Prescription of antimicrobial agents to elderly people in relation to the type of infection

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Abstract

Objective: to describe how frequently antimicrobial agents are prescribed for elderly people and to examine the prescribing practice of treating physicians.

Design: for each of the 1196 subjects examined, a review of the medical records was carried out for the year preceding the examination and data on antimicrobial prescriptions, including types of infections, were recorded. The sales statistics of antimicrobial agents in this population were compared with the nation-wide ones, collected by the National Agency for Medicines.

Setting: a health centre in Iieto, a rural district in southwestern Finland; 1990-91.

Subjects: 1196 subjects, aged 64–97 years, 488 men and 708 women.

Main outcome measures: frequencies of prescriptions of specified antimicrobial agents, including types of infection in relation to gender and form of care over a 1-year period.

Results: more women (36%) than men (28%) had received antimicrobial agents. The proportion who had received such agents increased with increasing age, the trend being more marked in men. The mean number of prescriptions per user per year was slightly lower in men than women (0.6 and 0.7 respectively). In both sexes, 54% of the users of antimicrobial agents had received only one prescription. Cephalosporins and penicillins were the most commonly prescribed agents. Among those who had received three or more antimicrobial prescriptions, cephalosporins had been used most frequently. Elderly people living in long-term institutional care were treated with antimicrobial agents more frequently than those living outside institutions. Of all antimicrobial prescriptions given to women, 60% were prescribed for urinary tract infections, 21% for respiratory infections and 8% for skin infections. The figures for men were 18, 45 and 10%.

Conclusions: multiple use of antimicrobial agents is common in old age, especially in those in institutions. More attention should be to the provision of appropriate antimicrobial treatment.

Keywords: antimicrobials, infection, old age

Introduction

Research on the use of antimicrobials is an area of increasing importance [1]. As more people live into old age [2], there is a growing need for studies on old people. Treatment for infections is costly. Knowledge of the use of antimicrobials and the infections leading to their use is therefore important.

Antimicrobial therapy has been said to have caused a 10-year increase in the life expectancy of the population during the 20th century [3]. A threat to the use of antimicrobials is the worldwide increase of bacterial resistance [4, 5]. Antimicrobials are unique as pharmacological agents, because they have effects not only on the patient, but also on the patient’s environment [6]. In the process of killing the targeted pathogen, antimicrobial agents also kill other susceptible strains of bacteria that share the immediate ecosystem. With repeated antimicrobial treatments, environments may end up having high numbers of
resistant bacteria and act as a reservoir for resistance genes [6].

There are many studies on the use of antimicrobials in hospitals [7-11]. However, there are only a few studies that deal with the use of antimicrobials outside hospitals [12-16] or with their use in old age. The frequencies of infections leading to antimicrobial treatment are not well known either [17].

The first aim of this study was to describe how often antimicrobial agents are prescribed for elderly patients. The second aim was to identify features of the prescription routines of the physicians treating them.

**Population and methods**

**Population**

Everyone born in or before 1926 was invited in a random order for an examination in the health centre of Lieto between October 1990 and December 1991. Four hundred and eighty-eight men and 708 women, 93% of those eligible, participated [18]. The population of Lieto on 31 December 1989 was 12,077, with 10% aged 65 years or over. Lieto is a semi-industrialized rural district. The living conditions of this population are typical of those prevailing in southern Finland.

The municipal health centre in Lieto provides primary health care for the population, including 24 h emergency services. It has a 40-bed local hospital for acute cases and chronic patients, a 30-bed nursing home, a laboratory and a radiological unit. In 1990-91 visits to the health centre were free of charge. Visits to the health centre physicians by old people make up about 80% of their medical consultations. In Lieto, as elsewhere in Finland, most of the physicians working in health centres are general practitioners.

**Characteristics of the survey population and representativeness of the sample**

A total of 1196 subjects, 488 men and 708 women, were included in the study population. Sixty-two percent of them were 64-74 years old, 31% 75-84 years old and 7% 85 years or over. The mean age of the men was 72 years (SD 7 years, range 64-97 years) and of the woman 75 years (SD 7 years, range 64-96 years). Ninety-five percent lived in the community, while the remaining 5% lived in nursing homes or other long-term care institutions.

For each participant, data on the antimicrobial prescriptions for the preceding year were collected from the medical records by one of the authors (R.I.). The medical records from possible appointments with private practitioners were not available. The prescriptions of antimicrobials per person (a maximum of eight) were registered by recording their Anatomical Therapeutic Classification of drug codes [19], the International Classification of Diseases (9th revision) codes of the diagnoses on which the prescriptions were based on and the mode of care (institutionalized versus non-institutionalized). The sales figures of the different antimicrobials in Lieto and in the whole of Finland in 1994 were based on the national sales statistics and were obtained from the National Agency for Medicines.

**Statistical methods**

Stratified data analysis [20] was used to describe the characteristics of the subjects and to analyse the relationships between the subjects, the infections and the use of antimicrobial agents. The calculations were carried out on an IBM VM/SP computer using the SAS library [21].

**Results**

The frequencies of prescriptions given to elderly people in Lieto in 1994 were compared with those in the whole Finnish population of the same age. Generally, the frequencies of prescriptions in Lieto were of the same order of magnitude as those in the whole of Finland (Figure 1). The patterns of distribution were also similar.

**Prescriptions by sex, age and mode of care**

Twenty-eight percent of the men and 36% of the women had been prescribed antimicrobials during the preceding year (Table 1). The proportion of the women who had been treated with antimicrobials showed a slightly increasing trend with increasing age. For the men, the respective trend was more marked.

The number of antimicrobial prescriptions averaged over the whole survey population was slightly lower in men than women (Table 2). Those in long-term institutional care had received antimicrobial treatment more frequently than the non-institutionalized elderly population. In both sexes, 54% of those prescribed antimicrobial treatment received it only once. Two prescriptions were given to 22% and three or more prescriptions to 24%.

In non-institutionalized subjects, 56% of the users received only one prescription, while the percentage in the institutionalized users was 42%. Twenty-two percent of the non-institutionalized and 21% of the institutionalized users received two prescriptions. Three or more prescriptions were given to 22% of the non-institutionalized users, but the corresponding percentage in the institutionalized ones was 38%. In both sexes, the mean number of prescriptions was highest in users aged 85 years and over, but the difference between this and the younger age groups was small.
Prescriptions by the type of antimicrobial agent

Cephalosporins and penicillins were the most frequently prescribed agents (Table 3). In men, tetracyclines were the most frequently prescribed agents in the youngest age group, while first-generation cephalosporins were most common in the older age groups (Table 4). In women, first-generation cephalosporins and sulphaphenicol were most common in all age groups, but pivmecillinam was also frequently prescribed to those aged 85 years or over.

Prescriptions by the type of infection

In both sexes, urinary tract infections (UTIs) and acute bronchitis were the most common types of infection, resulting in antimicrobial treatment (Figure 2). Antimicrobial treatment against UTIs was most common in women, while treatment for acute bronchitis was most common in men.

The diagnoses of UTI were made on symptoms, strip tests and urine cultures. The proportions of all antimicrobial prescriptions that were for UTIs were 60% for women and 18% for men. In non-institutionalized women, 58% received antimicrobial treatment for UTIs, but the figure for institutionalized women was 70%. For men the figures were 10% in non-institutionalized and 73% in institutionalized.

Most of the prescriptions for UTIs in women were for sulphafurazone or trimethoprim alone (37%), pivmecillinam (24%) and first-generation cephalosporins (22%). In men, the antimicrobial agents were: first-generation cephalosporins (36%), sulphafurazone or trimethoprim alone (31%) and quinolones (12%).

Of all antimicrobial prescriptions given to men, 45% were for respiratory infections. The proportions that received antimicrobial agents against respiratory infections were 49% in the non-institutionalized group and 18% in the institutionalized group. For women, 21% of

Table 1. Subjects prescribed antimicrobial agents during the preceding year, by age and sex

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Men Total</th>
<th>Men Prescribed</th>
<th>Men %</th>
<th>Women Total</th>
<th>Women Prescribed</th>
<th>Women %</th>
</tr>
</thead>
<tbody>
<tr>
<td>64-74</td>
<td>322</td>
<td>78</td>
<td>24</td>
<td>417</td>
<td>132</td>
<td>32</td>
</tr>
<tr>
<td>75-84</td>
<td>146</td>
<td>49</td>
<td>34</td>
<td>228</td>
<td>96</td>
<td>42</td>
</tr>
<tr>
<td>≥ 85</td>
<td>20</td>
<td>12</td>
<td>60</td>
<td>63</td>
<td>27</td>
<td>43</td>
</tr>
<tr>
<td>Total</td>
<td>488</td>
<td>139</td>
<td>28</td>
<td>709</td>
<td>255</td>
<td>36</td>
</tr>
</tbody>
</table>
Table 2. Mean numbers of prescriptions of antimicrobial agents per person during the preceding year, by group and sex

<table>
<thead>
<tr>
<th>Group</th>
<th>Group size</th>
<th>Mean no. of prescriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>Whole population</td>
<td>488</td>
<td>708</td>
</tr>
<tr>
<td>Non-institutionalized</td>
<td>469</td>
<td>662</td>
</tr>
<tr>
<td>Institutionalized</td>
<td>19</td>
<td>46</td>
</tr>
</tbody>
</table>

Users of antimicrobial agents

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Non-institutionalized</th>
<th>Institutionalized</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>64-74</td>
<td>127</td>
<td>19</td>
<td>1.9</td>
<td>1.6</td>
</tr>
<tr>
<td>75-84</td>
<td>78</td>
<td>132</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>≥ 85</td>
<td>12</td>
<td>27</td>
<td>2.2</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Antimicrobial prescriptions were for respiratory infections: these were prescribed to 24% of the non-institutionalized group and 11% of the institutionalized group. Antimicrobial treatment for pneumonia was rare in this population: 11 subjects out of the total of 1196 (0.9%) received antimicrobial treatment for this condition.

The antimicrobial treatments for respiratory infections in the men were doxycycline (29%), amoxycillin (20%) and erythromycin (11%). In women, the most frequently used agents were: doxycycline (36%), amoxycillin (14%) and erythromycin (12%).

Ten percent of all the antimicrobial prescriptions given to men and 8% of those given to women were against skin infections. Antimicrobial treatment against skin infections mostly consisted of first-generation cephalosporins (41% in men and 43% in women).

Discussion

The subjects were identified in a survey which covered over 90% of the people aged 64 years or more in a Finnish municipality. We were able to review all medical records of those surveyed. Because the sales figures of antimicrobials in Lieto were similar to the national figures, we can presume that the results are representative of the whole of Finland.

In Lieto, 54% of the users received only one antimicrobial prescription in 1 year, which might reflect good practice in the treatment of infectious

Table 3. Prescription of antimicrobial agents in users (139 men and 255 women) according to sex and to the number of prescriptions they received in the preceding year

<table>
<thead>
<tr>
<th>Agent</th>
<th>Proportion receiving agent (%)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Men</td>
<td></td>
<td></td>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. of prescriptions</td>
<td>≥3</td>
<td>All</td>
<td>No. of prescriptions</td>
<td>≥3</td>
<td>All</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tetracyclines</td>
<td></td>
<td>16</td>
<td>15</td>
<td>26</td>
<td>16</td>
<td>7</td>
<td>9</td>
<td>4</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pivmecillinam</td>
<td></td>
<td>1</td>
<td>4</td>
<td>0</td>
<td></td>
<td>15</td>
<td>14</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phenoxy methylpenicillin</td>
<td></td>
<td>14</td>
<td>7</td>
<td>0</td>
<td>24</td>
<td>8</td>
<td>5</td>
<td>0</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoxycillin</td>
<td></td>
<td>15</td>
<td>4</td>
<td>0</td>
<td></td>
<td>4</td>
<td>2</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cephalosporins</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-generation</td>
<td></td>
<td>17</td>
<td>15</td>
<td>47</td>
<td></td>
<td>18</td>
<td>32</td>
<td>68</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second/third-generation</td>
<td></td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>26</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulphatrimethoprim</td>
<td></td>
<td>14</td>
<td>25</td>
<td>18</td>
<td>14</td>
<td>24</td>
<td>22</td>
<td>14</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrolides</td>
<td></td>
<td>8</td>
<td>22</td>
<td>0</td>
<td>8</td>
<td>7</td>
<td>3</td>
<td>0</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quinolones</td>
<td></td>
<td>3</td>
<td>4</td>
<td>9</td>
<td>4</td>
<td>7</td>
<td>11</td>
<td>0</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
diseases. The elderly subjects did not have modern antimicrobial agents available to them when they were young; sulphonamides were first used against human diseases in 1933 in Germany and a few years later in the other European countries, and penicillin was introduced in 1943-45. Thus the subjects of the Lieto study had been at least 7 years old when the first antimicrobial agents were introduced into clinical practice in Europe [3]. This means that the younger generations will have very different patterns of antimicrobial use and a different bacterial environment to cope with when they grow old.

In Lieto, the institutionalized population used antimicrobials frequently. Seventy-four percent of the institutionalized subjects had been prescribed antimicrobials at least once during the preceding year. This agrees with studies from elsewhere. In USA, 54% of 3899 elderly nursing home patients had received at least one antimicrobial course over a similar period [22].

According to a recent report, the consumption of antimicrobials in Finland is growing more rapidly in hospitals and nursing homes than in outpatient care and the trend is towards broad-spectrum preparations [23]. This may be especially true when a person receives repeated antimicrobial prescriptions. In our study, the persons who had received at least three prescriptions were more often treated with cephalosporins. The negative aspect of the use of broad-spectrum agents is that the more a person takes antimicrobials, the more likely it is that broad-spectrum antimicrobials may have to be used to treat infectious diseases properly. Such use will have implications for the emergence of antimicrobial resistance and multi-resistant strains [16]. Consequently, the problems due to bacterial resistance will probably increase in the future when today's younger people, many of whom will have been prescribed antimicrobials frequently, reach old age.

Most prescriptions given to elderly people were for UTIs. In Finland pivmecillinam (amdinocillin) is recommended for first-line therapy in UTIs. There is also a tendency to use sulphonamides. Antibiotics for UTIs have to be started immediately without knowledge of the causative agent. Otherwise, an untreated infection might worsen the general condition of an old person or prove fatal. Although in such cases broad-spectrum agents are often used, the importance of an aetiological diagnosis cannot be stressed too highly, since multiple prescriptions against common infections may have worrying implications for the future if inappropriate therapy is prescribed. The use of well-targeted narrow-spectrum agents could cut the long-term costs of increasing resistance and prevent the spread of bacterial resistance. The emergence of bacterial resistance in elderly patients may be potentially harmful in both long-stay rehabilitation facilities and acute care settings.

In our study, the incidence of acute respiratory infections was not recorded, but 1.6 antimicrobial courses per 100 person-months of observation had been prescribed for respiratory infections. In 1995 Hodder and co-workers reported the average incidence of acute respiratory infections in elderly people to be low, averaging 2.5 episodes of illness per 100 person-months of observation [24]. In the prospective study reported in the same year by Ruben and co-workers, 417 non-institutionalized people aged 65 years and over were followed-up for up to 24 months and 259 respiratory infections were diagnosed (2.6 episodes per 100 person-months of observation) [17]. Our figures for respiratory infections seemed to be lower than those reported elsewhere. However, the above figures are in agreement with each other, if we presume that not all of those with respiratory infections in Lieto had consulted a doctor or that some infections had been considered by the doctors to be of viral origin.
and not treated with antimicrobial agents—which could be a sign of good prescribing practice in Lieto. However, the appropriate use of antimicrobial agents for the treatment of respiratory infections, especially acute bronchitis, is questionable. They are too commonly used to treat viral respiratory infections, even though antimicrobial agents neither shorten the course of acute illness nor prevent secondary bacterial infections [25].

In our study most antimicrobial prescriptions for respiratory infections (mainly acute bronchitis) consisted of tetracyclines (mostly in the form of doxycycline), amoxicillin (which has largely replaced ampicillin in Finland) and erythromycin. It is recommended that antimicrobial agents are not used for this disease. Acute bronchitis is often treated unnecessarily, but not only in Finland, where over the last few years the overall antimicrobial consumption trend in outpatients has been approaching the average Nordic level [23]. The heavy use of tetracyclines in older people is inappropriate.

Only 11 prescriptions, 5% of all prescriptions against respiratory infections, had been given for pneumonia. This figure is low, given that the incidence of pneumonia has been reported to be 20-40 per 1000 persons per year in elderly persons who live in the community, but as high as 250 cases per 1000 persons per year in those living in nursing homes [26]. We presume that the respiratory diagnoses leading to antimicrobial treatment might have been biased towards diagnoses other than pneumonia. The figure may also be low because there were no influenza epidemics during the survey period.

In our study, 8.6% of all antimicrobial prescriptions were for skin infections, chronic ulcer of the skin being the most common problem. In the prospective study by Ruben and co-workers, skin infections comprised 18% of all infections in non-institutionalized persons [17]. Skin infections are also common in nursing home populations [22]. The magnitude of the problem of skin infections is notable, because multiple prescription against these infections may have a poor therapeutic effect and may also significantly increase the spread of resistant bacterial strains [27, 28]. Resistant strains may be transferred to other patients in poor hygienic conditions or, in some instances, act as a reservoir for resistance genes [27].

In conclusion, multiple use of antimicrobial agents is common in elderly people, especially those in the institutional care. This may have serious consequences and more attention should be paid to the better use of antimicrobial agents and the use of appropriate antimicrobial treatment.

Acknowledgements
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Key points
- Multiple use of antimicrobial agents is common in elderly people, especially those in institutional care.
- Antibiotics are being used inappropriately for acute bronchitis, which is usually viral.
- Inappropriate antibiotics are being prescribed for some chest, urinary and skin infections.
- The problems of bacterial resistance will probably increase as those who are younger now use different antimicrobials and are exposed to a different bacterial environment.
- More attention should be paid to the better use of antimicrobial agents in older people.

References


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Chan Kam-Lin, 99, given an award by Wong Ngan, 67, at Hong Kong Chinese Women's Club Madam Wong Chan Sook Ying Memorial Care and Attention Home for Aged's 'university' ceremony.
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