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Improving the Russian-language Wikipedia articles on medicines using new knowledge Cochrane

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Abstract

Aim. To evaluate the effectiveness of the Cochrane Russia Initiative to improve the articles of the Russian-language Wikipedia by including information from Cochrane Systematic Reviews (CSR) to ensure the accuracy and impartiality of their content as an information basis for the quality use of medicines by doctors and the public.
Methods. Wikipedia articles on selected drugs were improved by introducing evidence from Cochrane Systematic Reviews — "Cochrenized". A parallel open-label non-randomized controlled intervention study was conducted. We assigned 2 groups of drugs and Wikipedia articles about them: the intervention group ("Cochrenization") and the control group (36 articles each). Control group articles were not edited. The change in the number of visits to Wikipedia pages for the year (2018–2019) was measured, the statistical significance of the differences was assessed by using the Wilcoxon signed-rank test.
Results. We edited 36 Wikipedia articles, including 13 articles on migraine treatment, 9 diabetes mellitus, 14 pain and inflammation articles. These articles constituted the intervention group. The control group consisted of articles on cardiovascular (11), gastrointestinal (14) and dermatological agents (11). We used the Cochrane Russia Initiative dashboard on Wikipedia to compare the number of article views before and after the intervention and Cochrane analytics on demand for translations of Cochrane systematic reviews summaries. After "Cochrenization", the number of Wikipedia article views (2018–2019) increased in total/average article views for treatments: migraines by 18%/47%, pain and inflammation — 16%/43%, diabetes mellitus — 18%/0%. Analysis of Cochrane reports showed an increase in the number of views of Cochrane systematic reviews summaries on the Cochrane.org website in general by 9 times and from Russian-speaking browsers by 11 times. Improvement of medicine-related articles of the Russian-language Wikipedia by the introduction of information from Cochrane systematic reviews was accompanied by an increase in their demand in terms of the number of views in general by 34%, with a similar increase in control (without intervention) (p-value of the experimental group — 0.002, control — 0.000). The Wikipedia articles on medicines, which belonged to the Russian Vital and Essential Drugs List or the World Health Organization Model List of Essential Medicines, got more views.
Conclusion. The role of confounding factors justifies the feasibility of developing a methodology for studying the usefulness of improving Wikipedia articles, different from controlled trial research methodology; further inclusion of Cochrane knowledge into Wikipedia is needed.
Keywords: Cochrane, Cochrane Library, Wikipedia, Cochrane evidence.

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Background. Billions of people worldwide use Wikipedia daily as a source of medical information. Wikipedia contains many pages related to health and healthcare issues and is becoming an increasingly popular information resource for practitioners, researchers, and medical and pharmaceutical students, as well as healthcare consumers or the general population.

Cochrane is an international and independent organization involving researchers, healthcare professionals, patients, caretakers, and individuals, whose mission is to promote evidence-based health

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and healthcare decisions through high-quality, relevant, and accessible systematic reviews and other generalized scientific data [1]. With over 100,000 members in over 170 countries, it received no commercial sponsorship and no other conflicts of interest. Cochrane members are global leaders in their respective fields, and Cochrane groups are located in the most recognized medical and academic organizations worldwide [1].

In 2014, Cochrane partnered with Wikipedia to support the sharing of new knowledge from Cochrane reviews (or evidence) in health-related Wikipedia articles and develop strategies to ensure that Wikipedia content is relevant, impartial, and of high-quality. The Cochrane groups have adopted various strategies for engaging in this initiative, including educational approaches [2].

Nowadays, more and more healthcare professionals spend their entire lives in an environment where smartphones, live streaming, and web surfing are becoming ubiquitous [3]. Their expectations are aimed at making web access universal with constantly available information [4]. Information consumption and medical institution implementation are rapidly changing, as more and more people are involved in the digital space [5, 6].

Medical professionals are faced with theoretically unknown information in approximately half of their clinical practice [7]. Concurrently, patients have thousands of questions during the entire disease period [8, 9]. The internet is a common way of meeting these "information needs," daily. Search engines, such as Google, handle approximately 280 million health-related queries [10, 11].

Wikipedia is one of the most popular search results on Google [12, 13]. Launched in 2001, Wikipedia represents "a multilingual free content web encyclopedia project supported by the Wikimedia Foundation and based on an openly edited content model" [14]. Wikipedia is the fifth most popular website on the internet with >2 million visits per day [15] and the most popular internet health care resource worldwide [16–18]. Indeed, Wikipedia usage by students [19–21], doctors [19, 22], pharmacists [23], and nurses [24, 25] to meet their information needs is widespread. Wikipedia medical articles in different languages are accessed over 10 million times daily [26]. However, there are caveats regarding Wikipedia usage as the main information resource [27, 28]. Despite this, Wikipedia's reputation in the academic community is steadily growing [29], as is its quality perception [30].

Medical articles in the English-language Wikipedia are supported by the efforts of volunteers within the WikiProject [20, 31]. Efforts for quality improvement of health articles related to Wikipedia are numerous, including initiatives to encourage healthcare professionals and students to contribute to Wikipedia, other language translation efforts, healthcare organization and institution partnerships, and offline content development for those with limited internet access [16, 28, 32].

The Cochrane and Wikipedia partnership is intended to maintain the inclusion of evidence developed and distributed by the Cochrane organization up-to-date and keep Wikipedia articles updated with new reviews and updates from previously published reviews [2]. Over the past 20 years, Cochrane contributed to the health decision-making transformation [33].

Cochrane summarizes scientific evidence by developing systematic reviews, such as documents that answer a specific clinical question using a reproducible methodology in strict adherence to a previously developed and published study protocol [34]. The Cochrane database of systematic reviews is a part of the Cochrane Library with 8,084 Cochrane reviews in September 2019 (8,090 in February 2021). Its impact factor reached 7,755 in 2018 and 7,890 in 2019 and ranked as the leading place among medical journals [35].

Cochrane reviews are systematic reviews of primary research in healthcare practice and policy that are internationally recognized as the highest research quality standard [36]. The English-language medical Wikipedia (Wikimedia) uses information from the Cochrane reviews to improve the quality of articles [37–39]. More than 3,000 Cochrane systematic reviews are currently cited in articles in the English-language Wikipedia [40].

Cochrane scientific evidence-based is constantly evolving and growing, thus significant efforts are required to maintain consistency between Wikipedia medical articles and available Cochrane reviews. For example, the English-language Wikipedia comprises over 32,000 medical articles, and the Cochrane Library has over 8,000 Cochrane reviews. In addition, approximately 30 new Cochrane reviews and 30 updated reviews are published monthly [41].

Maintaining the consistency between the two datasets and ensuring the accuracy and concordance of Cochrane evidence presentation is a time-consuming task for the global Wikipedia community. The inevitable discordance between the available Cochrane reviews and their citations in Wikipedia provides a significant opportunity for computer automation technologies to align the content from a high-quality factual resource (Cochrane Library) with one of the most popular online knowledge bases (Wikipedia) [42], in line with Cochrane Development Strategy [43].

This study aimed to assess the effectiveness of the Cochrane Russia Initiative to improve the articles of the Russian-language Wikipedia by incorporating information from Cochrane reviews to ensure independent and unbiased information available on the effects of medicines as an information basis for proper drug usage by healthcare workers and the general population.

Materials and methods. Wikipedia articles on selected drugs and relevant Cochrane systematic reviews were used as research materials, including the original texts of the Cochrane reviews and Russian translations of the Cochrane plain language summaries. Our study represents a two-arm, parallel, open-label, non-randomized, controlled intervention study with a 1:1 distribution that is formulated using traditional terms to describe the clinical trial methodology.

Two groups of drugs and related Wikipedia articles were identified, namely the intervention group (36 articles) and the control group (36 articles). The intervention group consisted of editing (updating) the Russian-language Wikipedia articles using information from the Cochrane systematic reviews. Editing was not performed in the control group articles.

Drugs (and related Wikipedia articles) were selected into the control and intervention groups for an equal ratio of medicines in the categories present in the list of vital and essential drugs (LVED) of the Russian Federation in 2019 [44], in the World Health Organization Model List of Essential Drugs (WHOMLED) of 2019 [45], and in the range of drugs with the highest pharmacy sales (top-selling) in 2019 [46]. Randomization was not performed, and the continuous inclusion principle of all drugs from the selected groups was used, with a corresponding Wikipedia article.

A total of 36 Wikipedia articles on drugs were edited (updated), including 13 articles on anti-migraine drugs, 9 on hypoglycemic (antidiabetic) drugs, and 14 on non-steroidal anti-inflammatory drugs (NSAIDs). Articles on these drug groups constituted the intervention group (Appendix Table 1). The control group included Wikipedia articles on cardiovascular, gastrointestinal, and dermatological drugs (Appendix Table 2).

Supplementing or enriching, clarifying, and editing the Wikipedia articles with information introduction from the Cochrane systematic reviews and references were called the "Cochrenization" of Wikipedia articles. The introduction of additional information on selected drug usage consisted of the adverse effects in the sections "Side effects" of Wikipedia articles, wherein some cases are overdose effects, etc. Each addition or clarification of available information was accompanied by the introduction to the list of references of the relevant references to Cochrane systematic reviews, as well as their plain language Russian summary translations, published at https://www.cochrane.org/ru.

Without the Cochrane systematic reviews for a specific drug (isolated cases, for example, nimesulide), the Big Drug Reference Book [47] was used to enter independent information and a similar article in the English-language Wikipedia.

The introduced changes were saved and published. Wiki editors and moderators approved our supplements with references in all cases. During the initial editing, an introduction of a special section on drug efficacy and safety evidence in each Wikipedia article was attempted. However, this option was not approved by the Wiki Moderator community.

An average of 2.88% of the content of each page by volume of text on NSAIDs was edited and 87 references were added to Cochrane summaries in plain language (in Russian and English) to the same pages. An average of 2.29% of the content of each page was edited for hypoglycemic (or antidiabetic) drugs, and 2 references of Cochrane plain language summaries (in English) were added to the same pages. In addition, an average of 1.41% of the content of each page on anti-migraine drugs was edited, and 51 references of Cochrane plain language summaries (in Russian and English) were added to the same pages.

The Cochrane Russia Wikipedia Initiative dashboard was used to examine the pageview statistics and compare indices of pre- and post-Cochrenization views of Wikipedia articles. The Wikipedia Pageviews Analysis API applications programming interface (available with a standard [free] account) [48] was used to view the studied (included in the study) Wikipedia pages and track the activity on these pages.

By generating various reports of real-time data, this system answers questions about article users, details of their visits, number of Wikipedia article views, and time and place (country) of visit, as well as how users "arrived" on Wikipedia article page, that is which sites, search engines, and other variations of internet sources have directed users to a specific Wikipedia article page.

The number of Wikipedia page views before and after the intervention was analyzed, namely editing or "Cochrenization" of Wikipedia pages, to assess the impact of our intervention on the demand for edited Wikipedia articles.

Regular Cochrane and Cochrane Library statistics on the number of views of the Russian-language content of the Cochrane systematic reviews

were also considered, as well as the Russian translations of the Cochrane plain language summaries of the Cochrane systematic reviews.

Results (changes in the statistics of views of the studied Wikipedia articles from the baseline level) were evaluated 12 months after the intervention (article content supplementation with information from the Cochrane reviews). The difference in the number of Wikipedia page visits before and after the intervention, such as enrichment of Wikipedia articles with evidence from Cochrane systematic reviews, was used as the main intervention effectiveness indicator.

Statistical data analysis was performed using Microsoft Excel and the Statistical Package for the Social Sciences statistical software package. A descriptive data analysis was performed and the number of pre- and post-intervention Wikipedia page views under study and the change in the number of views were calculated and expressed as a percentage for all studied Wikipedia articles on drugs, and the obtained data were grouped into tables. The mean values for the median with an interquartile range Me [25%–75%] were estimated using descriptive statistical methods. A sample of the number of Wikipedia page/article visits for each month in one year (first, 2018) before editing and one year (second, 2019) after editing Wikipedia articles was used as data for calculating the median and interquartile range. The change in the number of Wikipedia page visits was estimated and the level of statistically significant differences was checked according to the Wilcoxon test. Changes and differences were considered significant at $p < 0.05$.

Results and discussion. The number of visits and the percentage increased number of visits to the Russian-language Wikipedia pages for selected drugs for 2018 and 2019 were studied.

To present the results, the drugs of the control and the intervention groups were divided into two groups, depending on their LVED listing of the Russian Federation in 2019. Tables 1 and 2 present the control group drug results.

Tables 3 and 4 present the results of the Russian-language Wikipedia page visits for drugs of the intervention group, depending on their LVED of the Russian Federation listing.

The final analysis of page visits of the Russian-language Wikipedia for 2018–2019 is presented in Table 5. The increased number of visits to the selected Wikipedia pages was calculated depending on the presence or absence of direct open advertisements of the drug on the Russian-language Wikipedia page. The presence of direct open advertisements for certain drugs, such as pictures of drug packaging, is becoming a serious interfering factor in our research and a violation of Wikipedia rules.

Compared to 2018, the number of visits to the studied Wikipedia articles in 2019, including after editing, increased not for all selected drugs. Increased demand for Wikipedia articles was noted on diclofenac, ketorolac, nimesulide, naproxen, indomethacin, celecoxib, meloxicam, sodium metamizole, diflunisal, gliclazide, vildagliptin, pioglitazone, valproic acid, metoprolol, metoclopramide, propranolol, venlafaxine, ergotamine, and gabapentin.

Increased demand was unnoticed for Wikipedia articles on acetylsalicylic acid, ibuprofen, paracetamol, ketoprofen, metformin, sitagliptin, amitriptyline, topiramate, lidocaine, timolol, phenazone, acarbose, glimepiride, rosiglitazone, exenatide, dihydroergotamine, and sumatriptan.

After editing Wikipedia pages using Cochrane evidence compared to baseline, the total number of views of Wikipedia articles on NSAIDs increased by 16% (TPV 2,706,135 in 2018 and 3,151,845 in 2019) and by 43% in terms of medians (Median of medians 6467.5 in 2018 and 9242 in 2019); that on anti-migraine drugs 18% (TPV 844,726 in 2018 and 1,058,102 in 2019) and 47% (Median of medians 3493 in 2018 and 5150 in 2019); and on hypoglycemic (antidiabetic) drugs by 18% (TPV 259,377 in 2018 and 306,767 in 2019) without an increase in medians (Median of medians 571 in 2018 and 569 in 2019).

The average indicator analyses revealed a general increase of 61% in the number of views of Wikipedia articles on NSAIDs (not included in the LVED) after editing. Statistically significant differences in the increased number of views were obtained for Wikipedia articles on naproxen, indomethacin, celecoxib, nimesulide, meloxicam, and metamizole sodium. The highest growth in page views was for indometacin (129%) and meloxicam (141%). The range of NSAIDs included in the LVED increased in article views on diclofenac and ketorolac.

Therefore, differences were found in the rates of Wikipedia page visits for LVED and non-LVED drugs, as well as for WHOMLED and non-WHOMLED drugs. In addition, differences were revealed in the interest (by the number of visits) to drug articles on Wikipedia as a whole, depending on the drug listing in both the WHOMLED and LVED with a large total number of visits in articles on drugs in these lists. Regarding the seasonal changes in the statistics of article/page views about drugs on Wikipedia, the peaks of visits of articles on NSAIDs occurred in the autumn-winter periods, which is associated with the seasonality of some diseases.

Table 1. The number of Russian-language Wikipedia page visits on drugs from the List of Vital and Essential Drugs for 2018–2019, control group

Medicinal product name	Number of visits to the corresponding Wikipedia article in 2018, Me [min–max]	Number of visits to the corresponding Wikipedia article in 2019, Me [min–max]	Increase, %
Cardiovascular drugs			
1. Losartan	1834 [1710–1983]	3635 [2789–4365]	98*
2. Bisoprolol	6844 [6554–7169]	14 206 [10 140–16 384]	107*
3. Amlodipine	3983 [3484–4415]	5967 [5832–6707]	50*
4. Indapamide	1573 [1514–1691]	3096 [2010–3610]	97*
5. Pentoxifylline	2490 [2329–2780]	5518 [4561–7436]	121*
6. Clonidine	6596 [5769–6884]	8527 [8123–9811]	29*
Total number of all visits	310,323	603,060*	94*
Median of medians	3237 [1768–6658]	5742 [3500–9947]	77
Gastrointestinal drugs			
1. Senna glycoside	302 [275–322]	276 [187–296]	–8
2. Pancreatine	7993 [5955–9104]	12 518 [9570–14,754]	57*
3. Algeldrate + magnesium hydroxide	1096 [978–1236]	3090 [1949–3752]	181*
4. Ranitidine	3076 [2923–3981]	3770 [3420–6039]	23*
5. Atropine	14,624 [12,503–17,251]	14,183 [11,586–15,052]	–3
6. Loperamide	4682 [4396–5193]	9144 [6564–10,190]	95*
7. Activated carbon	15,210 [12,971–16,268]	14,989 [14,395–16,431]	–1
8. Lactulose	3285 [3122–3504]	3282 [3150–3619]	0
Total number of all visits	654,845	862,722	31
Median of medians	3983 [1591–12,966]	6457 [3138–13,766]	62
Dermatological drugs			
1. Salycilic acid	8914 [8723–10,293]	9486 [8949–10,824]	6
2. Povidone iodine	2669 [2576–2860]	3597 [2493–5027]	35
3. Mometasone furoate	3732 [3575–4216]	4313 [4216–4903]	16*
Total number of all visits	206,855	295,074	43
Median of medians	3732 [2669–8914]	4313 [3597–9486]	16
Total			
Total number of all visits	1,172,023	1,760,856	50
Median of medians	3732 [2162–7419]	5518 [3439–11,002]	48*
Median of medians of WHOILED	3983 [2252–8454]	5967 [3440–13351]	50*

Note: data are presented as the median and interquartile range (Me [25%–75%]); *Wikipedia pages with a statistically significant increased number of visits ($p < 0.05$); WHOILED—World Health Organization Indicative List of Essential Drugs.

Wikipedia article improvements with the introduction of the information from the Cochrane Systematic Reviews increased the demand for articles on hypoglycemic (antidiabetic) drugs, such as gliclazide, vildagliptin, and pioglitazone. The last two drugs in 2018 and 2019 were excluded from the LVED. Vildagliptin was included in the LVED in 2020 [49].

Content "Cochrenization" of Wikipedia articles on drugs used for migraines (venlafaxine, ergotamine, gabapentin [all three are excluded in the LVED], valproic acid, metoprolol, propranolol, and metoclopramide) increased the number of their views.

Wikipedia pages for drugs in the control group showed an increased number of views. Cardiovascular drugs from LVED (losartan, bisoprolol, amlodipine, indapamide, pentoxifylline, and clonidine) increased for 94% in page views (p-value = 0.000). In the range of articles on drugs

Table 2. The number of the Russian-language Wikipedia page visits for drugs not listed in the List of Vital and Essential Drugs for 2018–2019, control group

Medicinal product name	Number of visits to the corresponding Wikipedia article in 2018, Me [min–max]	Number of visits to the corresponding Wikipedia article in 2019, Me [min–max]	Increase, %
Cardiovascular drugs			
1. Ouabain	306 [271–329]	269 [249–327]	–12
2. Quinidine	412 [387–451]	476 [442–495]	16*
3. Isoprenaline	1003 [905–1185]	1276 [948–1490]	27
4. Ethacrynic acid	267 [166–406]	315 [154–545]	18
5. Rosuvastatin	1571 [1455–1647]	2850 [2207–3473]	81*
Total number of all visits	47,003	74,504	59
Median of medians	414 [286–1287]	476 [292–2063]	15
Gastrointestinal drugs			
1. Chenodeoxychloic acid	367 [310–408]	315 [277–358]	–14
2. Domperidone	2133 [2032–2284]	2310 [2074–2568]	8
3. Castor oil	13,719 [12,782–14,927]	19,851 [18,522–22,841]	45*
4. Betaine	2464 [2410–2555]	2985 [2807–3237]	21*
5. Polymethylsiloxane polyhydrate	1314 [1227–1437]	1481 [1323–1543]	12
6. Colloidal silicon dioxid	2190 [2047–2286]	2396 [2105–2607]	9
Total number of all visits	293,463	395,159*	35*
Median of medians	2161 [1077–5278]	2353 [1190–7202]	9
Dermatological drugs			
1. Trypsin	3740 [3401–4000]	3810 [3541–4509]	2
2. Coal tar	1654 [1566–1721]	1628 [1291–1822]	–2
3. Hyaluronic acid	17,013 [16,686–17,837]	17,843 [16,369–19,029]	5
4. Pantothenic acid	6730 [6519–7256]	8106 [7600–9122]	20*
5. Dexpanthenol	6557 [5901–7180]	7188 [6863–12217]	10*
6. Iodoform	1366 [1109–1493]	1272 [1051–1378]	–7
7. Triclosan	2037 [1783–2101]	1728 [1698–2003]	–15
8. Fusidic acid	582 [558–595]	602 [533–657]	3
Total number of all visits	518,291	582,208	12
Median of medians	2889 [1438–6687]	2769 [1361–7877]	–4
Total			
Total number of all visits	858,757	1,051,871	22%
Median of medians	1654 [582–3740]	1728 [602–3810]	4%*
Median of medians of WHOILED	2037 [1003–3740]	2850 [1272–5518]	40%*

Note: data are presented as the median and interquartile range (Me [25%–75%]); *Wikipedia pages with a statistically significant increased number of visits ($p < 0.05$); WHOILED—World Health Organization Indicative List of Essential Drugs.

influencing the cardiovascular system, an increased share of visits by 59% was found due to quinidine and rosuvastatin articles.

Articles on gastrointestinal drug share of views increased by 31% due to articles on algeldrate + magnesium hydroxide, pancreatin, ranitidine, and loperamide.

An increase was also found in the number of Wikipedia article views on dermatological agents, such as mometasone, pantothenic acid, and dexpanthenol.

In general, an equal increase was found in the proportion of article views for both the intervention (by 34%) and the control groups (by 39%) due to

Table 3. Number of the Russian-language Wikipedia page visits on drugs from the List of Vital and Essential Drugs before and after editing Wikipedia articles using evidence from Cochrane Systematic Reviews (2018–2019): intervention group

Medicinal product name	Number of Cochrane references to the article	Text change, % of the original volume	Number of visits to the corresponding Wikipedia article in 2018, Me [min–max]	Number of visits to the corresponding Wikipedia article in 2019, Me [min–max]	Increase, %
Non-steroidal anti-inflammatory drugs					
1. Acetylsalicylic acid	3	2.72	54,001 [50,924–57,124]	54,606 [48,716–60,868]	1
2. Ibuprofen	5	1.02	47,907 [36,004–53,792]	38,568 [33,750–42,656]	–20
3. Paracetamol	21	1.41	37,332 [30,168–44,510]	45,136 [36,506–48,775]	21
4. Diclofenac	1	0.91	16,826 [14,747–18,533]	22,533 [16,077–23,319]	34*
5. Ketoprofen	5	2.88	6164 [5478–6860]	4887 [4663–5502]	–21
6. Ketorolac	4	3.36	6771 [6510–6852]	9197 [7407–9708]	36*
Total number of all visits	—	—	2,236,242	2,391,410	7
Median of medians	—	—	27,079 [6619–49,430]	30,551 [8119–47,503]	13
Antidiabetic drugs					
1. Metformin	2	0.42	15,577 [13,486–17,332]	16,891 [14,912–19,076]	8
2. Gliclazide	0	5.56	571 [509–613]	801 [677–1007]	40*
3. Sitagliptin	0	2.38	591 [548–653]	618 [548–899]	5
Total number of all visits		—	229,095	270,348	18
Median of medians		—	591 [571–15577]	801 [618–16,891]	35
Drugs for the treatment and prevention of migraine					
1. Valproic acid	5	0.63	4630 [4269–4942]	5150 [4874–6148]	11*
2. Amitriptyline	2	0.35	18,080 [13,218–21,090]	16,346 [14,590–22,054]	–10
3. Topiramate	7	3.23	1321 [1273–1412]	1427 [1342–1750]	8
4. Metoprolol	0	3.08	1659 [1584–1848]	3115 [2092–3922]	88*
5. Metoclopramide	0	1.3	3493 [3323–3587]	5528 [4889–5925]	58*
6. Lidocaine	12	0.92	15,075 [14,056–18,008]	13,255 [13,116–16,880]	–16
7. Timolol	1	1.52	541 [482–550]	656 [599–805]	21
8. Propranolol	0	0.96	4614 [4222–5023]	5873 [5202–7468]	27*
Total number of all visits	—	—	662,841	807,034	22
Median of medians	—	—	4054 [1405–12,936]	5339 [1849–11,409]	31
Total					
Total number of all visits	—	—	3,128,178	3,468,792	10
Median of medians	—	—	6164 [1490–17,453]	5873 [2271–19,712]	–5
Median of medians of WHOILED	—	—	4630 [2364–27,706]	7041 [4132–27,729]	52

Note: data are presented as the median and interquartile range (Me [25%–75%]); *Wikipedia pages with a statistically significant increase in the number of visits ($p < 0.05$); WHOILED—World Health Organization Indicative List of Essential Drugs.

Table 4. Number of the Russian-language Wikipedia page visit on drugs not included in the List of Vital and Essential Drugs before and after editing Wikipedia articles using evidence from Cochrane Systematic Reviews (2018–2019): intervention group

Medicinal product name	Number of Cochrane references to the article	Text change, % of the original volume	Number of visits to the corresponding Wikipedia article in 2018, Me [min–max]	Number of visits to the corresponding Wikipedia article in 2019, Me [min–max]	Increase, %
Non-steroidal anti-inflammatory drugs					
1. Nimesulide	0	0.55	9660 [9039–10,988]	15,724 [15,029–18,229]	63*
2. Naproxen	4	2.63	3319 [3185–3523]	3688 [3529–4382]	11*
3. Indometacin	3	2.86	3070 [2850–3320]	7041 [4452–8912]	129*
4. Celecoxib	3	3.7	1751 [1594–1783]	2217 [1831–2705]	27*
5. Meloxicam	1	2.67	3854 [3645–4342]	9287 [6010–10201]	141*
6. Metamizole sodium	1	1.06	12,299 [11,883–13,088]	13,491 [12,091–14,178]	10*
7. Phenazone	0	2.13	1670 [1364–1768]	1743 [1495–1851]	4
8. Diflunisal	1	10.0	57 [55–59]	82 [61–88]	44*
Total number of all visits	—	—	469,893	760,435*	61*
Median of medians	—	—	3194 [1690–8208]	5364 [1861–12,440]	67
Antidiabetic drugs					
1. Acarbose	0	1.75%	649 [570–713]	602 [532–649]	–7
2. Vildagliptin	0	1.92%	295 [281–337]	495 [444–795]	68*
3. Glimepiride	0	3.12%	572 [556–607]	569 [511–674]	–1
4. Pioglitazone	1	8.33%	263 [243–281]	340 [321–444]	29*
5. Rosiglitazone	1	2.13%	183 [172–209]	182 [170–239]	–1
6. Exenatide	0	1.06%	339 [237–368]	281 [265–391]	–17
Total number of all visits			30,282	36,419	20
Median of medians			317 [243–591]	417 [256–577]	31
Drugs for the treatment and prevention of migraine					
1. Venlafaxine	1	0.58	4558 [4310–4771]	5475 [4803–6393]	20*
2. Dihydroergotamine	0	3.12	327 [265–346]	323 [276–385]	–1
3. Ergotamine	0	1.85	1046 [979–1130]	1174 [1128–1463]	12*
4. Sumatriptan	6	1.41	2718 [2554–2738]	3048 [2340–3289]	12
5. Gabapentin	7	1.41	5291 [4867–5701]	8322 [6597–8927]	57*
Total number of all visits	—	—	181,885	251,068	38
Median of medians	—	—	2718 [686–4924]	3048 [1128–6898]	12
Total					
Total number of all visits	—	—	682,060	1,047,922	54
Median of medians	—	—	1670 [327–3854]	1743 [340–7041]	4*
Median of medians of WHOILED	—	—	1670 [339–5291]	1743 [495–8322]	4*

Note: data are presented as the median and interquartile range (Me [25%–75%]); *Wikipedia pages with a statistically significant increase in the number of visits ($p < 0.05$); WHOILED—World Health Organization Indicative List of Essential Drugs.

Table 5. Final figures for the number of page visits of the Russian-language Wikipedia (2018–2019).

Comparison groups	Average indices of visits to selected Wikipedia articles for 2018, Me [25%–75%]	Average indices of visits to selected Wikipedia articles for 2019, Me [25%–75%]	Increase, %
Whole control group, n = 36	2477 [1327–6586]	3439 [1517–8422]	39*
Whole intervention group, n = 36	3195 [577–8937]	4288 [628–12263]	34*
Control group, VED, n = 17	3732 [2162–7419]	5518 [3439–11002]	48*
Intervention group, VED, n = 17	6164 [1490–17453]	5873 [2271–19712]	–5
Control group, non-VED, n = 19	1654 [582–3740]	1728 [602–3810]	4*
Intervention group, non-VED, n = 19	1670 [327–3854]	1743 [340–7041]	4*
Control group, WHOILED, n = 13	3983 [2252–8454]	5967 [3440–13351]	50*
Intervention group, WHOILED, n = 13	4630 [2364–27706]	7041 [4132–27729]	52
Control group, non-WHOILED, n = 23	2037 [1003–3740]	2850 [1272–5518]	40*
Intervention group, non-WHOILED, n = 23	1670 [339–5291]	1743 [495–8322]	4*
Control group, with advertisement, n = 6	4333 [2738–8720]	6578 [3234–10605]	52
Intervention group, with advertisement, n = 4	42,620 [14,411–52,477]	41,852 [16,540–52,239]	–2
Control group, without advertisement, n = 30	2162 [1236–6630]	3041 [1275–8212]	41*
Intervention group, without advertisement, n = 32	2235 [571–5126]	3082 [606–8002]	38*
Whole control group, n = 36	2477 [1327–6586]	3439 [1517–8422]	39*
Intervention group, 3 or more Cochrane references, n = 13	5291 [2894–26519]	7041 [3368–25911]	33
Intervention group, less than 3 Cochrane references, n = 23	1046 [339–4614]	1174 [495–9287]	12*
Intervention group, changes, 1% or more, n = 28	1665 [549–4932]	1980 [577–8002]	19*
Intervention group, changes, <1%, n = 8	12,619 [4618–16,546]	14,489 [5575–1675]	15

Note: data are presented as the median and interquartile range (Me [25%–75%]); VED—vital and essential drugs; *Wikipedia pages with a statistically significant increase in the number of visits ($p < 0.05$); WHOILED—World Health Organization Indicative List of Essential Drugs.

the limitations of this study, which is a large number of possible confounding factors and the difficulty of creating an adequate control group taking these factors into account. These confounding factors are population morbidity patterns, drug advertising, and drug costs.

Disease statistics in Russia show that people are interested in topical disease treatments, such as diseases of the cardiovascular, nervous system and sensory organs, gastrointestinal tract, musculoskeletal system, and connective tissue, as well as conditions associated with injuries, poisoning, and some other consequences of external exposure [50]. In most cases, patients follow the doctor's advice when purchasing the medicine. Consumers are more independent in their choice of headache medications and rely more on a physician to treat joint and back pain, allergies, and skin conditions.

Before treatment initiation, the patient studies carefully the drug information. The internet plays an important role in the decision to purchase medicines. According to a large-scale analysis by IPG Mediabrands "DNA Health connections," patients in Russia mostly adhere to doctor's prescriptions. However, before treatment initiation, 84% of our compatriots carefully study the information of the drug prescribed by a doctor on the internet, and consumer reviews on the internet are of great importance for making a purchase decision [51].

Researchers in the field of rational use of medicines note that, nowadays, their advertising is a tool for their promotion worldwide, not information [52]. Companies primarily violate the ethical principles of drug advertising to conquer the pharmaceutical market [53]. Distorted information based on low-quality clinical studies, or in the absence of such studies, leads to inappropriate drug usage, for example, quinidine [54]. Therefore, the list of drugs that increased the number of Wiki-

pedia page views showed the drugs most often prescribed by healthcare professionals during this period.

To assess the putative impact of adding references to the Russian translations of the Cochrane review summaries to the Russian-language Wikipedia articles on drugs on the demand of Russian translations of Cochrane review summaries published on cochrane.org, Cochrane reports and regular statistics (available over 2018–2019) on the number of views of the Russian-language content of the site cochrane.org were examined.

According to Cochrane reports and analytics, access to cochrane.org (page views) is largely driven by the languages into which Cochrane's evidence is translated. Analysis of Cochrane reports showed that compared to 2018, a significant increase was found in 2019 in the number of page views of the Russian-language content of the cochrane.org website as a whole (by nine times, 1,002,738 views in 2018 and 9,782,192 in 2019) and from Russian-speaking browsers (by 11 times, 579,421 in 2018 and 6,393,549 in 2019). Therefore, the "Cochrenization" of the Russian-language Wikipedia articles on drugs has contributed to the increased demand and use of Russian-language translations of the Cochrane Review summaries published on the cochrane.org website. However, confirmation and a more detailed analysis require the data on access to the Russian-language content of the cochrane.org site through references from the Russian-language Wikipedia pages, which we plan to implement in the future.

Research limitations. This study has some limitations that require these results, however compelling they may seem, to be treated with caution. This is one of the first studies of posting Cochrane evidence on Wikipedia pages. Open editing of Wikipedia pages, both intervention and control pages, by the Wikipedia community minimized the differences between the groups. Determining whether the users read only a part or the entire text of the evidence article from Cochrane systematic reviews and whether this information was useful to the reader or user was impossible.

The pageview data only indicates that the page was viewed. Vulnerabilities in Wikipedia articles arise when opposing factions edit articles to reflect their own opinions [55], which are a general limitation on researching Wikipedia articles, given the specifics of posting, editing, and approving contained information.

The inclusion of Cochrane knowledge was planned to be expanded in Wikipedia articles on drugs, together with an improved quality of the Russian-language Wikipedia and drug use by the Cochrane Russia Initiatives on the Russian-language Wikipedia, which we plan to investigate in the future.

CONCLUSIONS

1. Improved medicinal Wikipedia articles by introducing information from the Cochrane systematic reviews and references and translating their abstracts into the Russian-language was accompanied by increased demand in the number of article views, with an increase by 34% from 2018 to 2019 (total number of page visits was 3,810,238 in 2018 and 4,516,714 in 2019; median of medians was 3,195 in 2018 and 4,288 in 2019). Without intervention, a similar increase was found in the number of article views on the control group (without intervention) with an increase by 39% from 2018 to 2019 (total page visits were 2,030,780 in 2018 and 2,812,727 in 2019; median of medians was 2,477 in 2018 and 3,439 in 2019).

2. After editing the Wikipedia pages using the Cochrane evidence compared to the baseline, total Wikipedia article views on NSAIDs increased by 16% (total page views were 2,706,135 in 2018 and 3,151,845 in 2019; median of medians was 6467.5 in 2018 and 9242 in 2019), in anti-migraine drugs by 18% (total number of page visits was 844,726 in 2018 and 1,058,102 in 2019; median of medians was 3493 in 2018 and 5150 in 2019), and hypoglycemic (antidiabetic) drugs by 18% (total number of page visits was 259,377 in 2018 and 306,767 in 2019; median of medians was 571 in 2018 and 569 in 2019).

3. The number of Wikipedia article views on the selected drugs, both improved using the Cochrane evidence and not edited by us, based on their Russian LVED and WHOMLED listing with a large total number of article visits about drugs included in these lists.

4. The role of confounding factors, such as drug promotion and specificity of creating and editing Wikipedia articles, justifies the feasibility of developing a methodology for studying the usefulness of Wikipedia article improvement, different from the traditional concept of comparing an intervention group with a control group, with the understanding of the control group absence.

5. Further incorporation of Cochrane knowledge into Wikipedia drug articles is required to improve the quality of the Russian-language Wikipedia and drug use, as well as further research in this new field.

Author contributions. A.S.P. conducted the research, edited the Wikipedia articles, translated the abstracts of the Cochrane systematic reviews into Russian, collected and analyzed the data, prepared the initial

version of the manuscript; E.G.A. discussed the project concept, translated and edited the abstracts of the Cochrane systematic reviews in Russian, validated the data, and wrote the manuscript; E.V.Yu. edited the Russian translations of abstracts of the Cochrane systematic reviews, and edited the manuscript; and L.E.Z. created the work concept, exercised project administration and management, performed the data analysis and validation, wrote and edited the manuscripts, and formulated the conclusions.

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Appendix Table 1. List of drugs in the intervention group, their listing in the restrictive lists of drugs of the Russian Federation and WHO, and data on pharmacy sales for 2019

No.	Medicinal product name	LVED RF 2019	WHOMLED 2019	Pharmacy sales in RF 2019–2020	Open advertising in Wikipedia
1.	Acetylsalicylic acid	+	+	Top	Yes, 07.2020
2.	Ibuprofen	+	+	Top	Yes, 08, and 10.2020
3.	Paracetamol	+	+		Yes, 09.2020
4.	Diclofenac	+			No
5.	Ketoprofen	+			No
6.	Ketorolac	+			Yes, 06.2019
7.	Valproic acid	+	+		No
8.	Amitriptyline	+	+		No
9.	Topiramate	+			No
10.	Metoprolol	+	+		No
11.	Metoclopramide	+	+		No
12.	Lidocaine	+	+		No
13.	Timolol	+	+		No
14.	Propranolol	+	+		No
15.	Metformin	+	+		No
16.	Gliclazide	+	+		No
17.	Sitagliptin	+			No
18.	Nimesulide				No
19.	Naproxen				No
20.	Indometacin		+		No
21.	Celecoxib				No
22.	Meloxicam				No
23.	Metamizole sodium				No
24.	Phenazone				No
25.	Diflunisal				No
26.	Venlafaxine				No
27.	Dihydroergotamine				No
28.	Ergotamine				No
29.	Sumatriptan				No
30.	Gabapentin				No
31.	Acarbose				No
32.	Vildagliptin				No
33.	Glimepiride				No
34.	Pioglitazone				No
35.	Rosiglitazone				No
36.	Exenatide				No

Note: LVED—List of Vital and Essential Drugs; WHOMLED—World Health Organization Model List of Essential Drugs.

Appendix Table 2. List of drugs in the control group, their listing in the restrictive lists of drugs of the Russian Federation and WHO, and data on pharmacy sales for 2019

No.	Medicinal product name	LVED RF 2019	WHOMLED 2019	Pharmacy sales in RF 2019–2020	Open advertising in Wikipedia
1.	Losartan	+	+	Top	No
2.	Bisoprolol	+	+	Top	No
3.	Amlodipine	+	+		Yes, 10.2019
4.	Indapamide	+			No
5.	Pentoxifylline	+			No
6.	Clonidine	+			No
7.	Senna glycosides	+	+		No
8.	Pancreatin	+	+		No
9.	Algeldrate + magnesium hydroxide	+			Yes, 03.2015, 10.2011, 04.2009, 03.2009
10.	Ranitidine	+	+		No
11.	Atropine	+	+		No
12.	Loperamide	+	+		Yes, 05.2018
13.	Activated carbon	+	+		Yes, 07.2019, 02.2018
14.	Lactulose	+	+		Yes, 05.2020, 10.2019
15.	Salicylic acid	+	+		No
16.	Povidone iodine	+	+		No
17.	Mometasone furoate	+			No
18.	Trypsin				No
19.	Coal tar		+		No
20.	Hyaluronic acid				No
21.	Pantothenic acid				No
22.	Dexpanthenol				Yes, 12.2020
23.	Iodoform				No
24.	Triclosan				No
25.	Fusidic acid				No
26.	Ouabain				No
27.	Quinidine				No
28.	Isoprenaline				No
29.	Ethacrynic acid				No
30.	Rosuvastatin				No
31.	Chenodeoxychloic acid				No
32.	Domperidone				No
33.	Castor oil				No
34.	Betaine				No
35.	Polydimethylsiloxane polyhydrate				No
36.	Colloidal silicon dioxide				No

Note: LVED—List of Vital and Essential Drugs; WHOMLED—World Health Organization Model List of Essential Drugs.