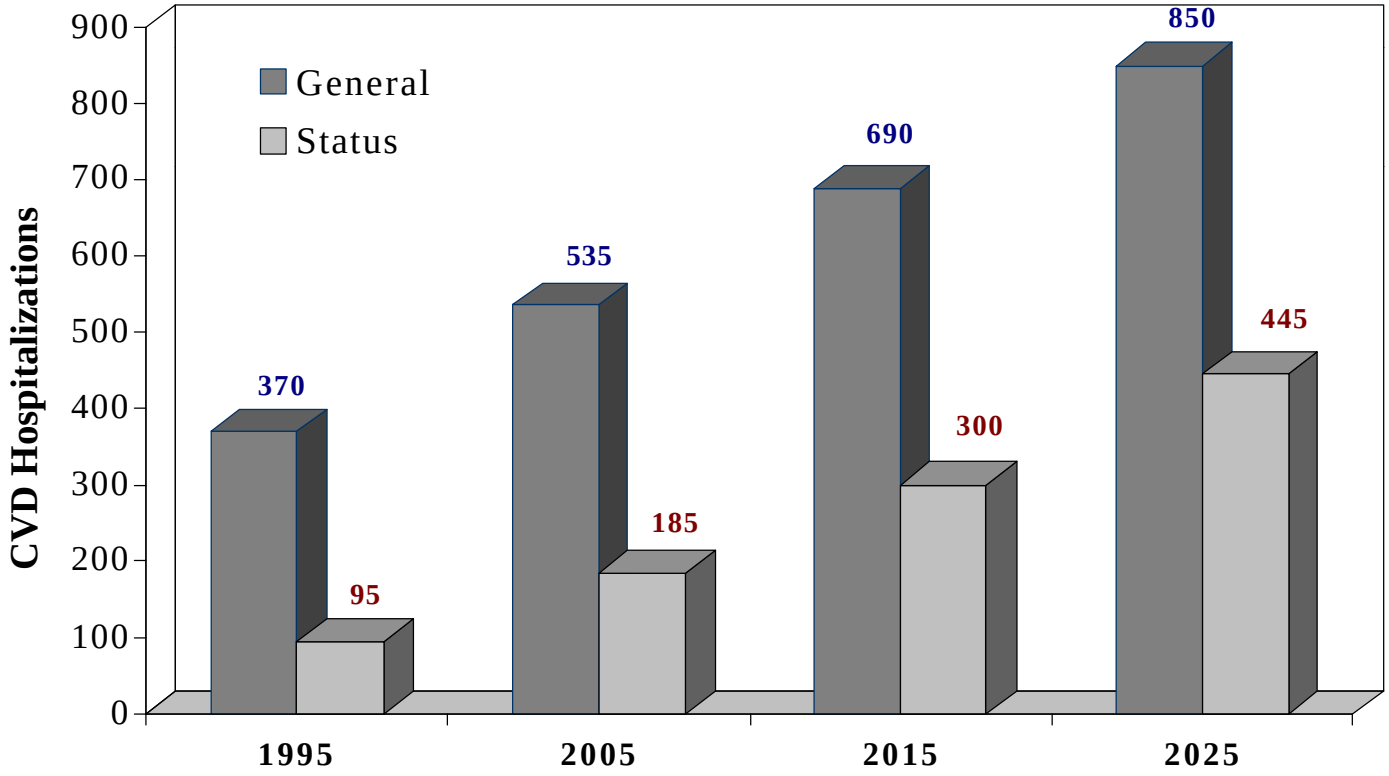
Lower Limb Amputation Rates by Diabetic Status, Age, and Gender



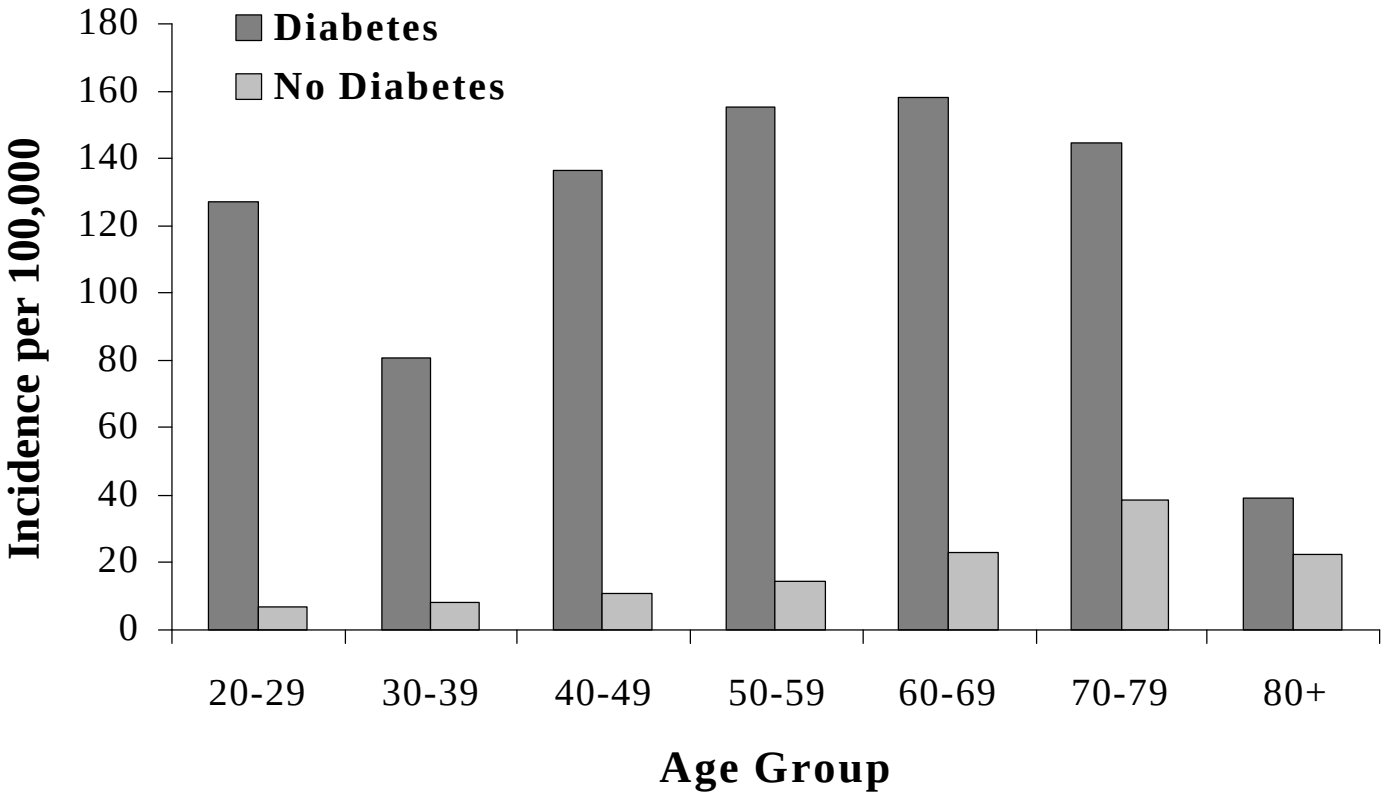
Projected Number of Lower Limb Amputations Among Persons with Diabetes



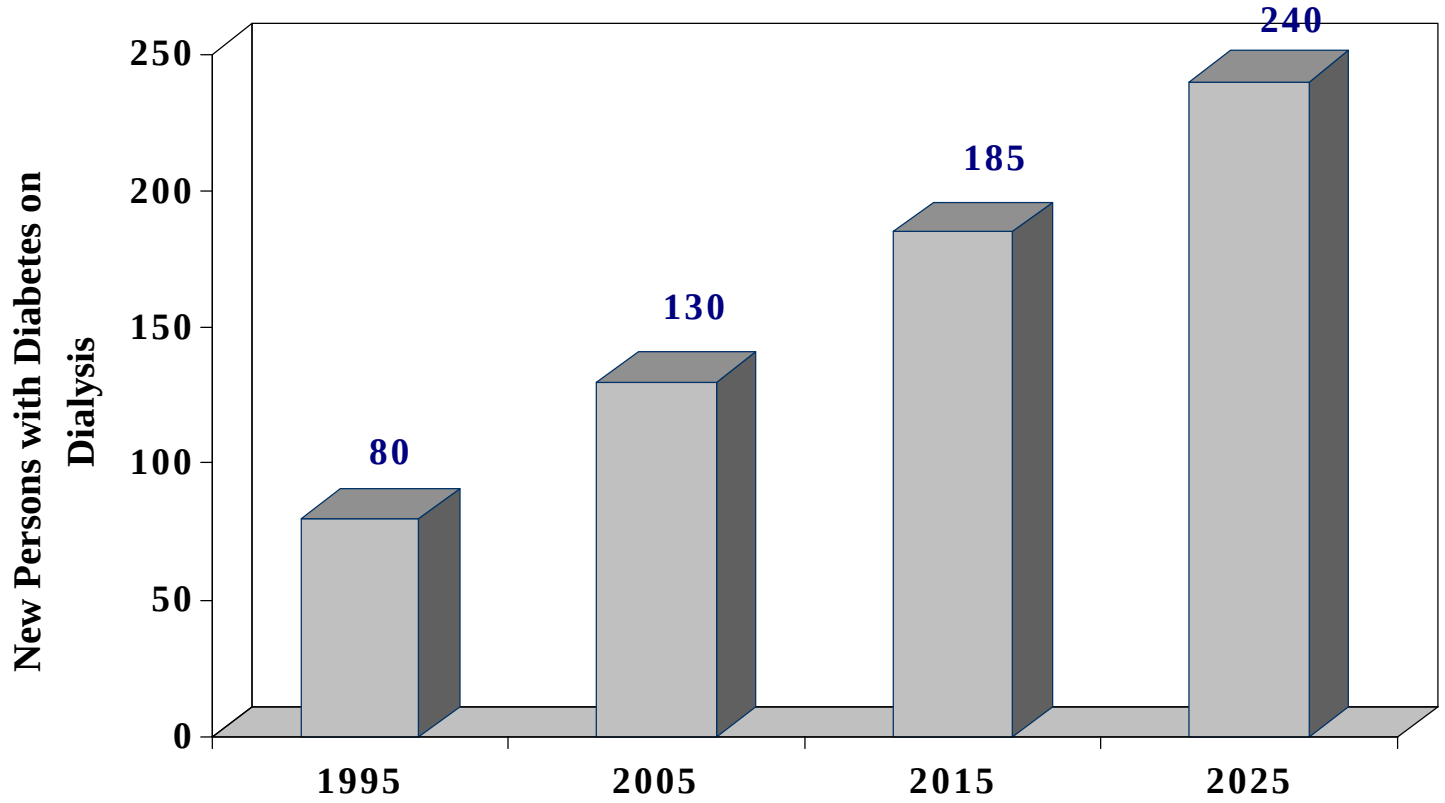
Projected Number of Lower Limb Amputations Among Persons with Diabetes, By Status



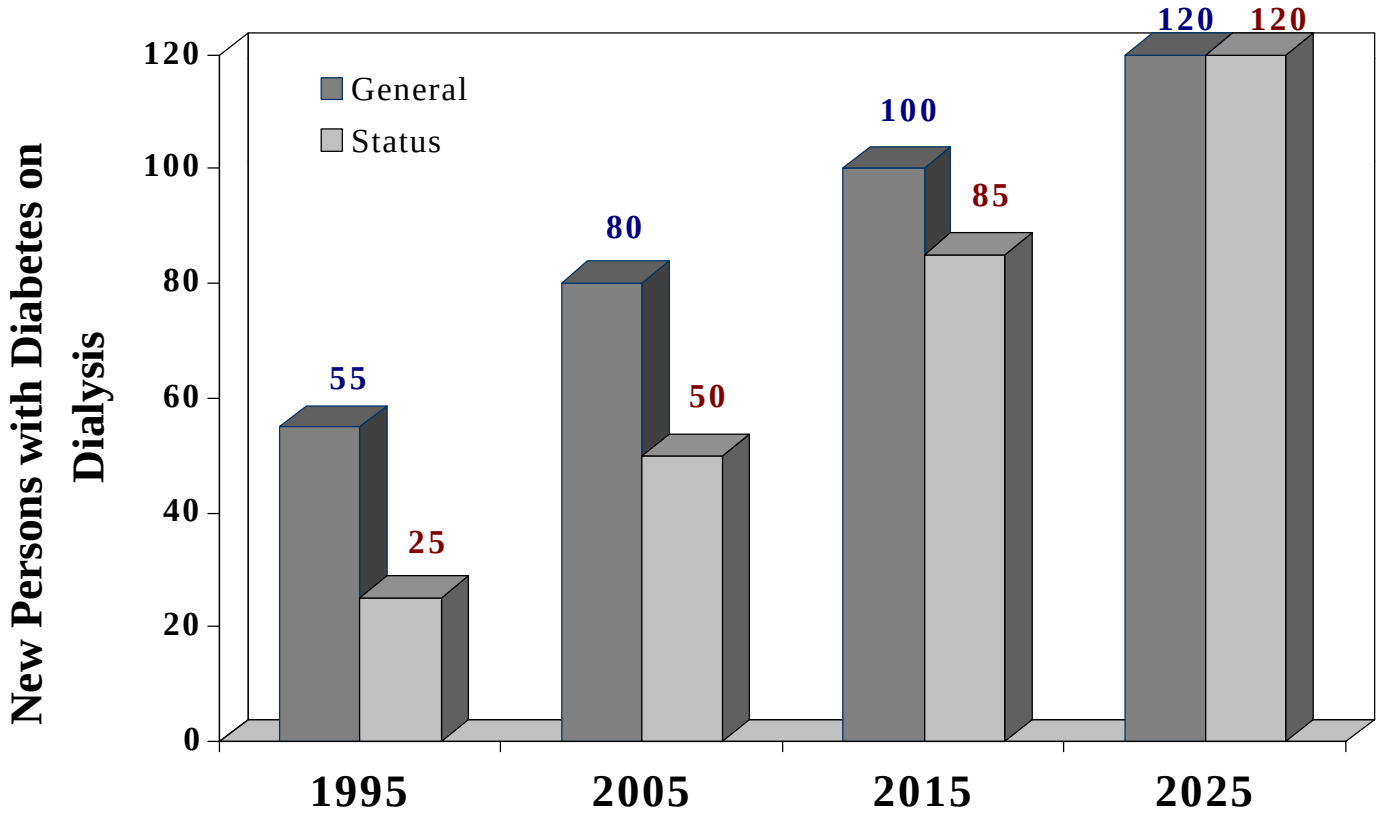
Incidence of New Persons on Dialysis, By Age and Diabetic Status



Projected Number of New Persons with Diabetes On Dialysis



Projected Number of New Persons with Diabetes On Dialysis, By Status



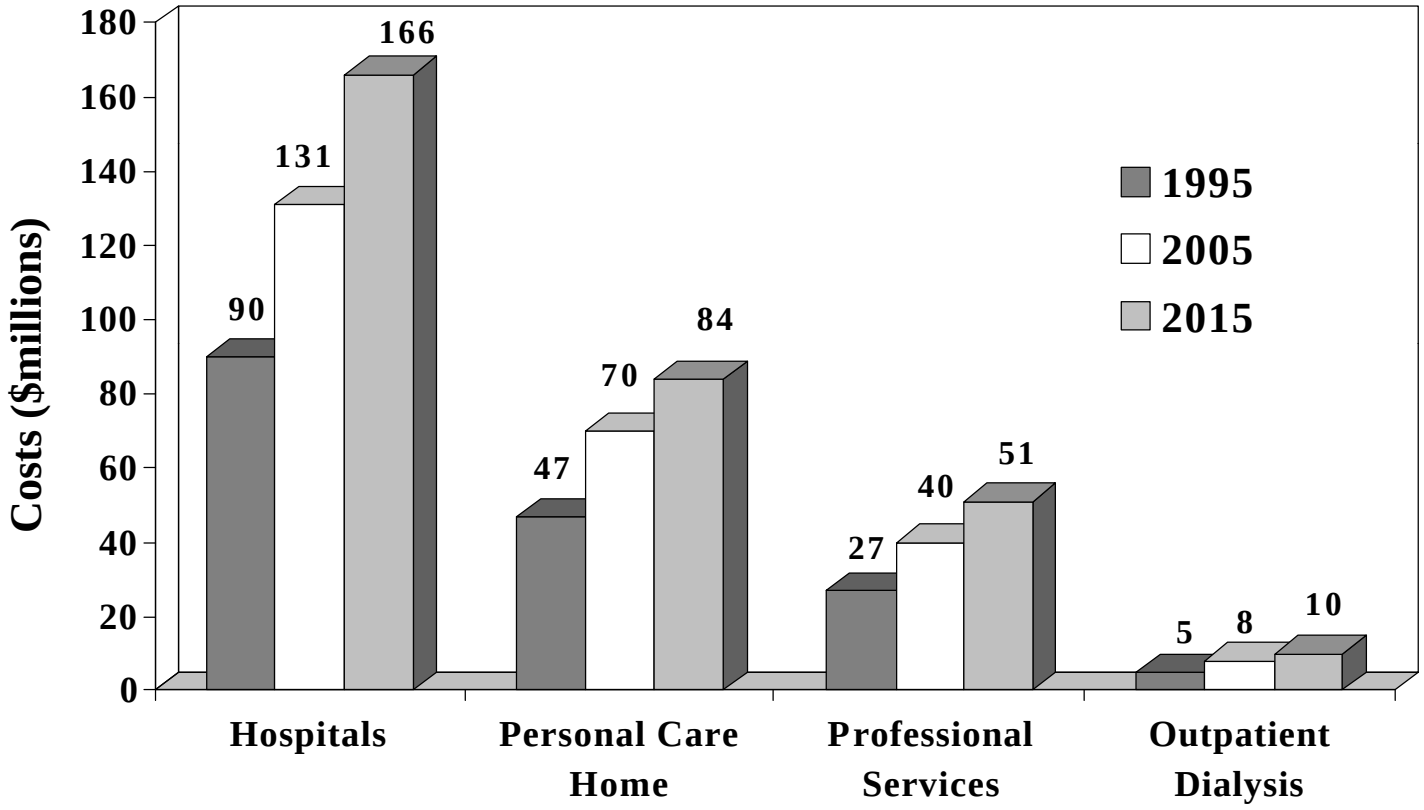
Costing Methodology

- Considered only direct costs due to:
  - Hospitalizations.
  - Professional services (e.g. physician billings).
  - Personal care home costs.
  - Outpatient dialysis services.
- Estimates based on per capita costs among persons with diabetes during fiscal year 1995/96, by age and Status.

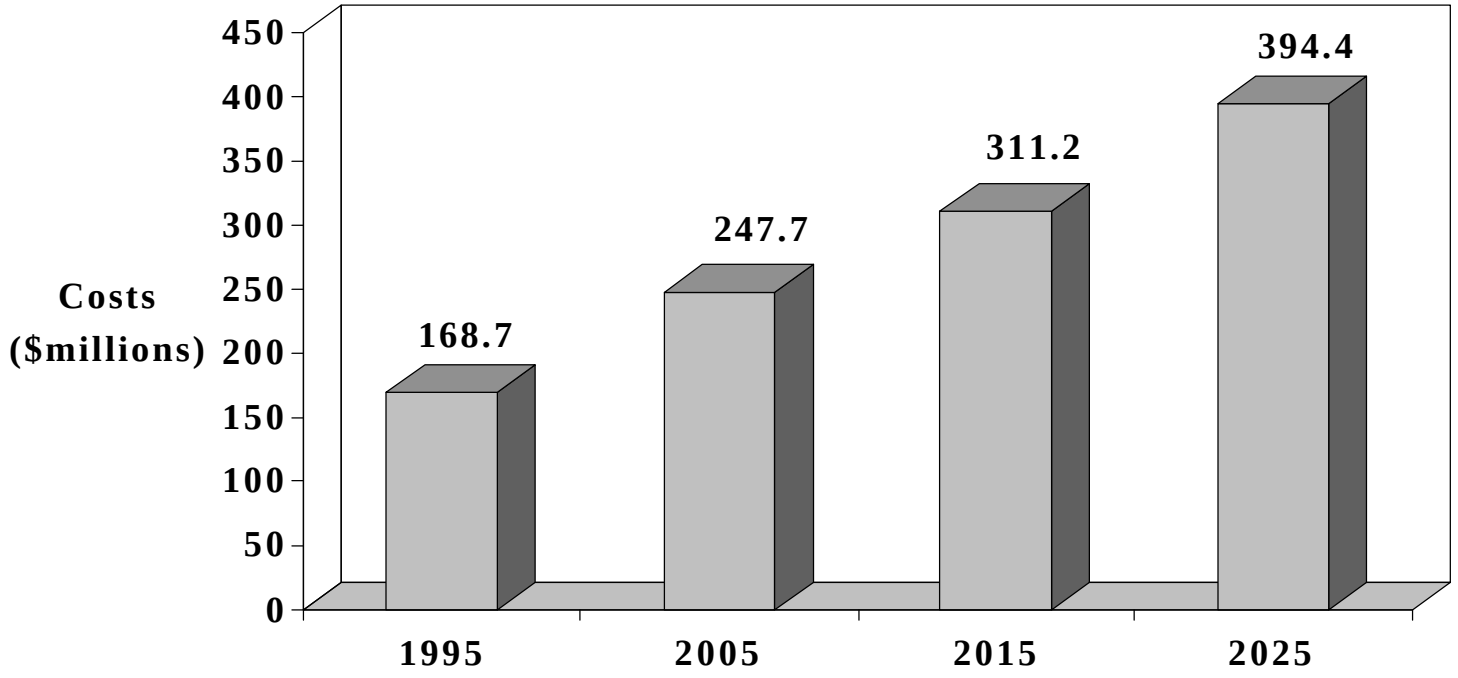
Estimated Selected Direct Health Care Costs, Manitoba 1995/96

	General Population		Status Population	
	Diabetes	**No Diabetes**	**Diabetes**	**No Diabetes**
Hospital	**$1196**	**$479**	**$2362**	**$893**
PCH	**$340**	**$251**	**$195**	**$156**
Professional	**$519**	**$271**	**$606**	**$267**
Dialysis	**$114**	**$10**	**$493**	**$43**
Total	**$2169**	**$1011**	**$3656**	**$1359**

Projected Costs of Selected Health Care Services Among Persons with Diabetes: Manitoba

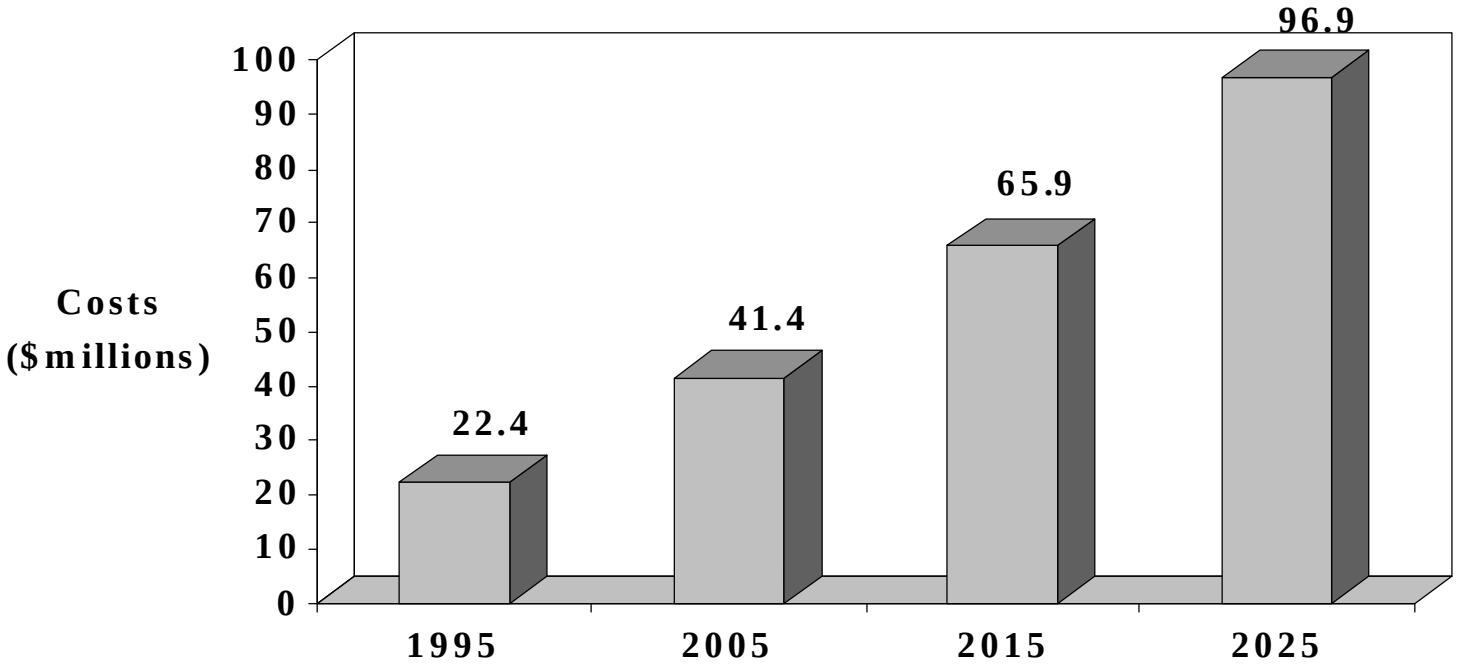


Selected* Direct Health Care Costs for Persons With Diabetes: Manitoba 1995



* includes hospitalizations, professional (physician) services, personal care home, outpatient dialysis

Selected* Direct Health Care Costs for Status Persons With Diabetes: Manitoba 1995



* includes hospitalizations, professional (physician) services, personal care home, outpatient dialysis

RESULTS III

CANADIAN PROJECTIONS

Methodology Notes

- Assumes that the age-specific prevalence is the same as Manitoba.
- Uses Statistics Canada population estimates.

Summary

- Unless there are substantial declines in diabetes incidence:
  - The prevalence of diabetes will continue to rise.
  - This will be due to a rising prevalence and a continued aging of the population.
  - Much of the increased prevalence will occur in older age groups.
  - The rise in prevalence will be much greater in the Aboriginal population.

Summary (cont.)

- Unless there are substantial declines in the incidence of diabetic complications:
  - The health burden due to all types of diabetic complications will continue to rise.
  - This will be due to a rising prevalence of diabetes and an aging diabetic population.
  - Health care costs associated with diabetes will rise dramatically.
  - Diabetic complications will rise more quickly in the Aboriginal population.

RECOMMENDATION

- Address diabetes as a ***public health*** issue.

A Public Health Approach

- Focuses on prevention.
- Population-based.
- Strategic.
- Evidence-driven.
- Multisectoral and multidisciplinary.