Measuring prescribing: the shortcomings of the item

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Abstract

Objectives—To assess the validity of the item as a measure of the volume of a drug prescribed; and to investigate the possibility that higher quantities per item are prescribed for patients who are not exempt from the prescription charge.

Design—Five substudies. For the first, a frequency distribution was derived of the different quantities per item of 10 commonly used drugs prescribed by 20 randomly selected practices in each of five family health service authority areas. For the second, the variation in average quantity per item for the same drugs in the same practices was calculated. For the third and fourth, variation in average quantity per item for 90 commonly used drugs was calculated for all 90 family health service authorities and for all 14 regional health authorities in England. For the fifth, the average quantity per item for each of the 90 drugs was regressed on the percentage of items exempt from the prescription charge, at family health service authority level, and the percentage of variation explained by the regression found.

Main outcome measure—Distribution of quantity per item; variation in average quantity per item between the practices, between family health service authorities, and between regions; and percentage of variation between family health service authorities accounted for by exemption from the prescription charge.

Results—Wide variation was found in the quantities per item prescribed by the practices, and in the average quantity per item between practices and between family health service authorities. No family health service authority was consistently high or low in quantity per item across the 90 drugs. Variation in average quantity per item was less at regional than at family health service authority level, though still high for many of the drugs. The proportion of variation accounted for by exemption from prescription charges ranged from 0% to 49% across the 90 drugs.

Conclusions—The item is unsuitable as a measure of prescribing volume, even at regional level: a new measure, based on standard daily dosages, is needed. The percentage of the variation in quantity per item accounted for by exemption is inconsistent, and in over half the 90 drugs it was below 20%—therefore it is not a useful predictor.

Introduction

General practitioners in England have been sent analyses of their prescribing since the early days of the NHS: brief reports once a year until 1988, and more detailed quarterly reports (prescribing analyses and cost (PACT) data) since then. The number of items prescribed has always been used as a measure of volume, though this indicator has long been recognised as unsatisfactory because an item may stand for any number of tablets, millilitres of liquid, or other unit.

The item appears in the routinely reported average

cost per item and items per 1000 patients (or prescribing units) each quarter or year. The quantity of drug ordered in an item is an important factor in both these ratios, putting their validity in question. Despite this, these measures are used judgmentally, particularly at practice level.

The aim of the present study was to assess the validity of the item as a measure of volume by investigating the variability of quantity prescribed per item. The investigation looked at variation in quantity between prescriptions and variation in average quantity per item between practices, family health services authorities and regions.

Since it is often said that general practitioners tend to give larger quantities per item to patients who have to pay for their prescriptions, a second aim was to investigate the relation between quantity per item and exemption from the prescription charge.

Method

The first two analyses—of variation between prescriptions and between practices—required data on prescribing at practice level and were limited to practices in five family health services authorities and to 10 commonly used drugs. The three other analyses—concerning variation between family health services authorities and between regions—required data on prescribing and exemption for all 90 family health services authorities.

Data on items and quantity per item for the 12 months ending 31 May 1992 and relating to 90 commonly used drugs were obtained from the Prescription Pricing Authority. The drugs selected included many used over the long term for chronic conditions, and also some given in short courses for acute illnesses. The exemption data were provided by the Department of Health.

The most appropriate way of expressing variation differed according to the substudy. Variation between prescriptions would be apparent from a frequency table, but for the other studies a statistical measure was required. The coefficient of variation (standard deviation divided by the mean, often expressed as a percentage), is commonly used to measure the dispersion of a distribution, since the standard deviation alone is unhelpful in comparing distributions with very different means (as occurred between family health services authorities). When small numbers are involved, or the distributions are skewed, the coefficient of variation may be unduly distorted. In these circumstances, the semi-interquartile range (half the difference between the third and first quartiles) and the median are used in preference to the standard deviation and mean: the analogue of the coefficient of variation is thus the semi-interquartile range divided by the median, again expressed as a percentage. For the normal distribution this is approximately two thirds of the coefficient of variation. In the fifth study, the average quantity per item for each of the drugs in each

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family health services authority was regressed on percentage exemption, and the percentage of variation explained by the regression was found. The resulting coefficients of determination were expressed as percentages.

VARIATION BETWEEN PRESCRIPTIONS

The five family health services authorities were selected on the basis of percentage of items exempt from the prescription charge, since exemption may influence the quantity per item that a doctor orders. Nationally, percentage exemption ranges from 72% to 92%; the values for the five selected authorities were: Berkshire, 76%; Ealing, Hammersmith, and Hounslow, 82%; Stockport, 83%; Wolverhampton, 86%; and Sunderland, 89%. Within each of these areas, 20 practices were randomly selected from the identifying code numbers of all practices with more than 1000 registered patients.

Ten drugs were studied: amoxycillin 250 mg; aspirin 300 mg; atenolol 100 mg; captopril 25 mg; cephalexin 500 mg; co-amoxiclav 375 mg; diazepam 5 mg; digoxin 125 µg; frusemide 40 mg; and phenytoin 100 mg. For each drug, the quantities prescribed in each item were summarised in a frequency table.

VARIATION BETWEEN PRACTICES

The variations in average quantity per item between the same practices in each of the five family health services authorities were analysed for each of the 10 drugs. For these small datasets, variation was measured by the semi-interquartile range divided by the median.

VARIATION BETWEEN FAMILY HEALTH SERVICES AUTHORITIES

The average quantity per item for each of the 90 drugs was summarised in terms of the mean, standard deviation, and coefficient of variation across the 90 areas.

VARIATION BETWEEN REGIONAL HEALTH AUTHORITIES

The average quantity per item for each of the 90 drugs was summarised in terms of the semi-interquartile range divided by the median, since the number of regions (14) was small.

RELATION OF QUANTITY PER ITEM TO PERCENTAGE EXEMPTION

The exemption data related only to prescribing practices, since exemption is not recorded in dispensing practices. The coefficients of determination for each drug were calculated, showing what percentage of the variation was accounted for by exemption from prescription charges.

Results

VARIATION BETWEEN PRESCRIPTIONS

Table I gives the frequency with which different quantities of atenolol 100 mg were prescribed in the 100 practices combined. This drug at this strength is used to illustrate the findings because the number of tablets taken daily is the least likely to vary of all the drugs studied, making its data the easiest to interpret. The number of tablets varied from five to 336; 28 and 56 tablets (four and eight weeks' supply) accounted respectively for 46% and 31% of the items. Similar patterns were found in each of the five areas individually.

The nine other drugs all had wide variation, with co-amoxiclav 375 mg showing least. This short term antibiotic was given in quantities ranging from three to 336 tablets, but 54% of the items were for 21 tablets, and no other single quantity accounted for more than 20%.

VARIATION BETWEEN PRACTICES

Table II shows the variation in average quantity per item for atenolol 100 mg between the practices in each of the five areas. Two practices had no prescriptions for the drug at this strength, so the summaries for their areas are based on 19 practices. Variation, measured as the semi-interquartile range divided by the median, ranged from 10% in Stockport, where the average quantities from most practices were items intended to last for a month, to 34% in Wolverhampton, where some practice averages were for one month but many were for two months or more. The nine other drugs yielded comparable results.

TABLE II—Variation in average quantity per item of atenolol 100 mg prescribed in practices within family health services authorities

	Lower quartile	Median	Upper quartile	Variation (%)*
Berkshire (20 practices)	44	51	66	22
Ealing (19 practices)	39	49	64	25
Stockport (19 practices)	30	33	37	10
Wolverhampton (19 practices)	32	46	63	34
Sunderland (20 practices)	30	44	53	26

*Semi-interquartile range divided by median.

VARIATION BETWEEN FAMILY HEALTH SERVICES AUTHORITIES

Table III shows that the coefficients of variation of the 90 drugs ranged between 3% and 26%. For atenolol 100 mg the coefficient was 13%; the mean of 45 and the standard deviation of 6.1 correspond to an extremely wide normal range of 23 to 57 tablets for the average quantity per item in a family health services authority. The short term antibiotics tended to have low coefficients (3% to 7%), but it is difficult to see any other meaningful trends in the data. A matrix was constructed showing the average quantity per item for each of the 90 drugs prescribed in each of the 90 family health services authority areas (the matrix is too large to present here). No area showed consistently high or low average quantities across all the drugs.

VARIATION BETWEEN REGIONAL HEALTH AUTHORITIES

Table III shows that the semi-interquartile range divided by the median varied from 1% to 14% across the 90 drugs. For atenolol it was 7%; the interquartile range was from 40 to 50 tablets per item, and half the regions therefore had an average quantity per item outside this range. The values should be compared with the corresponding coefficients of variation at family health services authority level, bearing in mind that the semi-interquartile range divided by the median is approximately two thirds of the coefficient of variation for the normal distribution. Thus, for magnesium trisilicate mixture, for example, variation was similar at the two levels; for atenolol 100 mg the regional variation was slightly less.

Variation between regions was less than variation between family health service authorities for many drugs, as would be expected. However, a semi-quartile range divided by the median of 5% indicates a considerable degree of variation in average quantity per item, and a value of 10% an enormous variation. In this sample, 33 of the 90 drugs had a value of 5% or more, and for six drugs it was 10% or more.

RELATION OF QUANTITY PER ITEM TO PERCENTAGE EXEMPTION

Kensington, Chelsea, and Westminster was the area with fewest items exempt (72%) and Liverpool the one with most (92%). The figure shows the relation of percentage exemption to quantity per item, across the 90 areas, for atenolol 100 mg. Reference to the last column of table III shows that this drug had a coefficient of determination of 40%—that is, 40% of

TABLE I—Quantities of atenolol 100 mg prescribed

No of tablets	No of items	No of tablets	No of items
5	1	75	1
7	25	84	1287
8	4	90	77
10	2	91	7
14	43	92	2
21	1	98	115
24	1	100	116
28	7829	112	295
30	1156	120	16
35	1	126	9
36	1	140	3
38	1	154	8
40	2	156	1
42	201	164	1
45	1	168	30
47	2	180	2
49	2	182	5
50	18	196	9
56	5208	200	7
60	325	210	3
70	20	224	8
74	4	336	1

TABLE III—Distribution of average quantity per item across family health services authorities (FHSAs) and regional health authorities, with coefficient of determination for regression of quantity per item on percentage exempt across FHSAs

Drug	FHSA		Variation in region (%)*	Coefficient of determination in FHSA (%)	Drug	FHSA		Variation in region (%)*	Coefficient of determination in FHSA (%)
	Mean (SD)	Coefficient of variation (%)				Mean (SD)	Coefficient of variation (%)		
Amoxycillin 250 mg	20 (0.7)	3	2	4	Insulin (Human Actrapid) 10 ml	3.3 (0.27)	8	3	0
Intal 20 mg	122 (4.8)	4	1	22	Ventolin 400 µg Rotacaps	129 (11)	8	3	22
Flucloxacillin 250 mg	29 (1.2)	4	1	0	Verapamil 40 mg	113 (9.4)	8	1	20
Co-amoxiclav 125/250 mg	22 (0.9)	4	1	0	Captopril 25 mg	89 (7.5)	8	4	31
Microgynon	96 (4.3)	4	2	15	Becotide 200 µg Rotacaps	122 (10.3)	8	3	25
Ibuprofen 400 mg	78 (3.5)	5	2	11	Isosorbide mononitrate 20 mg	90 (7.7)	9	5	18
Naproxen 500 mg	62 (2.9)	5	1	1	Insulin (Actrapid) 1.5 ml	14 (1.2)	9	4	18
Co-proxamol	104 (4.9)	5	2	0	Vitamin capsules	66 (6.1)	9	3	29
Cephalexin 500 mg	22 (1.1)	5	1	1	Bethamethasone ointment	44 (4.1)	9	4	1
Terfenadine 60 mg	53 (2.6)	5	2	35	Carbamazepine 200 mg	114 (10.8)	9	3	33
Marvelon	100 (5.3)	5	2	16	Premarin 0.625 mg	69 (6.6)	10	4	45
Trimethoprim 200 mg	15 (0.8)	5	1	1	Nifedipine 20 mg	83 (8.0)	10	6	32
Co-trimoxazole 480 mg	29 (1.7)	6	1	4	Estraderm TTS 50	18 (1.8)	10	5	29
Nitrazepam 5 mg	48 (2.8)	6	2	19	Oilatum emollient	417 (41)	10	3	22
Terodilene 12.5 mg	80 (4.6)	6	2	17	Metaclopramide 10 mg	56 (5.5)	10	3	1
Mag Trisil mixture	481 (29)	6	4	12	Quinine 300 mg	42 (4.2)	10	6	40
Temazepam 10 mg	42 (2.5)	6	3	33	Becotide 100 µg metered dose inhaler	1.2 (0.12)	10	5	27
Dothiepin 25 mg	67 (4.1)	6	2	16	Co-amiflofruse	47 (4.8)	10	6	40
Norethisterone 5 mg	68 (4.3)	6	2	0	Phenytoin 100 mg	106 (10.8)	10	6	47
Mebeverine 135 mg	83 (5.2)	6	3	2	Loperamide 2 mg	42 (4.3)	10	6	25
Co-dydramol	96 (6.3)	7	3	3	Becotide 50 µg meter dose inhaler	1.2 (0.13)	10	2	27
Prempak-C-comb	128 (8.3)	7	5	35	Folic acid 5 mg	55 (5.7)	10	7	20
Penicillin V 250 mg	30 (2.0)	7	3	4	Frusemide 40 mg	57 (6.0)	11	5	36
Diltiazem 60 mg	115 (7.8)	7	3	12	Metformin 500 mg	93 (10.0)	11	2	16
Pholcodine linctus	259 (17.7)	7	3	17	Slow-K 600 mg	87 (9.6)	11	3	11
Cimetidine 400 mg	60 (4.1)	7	3	11	Procyclidine 5 mg	79 (9.0)	11	4	10
Amitypyline 25 mg	70 (4.8)	7	4	18	Digoxin 125 µg	45 (5.2)	12	8	38
Prochlorperazine 5 mg	66 (4.5)	7	3	4	Aspirin 75 mg	58 (7.0)	12	7	30
Lactulose solution	482 (34)	7	5	33	Atenolol 50 mg	45 (5.6)	12	7	42
Diclofenac 100 mg	38 (2.6)	7	3	19	Bendrofluazide 5 mg	46 (5.8)	13	8	46
Aminophylline 225 mg	84 (5.9)	7	3	21	Oxytetracycline 250 mg	57 (7.6)	13	7	23
Paracetamol 500 mg	102 (7.3)	7	4	20	Atenolol 100 mg	45 (6.1)	13	7	40
Chlorpromazine 25 mg	76 (5.6)	7	2	5	Co-amilozide	47 (6.4)	14	9	48
Lorazepam 1 mg	59 (4.6)	8	2	2	Allopurinol 300 mg	45 (6.3)	14	9	42
Naftidrofuryl 100 mg	120 (9.3)	8	4	5	Cyclopenthiiazide/Potassium	55 (7.9)	14	11	36
Prednisolone 5 mg	64 (5.0)	8	5	45	Glubenciamide 5 mg	80 (11.7)	15	9	38
Diazepam 5 mg	56 (4.4)	8	3	2	Chlorpropamide 250 mg	62 (9.3)	15	10	25
Doxycycline 100 mg	11 (0.9)	8	1	0	Aspirin 300 mg	55 (8.2)	15	12	39
Co-codamol	95 (7.5)	8	3	0	Sudafed plus	39 (6.0)	15	7	0
Dihydrocodeine 30 mg	86 (6.9)	8	4	3	Tamoxifen 20 mg	56 (9.3)	16	7	11
Betahistine 8 mg	101 (8.1)	8	4	18	Simvastatin 10 mg	44 (7.3)	17	5	15
Ferrous sulph 200 mg	81 (6.6)	8	4	9	Thyroxine 100 µg	64 (11.1)	17	14	49
Sulphasalazine 500 mg	149 (12.1)	8	4	34	Bezafibrate 400 mg	42 (7.5)	18	9	28
Diazepam 2 mg	58 (4.7)	8	2	1	E45 cream	242 (47)	19	11	31
Minocycline 50 mg	78 (6.3)	8	5	44	Hydroxocobalamin injection	3.8 (0.97)	26	12	4

*Semi-interquartile range divided by median.

Plot of average quantity per item of atenolol 100 mg against percentage of items exempt from prescription charges

the variation in quantity per item was accounted for by exemption. For more than half the drugs the coefficient was below 20%, and the highest value recorded (for thyroxine 100 µg) was 49%. An inverse relation—a higher percentage exempt corresponding to greater quantity per item—was found for three drugs: amoxycillin 250 mg, ibuprofen 400 mg, and pholcodine linctus.

Discussion

The example of atenolol 100 mg illustrates the diversity of quantity prescribed at one time that is concealed when items are used as the measure of volume. Even if the two commonest quantities of 28 and 56 tablets had been the only amounts ordered, this would still mean that one practice might be giving double the quantity prescribed by another with the same item rate. The diversity is shown further by the

large variation in average quantity per item between practices, and any suggestion that the differences should average out over many practices is repudiated by the high coefficient of variation at family health services authority level.

Analyses for the other drugs showed that the item as a measure of volume was similarly inappropriate for them. No individual area was consistently low or high across the drugs studied.

Perhaps the most surprising finding was how often the interpractice variation in quantity per item did not average out at regional level. More than a third of our 90 drugs showed so much variation even there that, in

Practice implications

- Drug volume is currently measured by the number of items prescribed, though the quantity ordered per item can and does vary greatly
- The average quantity per item varies widely between practices and between family health services authorities
- No family health services authority is characterised by consistently high or low quantities per item
- Variation in quantity per item is less at regional level, but it is still high for many drugs
- Number of items is unsuitable as a measure of drug volume and should be replaced by a standardised measure such as the defined daily dosage

general, the use of the item as a measure of volume cannot be recommended in regional prescribing data.

The attempt to explain the wide variation in quantity per item by the percentage of prescriptions exempt from the prescription charge had a limited success in that the predicted negative relation was found for most of the drugs. The variation it accounted for was inconsistent, ranging from none to 49%, and for over half the drugs it was below 20%. This makes the exemption factor of little use as a predictor of quantity per item. The likeliest source of variation still seems to be the behaviour of individual doctors.

At a time when prescribing is subject to so much analysis and comment, particularly at practice level, it is clearly both unwise and unfair to base comparisons on ratios that use the number of items in either the numerator or the denominator. It is encouraging to note that two recent papers concerned with

prescribing^{1 2} have used defined daily dosages, as set by a working party of the World Health Organisation,³ to measure drug volume. These units are not without their problems,⁴ but they avoid many of the deficiencies of the item.

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1 McGavock H, Webb CH, Johnston GD, Milligan E. Market penetration of new drugs in one United Kingdom region: implications for general practitioners and administrators. *BMJ* 1993;307:1118-20.

2 Maxwell M, Heany D, Howie JGR, Noble S. General practice fundholding: observations on prescribing patterns and costs using the defined daily dose method. *BMJ* 1993;307:1190-4.

3 WHO Collaborating Centre for Drug Statistics Methodology. *Anatomical therapeutic chemical classification index*. Oslo: WHO, 1993.

4 Harris CM, Cullen J, Roberts DJ. Prescribing costs: consider national standards for daily dosages. *BMJ* 1994;308:207.

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ANY QUESTIONS

What are the aetiology and pathogenesis of silent chronic pancreatitis in elderly people?

Truly asymptomatic pancreatitis is unlikely to be identified clinically.¹ On the other hand, at necropsy chronic inflammation has been described in more than 10% of individuals, being moderate or pronounced in 4%.

Clinically silent chronic pancreatitis is so called because patients do not suffer from the characteristically severe pain associated with chronic pancreatitis. The condition is diagnosed because the patient complains of appreciable weight loss and diarrhoea; has steatorrhoea; develops diabetes mellitus or poor control of previously stable diabetes; or suffers from involvement of anatomical structures adjacent to the pancreas, such as painless jaundice from biliary obstruction.

Aetiologically, silent chronic pancreatitis in elderly people is primary or secondary. Secondary disease usually represents the burnt out end stage of alcohol associated chronic pancreatitis, with virtually complete destruction of the pancreatic acinar tissue. Under these circumstances calcification of the pancreas, with exocrine and endocrine insufficiency, precedes pain relief by about five years. A few patients (5%) with alcohol associated chronic pancreatitis never suffer from pain before reaching the stage of acinar and insular insufficiency.

Occasionally, end stage pancreatic insufficiency occurs painlessly after upper abdominal trauma or during the course of hyperparathyroidism.²

Most patients who develop symptoms that are found to be attributable to painless chronic pancreatitis have been considered to suffer from idiopathic senile chronic pancreatitis.³ Ninety five per cent of these patients are over 50, with an average age of 62 at presentation. More than 80% are men. Three quarters of them do not suffer from pain, and 60% show radiological pancreatic calcification.

There is a strong association between idiopathic senile chronic pancreatitis and peripheral, coronary, and cerebral vascular disease—such disease is more than four times as common as expected for the age group and three times as common in patients with alcohol associated chronic pancreatitis. Many of the patients have one or more risk factors for vascular disease, such as heavy smoking, hypertension, or diabetes mellitus. More than 80% of patients with idiopathic senile chronic pancreatitis who die do so from associated vascular disease.—K G WORMSLEY, consultant physician, Sussex

1 Warshaw AL. Pain in chronic pancreatitis. *Gastroenterology* 1984;86:987-9.

2 Fitzgerald O. Painless pancreatitis and other painless pancreatic disorders. *Clinical Gastroenterology* 1972;1:195-218.

3 Ammann RW. Alcohol- and non-alcohol-induced pancreatitis: clinical aspects. In: Burns GP, Bank S, eds. *Disorders of the pancreas*. New York: McGraw-Hill, 1992:253-72.

What advice can be given to a 47 year old, overweight man whose stentorian snoring and apnoea disturb his wife?

Before giving advice it is important to obtain a fuller history. The management of the sleep apnoea/hypopnoea syndrome is quite different from that of simple snoring. The patient should be asked about daytime sleepiness and how frequently he falls asleep at work, when reading, or when driving. Patients with the syndrome usually find nocturnal sleep unsatisfying and may sometimes have frightening choking attacks on waking. It is essential to establish the use of alcohol, sedatives, and smoking, all of which may make snoring worse. The patient's wife should be asked whether he snores in all postures or just on his back and to estimate the frequency of episodes of apnoea.

If there is any suggestion of daytime sleepiness in a loud snorer with witnessed episodes of apnoea he or she should be referred to a sleep centre for treatment with continuous positive airway pressure.

If there is no history of sleepiness, difficulty in concentrating, unsatisfying sleep, or nocturnal choking and the episodes of apnoea are few and far between you are left with the difficult and often unrewarding problem of how to manage snoring. In this patient weight loss is important. The patient should be advised to avoid alcohol in the evening as it relaxes the upper airway dilating muscles, predisposing to upper airway narrowing and snoring. Sedatives should be avoided for the same reason. Smoking should be stopped, but it is often inappropriate to ask a patient to lose weight and stop drinking and smoking at the same time. Smoking is the least important in this overweight man. If the patient snores only when lying on his back the old wife's tale of stitching a tennis or golf ball into the back of the pyjama jacket sometimes works. In a minority of snorers a nasal dilating clip, obtainable over the counter, can help, but most people find that it falls out.

I do not think that referral to an ear, nose, and throat surgeon is appropriate unless the patient has gross abnormalities of the upper airway. Major ear, nose, and throat operations such as uvulopalatopharyngoplasty may help in some patients, but there is a cost in terms of pain and potential voice and regurgitation problems. Furthermore, such a procedure does not always help, has been associated with perioperative death, and may make it impossible for the patient to be treated with continuous positive airway pressure in later life. Laser treatment of the palate is at an experimental stage.

Unfortunately, it is often impossible to do much to help simple snoring, and the best that can be done is to explain the mechanisms of snoring and the rationale for losing weight and avoiding alcohol and place the onus on the patient.—N J DOUGLAS is director, Scottish National Sleep Laboratory, Edinburgh