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ANALYSIS OF THE KROK 1 AND HISTOLOGY SUBTESTS DYNAMICS OF STUDENTS OF DNIPROPETROVSK MEDICAL ACADEMY

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Abstract. Analysis of the krok1 and histology subtests dynamics of students of Dnipropetrovsk medical academy. Pototskaya O.Yu., Shevchenko K.M., Averkina L.I., Kobeza P.A. *Objective control of the level of knowledge in medical universities is the basis for guaranteeing the quality of education. There are a lot of examples of universal systems designed to academic achievemets of evaluate medical students in different countries, including USMLE, IFOM and others; particularly in Ukraine licensing exam Krok 1 has been conducted since 2005. Results of Krok 1 are also used for ranking medical universities at the national level. The purpose of our work was to conduct a comparative*

analysis of the results of the licensing exam Krok 1, in particular, a subtest in histology, among students of specialties 221 "Dentistry" and 222 "Medicine" and different languages of training (Ukrainian, Russian, English) in Dnipropetrovsk medical academy. We have revealed that all the analyzed contingents of students (DMA as well as Ukrainian) in the most of observation periods from 2014 to 2019 had lower average results in histology compared to average Krok 1 results. This could be explained by low quota of tests in histology for students of specialty 222 "Medicine" which is 4-6%, and absence of the threshold level for doing each particular subject. These conditions do not motivate students of the third course to recollect a complicated discipline that ended more than a year ago. Another problem is in the content of anchor questions in Krok 1 booklets: the number of such questions are distributed unevenly among booklets of different years and different languages of training. As a result, students with different languages of training are in unequal conditions. In addition, the variation in the number of anchor tests from year to year, the lack of a declared quota of such tests discourages students and makes it difficult to develop algorithms for preparing for Krok I.

Реферат. Анализ динамики результатов Крок 1 и субтестов по гистологии студентов Днепропетровской медицинской академии. Потоцкая О.Ю., Шевченко Е.Н., Аверкина Л.И., Кобеза П.А. *Объективный контроль уровня знаний в медицинский университетах является основой гарантии качества образования. Существует масса примеров универсальных систем, предназначенных для оценки успеваемости студентов-медиков в разных странах, включая USMLE, IFOM и другие; в частности, в Украине с 2005 года проводится лицензионный экзамен Крок 1. Результаты этого экзамена используются также и для ранжирования медицинских университетов на национальном уровне. Целью нашей работы было проведение сравнительного анализа результатов лицензионного экзамена Крок 1, в частности субтеста по гистологии, среди студентов специальностей 221 «Стоматология» и 222 «Медицина» разных языков обучения (украинский, русский, английский) в Днепропетровской медицинской академии. Мы обнаружили, что все проанализированные контингенты студентов (ДМА, а также Украины в целом) в большинстве периодов наблюдения с 2014 по 2019 год имели более низкие средние результаты по гистологии по сравнению со средними результатами Крок 1. Это можно объяснить низкой квотой гистологических тестов для студентов специальности 222 «Медицина», которая составляет 4-6%, и отсутствием порогового уровня для прохождения каждого конкретного предмета. Эти условия не мотивируют студентов третьего курса повторять сложный предмет, который закончился более года назад. Еще одна проблема заключается в содержании якорных тестов в буклетах Крок 1: количество таких вопросов распределено неравномерно среди буклетов разных годов и разных языков обучения. Как результат, студенты, обучающиеся на разных языках, поставлены в неравные условия. Кроме того, разница в количестве якорных тестов из года в год, отсутствие заявленной квоты таких тестов дезориентирует студентов и усложняет разработку алгоритмов подготовки к Крок 1.*

The quality of medical education largely depends on the objectivity and accuracy of its control system. There is a tendency all over the world to use a unified system of testing medical students at the state level with the help of closed test tasks with numerous choice of answers. Examples are the USMLE (The United States Medical Licensing Examination) tests used in the United States [7]; IFOM (International Foundations of Medicine) – an international form of USMLE [6]; Medical Council of India Screening Test (alternative name – Educational Commission For Foreign Medical Graduates, ECFMG), used in India to monitor students studying abroad [4]; PLAB (Professional and Linguistic Assessments Board), used in the UK to qualify doctors educated in other countries [5], and many others. An analogue of such systems in Ukraine is the licensing exam Krok, which has been conducted at the state level since 2005 [3]. According to the results of this exam, not only the level of training of individual students is assessed, but also the quality of work of medical universities, individual departments and faculties.

Given the ever-increasing importance of the licensing exam Krok 1, we decided to analyze the dynamics of its main indicators and correlate with the results of subtests in histology, which will help identify the main factors influencing test results and increase the effectiveness of student training at the histology department.

The purpose of our work was to conduct a comparative analysis of the results of the licensing exam Krok 1, in particular the subtest in histology of students of Dnepropetrovsk Medical Academy (DMA), majoring in specialties 221 "Dentistry" and 222 "Medicine" in different languages of training (Ukrainian, Russian, English).

MATERIALS AND METHODS OF RESEARCH

The material for the analysis was the analytical information provided by the Testing Center at the Ministry of Health of Ukraine from 2011 to 2019 [3]. For students majoring in 222 "Medicine" extended analytical data for DMA have been available since 2014, while for students majoring in 221 "Dentistry" – since 2015, so the time range of detailed analysis of these contingents differs by one year, respectively.

During the analysis there was calculated: the arithmetic mean of Krok 1 results for DMA; arithmetic mean results of subtests in histology in DMA;

the number of students who passed the threshold level of Krok 1 – 60.5% (the threshold level changed during the years of observation, so conditionally all the results were listed at the last value of 60.5%); correlation coefficient between arithmetic mean values of subtests in histology and content of anchor tests in booklets; correlation coefficient between the results of Krok 1 and subtests in histology within each year; correlation coefficient between arithmetic mean of Krok 1 results in DMA and in Ukraine as a whole; specific number of students for each year in whom the result of Krok 1 was higher than the result of the subtest in histology. The latter indicator made it possible to assess how the histology subtest affected the overall result of Krok 1.

Verification of the assumptions of the truth value of statistical hypotheses for paired groups with a normal distribution was performed using statistical parametric analysis. Statistical significance was revealed using a p-value that corresponded to a given value for ≤ 0.05. The main data set was analyzed in the Microsoft Excel application package (product number: 89409-707-4157945-65401 2007), using the standard Student's t-test. The level of reliability for each represented group of students for the period from 2014 to 2019 academic year is determined. The results of the study present the main indicators of descriptive statistics using generally accepted statistical criteria.

RESULTS AND DISCUSSION

222 "Medicine" (Ukrainian language)

Domestic students majoring in 222 "Medicine" are characterized by high competition for admission to universities, so their performance level is traditionally higher than that of students of other specialties. Since this contingent is trained mainly at the expense of the state budget and is the main source of new staff for domestic medicine, it is precisely by the results of the licensing exam Krok that the effectiveness of medical universities is assessed. Because of this, we analyzed a number of indicators of the results of Krok 1 of domestic students majoring in 222 "Medicine" for a little longer period of time (2011-2019) as compared to other categories, and compared to the average in Ukraine.

The average results of the Krok 1 exam of domestic students majoring in 222 "Medicine" in Ukraine for 2011-2019 showed positive dynamics. From 2013 to 2018, the arithmetic mean of subtest in histology in the DMA was higher than in Ukraine as a whole (Fig. 1).

The data necessary for calculations of reliability of changes of Krok 1 results in DMA in dynamics, the

Testing Center has been providing since 2014 (Table 1). During the period from 2014 to 2019, the results of passing Krok 1 by DMA students were relatively stable (Fig. 2C).
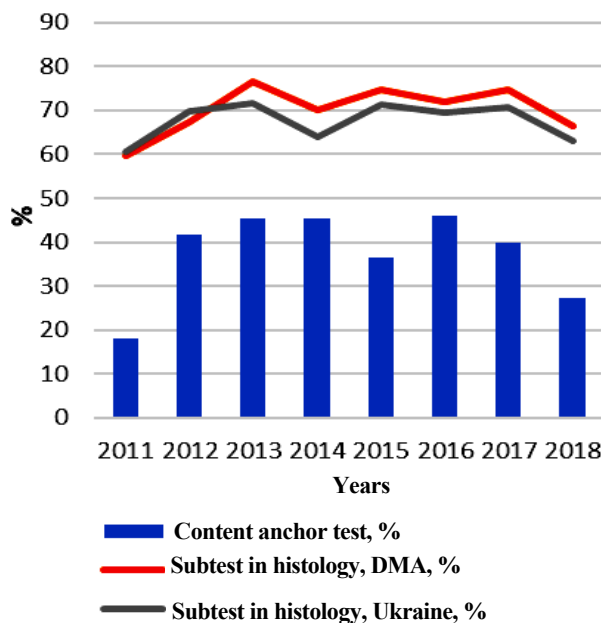
Fig. 1. Dynamics of arithmetic mean values of subtest in histology in a complex exam Krok 1 of domestic students majoring in 222 "Medicine" in DMA and in Ukraine as a whole, as compared to dynamics of contents of anchor tests in histology in corresponding booklets on Krok 1

The large level of gap between the average results of Krok 1 and the subtest in histology indicates an insufficient level of preparation of students for a particular subject. The low average results of Krok 1 can also be attributed to the problems of training in a non-native language.

222 "Medicine" (English language)

The dynamics of the results of tests in histology over the period from 2014 to 2019 in general repeated the main trends of the results of Krok 1 (Fig. 2B).

Given the relatively low results of the subtest in histology of English-speaking students majoring in Medicine, the low level of correlation between the results and content of anchor tests, as well as the large difference between the average results of Krok 1 and the subtest in histology, it is possible to draw a conclusion on the insufficient level of preparation of students of the third year of study on the eve of Krok 1. To solve this problem, it is advisable to encourage students' self-preparation, giving them the opportunity to test online on the site or test programs with anchor tests.
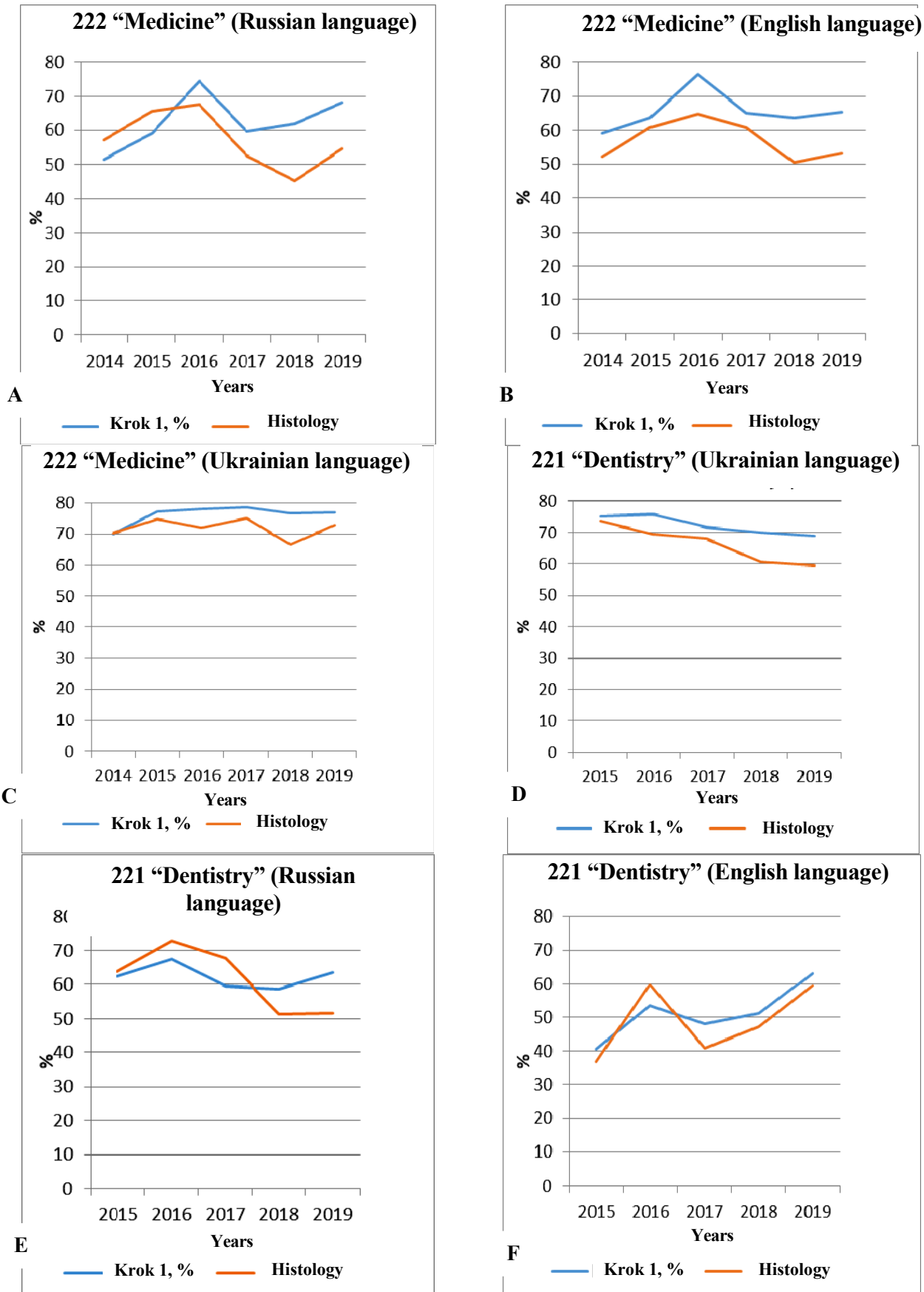
Fig. 2. Dynamics of arithmetic mean values of Krok 1 results and subtests in histology of students of DMA majoring in 222 "Medicine" and 221 "Dentistry" with different language of training

Dynamics of some indicators of Krok 1 results of students of DMA majoring in 222 "Medicine" for the period from 2014 to 2019

Language of training, year	Results of Krok 1 / subtest in histology	Total number of students, n	Krok 1 >60,5%	Arithmetic mean of results M±m	Krok > histology	Correlation Krok: histology
Russian 2014	Krok 1, %	81	22%	51.5±1.4	38%	71.8%
	Histology, %		33%	57.1±1.9		
Ukrainian 2014	Krok 1, %	382	80%	70.0±0.6	49%	70.1%
	Histology, %		65%	70.2±0.9		
English 2014	Krok 1, %	48	40%	59.1± 0.6†	73%	16.6%
	Histology, %		17%	52.2±1.6		
Russian 2015	Krok 1, %	106	56%	59.0±1.5*	27%	72.2%
	Histology, %		57%	65.66±1.9*		
Ukrainian 2015	Krok 1, %	481	96%	77.5±0.4*	62%	57.3%
	Histology, %		83%	74.7±0.5*		
English 2015	Krok 1, %	49	61%	63.7±2.9‡	49%	82.1%
	Histology, %		55%	60.8±3.8*‡		
Russian 2016	Krok 1, %	48	56%	74.5±1.0*‡	71%	46.3%
	Histology, %		54%	67.5±2.1		
Ukrainian 2016	Krok 1, %	475	93%	78±0.5‡	68%	63.8%
	Histology, %		68%	71.9±0.8*		
English 2016	Krok 1, %	99	93%	76.4±09*‡	88%	59.8%
	Histology, %		50%	64.8±1.4		
Russian 2017	Krok 1, %	52	47%	59.5±1.7*	66%	56.7%
	Histology, %		21%	52.6±2.5*‡		
Ukrainian 2017	Krok 1, %	454	97%	78.6±0.4‡	59%	58.7%
	Histology, %		77%	74.9±0.7*‡		
English 2017	Крок 1, %	127	71%	65.1±1.2*†‡	65%	79.0%
	Гістологія, %		50%	60.9±1.7†‡		
Russian 2018	Krok 1, %	36	58%	61.8±1.8	86%	64.4%
	Histology, %		14%	45.3±2.6*		
Ukrainian 2018	Krok 1, %	448	95%	76.7±0.5*‡	72%	58.8%
	Histology, %		71%	66.5±0.9*‡		
English 2018	Krok 1, %	130	63%	63.7±1.0‡	78%	43.3%
	Histology, %		27%	50.3±1.5*		
Russian 2019	Krok 1, %	29	83%	68.0±1.9*	93%	45.8%
	Histology, %		17%	54.7±2.2*		
Ukrainian 2019	Krok 1, %	417	95%	76.9±0.5‡	62%	62.0%
	Histology, %		70%	72.7±0.8*‡		
English 2019	Krok 1, %	123	75%	65.3±0.9	74%	65.9%
	Histology, %		30%	53.3±1.8		

Notes: * – significant difference compared to the previous year (p≤0.05); † – significant difference between Russian- / English-speaking students of one year (p≤0.05); ‡ – a significant difference between the specialties "Dentistry" / "Medicine" of one year (p≤0.05); Krok 1 >60.5% – the percentage of students whose result of Krok 1 >60.5%; Krok> Histology – the percentage of students whose result of Krok 1 is generally higher than the result of the subtest in histology.

221 "Dentistry" (Ukrainian language)

After analyzing the results of Krok 1 exam for the period of 2015-2019 of dentistry students studying in Ukrainian, we can note the relatively stable dynamics of the indicator (Fig. 2D). Performance indicators in solving tests in histology as part of the exam Krok 1 for all years of observation were much lower than the result of the exam as a whole (Table 2). The difference between the average results of Krok 1 and histology over the period from 2015 to 2019 gradually increased and reached a maximum of 9.6% in 2019.

Table 2

Dynamics of some indicators of Krok 1 results of students of DMA majoring in 221 "Dentistry" for the period from 2015 to 2019

Language of training, year	Results of Krok 1 / subtest in histology	Total number of students, n	Krok 1 >60.5%	Arithmetic mean of results M±m	Krok > histology	Correlation Krok: histology
Russian 2015	Krok 1, %	88	70%	62.4±1.6	44%	80.80%
	Histology, %		56%	63.9±1.9		
Ukrainian 2015	Krok 1, %	97	94%	75.4±1.0	63%	77.00%
	Histology, %		88%	73.6±1.0		
English 2015	Krok 1, %	10	10%	40.7±5.9†‡	50%	90.60%
	Histology, %		10%	37.0±6.3†‡		
Russian 2016	Krok 1, %	40	78%	67.6±1.9*‡	23%	78.60%
	Histology, %		83%	72.8±1.8*		
Ukrainian 2016	Krok 1, %	125	95%	75.8±0.7‡	80%	73.10%
	Histology, %		70%	69.4±1.1*		
English 2016	Krok 1, %	14	43%	53.5±6.0†‡	14%	97.30%
	Histology, %		43%	59.6±6.4*		
Russian 2017	Krok 1, %	34	65%	59.6±2.8*	21%	86.80%
	Histology, %		74%	67.8±3.3‡		
Ukrainian 2017	Krok 1, %	65	86%	71.7±1.5*‡	66%	85.50%
	Histology, %		78%	68.0±1.7‡		
English 2017	Krok 1, %	20	20%	48.1±4.1†‡	60%	86.80%
	Histology, %		15%	41.0±5.5*†‡		
Russian 2018	Krok 1, %	42	46%	58.6±1.4	76%	72.50%
	Histology, %		19%	51.3±2.1*		
Ukrainian 2018	Krok 1, %	49	86%	69.9±1.3‡	82%	82.70%
	Histology, %		39%	60.6±2.2*‡		
English 2018	Krok 1, %	12	17%	51.2±2.6†‡	58%	64.50%
	Histology, %		8%	47.1±3.6		
Russian 2019	Krok 1, %	20	65%	63.6±1.7*	90%	32.00%
	Histology, %		10%	51.7±2.0		
Ukrainian 2019	Krok 1, %	70	81%	69.0±1.1‡	83%	61.50%
	Histology, %		40%	59.4±1.6‡		
English 2019	Krok 1, %	15	53%	63.2±3.7*	71%	92.40%
	Histology, %		36%	59.5±5.0		

Notes: * – significant difference compared to the previous year ($p \leq 0.05$); † – significant difference between Russian- / English-speaking students of one year ($p \leq 0.05$); ‡ – a significant difference between the specialties "Dentistry" / "Medicine" of one year ($p \leq 0.05$); Krok 1>60.5% – the percentage of students whose result of Krok 1 >60.5%; Krok > Histology – the percentage of students whose result of Krok 1 is generally higher than the result of the subtest in histology.

In general, the negative dynamics of the results of subtests in histology can be explained by a decrease in the overall level of preparation for Krok 1, but a fairly large gap between the average results of Krok 1 and the subtest in histology (almost 10%) indicates insufficient preparation of the third-year students in histology before sitting exam Krok 1. One of the factors that have a negative impact on the results of the subtest in histology of students of the Faculty of Dentistry is the long time-lag between the exam on the subject and the test Krok 1 – more than three semesters.

221 "Dentistry" (Russian language)

The dynamics of the results of Krok 1 of students of the Faculty of Dentistry with the Russian-language form of training in 2015-2019 was ambiguous (Fig. 2E). Trends in the dynamics of results in histology in Krok 1 for the period analyzed were similar to the results of Krok 1 as a whole, but differed in amplitude.

Despite the good work on the preparation for anchor tests among by Russian-speaking students majoring in Dentistry, over the past two years there has been a significant gap between the average results in histology and the average results of Krok 1 (almost 12%), indicating insufficient training of this contingent of students in to histology immediately before the licensing exam. To improve the results of the subtest in histology in foreign students it is necessary to use modern digital technologies for the demonstration of histological structures during practical classes [1], which have been held at the histology department of the DMA since 2019.

221 "Dentistry"(English language)

Students majoring in "Dentistry", the English-language form of training, are a rather small contingent in the State establishment "DMA", their number in the period from 2015 to 2019 ranged from 10 to 20, which complicates the calculation of reliability. The average values of the results of Krok 1 from 2015 were at a level below the threshold and did not change significantly until 2019, when there was a significant increase to $63.2 \pm 3.7\%$ (Fig. 2F).

It should be noted that, despite the lowest results compared to other contingents, English-speaking students of dentistry show significant positive dynamics both in Krok 1 exam and in histology. In 2019, on the eve of the Krok 1 exam, computer testing was organized for these students from the database of anchor tests in histology; As a result, we obtained the smallest among other contingents difference between the average value of Krok 1 and the

subtest in histology – 3.7%, which indicates the effectiveness of working with the third year students at risk.

CONCLUSIONS

1. In all analyzed contingents of students of DMA (specialties "Dentistry" and "Medicine" with Ukrainian, Russian and English languge of training) and on average in Ukraine in most observation periods from 2014 to 2019, lower average indicators of subtests in histology were recorded compared to the average ones of Krok 1 as a whole. This indicates incomplete disclosure of students' potential to prepare for tests in histology and the need to take appropriate measures.

2. In the passing rate of Krok 1 a 60.5% quota of tests in histology in students majoring in 222 "Medicine" is 4-6%, with no threshold level of passing each subject separately. This discourages students to repeat a complex discipline that was over more than a year ago, which may be the reason for the relatively low average scores in histology as compared to Krok 1 results as a whole.

3. The content of anchor tests (repetitions from previous years) in histology in Booklets Krok 1 of different specialties and different language groups (Ukrainian and Russian/English) varies significantly, which puts students of different contingents in unequal conditions. In addition, varying the number of anchor tests from year to year, the lack of a declared quota of such tests discourages students and complicates the development of algorithms for preparation for Krok 1.

4. Lack of translation of basic textbooks into English (on the basis of which the tests were created) has a negative impact on the preparation of the relevant contingent of students for Krok 1 in histology.

5. Lack of open access to a detailed analytical summary of results of Krok 1 subtests for different contingents of students (not only domestic) of all medical universities of Ukraine makes it difficult to conduct an objective analysis of data and identify the real causes of fluctuations in results of Krok 1 in general and subtests in particular.

6. To improve the preparation of students for the licensing exam Krok it is advisable to create all the conditions for self-preparation before the exam or in the format of online testing on the website of the academy on the basis of Krok 1, or providing the opportunity to copy the installation file of the testing program.

Conflict of interest. The authors declare no conflict of interest.

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