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To cite this article: Mark Fagan, Marthe Mæhlen, Morten Lindbæk & Dag Berild (2012) Antibiotic prescribing in nursing homes in an area with low prevalence of antibiotic resistance: Compliance with national guidelines, Scandinavian Journal of Primary Health Care, 30:1, 10-15

To link to this article: <http://dx.doi.org/10.3109/02813432.2011.629156>



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Published online: 21 Dec 2011.



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ORIGINAL ARTICLE

Antibiotic prescribing in nursing homes in an area with low prevalence of antibiotic resistance: Compliance with national guidelines

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Abstract

Objective. To examine antibiotic prescribing in nursing homes and determine to what degree the prescribing was in accordance with the national guidelines for antibiotic prescribing. **Design.** Retrospective examination of patients' records who were prescribed antibiotics in the period 1 March 2007 to 28 February 2008. **Setting and patients.** Patients residing in the nursing homes of Arendal, Norway. **Main outcome measures.** Choice of antibiotic in respect of the recommendations in the national guidelines for antibiotic prescribing. **Results.** A total of 714 antibiotic courses were prescribed to 327 patients yielding a prevalence of 6.6%. Compliant prescribing was 77% for urinary tract infections (UTI), 79% for respiratory tract infections (RTI), and 76% for skin and soft tissue infections (SSTI). Ciprofloxacin was responsible for 63% of non-compliant prescribing. On the respite wards there was a higher rate of total prescribing, non-compliant prescribing, and prescribing by physicians employed at the local hospital. **Conclusion.** Guidelines for antibiotic use must be implemented actively and efforts to improve antibiotic prescribing in nursing homes must be aimed at both nursing home and hospital physicians.

Key Words: *Anti-bacterial agents, antibiotic resistance, compliance, geriatrics, infection, nursing homes*

Introduction

During the past 30 years the Norwegian population over 80 years old has more than doubled. There are now over 40 000 nursing home beds in Norway, three times the number in 1970 [1].

The institutionalized elderly have chronic diseases, they are functionally impaired, and have a poorer nutritional status than younger patients. Atypical presentations of infections including lack of fever, behavioural changes, or confusion can cause diagnostic difficulties resulting in an unnecessarily high use of antibiotics. Studies report that a significant proportion of antibiotic use is unwarranted and that there are large variations in antibiotic prescribing among nursing homes without obvious medical reasons [2–4]. Nursing home patients are frequently prescribed antibiotics without being examined by a physician [5,6]. Unwarranted antibiotic usage contributes to resistance problems, unnecessary side effects, and costs [7].

In Norway the use of antibiotics and the incidence of antimicrobial resistance has been low in comparison with other European countries [8–10]. However, antibiotic use has increased by more than 50% in the past 30 years, and by 14% in the last five years [11,12]. Parallel to this trend is an increase in the incidence of fluoroquinolone-resistant *Escherichia coli* and macrolides-resistant *Streptococcus pneumoniae* [12]. There are reports of epidemics of resistant microbes in nursing homes in Norway and abroad [13,14].

Guidelines aim to improve antibiotic prescribing. This study examines antibiotic prescribing in nursing homes and evaluates whether the prescribing is compliant with the national guidelines for antibiotic prescribing.

Material and methods

As of January 2007, the municipality of Arendal had 40 057 inhabitants, with 4.6% aged 80 or above.

The geriatric population has a relatively high use of antibiotics, but few studies document compliance with national guidelines when prescribing antibiotics.

- Compliance with guidelines for urinary tract, respiratory tract, and soft tissue infections was about 80%.
- Ciprofloxacin is the antibiotic responsible for the majority of non-compliant prescribing.
- Non-compliant prescribing and prescribing by physicians not employed at the nursing home is higher on respite wards than on the long-term wards.

There were 10 nursing homes with a total of 360 beds. In 305 of these beds, comprising 260 (85%) long-term beds and 45 (15%) respite beds, physicians used the electronic patient record system GERICA® when prescribing medications. There were 17 nursing home physicians, all in part-time positions. Physicians at the local hospital and the Emergency Call Service (ECS) could also prescribe to nursing home patients.

Data collection

We used the Anatomical Therapeutic Chemical Classification (ATC) [15] system to search GERICA® for all patients prescribed antibiotics from 1 March 2007 to 28 February 2008. We searched the patients' medical records and recorded the following; age, gender, ward (respite vs. long-term), indication for antibiotic, dose and duration of antibiotic treatment, the prescribing physician (nursing home, ECS, or hospital). Antibiotic use is given as defined daily doses (DDD) per 1000 bed days [15].

National guidelines for antibiotic use [16]

Urinary tract infections (UTI):

- Uncomplicated cystitis: pivmecillinam, trimethoprim, nitrofurantoin or amoxicillin.
- Pyelonephritis: pivmecillinam, pivampicillin, amoxicillin, or trimethoprim-sulfamethoxazole. Amoxicillin with enzyme inhibitors is not registered in Norway.

Respiratory tract infections (RTI). Acute Bronchitis: Antibiotics are not recommended.

- Community-acquired pneumonia: penicillin V (erythromycin for patients with penicillin allergy or clinical suspicion of Mycoplasma or Chlamydia).

- Exacerbations of COPD: amoxicillin, erythromycin, doxycycline.

Skin and soft tissue infections (SSTI):

- Erysipelas: penicillin V (erythromycin or clindamycin if penicillin allergy).
- Impetigo and infected leg sores: penicillin, dicloxacillin (erythromycin or clindamycin if penicillin allergy).

Compliance. Non-compliance was defined as choice of antibiotics not in accordance with the recommendations in the national guidelines. There are no recommendations for treatment of combined UVI/RTI or for unspecified infections.

Analysis and statistics

The data analysis utilized LONG-TERMExcel (2007 version) and the SPSS 17 statistics package (SPSS®, Chicago, IL USA). Frequencies of antibiotics prescribed were calculated to compare prescribing for the different diagnosis, and on the different wards. We used a chi-squared test to test for associations between the proportion of antibiotic prescribed according to national guidelines (vs. proportion not according to guidelines) and which ward patients were on (long-term vs. respite). We calculated odds ratios (OR) and 95% confidence intervals (95% CI).

Results

Total prescribing and indication

A total of 714 antibiotic courses were prescribed to 327 patients resulting in a total of 6110 DDD (Table I). This translates to 55 DDD/1000 bed days yielding a prevalence of 6.6%. Women accounted for 519 (73%) antibiotic courses, men for 195 (27%). The median age for women was 87 years, for men 82 years. On the long-term ward 484 courses were prescribed yielding a prevalence of 5.6%. On the respite ward 230 treatments were prescribed yielding a prevalence of 11.2%. Some 52% of the patients were treated with antibiotics more than once. There was no significant difference in indication for antibiotic prescribing or the choice of antibiotic between patients receiving a single treatment versus patients receiving more than one treatment.

Twenty different antibiotics were prescribed. Trimethoprim, pivmecillinam, ciprofloxacin and penicillin V accounted for 61% (n = 419). Prescriptions were for oral administration except for two

Table I. Indication for antibiotic prescribing and compliance with national guidelines: Number of prescriptions.

Antibiotic	Urinary tract (UVI)	Respiratory tract (RTI)	Skin and soft tissue	Combined UVI/RTI	Unspecified	Other	Total (%)
Trimethoprim	128	0	0	0	3	0	131 (18)
Pivmecillinam	128	0	0	0	0	0	128 (18)
Ciprofloxacin	59*	21*	3*	5	15	1	104 (15)
Penicillin	0	36	19	1	9	1	66 (9)
Doxycycline	1*	48	1*	0	3	3	56 (8)
Amoxicillin	8	21	3*	6	11	0	49 (7)
Cephalexin	18*	3*	10*	5	4	0	40 (6)
Dicloxacillin	3*	0	30	0	4	0	37 (5)
Nitrofurantoin	25	0	0	0	0	0	25 (4)
Erythromycin	0	12	10	0	1	0	23 (3)
Clindamycin	0	3*	15	0	2	1	21 (3)
TMP/SMZ	6	0	1*	3	3	0	13 (2)
Metronidazole	0	0	1	0	1	7	9 (1)
Clarythromycin	0	2*	2*	0	0	0	4 (0)
Other	2*	2*	2*	0	2	0	8 (1)
Total	378	148	97	20	58	13†	714
Compliance	77%	79%	76%	NA	NA	NA	

Notes: *Denotes non-compliance with the national guidelines. †Other infections included 4 cases of diarrhoea, 4 diverticulitis, 2 vaginitis, 1 cholecystitis, 1 caries, and 1 infection in the scrotum. Other antibiotics included azithromycin, cefuroxime, cloxacillin, tetracycline, and ofloxacin. NA = not applicable. TMP/SMZ = trimethoprim-sulphamethoxazole.

intravenous cefuroxime treatments and one intramuscular cloxacillin treatment.

Compliance with national guidelines (see Table I)

Altogether, 77% of the prescriptions for UTI, 79% for RTI, and 76% for SSTI were in compliance. Ciprofloxacin and cephalexin accounted for 85% (114/134) of the prescriptions not in compliance.

Prescriber (Table II)

In total, 73% of antibiotics were prescribed by nursing home doctors, 17% by doctors at the county hospital, 7% by the doctor in ECS, 3% by the patient's family doctor; two patients were treated by an unknown doctor and one by a dentist. It was more likely that a physician not working at the nursing home was the prescribing physician on the respite ward than on the long-term ward (OR 4.39, 95% CI 3.09–6.24, $p < 0.001$).

Table II. Workplace of the prescribing physician.

Physician	Prescriptions, n (%)	
	Long-term ward	Respite ward
Nursing home	400 (83)	121 (53)
Hospital	29 (6)	95 (41)
Emergency room	43 (9)	10 (4)
Primary care	10 (2)	3 (2)
Other	0 (0)	1 (0)
Total	484	230

Respite vs. long-term wards

Use of ciprofloxacin and penicillin V was higher on the respite wards, while use of trimethoprim and doxycycline was higher on the long-term wards. There was a tendency for higher non-compliant prescribing on the respite as compared with the long-term ward (OR 1.41, 95% CI 0.95–2.1, $p = 0.09$).

Discussion

Principal findings

Few studies specifically address compliance with antibiotic guidelines in the nursing home setting. In this study, choice of antibiotic was in line with national guidelines in almost 80% of cases. Unfortunately, the antibiotic responsible for most non-compliant prescribing was the broad-spectrum antibiotic ciprofloxacin. Some of the non-compliant prescribing may not be empiric and possibly warranted, but a previous study has shown low rates of microbiologic diagnosis prior to treatment with ciprofloxacin [17].

Consistent with other studies, UTI was the most common infection [3–5,18,19]. Mecillinam, trimethoprim, and nitrofurantoin were used almost exclusively for UTI, accounting for 75% of the antibiotics used for this infection, in line with national guidelines [16]. The fact that ciprofloxacin was the third and cephalexin the fourth most common agents prescribed for UTI is disconcerting. National guidelines restrict the use of ciprofloxacin to complicated UTI and

cephalexin is not recommended for empiric treatment at all. Both quinolones and cephalosporins are associated with extended-spectrum beta-lactamase (ESBL) infections [20]. They are also linked to the increase in serious *Clostridium difficile* infection for which the elderly are a high-risk group [21,22].

Penicillin-resistant pneumococci are rare in Norway, which makes questionable the choice of doxycycline as the most common antibiotic prescribed for respiratory tract infections. Doxycycline is recommended for use in patients with penicillin allergy or for *Chlamydia* or *Mycoplasma* infections, but these infections are uncommon in the elderly. The prescribing may be due to the ease of once-daily administration. Ciprofloxacin was prescribed for 14% of RTI, which is not in accordance with guidelines. It is a poorer choice than penicillin for treatment of Gram-positive infections which are the most common bacterial aetiology of RTI.

According to the guidelines for SSTI erythromycin and clindamycin are reserved for patients with penicillin allergy [16]. They were prescribed in 26% of the cases which is too high to be explained by penicillin allergy. Cephalexin is allowed to be marketed for the treatment of soft tissue infections, but it is not recommended for this use in the guidelines [16].

Ciprofloxacin was the most frequently prescribed antibiotic for unspecified infection and for combined UVI/RTI. There are no recommendations in the national guidelines for treatment of infection of uncertain aetiology. The diagnostic challenges in the geriatric population may cause physicians to choose a broad-spectrum agent when the focus of the

infection is unclear. There is a need for specific recommendations for treatment of the elderly with an infection of uncertain aetiology.

Strengths and weaknesses of the study

This study addresses prescribing differences on long-term versus respite wards and the contribution of hospital physicians to the prescribing in nursing homes on the respite wards. This is important because the use of respite wards as an attempt to reduce permanent institutionalization of the elderly is increasing in Norway.

A weakness with this study is its inability to identify precisely how diagnoses were made in all patients. It was possible to identify all patients who received antibiotics but it was not possible to search for diagnoses and identify patients not treated with antibiotics. As a result, this study cannot address the potential under-use of antibiotics in this population. It is doubtful that this is a problem as most previous studies document the inappropriate over-use of antibiotics in the institutionalized elderly. Also, the level of prescribing in this study was near the mean in a study examining variation in antibiotic prescribing in Norwegian nursing homes [4].

It was not always possible to differentiate between pyelonephritis, cystitis, and asymptomatic bacteriuria due to unsystematic documentation in the patients' records. Similarly, it was difficult to differentiate consistently between patients treated for pneumonia, exacerbation of COPD, or bronchitis. Studies evaluating the quality of diagnosis of the institutionalized elderly are necessary to reduce inappropriate antibiotic prescribing.

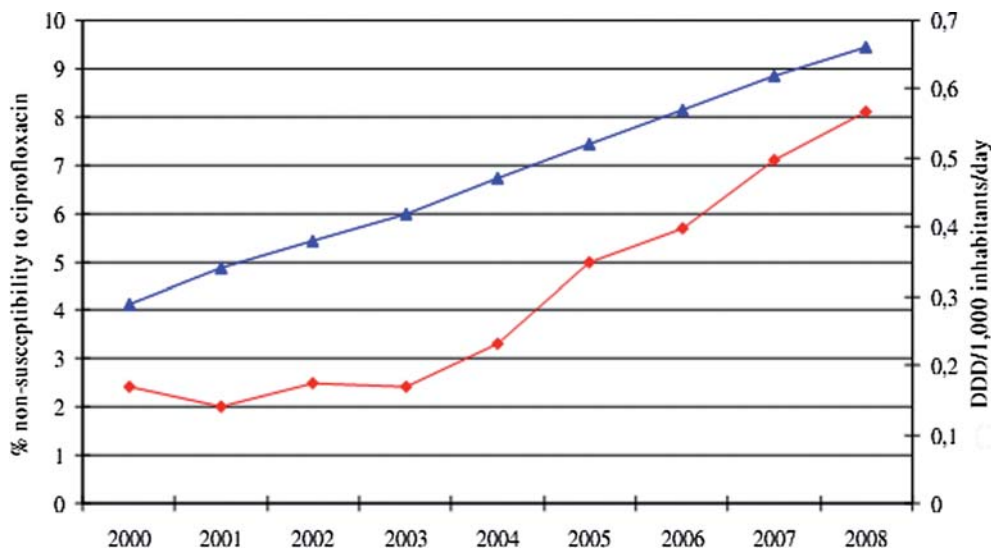


Figure 1. Prevalence of ciprofloxacin non-susceptibility in *Escherichia coli* blood culture isolates as defined by the 2008 breakpoint protocol (lower plot line) versus usage of ciprofloxacin (upper plot line) 2000–2007. Source: Figure based on NORM/VET report [12] with permission.

The choice of antibiotics in this study differed from previous Norwegian studies despite similarities in patient demographics, indication for prescribing, and the prevalence of infections [18,19]. Ciprofloxacin was the third most common antibiotic prescribed in our study but was not prescribed at all in the previous study [19]. Previously there was little *Escherichia coli* resistance to ciprofloxacin in Norway, but resistance has increased parallel with increased prescribing (Figure 1) [23]. Doxycycline, the antibiotic prescribed most frequently for RTI in this study, was not prescribed at all in the previous study. There was substantially less prescribing of penicillin and nitrofurantoin in this study also. Neither regional resistance problems nor resistance development in Norway since the previous study explains these differences. Due to the small size and isolated settings of these studies it is impossible to determine whether the results are representative of the country as a whole.

Variations in prescribing habits among different nursing homes or among the different physicians may explain these findings [4,24]. But they could also reflect increased use of extended-spectrum penicillins, ciprofloxacin, cephalosporins, and the relative decrease in the use of narrow-spectrum penicillin in Norway since 2000 [11]. This study was unable to determine the possible impact individual physicians had on the results.

We used the DDD unit of measurement in this study. This allows comparison with other studies but does not take into consideration patient characteristics like age, weight, and renal function, which are important factors in the elderly.

Respite vs. long term wards

Total prescribing and non-compliant prescribing was higher on respite wards than on long-term wards. Many of the patients on the respite wards were discharged from the local hospital with partially completed antibiotic treatment, explaining why a greater proportion of the prescriptions are written by hospital physicians compared with the long-term ward.

There are several barriers to implementation of guidelines [25]. Active implementation is necessary to achieve compliance with guidelines. This was not performed when the guidelines were launched, perhaps explaining a higher use of ciprofloxacin and doxycycline, and a lower use of penicillin and nitrofurantoin than recommended. Whether these changes are due to a disconcerting trend in antibiotic prescribing should be elucidated by a prospective national study. Interventions to improve antibiotic prescribing in nursing homes need to be aimed at both nursing home physicians and physicians at the local hospital.

Acknowledgements

The authors would like to thank Torhild Myhren for support with Gerica®, and the Primary Care Research Group in Aust Agder for guidance.

Ethical approval

The study has been approved by the regional ethics committee.

Source of funding

The Family Practice Research Committee and the Antibiotic Center for Primary Health Care.

Conflict of interest

The authors report no conflicts of interest.

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