Antibiotic Consumption Successfully Reduced by a Community Intervention Program

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Abstract

Background: The association between antibiotic use in the community and antimicrobial resistance is known. Attention has recently focused on the type of agents being prescribed.

Objectives: To implement, evaluate and compare the efficacy of two community intervention programs – continuous versus seasonal medical education – oriented to primary care physicians with emphasis on the appropriate use of antimicrobial drugs.

Methods: From October 2000 to April 2003 we conducted two interventions: a) a monthly educational campaign in selected clinics promoting appropriate diagnosis of common infectious diseases and prudent antibiotic use (continuous intervention group); and b) a massive educational campaign, conducted before two consecutive winters, promoting the judicious use of antibiotics for treating respiratory infections (continuous intervention group and seasonal intervention group). Sixteen similar clinics were randomized (8 to each group). The total antibiotic use was measured as defined daily dose/1000 patients/day, and compared between the groups.

Results: The total use of antibiotics decreased between 1999–2000 and 2002–2003 in both groups, but slightly more significantly in the continuous intervention group. The DDD/1000 patients/day for the seasonal group in 1999–2000 was 27.8 vs. 23.2 in 2002–2003; and for the continuous group 28.7 in 1999–2000 vs. 22.9 in 2002–2003, a reduction of 16.5% and 20.0% respectively ($P < 0.0001$). The main change in antibiotic use was noted for broad-spectrum antibiotics.

Conclusions: We present a successful community intervention program aimed to reduce unnecessary antibiotic use. Amplification of this type of intervention is imperative to stop the increase in antimicrobial resistance.

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The discovery of antimicrobial agents was one of the greatest achievements in medicine in the 20th century [1]. Just over 50 years ago the first patient received penicillin for the treatment of streptococcal and staphylococcal infection. Within a few years, penicillinase staphylococci began to emerge, first in hospitals and then spreading rapidly to the community [2]. The increase in resistance is a result of several factors, but the major cause is the overall volume of antibiotic prescribing, particularly for indications that do not require such therapy [1].

DDD = defined daily dose

The use of antibiotics in the community is indiscriminate and its restriction is very difficult, whereas in the hospital setting there usually is an infection control team. Several studies have focused on the excessive use of antibiotics in general, but only recently has attention focused on the type of agents being prescribed [3,4]. The increasing use of broad-spectrum antibiotics has important implications both for bacterial resistance and higher costs [1,3,4]. Broad-spectrum antibiotics constitute half of all antibiotic prescriptions for adults. Frequently however, they are prescribed for low risk adults in cases for which they provide little or no benefit, instead of older antibiotics, or for conditions that often do not require antibiotic treatment at all, such as viral respiratory infections [3,4].

Reducing the excessive use of antibiotics is essential to combat the increase in antibiotic resistance in both the community and hospital settings. Promoting the appropriate use of antibiotics through the development and application of treatment guidelines, together with educational efforts aimed at clinicians and nurses will help stop unnecessary prescribing and misuse of antibiotics, decrease treatment costs, and increase patient satisfaction [1]. We therefore decided to implement a community intervention program of continuous medical education targeting primary care clinics, with emphasis on the appropriate use of antimicrobial drugs, and evaluated the efficacy of this model of intervention.

Materials and Methods

This prospective randomized study was conducted in community outpatient clinics in northern Israel. These clinics, belonging to Clalit Health Services, the largest health management organization in Israel, provide health services to 70% of the population in the north of the country, including 442,758 Jews, Christian Arabs and Moslems living in urban and rural areas. Primary care is provided by group practices consisting of family physicians, pediatricians, nurses and pharmacists.

In October 2000 Clalit Health Service published and distributed a booklet to all primary physicians, “Guidelines for antimicrobial treatment in primary care,” which included the most common bacterial infections in children and adults, with the objective of promoting appropriate antibiotic use.

Table 1. Demographic data of patients in each group

	Continuous intervention group	Seasonal intervention group
Mean age (yrs)	32	32
Male/Female (%)	50.3/49.7	49.9/50.1
Age group (yrs)		
0–4	8.1	7.6
5–44	62.7	64.4
45–64	19.4	19.5
≥ 65	9.8	8.5

The 16 largest community clinics in the northern district were selected to participate in the study. Eight community clinics (with 86,330 patients) were randomized to participate in a community intervention program for continuing medical education aimed at improving diagnostic skills in infectious diseases, with emphasis on appropriate antibiotic treatment (continuous intervention group). Another eight community clinics (82,314 patients) with similar demographic characteristics were randomized as the seasonal intervention group [Table 1].

Intervention

- Once a month for 2 years (May 2001 to April 2003), each team in the continuous intervention group participated in an interactive teaching session. The intervention consisted of a "group education meeting" focusing on practical diagnostic tools directed at the decision "to treat or not to treat" with antibiotics. Physicians (general practitioners, pediatricians and family physicians), nurses and pharmacists were provided with therapeutic recommendations for common infectious diseases (respiratory, urinary, gastrointestinal, soft tissue) with clear criteria to distinguish between viral and bacterial infections in order to reduce unnecessary antibiotic use. If a decision to treat was taken, emphasis was placed on the first choice of antimicrobial therapy based on narrow-spectrum antibiotics of the correct class, dose and duration. The seasonal group did not receive this monthly intervention.
- A massive educational campaign involving the largest primary clinics (n=16) in the northern district was conducted during September-October 2001 and September-October 2002, prior to two consecutive winters, promoting the judicious use of antibiotics to treat respiratory infections. During a 2 hour interactive meeting, each participant received informative reminders for themselves and educational leaflets for their patients. Patients' leaflets contained information about the self-limited character of most respiratory tract infections, and "alarm signs" that require a new consultation with the family physician. Leaflets were translated from Hebrew to Arabic and Russian and were available in each doctor-nurse room and Clalit Health Services pharmacy.

Data on outpatient antibiotic use according to each clinic were provided by Clalit's Pharmacy Department database. Only systemic oral antibiotics for adult patients were measured as defined daily dose/1000 patients/day (pediatrics suspension drugs were excluded).

For the purposes of this study, penicillin, amoxycillin, cloxacillin, first-generation cephalosporins, erythromycin, tetracycline, nitrofurantoin and trimetoprim-sulphamethoxazole were defined as narrow-spectrum antibiotics. Amoxy-clavulanate, second and third-generation cephalosporins, new macrolides (azithromycin, clarithromycin), old quinolones (ciprofloxacin, ofloxacin) and clindamycin were defined as broad-spectrum antibiotics.

The study period included four consecutive winters (November to February): 1999–2000 as baseline data, 2000–2001 after guidelines distribution, and two consecutive winters (2001–2002, 2002–2003) representing the intervention period. We compared the changes in antibiotic use that occurred between the baseline period (1999–2000) and the last winter of the intervention (2002–2003). In addition, we calculated its economic impact.

We analyzed overall antibiotic use, broad-spectrum and narrow-spectrum, for both groups: the continuous (8 clinics, 86,330 patients) and the seasonal (8 clinics, 82,314 patients) for each of the winters evaluated, and compared the first and last winter.

We conducted all analyses using the Pearson chi-square statistics for two-way tables. P values less than 0.05 were considered statistically significant.

Results

Comparison of the continuous and seasonal intervention groups did not show any difference in demographic characteristics. Doctors, nurses and pharmacists in each group did not differ with regard to gender, age, practice characteristics and medical experience (a total of 200 participants in both groups and approximately 12 participants in each clinic).

At baseline (winter 1999–2000), total antibiotic use was higher in the continuous than in the seasonal group (28.7 vs. 27.8 DDD 1000 patients/day respectively). Broad-spectrum antibiotics accounted for 29.7% in the continuous intervention and 26.9% in the seasonal group (8.5 vs. 7.4 DDD/1000 patients/day respectively), while narrow-spectrum antibiotics accounted for 70.3% in the continuous vs. 73.1% in the seasonal intervention group (20.2 vs. 20.3 DDD/1000 patients/day respectively).

Total antibiotic use

We compared total antibiotic use during the last winter under intervention (November-February 2002–2003) vs. the baseline data (November-February 1999–2000), and found that antibiotic use decreased in the seasonal intervention group from 27.8 to 23.2 and in the continuous intervention group from 28.7 to 22.9 DDD/1000 patients/day ($P < 0.0001$). A reduction in total antibiotic use was observed in both groups, but slightly more significantly in the continuous group, taking into account that baseline antibiotic use was higher in this group (20.0% vs. 16.5% in the seasonal group, $P < 0.0001$) [Figure 1].

Narrow-spectrum antibiotic use

We found a reduction in the use of narrow-spectrum antibiotics in both groups, without a significant difference between them

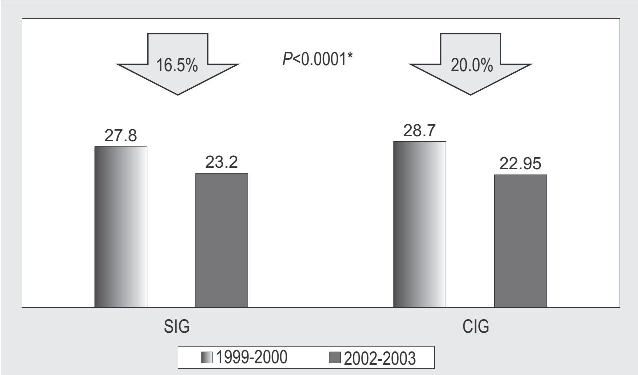

Figure 1. Reduction in total antibiotic use (measured as DDD/1000 patients/day), baseline winter (1999–2000) vs. last winter of intervention (2002–2003). CIG = continuous intervention group, SIG = seasonal intervention group. P < 0.0001* between SIG and CIG; 95% confidence interval 1.02–1.07

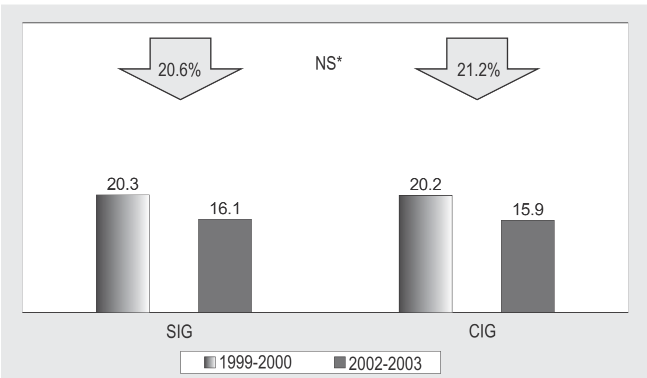

Figure 2. Reduction in narrow-spectrum antibiotic use (measured as DDD/1000 patients/day), baseline winter (1999–2000) vs. last winter of intervention (2002–2003). CIG = continuous intervention group, SIG = seasonal intervention group. NS* = no statistical significance between CIG and SIG; 95% confidence interval 0.98–1.04.

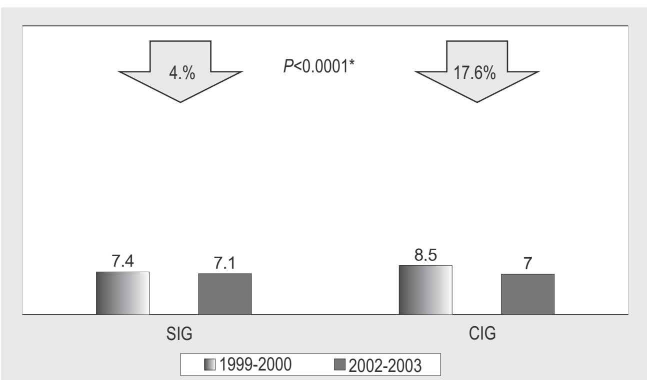

Figure 3. Reduction in broad-spectrum antibiotic use (measured as DDD/1000 patients/day), baseline winter (1999–2000) vs. last winter of intervention (2002–2003). CIG = continuous intervention group, SIG = seasonal intervention group. P < 0.0001* between CIG and SIG; 95% confidence interval 1.12–1.19.

(continuous intervention group 21.2% vs. 20.6% for the seasonal group, not significant) [Figure 2].

Broad-spectrum antibiotic use

A reduction was seen in both groups but was significantly more pronounced in the continuous (17.6%) compared to the seasonal group (4.0%) (P < 0.0001) [Figure 3].

Cost saving

Considering the total antibiotic cost, $330 was saved in the continuous intervention group and $186 in the seasonal group per 1000/patients/season (last winter under study, November-February 2002–2003 vs. baseline data November-February 1999–2000).

Discussion

Antimicrobial resistance is an emerging problem worldwide. It reduces the effectiveness of antimicrobial treatment, leading to increased morbidity and mortality as well as higher costs [5,6]. It is well established that there is a strong association between the usage of antimicrobial agents and the occurrence of resistance in both the hospital and the community setting [3,4,5]. Physicians are easily tempted to use newer and broad-spectrum antibiotics, thereby fueling the expanding cycle of resistance [3,4,6].

Our study focused on the continuous intervention clinics during the first 2 years (intervention A); we then concentrated our efforts on all the clinics (continuous and seasonal interventions) before and during two winters, obviously the most influencing periods (intervention B). The results of our study showed a reduction in antibiotic use (total, narrow and broad-spectrum) in both groups but slightly more pronounced in the continuous intervention group (specially in total and broad-spectrum antibiotics), pointing to a separate but also an additive effect for both types of interventions: continuous interactive educational groups (intervention A) and massive seasonal campaign focused on special issues (intervention B), considering the local characteristics and preferences of patients and doctors.

While recent studies showed an increase in first-line antibiotics without a decrease in total antibiotic use after an educational intervention [7], we demonstrate both a qualitative and quantitative change. Our results are concordant with a recently published Cochrane review, which notes that an interactive educational meeting is the most effective single intervention, but emphasizes the success of multifaceted approaches in reducing the inappropriate use of antibiotics in the community setting [8].

Previous interventions in community settings in Israel aimed at optimizing antimicrobial use showed a reduction of about 50% in antimicrobial use in children with acute otitis media after a brief explanation by the family physician to the child's parents [9]; another study achieved a decline in the total number of antibiotic prescriptions for pharyngitis and a rise in the penicillin-V/amoxycillin prescription rates after two short educational sessions with the medical staff [10]. Our intervention combined both approaches: patient and staff education (directly and through educational flyers), and had the strength of a long-term interventional activity.

Several studies and interventions have focused on the excessive use of antibiotics, but only recently has attention been focused on the type of agents being prescribed [3,4,11,12]. Furthermore, they reported that antibiotics were prescribed for 63% of patients with an acute respiratory infection while 54% received broad-spectrum drugs [11]. Steinman et al. [3] found increased use of broad-spectrum antibiotics among adults in the last decade (from 24% in 1991–92 to 48% in 1998–99), and suggested that only a minority of patients receiving these drugs were likely to have a resistant or complicated infection that mandated their use.

In our population, the proportional use of broad-spectrum antibiotics was stable at about 30% in both groups during the study, while the absolute use of broad-spectrum antibiotics decreased in all the groups, but more significantly in the continuous intervention group (0.3 DDD/1000 patients/day vs. 1.47 in the seasonal group) [Figure 3].

Many physicians do voice their concern about poor outcomes or treatment failure using old and inexpensive drugs. A Dutch trial [13] implemented group education meetings based on guidelines for respiratory infections. After 9 months the prescription rate for antibiotics in the intervention group fell by 12% compared to the control group, without affecting patient satisfaction or hospital referral rates. Moreover, Sharland and co-authors [14] demonstrated that a decline of 50% in antimicrobial prescriptions in primary practice was not accompanied by an increase in hospital admissions.

The NORM surveillance program for monitoring resistance and antimicrobial use in Norway reported that in 2003, the overall sales of antimicrobials for systemic use in humans represented 17.1 DDD/1000 inhabitants/day, almost unchanged for several years. However, within subgroups of antimicrobials, usage trends have changed, with increased use of broad-spectrum antibiotics, stable use of penicillin, and decreasing use of narrow-spectrum antibiotics [5]. In Israel, antimicrobials are given only with medical prescriptions. Therefore, our data on outpatient antibiotic use provided by the Pharmacy Department of Clalit Health Services are absolutely reliable. We measured antimicrobial use as DDD per 1000 patients/day and found it higher for the baseline period (November-February 1999–2000): 27.8 and 28.7 for the seasonal and continuous intervention groups respectively, but significantly lower after our intervention: 23.2 and 22.95 for seasonal and continuous intervention (last intervention period November-February 2002–2003).

Despite the fact that the DDD 1000 patients/day of total and broad-spectrum antibiotic use at the end of the intervention were similar in both groups (total 23.2 vs. 2.95, and broad-spectrum use 7.1 vs. 7 for the seasonal and continuous intervention groups respectively), the initial antibiotic use was higher in the continuous group, after which the decrease was more significant in the continuous group (16.5% vs. 20%, and 4 vs. 17.6% for total and broad-spectrum antibiotic use respectively, $P < 0.0001$) [Figures 1 and 3].

Very few studies provide information on the durability of the effect of this kind of intervention [8]. It is important to determine if it wanes over time. Meanwhile, repeated efforts will be needed to maintain this trend in the future.

Our study conclusions have some limitations. In October 2000 the Clalit Health Services distributed "Guidelines for antimicrobial treatment in primary care" to all primary physicians with the aim of promoting appropriate antibiotic use. That simple intervention can induce a change in prescribing habits and, together with the "winter campaign" (intervention B), influence the decrease in antibiotic use in the seasonal group. An additional limitation of the study is that we measured antimicrobial use without relation to prescription indication, although it is known that two-thirds of prescriptions in the winter season are issued for respiratory infections [6,8,12,13]. An additional limitation was the lack of a control group; yet data on antibiotic use in the clinics excluded from the study showed the opposite trend, with a mild increase in total, narrow and broad-spectrum antibiotic use (data not shown). In addition, we did not evaluate patient compliance and satisfaction, although it is known that good communication skills together with verbal and written information (leaflets) can reduce antibiotic use and most patients agree with this approach [15].

Patient outcomes should be monitored to ensure that reductions in antibiotic use have no adverse effects [8,12]. We did not assess the hospital referral rate, reconsultation and hospitalization rates in patients who did not receive antibiotics, or treatment failures due to narrow-spectrum antibiotic prescription. Previous studies showed a similar outcome when using first vs. second-line antibiotics (90.1% vs. 90.8% success rate) [4], without changes in the rate of reconsultation [12,15] or hospitalization [4,12,14,16]. We found a cost saving of $330 and $186 per 1000 patients per season, but the overall cost-effectiveness of the intervention (cost of campaign, educational material, time spent) has not been established.

Conclusions

This 4 year intervention in our community yielded reliable results in terms of reduction in global and broad-spectrum antibiotic use, with preference of narrow-spectrum antibiotics as the first choice when the decision is to treat. We applied a multifaceted approach, and it seems that efforts to reduce antimicrobial use are promising. Whether this decrease in use will be accompanied by lower rates of antibiotic resistance will need to be determined. Uncertainty remains regarding the sustainability of intervention effects. It is crucial that continuous efforts be made to reinforce and maintain the changed behavior, using a combination of methods such as the ones described above since it seems to work better than using one of them alone.

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