Quantitative disparities in outpatient antibiotic exposure in a Hungarian county

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Objectives: Although antibiotic utilization data expressed in defined daily doses (DDDs)/1000 inhabitants/day are often available for a given period and area, the actual antibiotic exposure of the population is rarely explored. We aimed to identify the real antibiotic exposure of the inhabitants of one Hungarian county.

Methods: The patient-level dispensing data for 2005 for Csongrád County were retrieved from the database of the Hungarian National Health Fund Administration. The number of antibiotic users was quantified, and differences in antibiotic use (quantity and frequency) were explored. Disparities were revealed by Lorenz curves. A new form of Lorenz curve was also introduced. The DDD values for 2005 were used.

Results: In 2005, a total of 486,115 antibiotic prescriptions were redeemed, and 3,329,385 DDDs were dispensed to 213,748 different patients; 50.3% of the inhabitants of Csongrád County (total population 424,615) took antibiotics. The average consumption of 1-, 2-, 3-, 4- and 5-time users was 7.5, 14.6, 21.0, 26.9 and 32.2 DDDs per user, respectively. Lorenz curves (including the new form of Lorenz curve) demonstrated the existence of disparities in antibiotic use. One percent of the users with the heaviest consumption were responsible for 6.9% of the total use and redeemed antibiotic prescriptions nine times or more during 2005.

Conclusions: Disparities in antibiotic use were detected: half of the inhabitants were exposed to antibiotics, and among antibiotic users, the quantity of antibiotics that they redeemed displayed great variance, mainly due to differences in the prescribing frequency. Special attention should be paid to those with frequent antibiotic use (five times or more annually).

Keywords: antibacterial, utilization, Hungary, Lorenz curve

Introduction

Antibiotic resistance has become a major public-health problem worldwide. Since the causal role of antibiotic overuse and misuse in microbial resistance development became obvious,\textsuperscript{1} the surveillance of antibiotic use has been receiving increasing attention.\textsuperscript{2,3} In the outpatient setting, the most common unit of measurement of drug use is the WHO-recommended defined daily dose (DDD) adjusted for the size of the population (i.e. DDD/1000 inhabitants/day).\textsuperscript{4} However, although the DDD/1000 inhabitants/day is undoubtedly one of the best expressions with which to benchmark overall antibiotic use, it does not reveal disparities in drug use. In the present report, we therefore set out to identify the real antibiotic exposure of the inhabitants of a Hungarian county by other means: quantifying the number of antibiotic users and their antibiotic consumption and thereby revealing differences in the quantity and frequency of antibiotic use.

Materials and methods

In Hungary, all antibiotics are prescription-only medicines that are equally reimbursed by the sole Hungarian health insurance company: the Hungarian National Health Fund Administration (HNHFA). In the present investigation, the systemic antibiotic prescriptions dispensed in Csongrád County in 2005 were analysed. Csongrád County, one of the 20 Hungarian counties, is situated in the south-eastern part of the country and has 424,615 inhabitants. Data were retrieved from the electronic database of the HNHFA, which has 100% population and pharmacy coverage. The

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Disparities in antibiotic exposure

The county-level antibiotic use was 21.5 DDD/1000 inhabitants/day. In total, 486 115 antibiotic prescriptions were redeemed at the pharmacies, and 3 329 385 DDDs were dispensed to 213 748 different patients. On average, 1.1 packages [standard deviation (SD): 0.4] and 6.9 DDDs (SD: 4.6) were ordered per prescription. Combination therapy was prescribed for only 6530 patients (3%) as a combination therapy. In Hungary, only one product can be ordered in the required quantity (i.e. the number of packages) on one prescription form. Combination therapy (e.g. dual therapy with clari-thromycin plus amoxicillin) must be ordered on separate prescription forms. For interpretive purposes, we also calculated the county-level antibiotic consumption, expressed in DDD/1000 inhabitants/day. The number of inhabitants was extracted from the 2005 yearbook of the Hungarian Central Statistical Office. Data analyses were conducted in Microsoft Excel, Microsoft Access and R (version 2.6).

Results

The annual antibiotic use at an individual level was analysed in terms of prescription frequency and dispensed quantity. DDDs were calculated according to the 2005 version of the WHO ATC-DDD index. Disparities in antibiotic consumption were revealed by the Lorenz curves. A new form of Lorenz curve was also introduced, which is discussed in the Results section.

Similar to the publication of Hallas and Støvring, all applied graphic displays were the reverse of the original, convex Lorenz curve. Claims for different antibiotics on the same day were regarded as a combination therapy. In Hungary, only one product can be ordered in the required quantity (i.e. the number of packages) on one prescription form. Combination therapy (e.g. dual therapy with clarithromycin plus amoxicillin) must be ordered on separate prescription forms. For interpretive purposes, we also calculated the county-level antibiotic consumption, expressed in DDD/1000 inhabitants/day. The number of inhabitants was extracted from the 2005 yearbook of the Hungarian Central Statistical Office. Data analyses were conducted in Microsoft Excel, Microsoft Access and R (version 2.6).

Discussion

The most widely accepted and used measurement unit of drug utilization is DDD/1000 inhabitants/day. In the case of chronic treatment (e.g. insulin therapy), the number of DDD/1000 inhabitants/day can be used to estimate the number and prevalence of treated patients (e.g. an insulin consumption of 13 DDD/1000 inhabitants/day means that, on average, 1.3% of the inhabitants use 1 DDD of insulin every day).

When acute treatment such as antibiotic therapy is prescribed, the short duration of drug use makes it difficult to estimate the number of exposed people from the number of DDD/1000

![Figure 1. Lorenz curves for antibiotic use. Data from Csongrád County, Hungary, 2005. The diagram on the right is a 10-fold enlargement of the indicated square in the diagram on the left. Lorenz curve ‘A’ (the thick continuous black line) shows the cumulative proportion of antibiotic use accounted for by cumulative percentiles of antibiotic users; those with higher annual antibiotic consumption being ranked first. Lorenz curve ‘B’ (the thin line with full circles; new form of Lorenz curve) depicts the cumulative proportion of antibiotic use versus cumulative percentile of users ranked according to the antibiotic redeeming frequency (those with higher annual antibiotic redeeming frequency being ranked first). If all users consumed a similar quantity, the curve would be diagonal (dashed line).]
inhabitants/day. The calculated average consumption per inhabitant would indicate that in 2005, each inhabitant took 7.8 DDDs (3 329 385/424 615 or 21.5 × 365/1000). As, on average, one prescription contained approximately 7 DDDs, this would mean that each inhabitant redeemed slightly more than one antibiotic prescription (7.8/6.9) in 2005. Naturally, this is only a theoretical situation as no antibiotics were prescribed for 49.7% of the inhabitants, whereas among those who redeemed antibiotic prescriptions, 52.6% were prescribed multiple courses.

Studies from Denmark and Italy reported antibiotic consumptions of 12.1 and 16.5 DDD/1000 inhabitants/day, respectively, with 30% and 40% of the inhabitants, respectively, exposed to antibiotics during 1 year. Both the Danish study and our own demonstrated differences in the numbers of redeemed DDDs among antibiotic users. In the report by Hallas and Støvring, 1% of the users with the highest antibiotic consumption in a Danish county accounted for 9.7% of the total antibiotic use, when compared with 6.9% in the present study.

The Lorenz curve (named after a Swiss economist) was first used to describe skewness in income. Hallas and Støvring introduced its use to reveal disparities in drug use. We observed that the differences in the annual DDD antibiotic consumption in Csongrád County were clearly related to the prescribing frequency (i.e. the heavy users were the frequent users). We therefore introduced a new form of Lorenz curve, grouping patients by antibiotic redeeming frequency (Figure 1, curve ‘B’). This form of Lorenz curve is also able to indicate disparities in antibiotic use, but its interpretation is more suitable in the case of acute therapy.

The main limitation of this study arises from not excluding patients who were prescribed combination therapy (e.g. dual antibiotic therapy) and focusing only on prescription data. However, as combination therapy occurred in only 3% of the cases and over-the-counter sales were previously proved to be marginal, there can be only a slight bias in our results. Another confounder is that the data cannot be stratified by age in the DDD calculations (children could not be analysed separately).

In conclusion, we have found that half of the population of Csongrád County redeemed antibiotics in 2005. Among the exposed patients, there were appreciable disparities in antibiotic use, which mainly originated from differences in the prescribing frequency. Special attention should be paid to patients who redeem antibiotic prescriptions five or more times during 1 year. The necessity of prescribing antibiotics should also be assessed, particularly to those prescribed antibiotics only once a year.

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Transparency declarations

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References