Trends in Antibiotic Utilization in Vancouver Associated With a Community Education Program on Antibiotic Use

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ABSTRACT

Objective: “Do Bugs Need Drugs” (DBND) is a community education program that was implemented in British Columbia (BC) in September 2005 to decrease inappropriate antibiotic use. This study conducted descriptive analyses of the association between DBND and changes in overall, pediatric, drug-specific, and indication-specific antibiotic utilization rates in Vancouver, BC.

Methods: Utilization data on all oral solid and liquid antibiotics classified as “antibacterials for systemic use” were obtained from BC PharmaNet for the years 1998 to 2008. Utilization data were linked to physician billing data to allow indication-specific analyses. Following conversion to the defined daily dose (DDD), the Holt-Winters exponential smoothing method was used to project expected antibiotic use in the period after implementation based on use prior to implementation. Differences between expected and observed utilization rates were calculated.

Results: Overall antibiotic use has stabilized in recent years (16.2 DDD/1000 population/day in 2008). Fluoroquinolone use remains high (1.5 DDD/1000 population/day), as does the steadily increasing use of newer macrolides (1.1 to 2.7 DDD/1000 population/day between 1996 and 2008). Encouraging declines in overall and indication-specific prescription rates among children were observed. Following 3 years of DBND activities, antibiotic use was 5.8% lower than expected and the number of prescriptions dispensed to children was 10.6% lower than expected.

Conclusions: This ecological study reports improvements in antibiotic use that occurred simultaneously to the delivery of the DBND program in Vancouver. However, we did not find a lowering of all targeted classes. Policy directives limiting the use of certain antibiotics may be required.

Key words: Antibiotics; intervention studies; pediatrics; macrolides

The audience and geographic reach of each program component and its impact on knowledge and short-term behaviour is evaluated on a yearly basis (BC Centre for Disease Control, unpublished data). The current study is an extension of this evaluation and aims to investigate the relationship between DBND and population-level changes in antibiotic utilization patterns in Vancouver, where the program was deployed to its fullest.

METHODS

Intervention

The DBND program consists of several independent components, as described on the program’s website (http://www.dobugsneed-drugs.org). Although not all components were initiated simultaneously, in January 2006 the first provincial television campaign was launched. This campaign is considered the effective beginning of the program, given that television is the most efficient method of advertising in terms of geographical and target audience reach.

Designating January as the first post-intervention month also facil-
Table 1.  Average Daily Antibiotic Utilization Rates in Vancouver by Year*

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* Rates expressed in DDD/1000 population/day  
† ATC=Anatomical Therapeutic Chemical

Data sources

Drug utilization data from January 1996 to December 2008 were obtained from the BC PharmaNet database. This database collects information on all antibiotics dispensed through community pharmacies in BC. All oral solid and liquid antibiotics under the heading of “antibacterials for systemic use” in the Anatomical Therapeutic Chemical (ATC) classification system were included in the dataset. Information on patient age and sex, geographical location of the pharmacy, antimicrobial agent prescribed, and the date, dose, and quantity dispensed was available. Under-reporting and misclassification in this type of administrative database is minimal.11

Antibiotic utilization rates for adults were expressed in defined daily doses (DDD) per 1000 population per day. The DDD is the international standard unit of measurement developed by the World Health Organization and is a measure of the “average maintenance dose per day for a drug used in its main indication in adults”.12 All data pertaining to children less than 15 years of age were expressed as prescriptions per 1000 population per day, as the DDD is not accurate for children whose antibiotic dosing is dependent on weight. Population statistics were obtained from BC Stats.13

The Medical Service Plan database contains information on patient age and sex, date of visit, physician reimbursement claims,14 physician specialty, and geographic location of the physician’s office. The Medical Service Plan and BC PharmaNet databases were linked by a third party for the years 1996 to 2007. Specifically, antibiotic prescriptions were linked to the most recent physician visit during the 5 days preceding the date of dispensing of the prescription, as previously described.15 Any prescriptions that could not be linked to a visit were removed from the analysis. All personal identifiers were removed prior to receipt of the final dataset.

Choice of populations, drugs, and indications of interest

Overall antibiotic utilization rates represent population-level utilization patterns, and were thus of interest. Particular attention was paid to the utilization patterns of fluoroquinolones and newer
The use of oral systemic antibiotics steadily declined in Vancouver during the late 1990s, reaching its lowest level in 2004 (15.5 DDD/1000 population/day). Despite an increase in 2005, utilization rates have stabilized in recent years. Antibiotic utilization rates in Vancouver have been lower than the provincial average since 2003. Nevertheless, these rates remain higher than in other cities in BC, such as Richmond (Figure 1).

From 1996 to 2005, fluoroquinolone use increased by 0.5 DDD/1000 population/day. However, the use of these pharmaceuticals decreased in recent years (from 1.6 to 1.5 DDD/1000 population/day between 2006 and 2008). Fluoroquinolone utilization rates are primarily driven by the use of ciprofloxacin, which increased 50% during the past 13 years. Macrolide utilization rates continue to rise due to the increase in the use of newer macrolides (clarithromycin and azithromycin; 1.1 to 2.7 DDD/1000 population/day between 1996 and 2008). Erythromycin use has steadily declined since 1996 (2.2 to 0.3 DDD/1000 population/day between 1996 and 2008).

The use of penicillins decreased during the end of the 1990s and into the 2000s, reaching a plateau in 2004. Penicillins continue to be the most frequently used class of antibiotics. Also apparent is the decline in use of tetracyclines and sulfonamide and trimethoprim combinations. Table 1 summarizes the changes in antibiotic utilization rates in Vancouver by ATC class, between 1996 and 2008.

### Trends in yearly pediatric prescription rates

Overall prescription rates for children decreased by 2.1 prescriptions/1000 population/day between 1996 and 2008. This decline was primarily driven by a drop in amoxicillin use (1.00 prescriptions/1000 population/day) and erythromycin use (0.49 prescriptions/1000 population/day). For the indications of acute bronchitis, acute pharyngitis, and otitis media, prescription rates among children decreased by 0.15, 0.13, and 0.25 prescriptions/1000 population/day, respectively, between 1996 and 2007 (Figure 2).
Amoxicillin remains the most prescribed antimicrobial for all three indications, followed by clarithromycin for acute bronchitis, penicillin V for acute pharyngitis, and azithromycin for otitis media.

Expected versus observed utilization rates

Monthly observed and expected antibiotic utilization rates among the Vancouver population and prescription rates among children, from January 2004 to December 2008, are depicted in Figures 3A and 3B, respectively. Annual difference between observed and expected rates from January 2006 to December 2008 are presented in Table 2. During the three years following program implementation, cumulative observed antibiotic use was 5.8% lower than expected (11,078,750 DDD instead of 11,760,530), whereas the observed number of cumulative prescriptions dispensed to children was 10.6% lower than expected (118,218 prescriptions instead of 132,239).

DISCUSSION

The overall consumption of antibiotics has stabilized; however, the use of specific classes of antibiotics, namely fluoroquinolones and newer macrolides, continues to rise. This trend is of concern as evidence suggests that certain agents within these classes may be more efficient at inducing bacterial resistance and multidrug resistant organisms. Among children, encouraging declines in overall and indication-specific prescription rates were observed. However, clarithromycin and azithromycin prescription rates have increased slightly in recent years. This trend may have important consequences with respect to antibiotic resistance among children.

Overall monthly utilization and prescription rates from January 2006 to December 2008 were below those expected based on past secular trends. These results demonstrate DBND’s potential influence on antibiotic utilization patterns, especially in the long term. In fact, we observed an improvement in the rate of change of utilization rates among all antibiotic targets of the program, which is an important impact measure. That is, the rate of increase of inappropriate prescribing was not as steep following the initiation of DBND compared to before. However, rapid changes in antibiotic use, such as those associated with policy directives like formulary restrictions, were not observed.

Because BC PharmaNet is the only comprehensive central prescription network in North America, our study is unique in reporting population-level antibiotic trends. The complete listing of all antibiotics used in the community in Vancouver allowed the analysis of changing utilization trends to be conducted using precise measures of utilization. Furthermore, a key aspect of this study was the ability to assess changes in utilization patterns by indication through the linkage of the BC PharmaNet and Medical Service Plan databases. This linkage allowed us to address the difficult question as to whether appropriate antibiotic use is increasing, such as the use of first-line agents.

Our study has several limitations. Due to the ecological nature of this project, we are unable to separate potential causal impacts of program implementation from natural secular trends. This limitation is common among population-level interventions that lack an appropriate control group. It is thus possible that the documented improvements in antibiotic use would have occurred even without DBND. Second, it is currently not mandatory for physicians to record medications provided directly to patients during an office, clinic, or emergency visit. Medications dispensed within hospital facilities or used for treatment of sexually transmitted infections are also not recorded in BC PharmaNet, although we do not believe that these factors have significantly changed before and after the intervention. Furthermore, sexually transmitted infections were not a main target of DBND, nor have they been shown to heavily impact utilization at a population level.

A review of the recent medical literature and discussions with practicing physicians indicated that no major changes in professional practice guidelines impacting antimicrobial use occurred simultaneously to DBND implementation. There was also no change in the formulary status of any important antimicrobial agents during the implementation period of DBND, removing the listing or de-listing of drugs from insurance plans as a potential confounder of this study. However, the impact of independent initiatives aimed at similar goals as DBND may have affected antibiotic utilization rates.

In conclusion, our study reports improvements in the overall use of antibiotics in Vancouver following the implementation of DBND. While a lowering of rates of all program targets was not observed, we hypothesize that this can be achieved through consistent and repeated implementation of current initiatives and expansion of the program to include educational sessions focused on other indications for which antibiotics are commonly misused, such as urinary tract infections. Future studies are required to assess long-term impacts of the program and similar initiatives, like the stabilization of bacterial resistance rates. Finally, implementation of policy restricting the use of certain antibiotics should be considered.

REFERENCES


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**RéSUMÉ**

**Objectif** : Le programme d’éducation communautaire « Do Bugs Need Drugs » (DBND) mis en œuvre en Colombie-Britannique (C.-B.) en septembre 2005 vise à réduire l’utilisation inappropriée des antibiotiques. Nous avons mené des analyses descriptives de l’association entre ce programme et les changements dans les taux d’utilisation des antibiotiques; études interventionnelles; pédiatrie; macrolides. Nous avons mené des analyses descriptives de l’association entre ce programme et les changements dans les taux d’utilisation des antibiotiques; études interventionnelles; pédiatrie; macrolides.


**Résultats** : L’utilisation globale des antibiotiques s’est stabilisée ces dernières années (16,2 DQD/1000 hab./jour en 2008). L’utilisation de fluoroquinolone demeure élevée (1,5 DQD/1000 hab./jour), et l’utilisation des nouveaux macrolides s’accroît de façon soutenue (1,1 à 2,7 DQD/1000 hab./jour entre 1996 et 2008). Nous avons observé des baisses encourageantes dans les taux de prescription globaux et par indication pour les enfants. Après trois années d’activité du programme DBND, l’utilisation des antibiotiques était 5,8 % plus faible que prévu et le nombre d’ordonnances délivrées aux enfants était 10,6 % plus faible que prévu.

**Conclusion** : Cette étude écologique fait état d’améliorations dans l’utilisation des antibiotiques simultanément avec la prestation du programme DBND à Vancouver. Nous n’avons toutefois pas constaté une baisse dans toutes les catégories ciblées. Des directives limitant l’utilisation de certains antibiotiques pourraient être nécessaires.

**Mots clés** : antibiotiques; études interventionnelles; pédiatrie; macrolides.

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**Canadian Public Health Association**

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**International Travel and Health 2010**

*Situation as of January 1st, 2010* [32.50 $]

This book explains how travellers can stay healthy and provides WHO guidance on vaccinations, malaria chemoprophylaxis and treatment, personal protection against insects and other disease vectors, and safety in different environmental settings. It covers all the principal risks to travellers’ health, both during their journeys and at their destinations. It describes all relevant infectious diseases, including their causative agents, modes of transmission, clinical features and geographical distribution, and provides details of prophylactic and preventive measures.

Features of this new edition include:

- vaccine-preventable disease descriptions combined with vaccine recommendations
- new information for travellers with HIV/AIDS
- updated vaccine recommendations and schedules
- updated country list with malaria and yellow fever information
- new and updated maps showing disease distribution
- expanded information relating to mass gatherings.

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**Voyages internationaux et santé 2010**

*Situation au 1er janvier 2010* [32,50 $]

Cet ouvrage explique comment rester en bonne santé lors d’un voyage et indique les recommandations de l’OMS concernant les vaccinations, la chimiothérapie et le traitement antipaludiques, les moyens de protection individuelle contre les insectes et autres vecteurs de maladies et la sécurité dans divers environnements. Tous les principaux risques sanitaires auxquels les voyageurs sont exposés pendant le voyage et à destination sont passés en revue. Toutes les maladies infectieuses entrant en ligne de compte sont décrites, de même que leurs agents étiologiques, leur mode de transmission, leurs caractéristiques cliniques, leur répartition géographique et les mesures prophylactiques et préventives.

Les points saillants de cette nouvelle édition sont les suivants :

- description des maladies évitables par la vaccination doublée de recommandations concernant la vaccination;
- nouvelles informations à l’intention des voyageurs VIH-positifs;
- actualisation des recommandations concernant la vaccination et des calendriers vaccinaux;
- liste actualisée des pays avec informations sur le paludisme et la fièvre jaune;
- cartes inédites ou actualisées montrant la répartition des maladies;
- supplément d’information sur les rassemblements de masse.