The Medical Care Costs of Mood Disorders: A Coarsened Exact Matching Approach

Stefanie Schurer
Michael Alspach
Jayden MacRae
Greg L. Martin

January 2015

The Medical Care Costs of Mood Disorders:
A Coarsened Exact Matching Approach

Stefanie Schurer
University of Sydney and IZA

Michael Alspach
Statistics New Zealand

Jayden MacRae
Compass Health

Greg L. Martin
Victoria University of Wellington

ABSTRACT

The Medical Care Costs of Mood Disorders:
A Coarsened Exact Matching Approach[*]

This paper is the first to use the method of coarsened exact matching (CEM) to estimate the impact of mood disorders on medical care costs in order to address the endogeneity of mood disorders. Models are estimated using restricted-use, general practice patient records data from New Zealand for 2009-2012. The CEM model, which exploits a discretization of the data to identify for each patient with a mood disorder a perfect statistical twin, yields estimates of the impact of mood disorders on medical costs that are lower than the estimates obtained from random effects models or conventional matching methods. For example, mood disorders lead to NZ$366 higher annual medical costs (in 2012 dollars) when perfect balancing of covariates is achieved, while minimal and conventional balancing yield estimated costs of over NZ$465 and NZ$400, respectively. The national government expenditures on managing mood disorders is estimated to be 13.4% of total general practice funding (NZ$123 Million) based on CEM.

Corresponding author:

Stefanie Schurer
School of Economics
The University of Sydney
Room 370, Merewether Building
Sydney, NSW 2006
Australia
E-mail: stefanie.schurer@sydney.edu.au

I Introduction

Mood disorders - depression and anxiety - are the fourth-leading cause of life-years lost due to disability worldwide, and the primary cause of loss of health in middle- and high-income countries (Lopez et al., 2006). The 12-month prevalence rates of, for instance, depression in Western European countries suggest that in any year in time up to 10% of a population suffer from an episode of depression (Greenberg et al., 2003; Thomas and Morris, 2003; Wells et al., 2006). Prevalence rates have grown steadily (Greenberg et al., 2003; Sobocki et al., 2007; Chang et al., 2012; Goldney et al., 2010).

Most patients suffer from their symptoms at repeated intervals (e.g. Roy and Schurer, 2013; Rouillon, 2011). During an acute episode, patients have difficulties to concentrate, are overly tired, lack motivation, and are significantly impaired in mastering daily routines. Such side-effects have been reported to reduce an individual's labor supply (e.g. Stewart et al., 2003) and efficiency while working (e.g. Berndt et al., 1998, 2002). The resulting economic burden of managing mood disorders for society is likely to be large.

As easy-to-use medication became available, many countries, including New Zealand and Australia, have opted to treat mood disorders in a primary care setting to integrate patients better into their communities (Sobocki et al., 2007; Greenberg et al., 2003; Fullerton et al., 2011). New Zealand's Ministry of Health recommended to general practitioners in its Evidence-based Best Practice Guidelines that depression should be treated with both drug regimes and counseling sessions (New Zealand Guidelines Group, 2008). For New Zealand, no study exists that calculates the current national government expenditures on managing mood disorders in general practice.

In this study, we fill this gap by using de-identified, patient-record data from general practice

consultations of an adult population provided by Compass Health, a Wellington-based primary care service provider, over a period of three years. In contrast to many other studies, which we will review in the next section, we estimate the medical care costs managing these conditions as a proportion of total national expenditures on general practice. We also depart from the general literature by applying coarsened exact matching methods (Ho et al., 2007) to address the potential endogeneity in the experience of mood disorders. Often mood disorders are the direct consequence of the experience of pain-intensive chronic illnesses, which also lead to a high level of health care utilization. Simply summing up all health care costs of individuals diagnosed with mood disorders will therefore overstate their economic burden. Coarsened exact matching methods allow us to carefully separate the medical cost of managing mood disorders from the medical costs caused by co-morbidities.

A crucial advantage of our patient-record data is that we directly observe the clinical diagnoses of mood disorders, and of any other co-morbidity, each service provided to primary-care patients and its price. Knowledge of each service provided allows us to accurately count and calculate each cost component, and therefore to assess the dominant treatment regimes that patients receive. Further, using a sophisticated word-search algorithm, we are able to derive from the GPs' clinical notes for each patient the total days not at work, if a medical certificate was issued, and make statements about the likely cost of lost productivity. Last, the availability of more than half of the total patient population in the area of study enables us to almost exactly match all individuals who suffer from mood disorders with a statistical twin based on a large battery of observable characteristics.

The final purpose of our study is two-fold. On the one hand, we seek to provide a most realistic estimate of the national government expenditures of managing one of the leading causes

of life-years lost. Such a number is relevant not only to policy-makers as an economic rationale for advocating higher (or lower) levels of expenditures, but also to treasury representatives to understand the leading contributors to government expenditures. On the other hand, we seek to provide an illustration of the usefulness of coarsened exact matching to calculate a realistic figure of public expenditures when endogeneity of the treatment (in our case mood disorders) is of concern.

II Economic cost of mood disorders

To best of our knowledge no study exists on the economic cost, in terms of national government expenditures, of managing mood disorders for New Zealand. Previous studies have assessed this question from a large-scale perspective for various countries in the OECD (Greenberg et al., 2003; Thomas and Morris, 2003; Cuijpers et al., 2007; Sobocki et al., 2007; Chang et al., 2012), across the European Union (Sobocki et al., 2006), and for South Australia (Hawthorne et al., 2003). The existing studies derive their national estimates of the economic burden of mood disorders through an accounting exercise in which the various cost components – the direct cost incurred through health care utilization and the indirect costs that result from lost productivity – are added up. To put the total costs into perspective, these studies compare the relative contribution of direct and indirect to the overall costs, and present the total costs as a proportion of GDP.

A review of this literature (See Table A.1, Online Appendix) shows that the total economic costs amount to about 1% of GDP in all countries except for South Korea (Chang et al., 2012) and South Australia (Hawthorne et al., 2003) where they represent 0.48% and 2.1% of GDP, respectively. In most studies, indirect costs are estimated to be higher than direct medical costs. At the low end are countries from the European Union for which lost productivity makes up 64% of

the total costs (Sobocki et al., 2006), whereas at the high end are South Korea and England with a share of 95% (Chang et al., 2012; Thomas and Morris, 2003). In most other studies, the costs due to lost productivity are 2-3 times larger than the costs due to health care utilization (Sobocki et al., 2006; Greenberg et al., 2003; Cuijpers et al., 2007; Hawthorne et al., 2003).

One reason for the large variation in costs across studies is that the 12-month prevalence rates of depression, which are used as the basis for extrapolating the sample calculations to a nationally representative number, differ widely. For instance, in the US the 12-month prevalence rate is 8.7%, but in South Korea it is only 2.5%. Another reason for the differences in the total cost of depression is the large degree of variation in which cost components are included. Although each of the reviewed studies includes both hospital care and prescription drugs, only five out of the seven studies includes GP consultations.

The studies which have multiple years of data available demonstrate an increase in the economic burden of depression over time, but differ in their conclusions why this may be the case. Greenberg et al. (2003) found that in the US an increase of total costs by 7% between 1990 and 2000 is mainly driven by an increase in the demand for prescription drugs (452%) and out-patient services (47%). In contrast, Sobocki et al. (2007) explained the 100% increase of the economic burden of depression/anxiety in Sweden that was observed between 1995 and 2007 with an increase of indirect costs by more than 130%.

None of the reviewed studies net out from the total cost the costs attributed to illnesses that coincide or cause depression such as the experience of chronic pain (Eaton, 2002; Frassure-Smith and Lesperence, 1995; Massie, 2004) or other chronic illnesses. In such a scenario, the total costs attributed to mood disorders are likely to be overestimated.

III Data

In this study we use clinical patient-record data obtained from primary care consultations in New Zealand to calculate the net medical and productivity-related cost of mood disorders. The data are made available by Compass Health which is a non-profit umbrella organization that provides quality management support services to general practitioners and collects data for two major Primary Health Organizations (PHOs) in three districts in the lower North Island: Mid-Central, Capital & Coast and Wairarapa. PHOs are a network of health care providers within New Zealand which were formed in the early 2000s as part of the Government's health reforms. They are funded by District Health Boards (DHB) to support the provision of essential primary health care services through general practices to those people who are enrolled with the PHO. Funding to these providers is based on the number of enrolled patients.

Compass Health manages 101 general practices that represent 88% of almost half a million patients registered with a primary health-care provider in this area. In exchange for reimbursement, primary health-care providers are contractually obliged to supply Compass Health with utilization data. Such information include the type and total number of services and referrals provided, the prices charged for the service, and patient details.

We acquired special permission to extract the clinical data (diagnosis and clinical notes) from general practices. In total, 50 practices, representing 56.5% of all patients managed by Compass Health, agreed to participate in this study. Participating practices did not differ in size and location from non-consenting (22) or non-responding (28) practices.

Compass Health provided us with three years of data (mid 2009 to mid 2012). Patients are identified over time by a unique national health number which is assigned for life to patients

when first time registering with a health-care provider anywhere in New Zealand. Patients were included in the final data set if complete information was available in all three years. Apart from clinical data, the data set contains personal information for each patient, such as date of birth, gender, ethnicity and location of residence. Knowledge of the location of residence allows us to match each individual to the smallest geographic unit available, so-called Meshblocks, for which statistical data is collected by Statistics New Zealand.

Patients were classified as suffering from depression or anxiety if they were diagnosed with depression or anxiety, and/or were prescribed anti-depressant/anti-anxiety medication in any of the three years of data available. We excluded all patients who were diagnosed with any another mental health condition. Diagnosis of depression/anxiety is based on the relevant Read Codes, the most widely used diagnosis classification system in New Zealand general practice (De Lusignan, 2005). As GPs often refrain from assigning a Read Code to a diagnosis, we complement our definition with the prescription of antidepressants, in particular selective serotonin re-uptake inhibitors.[1] Currently, 10% of New Zealand's population has been reported to having been prescribed antidepressants since 2006 (Exeter et al., 2009), a number which roughly coincides with the average 12-month prevalence rate (survey based) of depression and anxiety (Wells et al., 2006).

We constructed a measure for the total costs per patient per year by summing the following components:

$$\text{Cost}_{it} = \text{GPcon}_{it} \times P_{it}^{GP} + \text{Pharm}_{it} \times P_{it}^{Ph} + \text{Path}_{it} \times P_{it}^{Pa} + \text{Coun}_{it} \times P_{it}^{C} + AW_{it} \times Wage_{it},$$

(1)

---

[1]We included codes for all of the twenty approved antidepressants, but the most common are Paroxetine (Aropax) and Fluoxetine (Prozac). These are also commonly used to treat anxiety (Wells et al., 2006). We consulted two mental health care practitioners to identify an appropriate definition of depression/anxiety in the New Zealand institutional context.

where C_{it} represents the total costs expressed in New Zealand dollars (referred to as NZ$) price-adjusted to the second quarter of 2012, i and t refer to the individual and year, respectively. The individual cost components are the total number of: (1) General practice consultations $GPcon_{it}$, (2) prescription drugs $Pharm_{it}$, (3) pathology tests $Path_{it}$, (4) counseling services $Coun_{it}$, and (5) days absent from work AW_{it}. Each component's total count is multiplied by its current, inflation-adjusted price.

Prices to calculate each cost component are obtained from various sources. Prices for GP consultations (P_{it}^{GP}) were extracted from patient co-payment data. The prices for prescription drugs (P_{it}^{Ph}) are obtained from Pharmac, the Government's drug buying agency. We added an extra \$3.00 to each prescription drug that is charged by the pharmacy dispensing the drug. The price for pathology tests (P_{it}^{Ph}) was calculated on the basis of a weighted average of prices that we obtained through telephone interviews from four Wellington-based laboratories (Medlab Central Limited, SCL Hawke's Bay Limited, Hawke's Bay DHB, Aotea Pathology Limited).

The price of counseling services (P_{it}^{C}) was derived from data collected in the Primary Solutions programme run by Compass Health. It is the only subsidized counseling service available to patients with mental health problems. Access to the program is restricted to patients younger than 25 years, from economically weak backgrounds, from Maori or Pacific background, and requires a GP referral. No data are available on privately-financed counseling sessions for which no GP referral is required.

We measure the cost of absenteeism ($AW_{it} \times Wage_i$) as the number of days off work for which a medical certificate is required multiplied by an individual's daily labor-market income. The GP certified days off work are used as a proxy for the actual number of days taken off work in any year. Under New Zealand law employers are able to ask for proof of sickness or injury at any

time once an employee takes sick leave, but employers are not required to do so. We extracted the time interval for which the days off work were certified with the help of a natural-language-processing algorithm to identify the correct number of days. Once we obtained for each patient the total annual number of days off work, we conducted an extensive manual check to ensure the computed days off work matched the actual days off work written in the medical certificate.

As we do not know a patient's actual labor-market income, we use as proxy the median income of the smallest geographic area in which the individual resides (Meshblock).[2] A daily pay rate is calculated by dividing the Meshblock's median income by the total number of working days in a full year. Our method of estimating income represents a significant improvement over Hawthorne et al. (2003), which use a state average proxy, or Thomas and Morris (2003) and Cuijpers et al. (2007), which use national average income data stratified by age and gender.

IV Empirical methods

To estimate the treatment effect of depression and anxiety (DA_i) on the total medical and productivity-related cost C_{it}, we specify the following model:

$$C_{it} = \alpha + \beta DA_i + \gamma' X_{it} + \mu_i + \eta_{it}, \tag{2}$$

where i refers to patient i observed in time period $t = 2010, 2011, 2012$. The constant α measures the average costs in the sample. DA_i is a dummy variable that takes the value of 1 if the individual belongs to the treatment group (depression/anxiety), and 0 otherwise, and β measures the treatment effect of depression/anxiety. The vector X_{it} captures all control variables for which

---

[2]This proxy is derived from the 2006 National Census conducted and published by Statistics New Zealand, which was at the time of the study the most current Census data available.

the sample characteristics differ between treatment and control group. All remaining variations in costs are captured by individual-specific heterogeneity (μ_i) and time-period-specific shocks (η_{it}). This model is estimated with generalized least squares allowing for random effects. Assuming conditional independence and correct functional form, β estimates the causal effect of depression/anxiety on total costs.

We complement the regression analysis by employing coarsened exact and conventional matching methods. Matching estimators generally have the advantage that they force the analyst to be transparent about the effective balance of covariates between treatment and control group. Their semi-parametric nature also avoids the potential misspecification of the conditional mean of the outcome of interest, and the arbitrary specification of impact heterogeneity. In small samples matching estimators may lead to a loss of efficiency (See Imbens, 2004).

Coarsened exact matching estimators, in addition, have the advantage that they do not require an ex ante fix of the number of matched units. They control for the number of matches by setting the tuning parameters (Iacus et al., 2011; Ho et al., 2007). The estimator works best in a data scenario in which all or most covariates are discrete, which is the case in our dataset. In a first step, we find a perfect statistical twin for as many members in the treatment group as possible based on the original, categorical data. In a second step, we broaden the category of some control variable (e.g. age) and then find a perfect match for those observations which could not be matched in the first step using the coarsened categories. We repeat this exercise of coarsening the data until we have found a statistical twin for all members in the treatment group. We refer to each step in which we coarsen the data as matching generation.[3]

---

[3]We programmed the search algorithm for the exact statistical twin for each matching generation in Structured Query Language (SQL), which is a special-purpose programming language designed for managing data held in a relational database management system. It is straightforward to use STATA's psmacth2 or R-Project to conduct the CEM procedure.

The following variables are chosen for the exact-matching algorithm: (1) A discrete measure of age, (2) Gender (0,1), (3) Ethnicity (21 categories based on Statistics New Zealand classification),[4] (4) Economic deprivation of the neighborhood in which the individual lives (five categories),[5] and (5) nine major chronic health conditions diagnosed on the basis of Read code data (cancer, diabetes, arthritis, respiratory diseases, cardiovascular diseases, degenerative neurological diseases, renal diseases, gastric and intestinal diseases, and lipoid metabolism diseases). Gender, age, and ethnicity are variables that are unaffected by the treatment; economic deprivation of the neighborhood is a fixed characteristic of the area in which the individual resides; little evidence exists in the literature that depression/anxiety causes any of the nine listed chronic diseases, although evidence exists on the effect of chronic illnesses on the onset of depression (Eaton, 2002; Frassure-Smith and Lesperence, 1995; Massie, 2004).

If we cannot find an exact match based on the above criteria (which we will refer to as generation 1), we alter the matching algorithm.[6] For 66% of all cases (generation 1), we found a perfect match. When relaxing the continuous measure of age into a five-year interval (generation 2), we exactly matched another 13% of the sample. When reducing the 21 categories of ethnicity to nine broader categories (see level 1 defined by Statistics New Zealand), we were able to exactly match another 3.4% of the sample successfully (generation 3). For the remaining 17.6% (generation 4 and 5), we coarsened the data more dramatically (ten-year age intervals, number of co-morbidities in-

---

[4]See for definitions http://www.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/ethnicity.aspx

[5]The deprivation score is based on the deprivation index created by Statistics New Zealand, http://www.stats.govt.nz/browse_for_stats/people_and_communities/Geographic-areas/urban-rural-profile/explanatory-notes.aspx#moh, which is commonly presented as five quintiles ranging from 1-5, where 5 is the most deprived and 1 the least deprived neighborhood.

[6]For some cases in generation 1, we found up to nine perfect matches. In this case we chose a random selection procedure to select one single match. For three individuals we could not find any match and these were omitted from this study.

stead of distinct categories, and removing ethnicity from the algorithm). Table A.2 in the Online Appendix shows that the mean values of all observable characteristics are balanced between the treatment and control group even when pooling all five matching generations.

In the case of matching generation 1, 2 and 3 the change in the tuning parameter is minimal, which could be tolerated as small measurement error (See Iacus et al., 2011, p. 348). For these three generations, we calculate the average treatment effect on the treated ($A\bar{T}T_t$) in any particular year (t) as the average difference in total cost between patients diagnosed with, or treated for, depression/anxiety and their statistical twin. Standard errors are calculated using the delta method. The treatment effect is interpreted as the average excess cost of depression/anxiety incurred in the primary care sector and due to lost productivity. When using the sample that includes all five matching generations, we use a regression approach in which we control for the variables that were coarsened into broader categories.[7]

For comparison, we also construct the ATTs using kernel density and nearest-neighbour matching estimators (For an overview Imbens, 2004). The nearest- neighbour estimator is constructed with one match per observation (without replacement), and we choose the match with the shortest distance between treatment-group and control-group unit. In the case of the kernel-density estimator, we construct a weighted average of the outcomes of all non-treated units where the weight given to each non-treated unit depends on the closeness to the treated unit. Only units with common support are matched, which is the same assumption made in the coarsened exact matching estimator.[8]

---

[7]We alert that there is no statistically significant difference in ATTs when additionally controlling for the covariates in the full sample relative to calculating the raw mean difference. Alternatively, one can use standard matching estimators on the pruned data as employed in Jones et al. (2011). We attempted both regression and matching approaches on the pruned data and obtained almost identical results (available upon request).

[8]We use the the ado program "psmatch2" written by Edwin Leuven and Barbara Sianesi.

Finally, we use the above estimates to calculate the total cost of depression and anxiety to New Zealand's economy (CDA, see Eq. (3)). We obtain the cost ratio between treated and control group (based on the most conservative figure obtained from matching generation 1) and a nationally representative prevalence rate of depression and anxiety:

$$CDA = \left(\frac{P^D (R^{CDA} - 1)}{P^D \times R^{CDA} + (1 - P^D \times 1)} \right) \times C, \tag{3}$$

where P^D is the probability of depression/anxiety in the population, R^{CDA} is the ratio of the cost of depression/anxiety over the cost of the statistical twins, and C is the total expenditure on GP services in New Zealand for the reference period. We derive the population prevalence rate of depression and anxiety P^D by adjusting the prevalence rate obtained from our sample of lower North Island patients with population weights. These population weights are derived from Statistics New Zealand Census data (2006) on age, gender, and ethnicity.

V   Results

Our estimation sample consists of 111,575 out of 247,447 eligible patients. We excluded patients who are less than 18 years of age ($> 50\%$ of sample), who do not have complete data over three years (2%), and who suffered from alcoholism or a psychotic illness (3%). In total, the sample includes 26,889 individuals who are diagnosed to suffer from either depression or anxiety or both. The three-year prevalence rate of depression/anxiety in this clinical sample is therefore 24%, which lies within the life-time prevalence rates of depression (16%) and anxiety (25%) reported in Wells et al. (2006) (Summary statistics are accessible in Table A.3 in the Online Appendix).

Almost 80% of the sample are European and 10% are Maori or Pacific Islanders. Less individ-

uals are below the age of 30 (16.3%) than there are above 64 years (20%), but this is mainly due to our focus on the adult population. More than 17% carry a Community Services Card, which is means tested and gives the patient access to subsidized GP services and prescriptions. Almost 70% of the patients live in Capital and Coast, 22% in Mid-Central, and 8% in Wairarapa, which is representative of the population. The most common chronic illnesses after mood disorders are respiratory (12.4%), lipoid (9.6%), and cancer (8.2%) disease.

We first discuss the average treatment effect of mood disorders obtained from a random effects model, and compare the average additional costs of depression and anxiety to the average costs of other chronic illnesses. Main estimation results are presented in Table 1. In Model (1) in which we include no further control variables (except for year fixed effects), the average cost of mood disorders per year-per patient is NZ$465 with standard error (SE) 4.6. When controlling for the basic set of control variables except for health conditions, reduces this average cost by 7% to NZ$434 (SE 4.7) (Model (2)). When including measures for the major other health conditions (Model (3)), the average cost of mood disorders is reduced by 14% to NZ$372 (SE 4.9).[9]

The included variables in Model (3) explain 18% of the variation in the medical costs per patient. The average cost of mood disorders are large both in absolute and relative terms. Patients who were identified with depression or anxiety cost per year $372 more than patients without mood disorders, ceteris paribus. This is the third highest cost among all other major illnesses considered. Only patients with diabetes ($549) or cardiovascular disease ($395) incur higher costs, and these differences are statistically significant at the 5% level or better.

We now compare the treatment effect of mood disorders with the treatment effects obtained from the various matching methods. Table 2 summarizes the average treatment effect on the

---

[9]Full estimation results of Model (3) are reported in Table A.4 in the Online Appendix.

Table 1: Estimated effects of mood disorders on medical and productivity-related costs

	Model (1)	Model (2)	Model (3)
Depression-Anxiety	465.6***	433.9***	371.5***
	(4.6)	(4.7)	(4.9)
Year fixed effects	✓	✓	✓
Basic controls		✓	✓
Health Conditions			✓
Health conditions			
Cancer (0,1)			113.9***
			(7.8)
Diabetes (0,1)			548.7***
			(8.9)
Lipoid metabolism disease (0,1)			124.8***
			(7.4)
Degenerative disease (0,1)			212.8***
			(13.6)
Cardiovascular disease (0,1)			394.7***
			(7.8)
Respiratory disease (0,1)			259.4***
			(6.3)
Arthritis (0,1)			183.8***
			(9.1)
Gastric and intestinal disease (0,1)			224.7***
			(15.9)
Renal disease (0,1)			281.8***
			(14.9)
NT	334.603	334.603	334.603
N	111.575	111.575	111.575
R-sq overall	0.03	0.11	0.175

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Note: Each model is estimated with generalised least squares (random effects model). Standand errors are reported in parentheses. The dependent variable is 'Total medical and productivity-related costs' denominated in 2012 NZ$. Basic control variables included in Models (2) and (3) are: age groups, sex, ethnicity groups, location, socioeconomic deprivation, median income of area where living, whether the patient is a health care card owner.

treated (ATT) obtained from coarsened exact matching for the five different matching generations and from standard matching estimators. The most conservative estimate of NZ$366 (SE 6.26) is obtained from the exact matching algorithm (generation 1). The more generous our matching criteria, the greater is the average treatment effect. Using the full sample of 26,889 matched treatment and control patients, the ATT is NZ$413 (SE 5.3). The ATTs differ statistically between matching generations 1 and 4/5, but they do not differ statistically between matching generations 1 and 2/3. Both kernel density and nearest neighbor matching estimators yield ATTs of NZ$403 [SE 4.9] and NZ$391 (SE 5.7), respectively, and these latter estimates are different in both statistical and economic terms from the most conservative ATT obtained from matching generation 1.

Table 2: Excess costs of depression and anxiety (Average treatment effect of the treated, ATT

	N	ATT (in $)	SE	p-val[a]
Coarsened exact matching				
Matching generation 1	17747	365.6	6.26	
Matching generation 1-2	21275	371.8	5.83	0.210
Matching generation 1-3	22201	371.7	5.70	0.200
Matching generation 1-4	26723	411.7	5.34	0.000
Matching generation 1-5	26889	413.1	5.34	0.001
Standard matching estimators				
Kernel density matching	26813	403.1	4.86	0.001
Nearest neighbor matching	26812	391.9	5.64	0.001

Note: Standard errors are calculated with the delta method. [a] p-value refers to z-statistic on the hypothesis that ATT in this row is statistically the same as ATT of matching generation 1.

We continue our subsequent analysis of the excess counts and costs by expenditure component on the basis of matching generation 1, because it yields the most conservative estimates. However, the results from all five generations, in conjunction with the standard matching estimates can be used to put bounds around the likely cost estimate. The upper panel of Table 3 re-

ports the excess annual count of services by expenditure group. Patients with depression/anxiety, on average, visit a GP four more times per year, obtain five more prescriptions and 2.3 more referrals for pathology tests. They have 0.5 more episodes of days off work that require a medical certificate and spend less than a tenth of a day not working than comparable patients without depression/anxiety. All differences are statistically significant at the 1% level.

The lower panel of Table 3 reports the differences in excess cost of depression/anxiety by expenditure category. By far, the largest component in the total excess burden are prescription drugs (NZ$192), but patients with depression/anxiety also incur NZ$70 more in consultation fees, and NZ$16 more in pathology tests. Lost productivity costs are low, with a difference of NZ$65 per year. Also, the excess cost of counseling sessions is minimal at NZ$15. The latter is not surprising because only a very small group of disadvantaged individuals gets access to these subsidized counseling sessions, and the total number is limited to six sessions per year.

Also reported in Table 3 are the cost and count ratios (column 3) and their standard errors (column 4) that indicate by how much larger were the expenditures of patients with depression/anxiety per year relative to the control group. The cost for consultations are 1.5 times greater for depression/anxiety patients than for their statistical twins, whereas prescription cost and lost productivity cost are 1.8 times higher. In total, the annual costs of patients with depression/anxiety are 1.7 times greater than for patients who are identical to the depression/anxiety group in all other relevant characteristics. All ratios are statistically significant different from 1.

Based on the above estimates, we calculated the net direct cost of managing depression and anxiety as a share of national general practice expenditures and as percentage of national GDP. The cost ratio (excluding lost productivity) is 1.71 whereas the population-weighted prevalence rate of depression is 0.217. For the relevant time period (2012), Crown expenditures on general

Table 3: Excess count and costs of depression and anxiety and ratios, by expenditure

	ATT	SE[a]	Ratio	SE
Excess counts				
Consultation	4.36	0.047	1.514	0.007
Prescriptions	5.23	0.057	1.789	0.012
Pathology Tests	2.28	0.053	1.412	0.009
Subsidized counseling sessions	0.12	0.005	21.012	2.593
Times off Work	0.44	0.032	1.855	0.082
Days off Work	0.09	0.004	1.712	0.012
Excess costs				
Consultations	77.0	1.067	1.51	0.007
Prescriptions	192.4	2.760	1.79	0.012
Pathology Tests	16.5	0.403	1.41	0.009
Subsidized counseling sessions	14.8	0.540	21.01	2.593
Lost productivity	65.0	4.999	1.85	0.082
Total cost	365.6	6.261	1.71	0.012

Note: [a] Standard errors of Average Treatment Effect on the Treated (ATT) are calculated with delta method. [b] The standard errors of the cost and count ratios are bootstrapped with 1000 replications.

practice funding were $855 million (New Zealand Treasury, 2012), while the Accident Compensation Corporation (ACC) spent a total of $64.5 million on General Practice services (GPs, Nurses and Nurse Practitioners under Cost of treatment regulations and Rural GP and PRIME contracts), both expressed in 2012 NZ$. In total, the combined national expenditures on GP services were $920 million.[10]

Using equation (3), the net direct costs of managing depression and anxiety are $123 million [95% CI $114.7-$131.4]. This indicates that the government spent on all patients suffering from depression/anxiety between $115 and $131 million, which makes up between 12.5-14.2% of all GP expenditures. Given nominal GDP in New Zealand in 2012 of $200 billion, New Zealand's GPs provided treatments and services to manage depression/anxiety of at least 0.057-0.066 % of GDP.

---

[10]All figures are adjusted for inflation to be able to express the expenditures in 2012 NZ$.

VI   Conclusion

This is the first study to estimate the direct and indirect cost of managing mood disorders, depression and anxiety, in the New Zealand primary health care system. Using coarsened exact matching estimators, we estimate a conservative lower-bound estimate of the net cost of managing depression and anxiety in general practice as 13.4% of total primary care expenditures, or NZ$366 per patient per year when including lost productivity. More than 82% of these additional costs are incurred by direct, i.e. medical expenditure, while the remaining 18% are incurred by lost productivity. Almost two-thirds of the medical expenditures are driven by prescription drugs, 26% by consultation fees, and 5% by pathology tests. Less than 5% of the total medical costs are incurred through subsidized counseling services, which appears to stand at odds with the large contribution of prescription drugs. Total costs for patients with depression or anxiety are 1.7 times greater than the costs observed for patients that are not suffering from the condition. In combination with our calculation of a three-year prevalence rate of depression/anxiety of 21 percent, this excess cost ratio implies a GP-managed economic burden of mood disorders of at least 0.06% of GDP.

Two important conclusions can be drawn from our analysis: (1) similar to trends in the US (Pratt et al., 2011), Australia (Stephenson et al., 2013), and the UK (Spence, 2013), New Zealand's general practitioners tend to manage depression and anxiety mainly with antidepressant medication, and may even oversubscribe them (Exeter et al., 2009). Publicly subsidized counseling sessions are only available to a small group of individuals from disadvantaged backgrounds despite the Ministry of Health's guidelines to use both drug regimes and counseling sessions (New Zealand Guidelines Group, 2008); (2) the high cost of lost productivity due to depression/anxiety

documented in previous studies for other countries may be entirely driven by informal days taken off work, which makes it difficult to accurately measure and monitor the indirect burden of mood disorders.

Our estimates are smaller than estimates of the economic burden of mood disorders in the international literature because we net out the costs incurred through illnesses, age, and socioeconomic disadvantage that correlate strongly with mental health problems. One could argue however that the nature of our data makes it likely to underreport the prevalence of depression and anxiety, which will then lead to a smaller nationally-representative cost calculation. For instance, Cuijpers et al. (2004) found that those suffering minor depression were eight times less likely to utilize a health-care service than their severely depressed counterparts, while less than 50% of individuals with depression seek care (Wittchen et al., 2001; Kessler et al., 2003; Groom et al., 2003). Nevertheless, our three-year prevalence rate is in line with the 12-month prevalence rates reported in New Zealand's Mental Health Survey (Wells et al., 2006) and in the Dunedin Cohort Study (16.7%) for the same age group (Moffitt et al., 2010).

An important limitation of our study is the omission of costs incurred by in-patient service utilization. There is good reason to suggest that this omission will not invalidate our cost calculations. Similar to Australia, in New Zealand mood disorders are predominantly managed by primary care organizations due to a health-care-reform process that started in the mid-1990s. The *National Mental Health Strategy* was launched in 1994 by the New Zealand Government with the aim to (1) 'decrease the prevalence of mental illness and mental health problems within the community', and (2) 'to increase the health status of and reduce the impact of mental disorders on consumers, their families, care-givers and the general community' (Ministry of Health, 1994). Subsequent publications and the establishment of the Mental Health Commission in 1996 helped

to raise awareness about the high prevalence of mental health problems in the population and the need to include family and the community in its management (Mental Health Commission, 2012). The Ministry of Health's *Evidence-based Best Practice Guideline* for the treatment of depression explicitly recommended to refer only the most severe cases of mental health problems, those in imminent danger, to secondary care (New Zealand Guidelines Group, 2008).

In contrast to New Zealand, the economic burden of mood disorders in Australia is widely cited to be a staggering A\$12.6 billion with six million work days lost per year (e.g. Manicavasagar, 2012). These estimates are referred back to numbers published on the Beyond Blue webpage, a non-governmental organization that seeks to raise awareness about mood disorders. However, to the best of our knowledge we were unable to identify a report that describes the method that resulted in such a large cost calculation. It would be worthwhile replicating our analysis to derive a lower bound of the costs of managing mood disorders in Australia. Lower-bound estimates of these costs are useful for the Australian Treasury and Ministry of Health to monitor and forecast the expenditure burden of a major chronic illness.

References

Berndt, E.R., Bir, A., Busch, S.H., Frank, R.G. and Normand, S.L.T. (2002), 'The medical treatment of depression, 1991 - 1996: productive inefficiency, expected outcome variations, and price indexes', *Journal of Health Economics*, **21**(3), 373–396.

Berndt, E.R., Finkelstein, S.N., Greenberg, P.E., Howland, R.H., Keith, A., Rush, A., Russell, J. and Keller, M.B. (1998), 'Workplace performance effects from chronic depression and its treatment', *Journal of Health Economics*, **17**(5), 511–535.

Chang, S., Hong, J.P. and Cho, M. (2012), 'Economic burden of depression in South Korea', *Social Psychiatry and Psychiatric Epidemiology*, 1–7.

Cuijpers, P., de Graaf, R. and van Dorsselaer, S. (2004), 'Minor depression: risk profiles, functional disability, health care use and risk of developing major depression', *Journal of Affective Disorders*, **79**(1-3), 71–79.

Cuijpers, P., Smit, F., Oostenbrink, J., De Graaf, R., Ten Have, M. and Beekman, A. (2007), 'Economic costs of minor depression: a population-based study', *Acta Psychiatrica Scandinavica*, **115**(3), 229–236.

De Lusignan, S. (2005), 'Codes, classifications, terminologies and nomenclatures: definition, development and application in practice', *Informatics in Primary Care*, **13**, 65–69.

Eaton, W. (2002), 'Epidemiological evidence on the comorbidity of depression and diabetes', *Journal of Psychosomatic Research*, **53**, 903–906.

Exeter, D., Robinson, E. and Wheeler, A. (2009), 'Antidepressant dispensing trends in new zealand between 2004 and 2007', *Australian & New Zealand Journal of Psychiatry*, **43**, 1131–1140.

Frassure-Smith, N. and Lesperence, F. (1995), 'Depression and 18-month prognosis after myocardial infarction', *Circulation*, **19**, 999–105.

Fullerton, C.A., Busch, A.B., Normand, S.L.T., McGuire, T.G. and Epstein, A.M. (2011), 'Ten-year trends in quality of care and spending for depression.', *Archives of General Psychiatry*, **68**(12), 1218–1226.

Goldney, R.D., Eckert, K.A., Hawthorne, G. and Taylor, A.W. (2010), 'Changes in the prevalence

of major depression in an Australian community sample between 1998 and 2008', *Australian and New Zealand Journal of Psychiatry*, **44**(10), 901–910.

Greenberg, P.E., Kessler, R.C., Birnbaum, H.G., Leong, S.A., Lowe, S.W., Berglund, P.A. and Corey-Lisle, P.K. (2003), 'The economic burden of depression in the United States: How did it change between 1990 and 2000?', *Journal of Clinical Psychiatry*, **64**(12), 1465–1475.

Groom, G., Hickie, I. and Davenport, T. (2003), *Out Of Hospital, Out Of Mind! Report Detailing Mental Health Services in Australia in 2002 and Community Priorities for National Mental Health Policy for 2003-2008*, Mental Health Council of Australia, Canberra.

Hawthorne, G., Cheok, F., Goldney, R. and Fisher, L. (2003), 'The excess cost of depression in South Australia: a population-based study', *Australian and New Zealand Journal of Psychiatry*, **37**(3), 362–373.

Ho, D., Kosuke, I., Kin, G. and Stuart, E. (2007), 'Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference', *Political Analysis*, **15**, 199Ű236.

Iacus, S.M., King, G. and Porro, G. (2011), 'Multivariate matching methods that are monotonic imbalance bounding', *Journal of the American Statistical Association*, **106**(493), 345–361.

Imbens, G. (2004), 'Semi-parametric estimation of average treatment effects under exogeneity: A review', *The Review of Economics and Statistics*, **86**, 4–29.

Jones, A.M., Rice, N. and Rosa Dias, P. (2011), 'Long-term effects of school quality on health and lifestyle: Evidence from comprehensive schooling reforms in England', *Journal of Human Capital*, **5**(3), 342–376.

Kessler, R.C., Berglund, P., Demler, O., Jin, R., Koretz, D., Merikangas, K.R., Rush, A.J., Walters, E.E. and Wang, P.S. (2003), 'The epidemiology of major depressive disorder: Results from the national comorbidity survey replication (ncs-r)', *Journal of the American Medical Association*, **289**(23), 3095–3105.

Lopez, A., Mathers, C., Ezzati, M., Jamison, C. and Murray, D. (2006), 'Measuring the global burden of disease risk factors: 1990 - 2001', A. Lopez, C. Mathers, M. Ezzati, C. Jamison and D. Murray (eds.), *Global Burden of Disease and Risk Factors*, The World Bank and Oxford University Press, Oxford.

Manicavasagar, V. (2012), 'A review of depression diagnosis and management', *InPsych*, **February**.

Massie, M. (2004), 'Prevalence of depression in patients with cancer', *Journal of the National Cancer Institute Monographs*, **32**, 56–71.

Mental Health Commission (2012), *Blueprint II: Improving mental health and wellbeing for all New Zealanders, How things need to be*, Technical report, Mental Health Commission.

Ministry of Health (1994), *Looking forward: strategic directions for the mental health services*, Technical report, Ministry of Health.

Moffitt, T.E., Caspi, A., Taylor, A., Kokaua, J., Milne, B.J., Polanczyk, G. and Poulton, R. (2010), 'How common are common mental disorders? evidence that lifetime prevalence rates are doubled by prospective versus retrospective ascertainment', *Psychological Medicine*, **40**(6), 899–909.

New Zealand Guidelines Group (2008), *Identification of common mental disorders and management of depression in primary care: Summary*, Technical report.

New Zealand Treasury (2012), *Health Projections and Policy Options for the 2013 Long-term Fiscal Statement*, Financial statement, New Zealand Treasury.

Pratt, L., Brody, D. and Gu, Q. (2011), *Antidepressant Use in Persons Aged 12 and Over: United States, 2005-2008*, Data Brief 76, NCHS.

Rouillon, F. (2011), 'What do depressive episodes tell us about depressive disorder', *Medicographia*, **33**(2), 113–118.

Roy, J. and Schurer, S. (2013), 'Getting stuck in the blues: The persistence of depression in Australia', *Health Economics*, **22**(9), 1139–1157.

Sobocki, P., Jönsson, B., Angst, J. and Rehnberg, C. (2006), 'Cost of depression in Europe', *Journal of Mental Health Policy and Economics*, **9**(2), 87–98.

Sobocki, P., Lekander, I., Borgström, F., Ström, O. and Runeson, B. (2007), 'The economic burden of depression in Sweden from 1997 to 2005', *European Psychiatry*, **22**(3), 146 – 152.

Spence, D. (2013), 'Are antidepressants overprescribed? Yes', *British Medical Journal*, **346**, f191.

Stephenson, C.P., Karanges, E. and McGregor, I.S. (2013), 'Trends in the utilisation of psychotropic medications in australia from 2000 to 2011', *Australian and New Zealand Journal of Psychiatry*, **47**(1), 74–87.

Stewart, W., Ricci, J., Chee, E., Hahn, S. and Morganstein, D. (2003), 'Cost of lost productive work time among us workers with depression', *Journal of the American Medical Association*, **289**(23), 3135–3144.

Thomas, C.M. and Morris, S. (2003), 'Cost of depression among adults in England in 2000', *The British Journal of Psychiatry*, **183**, 514–519.

Wells, J.E., Oakley Browne, M.A., Scott, K.M., McGee, M.A., Baxter, J., Kokaua, J. and for the New Zealand Mental Health Survey Research Team (2006), 'Te Rau Hinengaro: The New Zealand Mental Health Survey: overview of methods and findings', *Australian and New Zealand Journal of Psychiatry*, **40**(10), 835–844.

Wittchen, H., Holsboer, F. and Jacobi, F. (2001), *Met and unmet needs in the management of depressive disorder in the community and primary care: The size and breadth of the problem*, Technical report, Max Planck Society.

ONLINE APPENDIX - NOT FOR PUBLICATION

Table A.1: Economic cost of depression: A summary of reviewed studies

| Study | Country | Currency (year) | Total cost per year | | | | GDP† (%) |
| | | | 12-month Prev | Direct | Indirect | Total$ | |
				(in millions)			
Hawthorne et al. (2003)	South Australia	AUD (1999)	6.7	300	996	1300	2.05
Greenberg et al. (2003)	USA	USD (2000)	8.7	26000	57000	83000	0.83
Thomas and Morris (2003)	England	Pound (2000)	5.3	370	8600	9055	0.93
Sobocki et al. (2006)	European Union	Euro (2004)	4.5	42000	76000	118000	1.00
Cuijpers et al. (2007)[c]	Netherlands	USD (2003)	5.8	1283	4113	5375	1.00
Sobocki et al. (2007)	Sweden	Euro (2004)	6.9	502	3000	3500	0.95
Chang et al. (2012)	South Korea	USD (2005)	2.5	168	3880	4050	0.48

Note: $) Total cost was calculated by multiplying the prevalence rate of depression/anxiety by the population of the reference year (2003) and then multiplied by the cost per patient. †) http://www.imf.org/external/pubs/ft/weo/2012/01/weodata/index.aspx;

Table A.2: Descriptive statistics of matching variables by treatment group

	Obs.	Treatment group				Control group				p-value
		Mean	SD	Min	Max	Mean	SD	Min	Max	
Male	80524	0.333	0.471	0	1	0.336	0.472	0	1	0.35
Age	80524	51.247	17.384	18	102	51.253	17.379	19	105	0.72
European	80524	0.851	0.356	0	1	0.853	0.355	0	1	0.61
Maori	80524	0.066	0.248	0	1	0.065	0.247	0	1	0.38
Pacific Peoples	80524	0.015	0.122	0	1	0.018	0.133	0	1	0.45
Asian	80524	0.041	0.199	0	1	0.043	0.204	0	1	0.39
Middle Eastern Latin	80524	0.024	0.153	0	1	0.019	0.136	0	1	0.29
Ethnicity unknown	80524	0.003	0.054	0	1	0.002	0.046	0	1	0.24
DHB Capital & Coast	80524	0.663	0.473	0	1	0.663	0.473	0	1	0.42
DHB Wairarapa	80524	0.113	0.317	0	1	0.113	0.317	0	1	0.81
DHB Mid Central	80524	0.224	0.417	0	1	0.224	0.417	0	1	0.84
Richest	80524	0.268	0.443	0	1	0.269	0.443	0	1	0.75
80th	80524	0.195	0.396	0	1	0.195	0.396	0	1	0.78
60th	80524	0.196	0.397	0	1	0.196	0.397	0	1	0.45
40th	80524	0.172	0.378	0	1	0.172	0.377	0	1	0.56
Poorest	80524	0.105	0.307	0	1	0.106	0.307	0	1	0.67
Cancer	80524	0.096	0.295	0	1	0.093	0.290	0	1	0.35
Diabetes	80524	0.075	0.263	0	1	0.064	0.245	0	1	0.38
Lipoid problems	80524	0.107	0.309	0	1	0.100	0.300	0	1	0.42
Degenerative disease	80524	0.035	0.184	0	1	0.022	0.148	0	1	0.45
Cardiovascular disease	80524	0.127	0.333	0	1	0.109	0.312	0	1	0.29
Respiratory disease	80524	0.153	0.360	0	1	0.138	0.345	0	1	0.23
Arthritis	80524	0.083	0.275	0	1	0.066	0.248	0	1	0.56
Gastric disease	80524	0.023	0.151	0	1	0.015	0.123	0	1	0.32
Renal disease	80524	0.025	0.158	0	1	0.020	0.140	0	1	0.65

Note: Treatment group is defined as having been diagnosed with depression or anxiety or having been prescribed with depression/anxiety medication in the last three years. Sample size is reported as person-year observations. DHB stands for District Health Board. p-value refers to the hypothesis test that the mean value of the relevant variable in the treatment group is the same as the mean value of the same variable in the control group. The control group comprises all five matching generations.

Table A.3: Descriptive statistics for eligible sample

	Obs.	Mean	SD	Min	Max
Depressed and anxiety	334603	0.240	0.427	0	1
Male	334603	0.441	0.496	0	1
European Ethnicity	334603	0.798	0.402	0	1
Maori Ethnicity	334603	0.074	0.261	0	1
Pacific Peoples Ethnicity	334603	0.027	0.162	0	1
Asian Ethnicity	334603	0.073	0.260	0	1
Middle Eastern Latin Ethnicity	334603	0.025	0.155	0	1
Age 18-19	334603	0.015	0.123	0	1
Age 20-24	334603	0.081	0.273	0	1
Age 25-29	334603	0.067	0.250	0	1
Age 30-34	334603	0.069	0.254	0	1
Age 35-39	334603	0.087	0.281	0	1
Age 40-44	334603	0.101	0.301	0	1
Age 45-49	334603	0.107	0.309	0	1
Age 50-54	334603	0.102	0.302	0	1
Age 55-59	334603	0.087	0.282	0	1
Age 60-64	334603	0.079	0.270	0	1
Age 65-69	334603	0.064	0.245	0	1
Age 70-74	334603	0.052	0.222	0	1
Age 75-79	334603	0.037	0.189	0	1
Age 80-85	334603	0.028	0.166	0	1
Age 85-89	334603	0.017	0.129	0	1
Age 90+	334603	0.008	0.089	0	1
High-user health care card	334603	0.006	0.076	0	1
Community Services Card	334603	0.173	0.378	0	1
Region: Capital and Coast	334603	0.695	0.460	0	1
Region: Wairarapa	334603	0.083	0.277	0	1
Region: Mid-Central	334603	0.222	0.415	0	1
Cancer	334603	0.082	0.275	0	1
Diabetes	334603	0.063	0.242	0	1
Lipoid problems	334603	0.096	0.294	0	1
Degenerative disease	334603	0.024	0.153	0	1
Cardiovascular disease	334603	0.097	0.296	0	1
Respiratory disease	334603	0.124	0.330	0	1
Arthritis	334603	0.059	0.235	0	1
Gastric and intestinal disease	334603	0.017	0.130	0	1
Renal disease	334603	0.021	0.142	0	1
Year 2010	334603	0.333	0.471	0	1
Year 2011	334603	0.333	0.471	0	1
Year 2012	334603	0.333	0.471	0	1
Median income in stat area	334603	150.103	45.720	11.68	371
Average cost	334603	630.953	1017.988	0	88345
Transaction count	334603	9.087	9.457	0	428
Days off work per episode	334603	0.555	4.708	0	362
Number of episodes off work per year	334603	0.127	0.523	0	21
Number of subsidized counseling sessions	334603	0.033	0.517	0	27
Number of scripts	334603	9.440	13.541	0	266
Transaction costs	334603	166.833	192.323	0	10578
Off-work cost	334603	78.480	697.190	0	86585
Laboratory cost	334603	6.909	11.021	0	615
Counseling cost	334603	4.024	61.576	0	2711
Laboratory costs	334603	52.173	80.668	0	3496
Total script costs	334603	329.444	555.595	0	25886

Table A.4: Full estimation results of Model (3): Determinants of total medical and productivity-related costs

	Coef	SE	t-stat	p-value
Depression-Anxiety	371.523	4.943	75.160	0.000
Male (0,1)	−112.273	4.237	−26.500	0.000
Maori (Base: European)	19.242	8.119	2.370	0.018
Pacific Peoples	34.651	12.951	2.680	0.007
Asian	−65.855	8.121	−8.110	0.000
Middle Eastern Latin	−52.992	13.337	−3.970	0.000
Ethnicity unknown	−71.215	32.838	−2.170	0.030
Deprivation: 80th percentile (Base: Richest)	1.822	5.978	0.300	0.761
60th	−5.685	6.078	−0.940	0.350
40th	−13.419	6.675	−2.010	0.044
Poorest	−23.249	8.165	−2.850	0.004
Deprivation Quintile unknown	−24.085	9.273	−2.600	0.009
Age 15-19 (Base 45-49)	−57.967	17.879	−3.240	0.001
Age 20-24	−41.675	9.680	−4.310	0.000
Age 25-29	−46.859	10.206	−4.590	0.000
Age 30-34	−35.095	10.090	−3.480	0.001
Age 35-39	−28.269	9.447	−2.990	0.003
Age 40-44	−26.749	9.056	−2.950	0.003
Age 50-54	48.280	9.048	5.340	0.000
Age 55-59	105.323	9.468	11.120	0.000
Age 60-64	165.921	9.783	16.960	0.000
Age 65-69	230.801	10.506	21.970	0.000
Age 70-74	264.446	11.441	23.110	0.000
Age 75-79	305.027	13.101	23.280	0.000
Age 80-85	407.172	14.630	27.830	0.000
Age 85-89	432.816	17.926	24.140	0.000
Age 90+	429.510	24.604	17.460	0.000
High-user service card (0,1)	1009.332	27.377	36.870	0.000
Community services card (0,1)	107.830	6.108	17.650	0.000
DHB Wairarapa (Base: Capital Coast)	−28.490	7.750	−3.680	0.000
DHB Mid-Central	37.298	5.294	7.040	0.000
Cancer (0,1)	113.880	7.753	14.690	0.000
Diabetes	548.729	8.893	61.700	0.000
Lipoid metabolism disease	124.841	7.400	16.870	0.000
Degenerative disease	212.755	13.581	15.670	0.000
Cardiovascular disease	394.677	7.768	50.810	0.000
Respiratory disease	259.360	6.297	41.190	0.000
Arthritis	183.788	9.120	20.150	0.000
Gastric and intestinal disease	224.649	15.859	14.170	0.000
Renal disease	281.759	14.888	18.930	0.000
Year 2011 (Base year 2010)	−14.021	3.210	−4.370	0.000
Year 2012	23.745	3.210	7.400	0.000
Constant	341.979	7.748	44.140	0.000
NT	334603			
N	111575			
R-sq: within	0.001			
R-sq between	0.277			
R-sq overall	0.175			

Note: The model is estimated with generalised least squares (random effects model). The dependent variable is 'Total medical and productivity-related costs' denominated in 2012 NZ$.