# Comparison of direct costs of type 2 diabetes care: Different care models with different outcomes

C.B. Giorda [a,*], R. Picariello [b], E. Nada [c], B. Tartaglino [c], L. Marafetti [a], G. Costa [b,d], A. Petrelli [b], R. Gnavi [b]

[a] Metabolism and Diabetes Unit, ASL TO5, Regione Piemonte, 10023 Chieri, TO, Italy
[b] Epidemiology Unit, ASL TO3, Regione Piemonte, Grugliasco, TO, Italy
[c] Chaira Medica Association, Chieri, TO, Italy
[d] Department of Public Health, University of Torino, Italy

**Abstract** *Backgrounds and aims:* To compare direct costs of four different care models and health outcomes in adults with type 2 diabetes.
*Methods and results:* We used multiple independent data sources to identify 25,570 adults with type 2 diabetes residing in Turin, Italy, as of 1 July 2003. Data extracted from administrative data databases were used to create four care models ranging in organization from highly structured care (integrated primary and specialist care) to progressively less structured care (unstructured care). Regression analyses, adjusted for main confounders, were applied to examine the differences between the models in direct costs, mortality, and diabetes-related hospitalizations rates over a 4-year period. In patients managed according to the unstructured care model (i.e., usual care by a primary care provider and without strict guidelines adherence), excess of all-cause mortality was 84% and 4-year direct cost was 8% higher than in those managed according to the highly structured care model. Cost ratio analysis revealed that the major cost driver in the unstructured care model was hospital admissions, which were 31% higher than the rate calculated for the more structured care models. In contrast, spending on prescription medications and specialist consultations was higher in the highly structured care model.
*Conclusion:* A diabetes care model that integrates primary and specialty care, together with practices that adhere to guideline recommendations, was associated with a reduction in all-cause mortality and hospitalizations, as compared with less structured models, without increasing direct health costs.
© 2014 Elsevier B.V. All rights reserved.

## Introduction

Aside from the toll diabetes takes on the body in terms of disability, morbidity and mortality, it has become one of the major cost drivers in national health service budgets [1,2]. Currently, it absorbs 10–15% of total health care spending and its socioeconomic burden is estimated to increase in the coming decades [3]. Health care models that successfully implement patient recall and annual screening have proved to be effective in identifying and treating at-risk patients and in reducing complications, whereas less structured care has been associated with poorer outcomes [4,5]. Although care models that reduce diabetes-related morbidity and hospital utilization can curb costs and promote the sustainability of diabetes care, little information exists on the real cost of such care models and the differences in actual consumption of resources.

* Corresponding author.
  E-mail address: giordaca@tin.it (C.B. Giorda).

In a previous analysis of multiple data sources for Turin, quality-of-care processes were evaluated with regard to adherence to guideline recommendations and as to whether guideline adherence was more consistent in patients receiving combined specialist and primary care than in those seen only by their primary care physician [6]. The main finding of the study was the effect of care processes and organizational factors (type and quality of care) had on diabetes endpoints [7]. As compared with patients who received high-quality care, in those who received usual care (i.e., no planned screening and no specialist referrals), excess all-cause mortality was 72%, and excess incidence of cardiovascular events was 32%. These trends were consistent for all outcomes: mortality for cardiovascular diseases and cancer was higher.

As seen in other chronic care models, however, the question arises as to whether current gaps in diabetes care need to be improved by reorganizing services and allocating resources so that investment in collaborative care would yield better health outcomes and cost savings. To address concerns about the sustainability of diabetes care, we thought it useful to compare the outcomes and costs of four different type 2 diabetes care models from the perspective of a universal public health service. Our aim was that this new understanding may be used to inform policies and develop strategies for diabetes care.

## Methods

The study base of this cohort study included persons residing in Turin (population, 900,000) as of 1 July 2003, aged from 36 to 80 years, with a diagnosis of type 2 diabetes. All Italian citizens, irrespective of social class or income, are cared for by a primary care physician (GP) as part of the National Health Service (NHS). Up to 60–70% of the care for people with diabetes is shared with a public network of about 650 diabetes clinics which deliver diagnostic confirmation, therapy, prevention, and early diagnosis of complications through close patient follow-up by a team of diabetologists, nurses and dieticians, and the scheduling of regular check-ups. Most patients are referred to these care units by their primary care physician and care is free of charge.

As detailed elsewhere [8], we used three data sources to identify persons with diabetes: 1) the register of Turin residents discharged from hospitals with a primary or secondary diagnosis of diabetes; 2) the register of antidiabetic drug prescriptions; and 3) the Regional Diabetes Registry, an administrative database of persons with diagnosed diabetes and exempt from out-of-pocket payment for antidiabetic drugs and consumables. All data sources were matched using a unique anonymous identifier (encrypted to protect patients' privacy) in deterministic linkage and then further linked to the Turin Population Register to include people alive on 1 July 2003, measure educational level, and identify health service areas, the smallest administrative subunit of the National Health Service (NHS). Because the automated system is anonymous, ethical committee approval and informed consent were not required. To minimize the inadvertent inclusion of persons with type 1 diabetes or gestational diabetes, as they come under specialist care for their condition, we excluded persons aged ≤35 years and those between 36 and 40 years treated with insulin alone.

Disease severity was estimated according to prescribed therapy and whether cardiovascular disease was present. Data on therapy were retrieved from the databases of antidiabetic drug prescriptions. Treatment was categorized as: no drug therapy; oral antidiabetics; and insulin. Patients prescribed both insulin and oral antidiabetics were included in the "insulin treatment" category; persons with diabetes who had not received any antidiabetic drug prescription were included within the "no drug therapy" category. All patients discharged from a hospital in the previous 5 years with a diagnosis of coronary heart disease, cerebrovascular disease or arterial disease were defined as having a diagnosis of cardiovascular disease.

Educational level was measured in three ordinal levels: high (college/high school, with ≥13 years of education), medium (middle school, with 9–12 years of education), and low (elementary school/no formal education, with ≤8 years of education).

All Italian citizens are entitled to primary care from a primary care physician and obtain through the NHS access to health care services which are recorded in a regional database. All claims for laboratory tests and specialist medical examinations reimbursed by the NHS from 1 January 2002 to 30 June 2003 (18 months) were linked to the population with diabetes. Accordingly, we were able to identify a Guidelines Composite Indicator (GCI), a performance measure which includes at least one glycated hemoglobin (HbA1c) test, plus at least two other examinations: fundoscopy, total serum cholesterol, or microalbuminuria. Fulfillment of GCI criteria was taken as a proxy measure for adequate adherence to diabetes screening guidelines [6].

Persons with type 2 diabetes who had at least one consultation with a diabetologist between 1 January 2002 and 30 June 2003 were categorized as receiving specialist care from a diabetes clinic, whereas those who had not were categorized as being cared for by their primary care physician only (more than 99% of patients had at least one contact with a GP in the same period). Accordingly, four care models were created: 1) "unstructured care" (care delivered by a primary care physician but not through a diabetes clinic and not meeting GCI criteria, i.e., poor guidelines adherence); 2) "only specialist care" (care delivered by a primary care physician and through a diabetes clinic but not meeting GCI criteria, i.e., poor guidelines adherence); 3) "only GCI" (care delivered by a primary care physician and not through a diabetes clinic but meeting GCI criteria, i.e., good guidelines adherence); 4) and "structured care" (care delivered by a primary care physician and through a diabetes clinic and meeting GCI criteria, i.e., good guidelines adherence).

Patients were followed up from 1 July 2003 to 30 June 2007 for all-cause and cardiovascular mortality, hospitalizations, and health care costs for NHS services. Data on