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МЕТОД ПОКРАЩЕННЯ ЯКОСТІ ТА ЕКОНОМІЧНОЇ ДОСТУПНОСТІ ФАРМАКОТЕРАПІЇ НЕГОСПІТАЛЬНОЇ ПНЕВМОНІЇ ДЛЯ ВИКОРИСТАННЯ У ЗАКЛАДАХ ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ

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Реферат

Мета. Розробка методу покращення якості та економічної доступності фармакоterapiї негоспітальної пневмонії з можливістю подальшого його використання у закладах охорони здоров'я України.

Матеріал і методи. Об'єктом дослідження була медична документація пацієнтів ($n=370$) із діагнозом негоспітальна пневмонія (1-а група - хворі проліковані у 2017 році за звичайним листком лікарських призначень ($n=270$); 2-а група - пацієнти проліковані за 2018 рік за розробленим нами "Стандартизованим листком лікарських призначень" ($n=100$)). Згідно наявності ускладнень чи супутньої патології, пацієнти обох груп були поділені на 4 підгрупи: 1 підгрупа - хворі з основним діагнозом - негоспітальна пневмонія без ускладнень і супутньої патології; 2-а - хворі з негоспітальною пневмонією та її ускладненнями; 3-я - хворі із негоспітальною пневмонією та супутньою патологією; 4-а - із негоспітальною пневмонією, її ускладненнями та супутньою патологією. Застосовано методи: системного аналізу, аналітико-порівняльний, інформаційно-пошуковий, клініко-фармакологічний, клініко-фармацевтичний, статистичний, структурно-логічний, клініко-економічний.

Результати й обговорення. Розроблено та впроваджено в роботу терапевтичного відділення одного із закладів охорони здоров'я стаціонарного типу міста Львова "Стандартизований листок лікарських призначень", за яким, на момент проведення дослідження, було проліковано 100 пацієнтів. Аналіз якості проведеної фармакоterapiї засвідчив зменшення кількості ліко-пов'язаних проблем у пацієнтів 2-ої групи (17 ліко-пов'язаних проблем на 100 хворих) у порівнянні з пацієнтами 1-ої групи (4364 ліко-пов'язаних проблем на 270 хворих). Результати дослідження відмінностей у середній вартості 1-го листка лікарського призначення пацієнтів 1-ої та 2-ої групи засвідчили, що завдяки застосуванню нашої розробки, вдалося достовірно зменшити середню вартість фармакоterapiї одного пацієнта ($p<0,0001$): у 1-ї підгрупі на 1426, 23 грн. [47,81\$] (з 2418,325 грн. [84, 47\$] - 2017 рік до 992, 10 грн. [36,66\$] - 2018 рік); 2-ї групи на 1527,72 грн. [50,94\$] (з 2724,40 грн. [95,16\$] до 1196,68 грн. [44,22\$]); 3-ї - на 1267,87 грн. [42, 11\$] (з 2338,31 грн. [81,67\$] до 1070,44 грн. [39,56\$]) і нарешті у хворих 4-ї групи - на 908, 39 грн. [28,96\$] (з 2272,755 грн. [79,38\$] у 2017 році до 1364,37 грн.

[50,42\$] у 2018 році). Таким чином, застосована нами нова форма листка лікарських призначень дозволила в середньому зекономити на раціоналізації фармакоterapiї негоспітальної пневмонії - 128 255, 25 грн. [4245,5 \$] на 100 пролікованих пацієнтів.

Висновок. Застосувавши "Стандартизований листок лікарських призначень", нам вдалося не лише зменшити кількість ліко-пов'язаних проблем, що виникали в результаті нераціонального застосування лікарських засобів, а й суттєво скоротити економічні витрати на лікування хворих із негоспітальною пневмонією. Загальна економія коштів, як результат раціоналізації фармакоterapiї пацієнтів становила 128 255, 25 гривень (4 245,50\$) на 100 пролікованих хворих.

Ключові слова: клініко-економічний аналіз, ліко-пов'язані проблеми, негоспітальна пневмонія, раціональна фармакоterapia.

Abstract

METHOD OF QUALITY IMPROVEMENT AND ECONOMIC EFFICIENCY OF PHARMACOTHERAPY FOR COMMUNITY-ACQUIRED PNEUMONIA AND ITS UTILITY IN UKRAINE HEALTH-CARE FACILITIES

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Aim. Development of a method quality improvement and economic efficiency of pharmacotherapy for community-acquired pneumonia with the possibility of its further use in Ukraine health care facilities.

Material and Methods. The object of the study was medical documentation of patients ($n=370$) diagnosed with community-acquired pneumonia (1st group - patients treated in 2017 on a regular prescription ($n=270$); 2nd group - patients treated in 2018 according to the "Standardized prescription form" developed by the authors ($n=100$)). According to the presence of complications or concomitant pathology, patients of both groups were divided into 4 subgroups: subgroup 1 - patients with the main diagnosis - community-acquired pneumonia without complications and concomitant pathology; 2 - patients with community-acquired pneumonia and its complications; 3 - patients with community-acquired pneumonia and concomitant pathology; 4 - patients with community-acquired pneumonia, its complications and concomitant pathology.

The following methods were applied: system analysis, analytical and comparative, systematic literature searching, clinical, pharmacological, pharmaceutical, statistical, structural and logical, economic.

Results and Discussion. The "Standardized prescription form" was developed and implemented in the therapeutic department of one of inpatient health care establishments of Lviv, which treated 100 patients at the time of the study. Quality assessment of pharmacotherapy revealed a decrease in the number of medication-related problems in patients of group 2 (17 medication-related problems per 100 patients) compared to patients of group 1 (4364 medication-related problems in 270 patients). The results of the study of differences in the average cost of one prescription form of patients of the 1st and 2nd groups revealed a possibility of a significant reduction of the average cost of pharmacotherapy per patient ($p < 0.0001$) with the application of our invention: in subgroup 1 - by 1426.23 UAH [47.81 \$] (from 2418.325 UAH [84.47 \$] in 2017 to 992.10 UAH [36.66 \$] in 2018); in subgroup 2 - by 1527.72 UAH [50.94 \$] (from 2724.40 UAH [95.16 \$] to 1196.68 UAH [44.22 \$]); in subgroup 3 - by 1267.87 UAH [42.11 \$] (from 2338.31 UAH [81.67 \$] to 1070.44 UAH [39.56 \$]) and in subgroup 4 - by 908.39 UAH [28.96 \$] (from 2272.755 UAH [79.38 \$] in 2017 to 1364.37 UAH [50.42 \$] in 2018). Thus, the new form of regular prescription form used by us allowed rationalizing pharmacotherapy of community-acquired pneumonia, saving 128 255.25 UAH [4245.5 \$] on average for 100 treated patients.

Conclusions. By applying the "Standardized prescription form", we not only managed to reduce the number of medication-related problems resulting from irrational use of medications, but also significantly reduced economic costs of treating patients with community-acquired pneumonia. The total cost savings as a result of the patients' pharmacotherapy rationalization was 128,255.25 UAH (\$ 4,245.50) per 100 treated patients.

Keywords: community-acquired pneumonia, medication-related problems, cost of pharmacotherapy, rational pharmacotherapy

Introduction

The quality and rational use of medications in various nosologies is a major contemporary problem. According to relevant information sources, 30-40% of patients with various diseases do not receive pharmacotherapy (PhT) in accordance with clinical guidelines (CG), and 20-25% of patients are prescribed treatment not indicated for them [1]. This issue is particularly acute for patients with pneumonia, which remains one of the leading mortality causes in the 21st century, causing estimated 2.38 million

deaths worldwide each year [2] and 230 thousand deaths in Europe [3]. In Ukraine, the incidence of community-acquired pneumonia (CAP) in 2015-2017 ranged from 384 to 458 cases per 100,000 of population. The mortality rate is from 11 to 14 cases per 100,000, that is, on average, more than 3% of all patients with pneumonia die [4].

In addition to high mortality, this pathology also places a significant economic burden on healthcare systems (HS) in virtually every country in the world. According to the American Thoracic Society (ATS), pneumonia is in the top 10 most costly diseases, especially at the inpatient stage [5]. The combined burden of CAP in the US is nearly 10.6 billion dollars (\$) per year [2, 6]. In this case, the bulk of the money is spent on the treatment of hospitalized patients. In Europe, a 10-day inpatient PhT equals from \$487.4 in Poland [7] to over \$12,000 in Switzerland [8]. Thus, international data shows that treating patients with CAP leads to significant economic costs, and the lack of proper monitoring and evaluation of the quality of the assigned PhT, therefore, adversely affects its rationality [9]. In addition, inadequacy of the assigned PhT can lead to both unforeseen complications and adverse side effects to medications and, as a consequence, additional costs. According to the relevant information sources, only 50-70% of patients with CAP are treated with appropriate antibacterial agents (ABAs), while nearly 60% of patients with viral upper respiratory tract infections receive antibiotics they do not need [10-12].

Therefore, in order to rationalize PhT and ensure the efficient use of financial resources, we believe that clinical, pharmaceutical and economic studies are important to offer evidence-based and cost-effective treatment strategies [10].

In 2018, Ukraine approved the Strategy for the Implementation of the State Policy of Providing the Population of Ukraine with medicines up until 2025, the main components of which are: rational use of medications in accordance with the clinical needs of patients,

and creation of new standards of care through implementation of European protocols for treatment of different diseases [13]. It is worth noting that adaptation of the best international clinical guidelines (CGs) in Ukraine has been ongoing since 2009, although the experience and the results of retrospective analysis show that this is not always guaranteed by doctors in their daily practice [14].

All of the above justifies the feasibility of conducting our study to evaluate the quality of care and pharmaceutical care for patients with CAP, the search of possible ways to optimize and rationalize it (particularly economically) and prevent systemic structural errors during the PhT process.

Material and Methods

The object of the study was medical records of patients (n=370) diagnosed with moderate to severe CAP, and successfully treated at the therapeutic ward of a healthcare institution in Lviv. The patients were divided into two groups: Group 1 - patients who received treatment in 2017 according to the regular prescription form (PF) (n=270), and Group 2 - patients treated in 2018 according to the "Standardized PF" developed by the authors (n=100). Based on the presence of complications or concomitant pathology (CP), patients of both groups were divided into 4 subgroups: subgroup 1 - patients with the main diagnosis - CAP without complications and CP; 2 - patients with CAP and its complications; 3 - patients with CAP, and CP; 4 - patients with CAP, its complications, and CP. Retrospective assessment of PhT quality in patients with CAP was performed according to the European Classification System PCNE, Version V5.01 for Identification of Drug Related Problems (DRPs) modified by A. Zimenkovsky (2012); due to the modern domestic realities of healthcare (HC) it was impossible to adequately use the newer versions. Evidence-based developments resulting from these observations were the following: approved (currently valid) national clinical protocol for treatment of CAP [15], adapted to the evidence-based clinical

guidelines [16], international clinical guidelines (CG) [17-19] of the State Registry of medications [20].

Calculations of the average cost of one regular PF of a patient treated in 2017-2018 was performed using the average wholesale price according to the state register of wholesale and retail prices for medicines in Ukraine as of January 10, 2018, at the rate of the National Bank of Ukraine (NBU), \$1=28.63 UAH, and as of 01.08.2018 according to the NBU rate, \$1=27.06 UAH.

Statistical processing was performed using the STATISTICA for Windows 5.0 software package (StatSoft, USA). Because the distribution of indicators in the groups of patients under study did not comply with the law of normality (validation using the Shapiro-Wilks test), they were presented as the median (minimum-maximum) (lower-upper quartile), and comparisons between groups were performed using the Mann-Whitney test.

The following methods were applied: system analysis, analytical and comparative, systematic literature searching, clinical, pharmacological, pharmaceutical, statistical, structural and logical, and economic. There was no conflict of interest to be considered. The study was not commissioned by individuals and legal entities.

Results and Discussion

Similarly to our previous retrospective study of PhT of patients with CAP [21], it was found that its quality is unsatisfactory while economic losses as a result of inappropriate, incorrect and irrational PhT amounted to 345,426.70 UAH (\$12,065.21) in 2017 for 270 patients. The aim of our study was to create and test an innovative method in actual clinical practice that would improve the quality of PhT of patients with this pathology and, as a result of its rationalization, reduce the economic costs. For this purpose, we have developed the "Standardized PF" (Fig. 1) 100 patients participating in the study were treated according to it (25 patients from each predefined subgroup). In its structure, it has few

Name of healthcare institution															
Regular Prescription Form															
№ of card								№ of ward							
Surname, name and patronymic of patient															
Main diagnosis:															
Complications:															
Concomitant diagnosis:															
Prescription															
Notes about prescription and performance															
Date															
Regime															
Diet															
1. Amoxicillin/clavulanic acid 1,2g TID IV	+	+	+	+	+	+	+	+							
	+	+	+	+	+	+	+	+							
	+	+	+	+	+	+	+	+							
2. Clarithromycin 0,5g BID tablet	+	+	+	+	+	+	+	+							
	+	+	+	+	+	+	+	+							
Or															
3. Ceftriaxone 1,0 IV	+	+	+	+	+	+	+	+							
4. Clarithromycin 500mg BID tablet	+	+	+	+	+	+	+	+							
	+	+	+	+	+	+	+	+							
5. Low molecular heparins	+	+	+	+	+	+	+	+							
6. Acetylcysteine 600 mg (1tablet) SID	+	+	+	+	+										
7. Infusion therapy:															
crystalloids															
colloids															
erythrocyte mass															
8. Enteral nutrition															
SpO ₂															
Oxygen therapy (l)															
Doctor															
Nurse															

Figure 1
"Standardized PF"

differences from the traditional ones (used in the HCIs of Ukraine); one of them is containing the medications (internationally non-proprietary names (INN)) forming the basis of PhT in accordance with the national CG of treatment of this nosology; it is also adapted to foreign CGs. The document contains a standard information section for general patient information: the number of the inpatient card; ward number; surname, first name, and patronymic; the main diagnosis, its complications, and CP. The main part is the actual scheme of the finished PhT. Under each INN of the medication there is an additionally provided place for the doctor to a trade name of a particular medication.

Thus, the basis of PhT included: first-range ABA - a broad-spectrum β -lactam antibiotic, particularly amoxicillin/clavulanic

acid at a dosage of 1.2 g TID, combined with a macrolide, particularly clarithromycin [18-19]. In patients with penicillin intolerance, it is advisable to use second-generation (cefuroxime) or third-generation cephalosporins (cefotaxime or ceftriaxone) [18-19] (II-range ABA). Regarding the choice of a macrolide, we prescribed clarithromycin, since it is indicated in the CG [19], as a macrolide of choice. However, at the discretion of the physician, it could be replaced with another macrolide (e.g. azithromycin), as it was previously explained to the physicians. In addition, the required (mandatory) minimum recommended duration of administered antibacterial therapy (ABT) prescribed by the CG [18-19] was 7-10 days for patients with moderate severity of CAP. We prescribed a 7-day PhT, which the doctor could

continue if there were objective indications. We would like to emphasize the adequate duration of ABT, since in the course of our previous studies of the PhT in this category of patients [21] a large proportion of the comments concerned this very point. Inadequate duration of ABT can be especially dangerous, since it may lead to the development of resistance to antibiotics in the future, as well as to the emergence, in particular, of antibiotic-associated diarrhea.

Low molecular heparins mentioned in our "Standardized PF" are recommended in patients with acute respiratory failure (RF) [17-19] and limited mobility to prevent thromboembolism. Besides, there are numerous reviews in the Pubmed database of their beneficial effects on the course of the disease in patients with CAP [22, 23]. In particular, the results of one study suggest that timely administration of combined ABT and unfractionated heparins leads to a decrease in the mortality of patients with this diagnosis [24].

In case of viscous sputum that is difficult to expectorate, mucolytics (acetylcysteine, carbocysteine, or ambroxol) may be used [17-19]. In patients with hypovolemia and dehydration at the beginning of CAP treatment, the use of a large amount of fluids both orally and via infusion therapy using balanced electrolyte solutions is indicated [17]. To this end, we considered it necessary in the "Standardized PF" to divide infusion PhT into groups: crystalloids (saline, Ringer's solution, lactate Ringer's solution, etc.), colloids (hydroxyethylated starch solutions), and erythrocyte mass. In the case of a prolonged disease course, it is recommended to use

nutritional support by the balanced commercial agents for clinical nutrition [18, 19].

The final point of the PhT is the constant monitoring of blood oxygen saturation for the maintenance of $P_aO_2 \geq 8$ kPa and SpO_2 in the target saturation range - 94-98% [18, 19], using, if necessary, oxygen therapy and indicating the number of liters of oxygen administered per minute. We would like to point out that there is no such point in the standard regular PFs used in the HCIs of Ukraine, and in the preliminary study of patients treated in 2017, blood saturation measurements and medical oxygen administration were only performed in 122 of 270 patients (45%).

For CAP complications or present CPs, which may require the use of additional medications, there are blank lines provided where the doctor can enter, if necessary, the required PhT.

The "Standardized PF" that we developed was implemented in the work of the therapeutic department of one of inpatient HCIs in Lviv (Ukraine). We conducted a study on how the quality of PhT in the observed patient category changed by identifying possible DRPs and comparing their numbers with those detected in 2017, and using the CE analysis to determine the average cost of one patient's "Standardized PF", and compare it with the average cost of the patient treated in 2017. The results of the comparative characteristics of patients by age and sex showed no significant differences in the composition of the studied subgroups in 2017 and 2018 (Table 1, 2).

With regard to the duration of PhT, a statistically significant reduction in the number of treatment days was observed only in patients with

Table 1

Comparative characteristics of the studied subgroups of patients according to age

Subgroup of patients (acc. to diagnosis)	Age of patients: median (min-max) [lower-upper quartile]				p **
	n*	2017	n*	2018	
Subgroup 1	48	41 (21-89) [32-54]	25	42 (20-69) [28-53]	0.77
Subgroup 2	43	47 (20-89) [32-63]	25	58 (21-87) [36-73]	0.14
Subgroup 3	115	64 (21-92) [53-73]	25	62 (18-86) [57-73]	0.86
Subgroup 4	64	60.5 (18-88) [39-72]	25	56 (21-77) [48-63]	0.2

1. * - the total of patients in a subgroup;

2. ** - determining the differences acc. to patients' age in a particular subgroup

Table 2

Comparative characteristics of the studied subgroups of patients according to gender

Subgroup of patients (acc. to diagnosis)	2017				2018				P*
	m	%	fem	%	m	%	fem	%	
Subgroup 1	26	54.17	22	45.83	12	48.0	13	52.0	0.6
Subgroup 2	20	46.51	23	53.49	10	40.0	15	60.0	0.6
Subgroup 3	62	53.91	53	46.09	12	48.0	13	52.0	0.6
Subgroup 4	37	57.81	27	42.19	11	44.0	14	56.0	0.3

* - Fisher's two-tailed exact test

Table 3

Comparative characteristics of the studied subgroups of patients according to the number of treatment days spent in the hospital

Subgroup of patients (acc. to diagnosis)	Number of bed-days: median (min-max) [lower-upper quartile]				p**
	n*	2017 pik	n*	2018 pik	
Subgroup 1	48	12 (4-22) [9-14]	25	10 (3-13) [7-11]	0.003
Subgroup 2	43	12 (3-19) [9-16]	25	10 (3-16) [8-11]	0.09
Subgroup 3	114	11 (2-30) [8-13]	25	10 (5-13) [7-11]	0.06
Subgroup 4	64	11 (4-27) [9-14,5]	25	10 (7-14) [9-12]	0.2

1. * - the total of patients in a subgroup;

2. ** - determining the differences acc. to the number of treatment days between the studied subgroups

a primary diagnosis ($p=0.003$). For other subgroups, although a decrease in the average number of treatment days was detected, the results obtained were not statistically significant (Table 3).

There were no significant differences in the complications and CPs of patients in both groups (Figure 2, 3).

Regarding ABT, among 270 of the

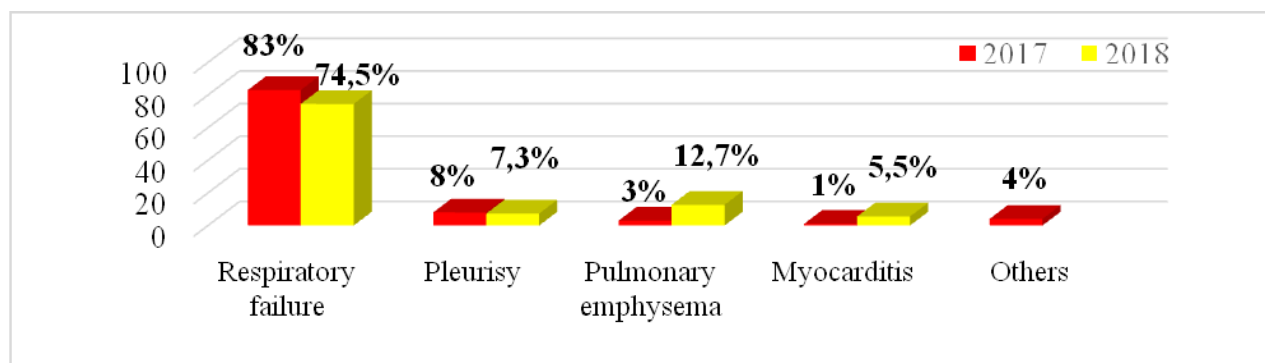


Figure 2

The results of standardization of complications of patients treated in 2017 and 2018

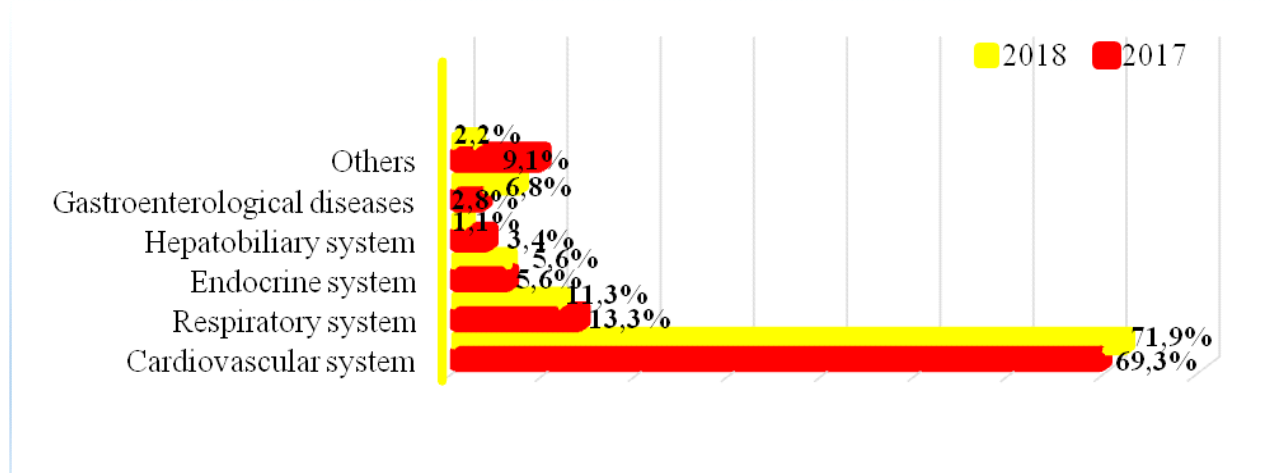


Figure 3

Distribution of patients with CP by anomalies of body systems in 2017 and 2018

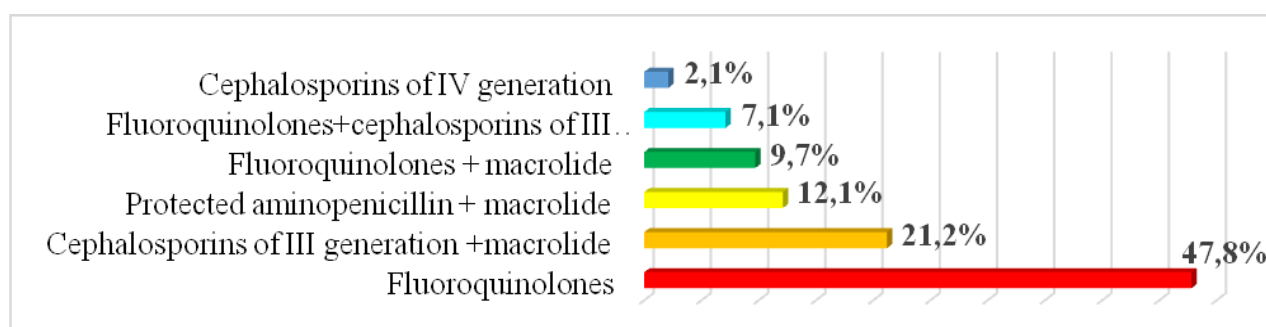


Figure 4
Combinations of ABAs administered to patients with CAP in 2017

analyzed regular PFs of patients treated in 2017, in 180 cases the ABAs did not follow the clinical protocol (33.3%). The most commonly used combinations are shown in Figure 4.

Among the patients treated according to "Standardized PF" (n=100), II-range ABT (cephalosporins of second or third generation+macrolide) was administered more frequently (n=57) compared to the I-range ABT (protected aminopenicillin + macrolide) (n=43). Regarding macrolide selection, the clear preference of doctors was the prescription of clarithromycin (n=78), compared to azithromycin (n=22), which, in our opinion, is a positive tendency

because it corresponds to highly effective foreign CGs.

Regarding the rest of the medications forming the basis of our PhT of CAP, the low molecular heparins were used in 76 patients; mucolytic agents in 95 patients; infusion therapy in 75 patients; and enteral nutrition in 11 patients. The following additional medications used by physicians for PhT of complications and CPs were the following: agents that affect the cardiovascular system (C) (n=16); non-steroidal anti-inflammatory drugs (M01AH17) (n=4); agents affecting the blood system and hematopoiesis (B) (n=10), musculoskeletal

Table 4

Detailed distribution of identified DRPs by the European PCNE V5.01 system modified by A. B. Zimenkovsky (2012) in 2017 and 2018 by absolute value

Code	Name of the DRP rubric according to the PCNE Classification Scheme V5.01	Number of cases (abs.)	
		2017	2018
P.2	Issues with the medications choice	930	9
P 2.1.	Irrational (improper) medication prescribed	276	-
P 2.2.	Improper drug form prescribed	79	-
P 2.3.	Application of the same medication from one group	156	9
P 2.4	Contraindications to the application of medication	19	-
P 2.5	No strict indications for the application of medication	197	-
P 2.6	Strict indications for the application of medication but the medication was not prescribed	203	-
P.3	Problems related to the dosage of medication	764	-
P 3.1.	PA was administered in subtherapeutic dose	34	-
P 3.2.	PA was administered in extra dose	65	-
P 3.3	The duration of PhT is insufficient	389	-
P 3.4	The duration of PhT is increased	276	-
P.5	Problems related to the possible drug interactions between the prescribed medications	1073	7
P 5.1	Possibility of potential interaction drug-drug	1073	7
P 7.	Technical DRP	691	-
P.8	Problems of evidence-based medicine, development of formulary system and the compliance of PhT with the applicable national clinical protocols on specific nosology	906	1
P 8.2	The lack of medication in the currently used CP for certain clinical case	423	-
P 8.3	Absence of medications in the State Registry of medications	346	-
P 8.4	The lack of evidence-based data concerning clinical effectiveness of medication	137	1
	Total	4364	17

Table 5

Comparative characteristics of the cost of PhT of the studied subgroups

Subgroup of patients (acc. to diagnosis)	Cost of PhT of one regular PF (UAH): median (min-max) [lower-upper quartile]				p**
	n*	2017	n*	2018	
Subgroup 1	48	2418.325 (398.2-8455.75) [1609.27-3476.145]	25	992.1(293.98-1298.5) [795.97-1084.91]	<0.0001
Subgroup 2	43	2724.4 (329.67-6010.95) [1559.29-4463.81]	25	1196.68 (269.46-2240.6) [737.05-1489.75]	<0.0001
Subgroup 3	115	2338.31 (81.42-12214.91) [1601.59-3617.6]	25	1070.44 (517.82-1775.6) [903.74-1362.3]	<0.0001
Subgroup 4	64	2272.755 (549.9-10386.3) [1740.24-3055.45]	25	1364.37 (538.32-2397.98) [987.48-1712.03]	<0.0001

1. * - the total of patients in a subgroup;

2. ** - determining the difference in the cost of PhT of one MPL between the studied subgroups of patients

system (M) (n=4), nervous system (N) (n=2), digestive system and metabolism (A) (n=1), as well as agents that affect the respiratory system (R) (n=1).

An analysis of the PhT quality showed a decrease in the number of medication-related problems. If in 2017 we were able to detect 4364 DRPs in 270 regular PFs, in 2018 they amounted to only 17 DRPs per 100 treated patients. It should be noted that DRPs were detected only in those regular PFs where additional medications were applied to the PhT of complications or the patient's CPs. As a result, we have been able to completely avoid technical DRPs (heading under code P.7) and problems related to the dosage of drugs (P.3), and to minimize problems related to drug interactions (LV) (P.5), the choice of drugs (P.2) and, additionally introduced by A. B. Zimenkovsky, the problems of evidence-based medicine, the development of the formulary system and the compliance of PhT with the applicable national clinical protocols on specific nosology кінець речення взагалі незрозумілий (Table 4).

The next step of the study was to determine the differences in the average cost of 1 MPL of patient treated in 2017 and 2018 (based on our "Standardized PF").

Comparisons, as noted above, were also made between patients in the same subgroup because it was deemed inappropriate to compare the cost of PhT of patients with different diagnoses (Table 5).

Therefore, with the application of "Standardized PF" it was possible to significantly reduce the average cost of a single patient's PhT ($p < 0.0001$): in subgroup 1 - to 1426.23 UAH [\$47.81] (from 2418.325 UAH [\$84.47] - 2017

to 992.10 UAH [36.66 \$] - 2018); in subgroup 2 - to 1527.72 UAH [\$50.94] (from 2724.40 UAH [\$95.16] to 1196.68 UAH [\$44.22]); in subgroup 3 - to 1267.87 UAH [\$42.11] (from 2338.31 UAH [\$81.67] to 1070.44 UAH [\$39.56]) and in subgroup 4 - to 908.39 UAH [\$28.96] (from 2272.755 UAH [\$79.38] in 2017 to 1364.37 UAH [\$50.42] in 2018). Thus, the new form of regular prescription that we used allowed saving by means of rationalization of PhT of CAP an average- amount of 128 255. 25 UAH [\$4245.50] for 100 treated patients.

Conclusions

By applying the "Standardized MLP", we not only managed to reduce the number of drug-related problems resulting from irrational medication use , but also significantly reduced the economic costs of treating patients with CAP. The total cost savings as a result of the rationalization of the patients' PhT was 128,255.25 UAH (\$4,245.50) per 100 treated patients.

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