



## How many antibiotic prescriptions are unsubsidised in New Zealand?

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### Abstract

**Aims** To determine the proportion of prescriptions for antibiotics which were unsubsidised, in one town in one year, and to use this to develop a model which could be used to estimate the number of unsubsidised prescriptions.

**Methods** Data on all prescriptions for antibiotics during 2002 were extracted from pharmacy computers in one town. Data were obtained from PharmHouse database on all subsidised prescriptions from the town pharmacies during 2002. (The PharmHouse database is a subset of the New Zealand Health Information System database and contains records of all the claims for medicines dispensed within New Zealand.) These were compared and the proportion of unsubsidised prescriptions for each antibiotic calculated. Weighted linear regression was used to develop a model of the relationship between the percentage of each drug subsidised, and patient and prescription characteristics obtainable in PharmHouse.

**Results** 64.4% of antibiotic dispensings in the study town were subsidised, and therefore captured by the PharmHouse database. The proportion varied substantially between different antibiotics. For particular drugs, the proportion of drugs unsubsidised could be predicted by the price of the drug, the number of days it was prescribed for, and the number of patients aged under six who received subsidised prescriptions.

**Conclusions** Previous studies using PharmHouse data are likely to have significantly underestimated the extent of drug use. Further research is needed on whether this model can help to estimate the extent of unsubsidised prescriptions.

Government subsidies for prescriptions are an important method of ensuring access to medicines people need. In New Zealand (NZ) the Government pays about 67% of overall pharmaceutical expenditure. While unsubsidised prescriptions do not contribute to government expenditure, pharmaceuticals and other medicaments absorb 23% of out of pocket health expenditure for NZ households.<sup>1</sup> This may lead to access problems for some people; for example those who are just above income and other thresholds. In addition, the existence of significant numbers of unsubsidised prescriptions makes any estimations of overall medicine consumption based on PharmHouse inaccurate. This means it is difficult, for example, to explore the relationship between antibiotic prescribing levels and resistance. A method of estimating the number of unsubsidised prescriptions, and correcting for these, is required.

Unsubsidised prescriptions include prescriptions for drugs which are never subsidised (e.g. Viagra, Xenical), as well as prescriptions which cost less than the relevant

patient contribution. Until recently, patients paid a co-payment based on their age (i.e. whether they are under 18 or under 6 years), income (in relation to family size and certain thresholds), recent health service use (GP visits and/or prescriptions (High Use Health Card [HUHC], Prescription Subsidy Card)). Whether patients are enrolled in a low cost Primary Health Organisation now also affects the co-payment they pay. For some drugs patients pay an additional “manufacturers surcharge”. Prescription prices are principally determined by the price per day of supply, and the number of days supplied.<sup>2</sup>

When medicines are dispensed by community pharmacies they are recorded in the pharmacy dispensing computer. If the Government is to make some financial contribution toward the cost of the prescription, an electronic record of it is also sent to HealthPAC (the organisation which pays government subsidies to pharmacies). These prescriptions are then included in PharmHouse, the data-warehousing system which is often used for drug utilisation research.<sup>3-6</sup>

When an unsubsidised drug is dispensed, or the price of a prescription is less than the patient co-payment, the patient pays the full price, the Government does not subsidise the prescription, and no record of the prescription leaves the pharmacy. The only repositories of information about these unsubsidised prescriptions are GPs and community pharmacies. GP databases cannot tell us whether any given prescription was actually dispensed, and they do not have pricing data (such as pharmacist fees), so it is difficult or impossible to determine which prescriptions are subsidised.<sup>7</sup>

The number of unsubsidised prescriptions is impossible to determine accurately, since these are not collected by any central agency. Sutton and Crampton estimated that 20% of prescriptions for adults without community service cards (i.e. people above the income threshold) were unsubsidised.<sup>8</sup> This was based on the assumption that the proportion of prescriptions costing less than the subsidy level (\$15) was the same for Community Services Card (CSC) holders (who receive discounted prescriptions upon presentation of their card) and non-CSC holders. However this may not be the case because of strategic decisions by doctors, pharmacists, and patients (for example, patients without CSCs may use stocks of medicines at home, or buy them over the counter rather than on prescription, if the prescription will not be subsidised).

While the 20% figure may be appropriate as an overall estimate, it does not allow us to look at rates of subsidisation for different drugs. In the study reported here we use data on antibiotic prescriptions from one town to develop a model which could be used to estimate the number of unsubsidised prescriptions.

The aim of our study was to determine how many antibiotic prescriptions were unsubsidised in one town during one year and to develop a method for estimating the number of unsubsidised prescriptions, using variables obtainable from PharmHouse data.

## Methods

In this study we collected all antibiotic dispensings from pharmacy computers of all pharmacies in a small town and compared them with PharmHouse data for the same pharmacies. We determined the number and proportion of unsubsidised antibiotic prescriptions, and constructed a model of how to estimate the number of unsubsidised prescriptions from data contained in the PharmHouse database.

A town was chosen that was a significant distance from other towns with pharmacies, and had a small number of pharmacies (but greater than two to protect commercial information). All pharmacy owners

consented to provide data. We downloaded all dispensings of all prescriptions from each of the pharmacies in 2002. In some computer systems this was impossible, so data from a longer period was downloaded. Using Microsoft Access software, data on dispensings of antibiotics (chemical entities and brand names identified as such in the New Ethicals Catalogue or the Pharmaceutical Schedule) for the 1 Jan–31 Dec 2002 period was extracted and combined. This produced a list of all dispensing of antibiotics in the town during the year.

We obtained data from PHARMAC on all subsidised prescriptions for antibiotics for a 5-year period 1998-2002. Each line of data represents one or more dispensings and includes the name of the drug, the date of dispensing, and a number for the pharmacy which dispenses the medicine. Data for 2002 and for the pharmacies in the town were extracted and summarised using Microsoft Excel software.

We tabulated the number of dispensings of each drug from each data source and calculated the proportion of dispensings which were missing from the PharmHouse data. Using weighted linear regression we also explored the relationship between this proportion (dependent variable) and price, length of supply, number of dispensings to CSC patients, to HUHC patients, to "J" patients (6–18 year olds), and to "Y" patients (under 6 year olds) (independent variables). Regressions were weighted by the number of dispensings from the pharmacy data. That is, more weight was put on drugs which were more frequently used. It was crucial that the independent variables were able to be determined within PharmHouse, so that a feasible and simple method of estimating unsubsidised dispensings could be developed.

To determine an appropriate price for each drug we calculated the price of one Defined Daily Dose (DDD) of the most commonly subsidised formulation of that drug. The most commonly subsidised formulation was determined from the PharmHouse data. DDDs for all drugs are determined by an expert committee and listed on the World Health Organisation Collaborating Centre for Drug Statistics Methodology website (ref: [www.whocc.no/atcddd](http://www.whocc.no/atcddd)). A DDD is the quantity of each drug likely to be used daily for its main indication. The price of one DDD of this formulation was found in the Pharmaceutical Schedule.<sup>9</sup>

The number of dispensings to CSC patients, to HUHC patients, to "J", and to "Y" patients for each drug was determined in Excel. Length of supply was calculated by dividing the number of units dispensed by dose per day (e.g. if 12 tablets were dispensed and the daily dose was 4, then length of supply = 3 days). Many records had missing data about daily doses. These records were excluded from this calculation. For two drugs with a small number of dispensings, the daily doses were obviously the result of a data-entry error, we recorded 'length of supply' as missing. For two drugs administered by injection we recorded length of supply as 1 day.

In the PharmHouse database there was a very small number of unsubsidised dispensings, which had probably been submitted by mistake, and another few dispensings where the subsidy from Government was recorded as less than zero. We ignored both of these in our analysis, since they are likely to be due to data-entry errors.

The proportion of missing (unsubsidised) dispensings was regressed on individual variables (price, length of supply, number of dispensings to CSC patients, to HUHC patients, to "J" patients (6–18 year olds), and to "Y" patients (under 6 year olds)). All the independent variables were then tested together. The least significant variable was then successively removed from the model.

The data for analysis was one record for each drug, with the proportion of unsubsidised dispensings and accompanying data. Each of these was based on a different number of dispensings so contained different amounts of information and thus could not be treated as equal. So the regression was weighted by the number of dispensings, which will be proportional to the inverse of the variance.

Regression as we have used it requires a normal distribution, however with only 25 data points it is difficult to test for normality. Simple tests such as a normal probability plot show that deviations from normality are not too severe, and would be unlikely to affect the result as regression is robust to most forms on non-normality, and there are no outliers at the ends of the distribution.

## Results

Data from the pharmacy computers in the town included 15,155 dispensings of antibiotics during 2002. Data from PharmHouse for the same period showed 9768 dispensings of antibiotics. Therefore only 64.4% of dispensings of antibiotics were subsidised.

The proportion of dispensings which were unsubsidised varied substantially between drugs (Table 1). For amoxicillin, the most commonly prescribed antibiotic, 38% of dispensings were unsubsidised. All benzylpenicillin, and no chloramphenicol was subsidised.

**Table 1. Unsubsidised prescriptions by drug**

Drug	Total number of dispensings (from pharmacy computers)	Proportion unsubsidised
Amoxicillin	4643	38%
Amoxicillin Clavulanate	2541	26%
Azithromycin	22	5%
Benzathine Penicillin	2	0%
Benzylpenicillin	6	0%
Cefaclor	549	15%
Cefuroxime	10	30%
Chloramphenicol	523	100%
Ciprofloxacin	305	10%
Clarithromycin	12	33%
Clindamycin	3	33%
Co-Trimoxazole	458	25%
Dicloxacillin	185	46%
Doxycycline	817	37%
Erythromycin	1042	36%
Flucloxacillin	1136	31%
Fusidic acid	339	100%
Hexamine hippurate	10	10%
Minocycline	264	7%
Nitrofurantoin	240	7%
Norfloxacin	650	31%
Phenoxyethylpenicillin	535	42%
Roxithromycin	200	39%
Tobramycin	4	100%
Trimethoprim	656	29%

When the proportion of missing dispensings was regressed on individual variables, only price was significant. After successively removing the least important variable only the estimated price per DDD, number of Y patients and average length of supply were included in the model and they all became significant. The equation worked out by this model allows people to put in values and determine the predicted proportion missing.

The equation is: Data missing =  $0.457 - 0.061 * \text{price} + 0.000079 * Y \text{ patients} - 0.007 * \text{length of supply}$

The adjusted R squared value is 0.46, this means that 46% of the variation in the outcome can be explained by the variables in the model. This shows how much better the model is at estimating the proportion missing for each drug, compared to a simple estimate using the average proportion of unsubsidised prescriptions.

## Discussion

Only 64.4% of antibiotic dispensings in the study town were subsidised, and therefore captured by the PharmHouse database. This varied widely by drug. For particular

drugs, the proportion of drugs unsubsidised could be predicted by the price of the drug, the number of days it was prescribed for, and the number of patients aged under six who received subsidised prescriptions.

A greater proportion of prescriptions are unsubsidised, and therefore patients are more likely to bear the whole cost, for drugs that are cheaper, and drugs that are prescribed short-term. This is presumably appropriate, since other things being equal, these would be less of a burden for patients. A greater proportion of prescriptions are unsubsidised for drugs where there are more subsidised prescriptions for children under six. This is likely to mean that drugs which are prescribed more for young children, are more likely to be sometimes unsubsidised. This is an interesting finding, which should be explored in further research.

We have not looked at drugs which are not eligible for subsidy (i.e. not listed on the Pharmaceutical Schedule). The best way to estimate the amount of these drugs used would be to approach suppliers. PharmHouse data cannot provide any information about this.

For our model, ideally estimations of price should be made for each formulation, rather than using the most commonly dispensed formulation for each drug. However the data we obtained from pharmacy computers used brand names, and there were compatibility problems between the software programmes used by the pharmacies, which made identifying formulations difficult.

This study relied on data from only one town, and only one class of drugs. Further work must be done to validate the model for other classes of drugs, in other towns. Further work is also needed to investigate the impact of reduced prescriptions charges in Access Primary Health Organisations (PHOs) on the level of unsubsidised prescriptions. The proportion of unsubsidised drugs would be different for other drugs and other towns. For example, the proportion of unsubsidised drugs is likely to be much lower for more expensive drugs which are taken for longer periods of time (e.g. statins). However, the *relationship* between price, average length of supply, patient variables, and the proportion of drugs which are unsubsidised may or may not be similar for other drugs or other towns, except where PHO funding has changed subsidy entitlements. Further research is needed into whether this model can help to estimate the extent of unsubsidised prescriptions.

Previous studies which used PharmHouse data to describe medicines use are likely to be significant underestimates. We found that only 64.4% of dispensings of antibiotics were subsidised in our study town in one year. Analysis of PHARMAC data has found there were 2,837,241 subsidised dispensings of antibiotics in NZ during 2002 (data unpublished). Simply using the average figure of 64.4% suggests that there may be another 1,568,413 unsubsidised dispensings, thus giving a total of 4,405,654.

Whether previous studies incorrectly estimate regional variation is debatable. We found that the major drivers of the extent of unsubsidised dispensings were price per day, length of supply, and number of patients aged under 6 years who received subsidised prescriptions. Price per day will not vary by region, length of supply probably does not vary very much<sup>3</sup> but the number of children under 6 years receiving prescriptions may, especially when small regions are examined.

PharmHouse remains a very valuable source of data on prescribing trends. Many overseas studies on drug utilisation (especially those looking at how social characteristics such as age, gender and socioeconomic status affect medicines) are not able to obtain national records. They may rely on records from samples of general practitioners,<sup>10-12</sup> interviews with patients<sup>13,14</sup> or samples of hospital admissions.<sup>15</sup> Those that do use national dispensing databases often have little patient information available. For example, in Ireland, Odubanjo et al use eligibility for subsidised medical services to divide the population into 'relatively affluent' or 'relatively deprived'.<sup>16</sup>

The addition of National Health Index (NHI) numbers to PharmHouse data will allow studies of the impact of patient demographics on prescribing to be carried out at a national level in New Zealand. However, the exclusion of unsubsidised prescriptions from PharmHouse is currently a major limitation of this data source. The model we developed in this study may help to overcome this, however.

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