

Patient awareness and practices regarding antimicrobial use and drug resistance

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SUMMARY Drug-resistant bacterial infections have become a substantial problem in various communities. Appropriate antimicrobial use is required because reducing antimicrobial use could reduce the number of resistant bacteria. The inappropriate use of antimicrobials can be prevented by improving the knowledge of patients, physicians, and other healthcare professionals; however, no antimicrobial awareness survey specifically aimed at patients has been conducted yet. Therefore, to promote proper antimicrobial use, mainly by patients, we conducted a survey on the attitudes of patients who brought their antimicrobial prescriptions from insurance pharmacies. The results were based on 858 responses. Awareness of the terms "bacteria, viruses, and antimicrobials" was > 80%, whereas that of "drug-resistant bacteria" was only 37.2%. Only 26.5% of respondents understood what the efficacy of antimicrobial drugs meant. Additionally, 31.5% of the respondents had experienced discontinuation antimicrobials, and approximately 70% of the reasons for discontinuation were self-judged symptom improvement. Furthermore, those who had experienced discontinuation were less aware of the various aspects of antimicrobial use than those who had not. In antimicrobial treatment, avoiding the emergence of drug-resistant bacteria is difficult, is detrimental to patients consuming treatment, and presents a major problem in society. Therefore, healthcare professionals should strive to optimize infectious disease treatment by providing appropriate guidance on the proper use of antimicrobials, significance of taking them, and harmful effects of their discontinuation to patients.

Keywords Antimicrobial, drug-resistant bacteria, insurance pharmacy, dose interruption

1. Introduction

Many infectious diseases caused by pathogens, such as bacteria and viruses, can now be treated with antibiotic and antiviral drugs. However, the spread of drug-resistant bacterial infections, for which the available antimicrobials are ineffective, has become a social problem. The increase in drug-resistant bacteria hinders the treatment of patients who were previously curable from drug administration, resulting in the spread of infections and increased mortality. Therefore, the National Action Plan to Antimicrobial Resistance (AMR) 2016–2020 was formulated in Japan in 2016 (1). One of the main themes of this action plan is the appropriate use of antimicrobials, with the aim of reducing their use. Indeed, reducing the use of antimicrobials reduces the number of bacteria resistant to those antimicrobials (2). Antimicrobials are often used to treat infections; however, the emergence and selection of resistant bacteria is difficult to avoid. Therefore, antimicrobials require appropriate use to balance maximum efficacy,

minimal side effects, and the emergence of new resistant bacteria.

Activities to promote the appropriate use of antimicrobials have been centered on hospitals; however, the first place that many patients with infectious diseases, including minor infections, visit is outpatient clinic. Oral antimicrobials are used far more often than injectable antimicrobials in Japan (3), and outpatient clinics account for a large proportion of this (4). There are reports of antimicrobials being prescribed for acute respiratory tract infections that were not originally necessary (5). As clinics are responsible for the majority of outpatient care, it is particularly important to promote the appropriate use of antimicrobials. However, physicians in clinics come from diverse backgrounds and specializations, and trends in infectious disease care and antimicrobial use are expected to vary. Furthermore, as a result of the doctor-patient relationship and patient satisfaction considerations, they often prescribe antimicrobials that are essentially unnecessary (6-8). Therefore, it is conceivable that the inappropriate use of antimicrobials

can be prevented by improving the knowledge of physicians and other healthcare professionals, as well as that of patients; however, no antimicrobial awareness survey targeting patients has been conducted.

Therefore, as the division of labor in medicine has progressed and prescriptions from clinics and hospitals are brought to insurance pharmacies, this study conducted a survey on the attitudes of patients who brought their prescriptions to insurance pharmacies regarding antimicrobials to formulate measures aimed at promoting the proper use of antimicrobials, with the patient at the center.

2. Materials and Methods

2.1. Subjects and questionnaire

Patients who brought their prescriptions to Iroha Pharmacy, an insurance pharmacy located in Funabashi City, Chiba Prefecture, between February 19 and April 28, 2024, were included. The study was explained orally at the prescription counter, and patients who provided their consent were given a survey form. The survey form was anonymous and consisted of questions related to patients' awareness and knowledge regarding their demographics (sex and age). The collection was performed using collection boxes placed at medicine delivery counters. This study was approved by the Ethics Committee of the Japanese University of Pharmacy and Life Sciences (Nichiyaku 5-18).

2.2. Evaluation and analytical methods

Questions 1 and 2 were regarding the demographics of the respondents (sex and age), whereas questions 3–5 and questions 7 and 8 were two-choice questions (yes and no). For question 6, efficacy of antimicrobials and for those who selected 'yes' for question 7, ever discontinued taking antimicrobials, the reason was selected (multiple answers allowed) for the relevant item. In addition, for question 7, Have you ever discontinued antimicrobials, those who selected 'Yes' were considered to have discontinued and those who selected 'No' were considered to have never discontinued and were divided into two groups to examine the relationship between each question.

Analysis was performed using simple tabulation and Fisher's exact test. js-STAR XR+ (Release 1.9.7 j) was used for statistical analysis and 5% was considered statistically significant.

3. Results and Discussion

The survey questionnaire covered 869 consenting respondents, of whom 11 persons whose questionnaires were omitted, and 858 were included in the analysis. The respondent characteristics were 431 (50.2%) male

and 427 (49.8%) female. The largest age group included 170 respondents (19.8%) in their 40s, followed by 144 respondents in their 30s (16.8%), and 142 respondents in their 50s (16.6%).

The aggregate results for each question by age group are presented in Table 1. The aggregate results were unbiased with regard to sex and age. Awareness of the terms "bacteria, viruses, and antimicrobials" was > 80% (questions 3 and 4). Regarding the efficacy of antimicrobials (questions 6), 536 respondents (62.5%) stated that they were effective against bacteria, but 309 of these also stated that they were effective against viruses and others (*e.g.*, antipyretic and analgesic); therefore, the exact recognition level was 227 (26.5%). The awareness of drug-resistant bacteria was 319 (37.2%) (questions 5). In addition, 270 (31.5%) patients of the respondent had ever interrupted antimicrobials, and 194 (71.9%) of the reasons for discontinuation were self-judged symptom improvement (questions 7). A total of 647 (75.4%) patients were unaware of the presence of the antimicrobial strains (types) (questions 8).

Table 2 shows that association of each question with whether or not the respondent had ever interrupted antimicrobials. Those who had experienced an interruption were significantly less aware than those who had not in terms of awareness of bacteria and viruses, antimicrobials, drug-resistant organisms and strains (types) of antimicrobials (respective *p*-values: $p = 0.032$, $p = 0.014$, $p = 0.001$, $p < 0.001$).

The survey was conducted in non-general pharmacies near specific healthcare facilities, and the aggregate results were unbiased with regard to sex and age. Regarding the questions, more than 80% of patients were aware of the terms "bacteria, viruses, and antimicrobials," whereas only 37.2% understood drug-resistant bacteria and 26.5% antimicrobial efficacy. In addition, approximately 30% of the patients experienced discontinuation without taking the drug for up to the prescribed number of days, and approximately 70% of the reasons for discontinuation were symptom improvement based on self-judgment. Furthermore, those who had experienced interruptions were less aware of the various aspects of antimicrobial knowledge than those who had not.

Limiting antimicrobial use reduce the number of bacteria that are resistant to these antimicrobials (2), and their increased use is associated with an increase in resistant bacteria. The inappropriate use of antimicrobials has been pointed out as a background to the spread of drug resistance, and limiting the use of antimicrobials to cases where they are necessary for the treatment of infectious diseases is crucial. Furthermore, optimizing the amount and duration of use to the minimum necessary while achieving the maximum effect to reduce drug-resistant bacteria. To promote the control of drug resistance, healthcare professionals and patients must understand antimicrobials and drug resistance.

Table 1. Aggregate results by age group for each question

	whole (n = 858)	20s or younger (n = 98)	30s (n = 144)	40s (n = 170)	50s (n = 142)	60s (n = 116)	70s (n = 125)	80s or older (n = 63)
Q1. Age								
Q2. Male / Female	431 (50.2%) / 427 (49.8%)	40 (40.8%) / 58 (59.2%)	67 (46.5%) / 77 (53.5%)	77 (45.3%) / 93 (54.7%)	85 (59.9%) / 57 (40.1%)	70 (60.3%) / 46 (39.7%)	61 (48.8%) / 64 (51.2%)	31 (49.2%) / 32 (50.8%)
Q3. I know the words 'bacteria and viruses.'	710 (82.8%)	80 (81.6%)	113 (78.5%)	141 (82.9%)	120 (84.5%)	100 (86.2%)	106 (84.8%)	50 (79.4%)
Q4. I know the word 'antimicrobial.'	752 (87.6%)	84 (85.7%)	124 (86.1%)	157 (92.4%)	127 (89.4%)	104 (89.7%)	107 (85.6%)	49 (77.8%)
Q5. I know the word 'drug-resistant bacteria.'	319 (37.2%)	25 (25.5%)	44 (30.6%)	79 (46.5%)	62 (43.7%)	51 (44.0%)	42 (33.6%)	16 (25.4%)
Q6. What kind of medicine do you think antimicrobials are? Drugs that prevent the growth of bacteria. Medicines that prevent viruses from increasing. Drugs that have other actions. (e.g., reduce fever, suppress cough and runny nose)	536 (62.5%) 391 (45.6%) 228 (26.9%)	54 (55.1%) 39 (39.8%) 38 (38.8%)	86 (59.7%) 68 (47.2%) 40 (27.8%)	115 (67.6%) 87 (51.2%) 34 (20.0%)	102 (71.8%) 64 (45.1%) 31 (21.8%)	77 (66.4%) 51 (44.0%) 31 (26.7%)	74 (59.2%) 57 (45.6%) 38 (30.4%)	28 (44.4%) 25 (39.7%) 16 (25.4%)
I am not sure about the effect.	126 (14.7%)	18 (18.4%)	16 (11.1%)	17 (10.0%)	13 (9.2%)	15 (12.9%)	25 (20.0%)	22 (34.9%)
Q7. I have ever failed to take the prescribed number of days of antimicrobials. (Those who answered Yes to Q7). Why did you not take the prescribed number of days?	270 (31.5%)	43 (43.9%)	48 (33.3%)	40 (23.5%)	45 (31.7%)	36 (31.0%)	34 (27.2%)	24 (38.1%)
Because my symptoms got better.	194 (71.9%)	30 (69.8%)	33 (68.8%)	28 (70.0%)	33 (73.3%)	27 (75.0%)	25 (73.5%)	18 (75.0%)
Because I forgot to take them and had some left over.	91 (33.7%)	20 (46.5%)	14 (29.2%)	19 (47.5%)	14 (31.1%)	8 (22.2%)	7 (20.6%)	9 (37.5%)
Because I decided to take them another time.	3 (1.1%)	0	1 (2.1%)	0	2 (4.4%)	0	0	0
Because I was not told by the doctor or pharmacist to finish taking them.	16 (5.9%)	1 (2.3%)	1 (2.1%)	3 (7.5%)	4 (8.9%)	1 (2.8%)	3 (8.8%)	3 (12.5%)
All other reasons were side effects.	10 (3.7%)	0	2 (4.2%)	1 (2.5%)	2 (4.4%)	3 (8.3%)	2 (5.9%)	0
Q8. I know that there are strains (types) of antimicrobials.	211 (24.6%)	20 (20.4%)	35 (24.3%)	52 (30.6%)	38 (26.8%)	24 (20.7%)	29 (23.2%)	13 (20.6%)

Table 2. Association of each question with whether or not the respondent had 'ever interrupted antimicrobials'

	Experience of discontinuation of medication		p-value
	experienced person (n = 270)	inexperienced person (n = 588)	
Q3. I know the words 'bacteria and viruses.'	212 (78.5%)	498 (84.7%)	0.032
Q4. I know the word 'antimicrobial.'	225 (83.3%)	527 (89.6%)	0.014
Q5. I know the word 'drug-resistant bacteria.'	79 (29.3%)	240 (40.8%)	0.001
Q8. I know that there are strains (types) of antimicrobials.	51 (18.9%)	160 (27.2%)	< 0.001

The problem for patients, which was also mentioned by approximately 30% of the patients in the study, was the discontinuation of antimicrobials owing to self-determination. In a previous survey, one in three parents reported that they had adjusted the dose of a medicine prescribed by a medical institution at their own discretion and given it to their child, and two in three parents had given their child the remaining medicine at their own discretion when their child developed similar symptoms (9). Interruption of antimicrobial medication not only allows bacteria in the body to survive because the dose required to kill them is not taken but may also lead to the development of drug-resistant bacteria that are resistant to the drug. In addition, drug-resistant bacteria that develop in the human body can be transmitted to animals (livestock and wildlife) by passing them into the environment, such as through sewage, and the possibility of direct human-to-animal transmission arises. Because approximately 80% of the patients in this study were not aware that there were different strains (types) of antimicrobials, it is possible that if treatment with an antimicrobial is required and the antimicrobial is changed owing to a change in symptoms, the possibility of discontinuation of the drug without being aware of the changed antimicrobial may occur. In addition, the results showed that those who had experienced interruptions were less aware of various aspects of knowledge about antimicrobials than those who had not experienced interruptions, but it can be inferred that the lack of patient knowledge may have led to the discontinuation of the drug. Therefore, it was considered possible to avoid the discontinuation of antimicrobials by providing appropriate guidance to patients when antimicrobials are prescribed and by improving their knowledge of antimicrobials.

Second, although this study was not conducted with healthcare professionals, possible problems with healthcare professionals include overprescription of antimicrobials. Examples of overprescription by healthcare professionals including the prescription of antimicrobials for the common cold and other conditions for which antimicrobials are ineffective, even if the infection is judged to be caused by a virus, fungus, or acid fungus, although normal antimicrobials are ineffective against such infections. For antimicrobial treatment, it is important to determine the causative organisms and their susceptibility to antimicrobials. For example, in empirical treatment, in which multiple possible causative organisms can be considered, it is extremely important to determine the extent of the range of causative organisms to be covered from the beginning of treatment. Given that the use of broad-spectrum antimicrobials generally has the disadvantage of selecting for resistant organisms, it is recommended that, as far as possible, only the main causative organisms are covered; if there is no improvement, it is advisable to switch to broad-spectrum drugs to cover less frequent

bacteria. In terms of the educational effect on healthcare professionals, one study found that the education of family doctors reduced antimicrobial prescriptions by 4.5% without worsening patient outcomes (10). Therefore, it can be inferred that a link exists between healthcare professionals' awareness of antimicrobials and their use. Based on the above, it is important to use antimicrobials appropriately and to promote and educate healthcare professionals so that they do not use them at inappropriate doses or for inappropriate periods of time to reduce the occurrence of drug-resistant bacteria.

This study has some limitations including the fact that it was conducted in a single insurance pharmacy and that detailed patient backgrounds, such as occupation, were not investigated. To further improve reliability, it is necessary to conduct an ongoing study in several centers with a large number of patients.

In conclusion, patients in this study that experienced antimicrobial treatment interruptions were less aware of various aspects of antimicrobial knowledge than those who had not. In antimicrobial treatment, avoiding the emergence of drug-resistant bacteria is difficult, is detrimental to patients under treatment, and presents a major problem in society. Therefore, healthcare professionals should optimize infectious disease treatment by providing appropriate guidance on the proper use of antimicrobials, significance of taking them, and harmful effects of their discontinuation to patients.

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