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Drug utilization 90% – a simple method for assessing the quality of drug prescribing

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Abstract *Objectives*: To describe a simple method for assessing the quality of drug prescribing.
Methods: We tested the idea that the number of drugs accounting for 90% of drug use – drug utilization 90% (DU90%) – may serve as an indicator of the quality of drug prescribing. We ranked the drugs by volume of defined daily doses (DDD) and determined how many drugs accounted for the DU90% segment. We also compared this segment with the pharmacotherapeutic guidelines issued by the Regional (local) Drug Committee to determine the adherence to its recommendations (index of adherence). The cost per DDD within the DU90% segment and for the remaining 10% was also calculated. The utilization of drugs based on prescriptions purchased during April 1995 was determined for 24 primary health care (PHC) centres in southwestern Stockholm.
Results: The number of different products, defined as all products marketed under a single brand name within an ATC (anatomic therapeutic chemical) category, in the DU90% segment varied twofold (81–164) between the 24 PHC centres. Differences in the number of GPs per PHC centre accounted for a third of this variation. The compliance with the Drug Committee recommendations varied between 54% and 78%. There was no relationship between the number of products accounting for the DU90% segment and the adherence to local prescription guidelines, i.e. prescribing more products did not increase the adherence.

The costs for the DU90% drugs varied from 2.26 SEK/DDD in one PHC centre to 3.75 in another one, with an average cost of 2.87 SEK/DDD, while for the remaining 10% it was the double (6:54 SEK/DDD). In all, the DU90% drugs made up 80.8% of the total cost as compared with 19.2% for the remaining 10%. In the DU90% segment, there was no clear relationship between adherence to the guidelines and the cost/DDD, i.e. following the evidence-based guidelines appeared to provide a higher quality of prescribing rather than cheaper prescribing.

Conclusions: The DU90% is an inexpensive, flexible, and simple method for assessing the quality of drug prescribing in routine health care. The number of products in the DU90% segment and adherence to prescription guidelines may serve as general quality indicators. The method may be adapted to provide comparative data between PHC centres, hospitals, regions etc. that may be cross-sectional and longitudinal. Other quality criteria, specific for each class of drugs, should complement these general indicators.

Key words Drug utilisation, Prescribing habits

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Introduction

Physicians can only master the prescribing of a limited number of drugs. Chinburapa et al. explored the limitations of knowledge on physicians' decision making behaviour [1]. When presented with a larger number of choices of therapy and more complex choices, physicians shifted from using compensatory (i.e. efficient) processes to using more inefficient, non-compensatory processes [1]. The result was a lower quality of prescribing when

limits of knowledge were exceeded. High quality prescribing is therefore associated with the use of a relatively limited number of pharmaceutical products.

In 1995, Sweden became a member of the European Union (EU). The membership will have a major impact on the Swedish pharmaceutical market. The regulatory authority in Sweden has had a long tradition in approving only pharmaceutical products considered to be as good as or better than those already on the market. This principle has resulted in Sweden having a limited number of pharmaceutical products, in the order of 3000, compared to 10 000 in the UK and 70 000 in Germany (24 000 in the *Rote Liste*) [2].

A gradual adaptation to the EU regulations has increased the Swedish drug market to about 3600 pharmaceutical products [3]. In the neighbouring country Denmark, a member of the EU since the 1970s and with about half the size of the Swedish population, 5000 pharmaceutical products are available [2]. If only market forces will determine the number of pharmaceutical products, Sweden can anticipate a drug market of the same size.

Quality of care has become an important issue in the provision of health-related services. The prescribing of medications is an integral part of health care, representing a relatively safe, effective and inexpensive mode of treatment. Quality assurance programmes in drug prescribing are therefore needed. We tested the idea that the quality of drug prescribing is related to the number of drugs that account for 90% of drug use (Drug Utilization 90% or DU90%) and that the number as well as the drugs in this segment may serve as simple indicators of the quality of drug prescribing.

Materials and methods

We applied the DU90% method to primary health care (PHC) prescribing in the southwest suburbs of Stockholm, which is the catchment area of Huddinge University Hospital and has a population of 252 000 (1995). In 1995 this area was served by 24 primary health care centres with 124 general practitioners (GPs). As part of an educational programme in rationalising drug prescribing among GPs in the area, a prescription survey was done for 1 month every second year [4], the last one in April 1995. The data are based on prescriptions purchased at the 24 community pharmacies in the area. Such data have been analysed only in the aggregate by health centres. The prescribing of individual physicians or patient records were not examined. OTC drugs, such as antacids, minor analgesics, vitamins, etc. are only included in this study if they were prescribed by a physician.

All drug utilization was quantified in terms of defined daily doses (DDDs) and retail cost and classified according to the Anatomic Therapeutic Chemical (ATC) system [5]. For this project, data were analysed by pharmaceutical product, defined as all products marketed under a single brand name and ATC group.

The concept of DDDs was developed as a standard measure of drug utilization which represents the average maintenance dose per day of a drug when used for its major indication [6, 7]. The DDD is a technical unit of comparison. It overcomes difficulties in comparing prescriptions of different price, pack size, duration and dose. Utilization is normally expressed as the number of DDDs per 1000 inhabitants per day (DDD/TID) which allows comparisons between countries, regions or, as in the present case, different PHC centres. It also allows evaluation of trends over time. The DDD was advocated as the sole standard dose unit for evaluating drug utilization in a recent review [8].

We identified all pharmaceutical products that had a DDD, as assigned by the WHO Collaborating Centre for Drug Statistics Methodology [5]. The number of tablets etc. in each prescription was converted into the numbers of DDDs. The total utilization for the month overall and for each centre was determined. We then calculated the number of drugs that accounted for 90% of the total volume of DDDs (the area under the curve), both overall and for each of the 24 centres. The 90% level was arbitrarily selected to focus on the quality of the bulk of the prescribing whilst allowing some leeway for individual variation.

Excluded were 86 pharmaceutical products (10% of 857) that did not have an assigned DDD, mainly dermatological preparations, shampoos, nasal solutions, ophthalmic drops, ointments, vaccines, and nutritional supplements. Those products constituted 5% of the total by cost and 5% by prescription volume. Exclusion of those drugs did not appreciably affect the results.

The drugs prescribed were also compared with the list of drugs recommended for use in the catchment area, which mainly contains first-line drugs for common diseases. This guideline is based on the principles of evidence-based medicine and is updated each year by the Drug Committee and distributed free of charge to all practitioners in the catchment area. This committee is now one of five local Drug Committees in the Stockholm region (1.7 million inhabitants) [9]. The 1995 list contained 213 pharmaceutical products [10] approved by the members of the Drug Committee and based on the selection done by the 13 Pharmacotherapy Task Forces with members representing GPs, hospital based specialists, pharmacists and clinical pharmacologists. Adherence to this guideline was defined as the proportion of prescribed drugs (in DDDs) in the DU90% segment that appear on the list of drugs recommended for use to form an index of adherence (DDDs corresponding to number of prescriptions). We also tested the DU90% on the same data but using the number of prescriptions instead of DDD as the unit of measurement for drug utilization and compared the results.

Costs were defined as the total retail price paid at the pharmacy and includes all markups and dispensing fees, regardless of payer. In order to compare the drug costs among the PHC centres, figures on the average cost/DDD were calculated for the DU90% segment and for the remaining 10%.

Descriptive statistical values (i.e. mean, SD, median, range) were calculated. Rates of agreement between the different variables were calculated with Spearman's rank order correlation coefficient (r_s). A value for $P < 0.05$ was considered significant.

Results

The principle of the DU90% method is illustrated in Fig. 1a and b. During April 1995, a total of 771 pharmaceutical products with DDDs prescribed by the 124 GPs were purchased at the pharmacies in the area; 208 pharmaceutical products constituted 90% of the total DDDs (208 = DU90% or 27% of all the 771 drugs).

The number of pharmaceutical products that formed the DU90% segment varied twofold and ranged from 81 in one PHC centre to 164 in another one, with the mean equal to the median of 128 (Table 1). The total number of products is correlated with the number of DU90% products ($r_s = 0.93$, $df = 22$, $P < 001$). There was a significant correlation between the number of GPs of each centre (ranging from 2 to 9) and the number of products prescribed (total number of products $r_s = 0.67$, $df = 22$, $P < 0.001$, and in the DU90% segment $r_s = 0.58$, $df = 22$, $P < 0.003$).

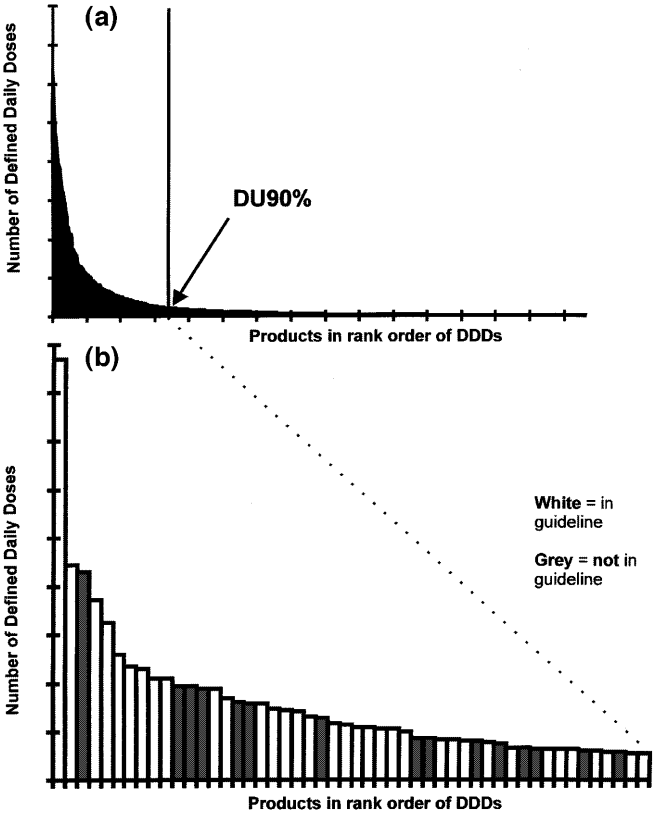

Fig. 1 a Number of drugs ranked by volume of defined daily doses (DDD). The arrow indicates the number of drugs accounting for 90% of the DDDs (DU90%; the area under the curve) **b** The DU90% segment enlarged, indicating drugs listed in a guideline (white) and drugs not listed (black). Index of adherence is calculated as the percentage of the number of DDDs in white/green of the total number of DDDs in this segment

The rate of adherence to the Drug Committee recommendations in the DU90% segment varied between 54% and 78% among the PHC centres, with a mean of 67%. There was no correlation between the number of GPs and the adherence to the guideline in the DU90% segment.

The total cost of drugs with an established DDD was 6.8 million Swedish kronor (SEK) during 1 month, with an average cost of 54 782 SEK per GP. The cost for DU90% segment represented 80.8% of the total cost, while the remaining 10% accounted for 19.2%, with a twofold variation among PHC centres (Table 2). Cost per DDD varied among the centres from 2.26 SEK/DDD to 3.75 in the DU90% segment, and from 3.77 to 9.12 in the remaining 10% segment (Table 2).

To illustrate the difference in ranking based on volume in DDDs, prescriptions or cost, the most commonly used pharmaceutical products in the DU90% segment are ranked by DDD in Table 3. Similar results were found when using prescriptions as the unit of drug utilization. Including pharmaceutical products without DDDs, a total number of 857 were purchased in the studied region during April 1995. Of these, 259 pharmaceutical products made up 90% of the total number of prescriptions. Within this number is included 18 products mainly for ophthalmologic and dermatological care that lacked DDD.

Discussion

We chose to focus on the quality of prescribing drugs that accounted for 90% of the volume to form the drug utilization 90%, i.e. DU90%. In this segment we propose to use the number of different products and, when applicable, the index of adherence to guidelines as general quality-of-care indicators for drug prescribing, the former based on evidence from decision making behavioural research [1]. Assuming consensus about evidence-based prescribing (alluding to the definition of evidence-based medicine: conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients) [11], these proposals are in line with the definition of an indicator: a measurable element of practice performance for which there is evidence or consensus that it can be used to assess the quality, and hence change in the quality, of care provided [12]. To assess health care quality nationally and internationally, it is first necessary to agree on indicators of performance. Criteria and standards can then be defined.

The 90% level was arbitrarily chosen as a reasonable cut-off point. It concentrates on the bulk of the prescribing, in our case on 27% of the total number of prescriptions, but still allows some leeway for individual variation. Future studies may elucidate whether another cut-off point (DU75% etc.) may be more appropriate. This is, however, of minor importance for the concept as such. In agreement with the ATC/DDD as standard units for comparison, the DU90% methodology is another standardised tool focusing on the quality of drug prescribing. The data were analysed for each health care centre but the same principle could be applied for individual physicians, a larger primary health care area or region, a clinic, a hospital or internationally [13, 14]. It could also be applied on ATC groups such as $DU90\%_{NSAID}$, $DU90\%_{benzodiazepines}$ etc. [13–15]. In this study the month of April was chosen based on previous experience in Sweden [4]. Depending on ease of access to data and the size of the population survey the time frame could be shorter or longer.

This survey refers to drugs prescribed and purchased at the pharmacies and therefore does not take into account OTC drugs or prescriptions issued by the GPs that were never presented at the pharmacies. From other surveys we know that this may account for a substantial amount of certain drugs, and it may also vary from one GP to another [16]. However, this paper focuses on the principle of how to present and implement drug utilization statistics as a basis for improving drug prescribing. The fact that a few of the medications do not have assigned DDDs does not invalidate this principle.

Table 1 Range of pharmaceutical products prescribed at 24 primary health care centres and purchased in Stockholm, April 1995, and analysed with DU90%

Centre	No. of GPs	No. of pharmaceutical products		Index of adherence[a]
		Total	90% by DDD (=DU90%)	
1	6	362	144	66
2	5	268	118	71
3	5	301	127	70
4	8	338	139	65
5	3	309	146	68
6	4	225	106	70
7	7	371	152	67
8	3	269	126	73
9	9	358	146	71
10	6	251	124	67
11	5	261	131	69
12	3	206	102	72
13	7	298	121	63
14	3	224	107	78
15	8	379	164	67
16	5	213	100	76
17	4	239	121	67
18	7	347	149	64
19	4	275	128	60
20	6	281	128	66
21	7	305	130	68
22	2	162	81	70
23	5	375	152	58
24	2	274	127	54
Mean	5.2	287	128	67
Median	5	278	128	67
SD	2	60	19.5	5
Range	2–9	162–379	81–164	54–78

[a] % DDDs of products listed in guideline in the DU90% segment

Table 2 Range of costs for pharmaceutical products prescribed and purchased at 24 primary health care centres analysed by DU90% (Stockholm, April 1995)

Centre	No. of GPs	Cost of DU90% (% of total)	Cost/DDD in DU90% segment	Cost/DDD in remaining 10%
1	6	78.7	2.57	6.18
2	5	78.0	2.26	5.99
3	5	77.2	2.28	5.93
4	8	78.5	2.52	6.17
5	3	78.7	2.81	6.77
6	4	78.3	2.79	6.70
7	7	81.1	2.96	6.13
8	3	79.2	2.74	6.43
9	9	78.2	2.86	7.11
10	6	75.5	3.21	9.12
11	5	81.2	3.44	7.09
12	3	77.7	3.10	7.75
13	7	87.3	3.15	3.77
14	3	81.5	3.14	6.28
15	8	76.0	2.78	6.62
16	5	84.2	2.84	4.66
17	4	79.1	3.24	7.63
18	7	80.4	2.84	6.19
19	4	77.5	2.75	7.12
20	6	78.9	2.91	7.25
21	7	76.3	2.87	7.93
22	2	86.8	3.75	4.93
23	5	77.2	2.50	6.58
24	2	77.7	2.60	6.57
Mean	5	79	2.87	6.54
Median	5	79	2.84	6.58
SD	2	3.1	0.35	1.10
Range	2–9	75.5–87.3	2.26–3.75	3.77–9.12

Table 3 Top 20 pharmaceutical products prescribed and purchased at 24 primary health care centres in Stockholm, April 1995 (ranked by defined daily doses)

Rank	Pharmaceutical Products	No. of DDDs	No. of prescriptions	Cost (SEK)
1	ASA 75 mg	73 100	710	24 664
2	Furosemide-NM	64 747	357	28 949
3	Carbamide ung	54 150	144	25 460
4	Levothyroxine	50 850	650	44 579
5	Furosemide retard	49 530	458	68 698
6	Budesonide turbo (inhalation)	44 100	560	325 676
7	Carbamide cream	37 465	82	19 656
8	Terbutaline turbo	36 500	703	134 554
9	Felodipine	35 889	362	187 316
10	Glibenclamide	35 102	442	87 524
11	Metoprolol	34 454	613	172 920
12	Atenolol	32 357	404	56 160
13	Carbamide lotion	28 900	49	13 487
14	Digoxin	28 644	401	16 770
15	Enalaprilat	27 560	212	112 774
16	Lactulose	27 480	217	27 266
17	Bendroflumethiazide	27 049	256	24 770
18	Salbutamol	26 980	399	80 483
19	Budesonide turbo (intranasal)	26 467	300	115 994
20	Propoxyphene + paracetamol	24 220	700	63 970

The DDD is an accepted and internationally well-known unit in drug utilization studies [6, 7, 17–19]. The annual publication *Swedish Drug Statistics* presents data on sales and prescribing in number of DDDs per 1000 inhabitants per day and cost (SEK) and classified by ATC [3]. We therefore found it convenient to use the volume of prescriptions expressed in DDDs. The same principle can be applied to other units of utilization such as prescriptions. However, this only applies for national comparisons, while for international comparisons the DDD is the preferable unit of measurement [6–8, 17–19].

In agreement with McGavock [20], we found a significant correlation between the number of GPs in the PHC centres and the number of different pharmaceutical products prescribed. We found that the number of GPs accounted for about a third (34%) of the variation in the number of products in the DU90% segment. Other factors that may account for the variation between PHC centres are the age structure and the morbidity of the population served.

The variations between health centres in the adherence to the prescription guidelines (range 54%–78%) suggest that there is room for improvement. With a higher adherence to these recommendations, and concentrating on the 90% prescribing volume, the range of variation between number of GPs and number of different drugs prescribed will become much less pronounced.

We also found a twofold variation in the cost per DDD in the DU90% segment between PHC centres (Table 2) and that the average cost per DDD for the DU90% segment drugs was less than half of that for the remaining 10%, (2.87 SEK vs 6.54 SEK). Many high volume medications are not very expensive (Table 3). This is in contrast to some extremely small volume drugs such as erythropoetin.

With regard to the number of different products in the DU90% segment there was one PHC centre outlier with a low number of products (81 in Table 1). This centre, with two GPs, had the most expensive profile in the DU90% segment. There was one outlier in the 10% segment with a higher cost per DDD of SEK 9.12 (Table 2). This centre had a quite ordinary cost profile within the DU90% segment. There was no correlation between the cost/DDD for drugs in the DU90% segment and the remaining 10% segment, suggesting that cost/DDD in these two segments were independent of each other. The proposal to use the number of different drugs prescribed as a general quality-of-care indicator for drug prescribing is a relatively crude first step. The next attempt may be to analyse the distribution of products by treatment areas, i.e. by ATC groups. In general practice a reasonable distribution among the major ATC groups can be postulated. A lack of products in certain ATC categories, as well as too many products in other categories, may serve as quality indicators.

In a cost containment society, a high quality of the bulk of the prescribing (the DU90% segment), including adherence to the Drug Committee recommendations, will also provide economic room for rare and expensive medications. This was also the conclusion of a GP study in the UK [21].

In England and the Netherlands it was found that a small minority of physicians accounts for a disproportionately large share of prescriptions of newly introduced (usually expensive) medications [22, 23]. Applying the DU90% method combined with the index of adherence to the Drug Committee recommendations will highlight such deviations in prescribing.

We believe that the proposed method for working with general quality-of-care indicators (the number of drugs accounting for DU90% and adherence to guidelines, the criteria of which remain to be defined) also can form the basis for more specific criteria for assessing the quality of prescribing in PHC, also by formulating consensus criteria and standards by the prescribers [24].

The DU90% method neither examines the appropriateness of the use nor gives outcome data; however it

does allow comparisons over time and between clinics, hospitals, primary care units and different geographical regions and may serve to identify problem areas where educational intervention is necessary. Although crude, the information provided is proper and may serve as the basis for more detailed analyses. Moreover, applying ATC/DDD statistics, increasingly available all over the world, to DU90%, it is rapid, inexpensive and flexible and it also provides economical data.

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