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Diphtheria in the Kazakh SSR in 1958–1961: Epidemiological Dynamics and Initial Results of Mass Immunisation

The article examines the change in the epidemiological situation in the Kazakh SSR at the turn of the 1950s and 1960s, considering the shift towards the mass immunisation of children. The objective of the study is to identify the rates, territorial characteristics and factors of the dynamics of incidence in 1958–1961, as well as to evaluate the initial results of the vaccination program. The source base consisted of archival reports and statistical documents from health authorities and the sanitary-epidemiological service. These documents contained information on regions, urban and rural areas, age groups, vaccination status, disease focality, clinical forms, laboratory confirmation and disease outcomes. The comparative-historical, problem-chronological and statistical methods were employed. The material was analysed using the endogenous-primary approach, which links epidemiological results with the internal capabilities of the republican healthcare system. The scientific novelty lies in the comprehensive introduction of little-studied statistical tables to research circulation, which made it possible to reconstruct regional processes that were not reflected in All-Union or average republic dynamics. A review of the evidence suggests that the situation remained tense at the end of the 1950s. Following a decline in the number of patients, 10,733 cases were registered in 1959. In 1960, their number decreased to 7,500, and in 1961 it was approximately half that of the previous period. However, it should be noted that the positive dynamics were not synchronous: in 1959–1960, growth continued in some areas, while the directions of change in cities and rural areas often differed. Despite the overall decline in 1961, cases in several territories continued to exceed the national average. A comparison of age and vaccination data confirmed the protective effect of vaccination but showed that nominal coverage alone was not sufficient for protection. The diseases observed in vaccinated and revaccinated children required consideration of the completeness of the vaccination course, the timing of the revaccination and the quality of the vaccines. Continued active transmission of the infection was indicated by cases in organised groups, multiple focal spots and registered outbreaks. It was concluded that mass immunisation was a decisive factor in the epidemiological shift. However, its impact was gradual and uneven across different territories. By 1961, the Republic had entered a period of steady decline in disease incidence, though it had not yet achieved full control of the infection. The effectiveness of the campaign was determined by a combination of factors, including vaccination coverage, organisational quality, laboratory surveillance, early diagnosis, hospitalisation and timely treatment.

Keywords: Kazakh SSR, diphtheria, infectious diseases, sanitary and epidemiological service, medical personnel, sanitary infrastructure, endogenous-primary approach, mass immunisation, vaccination, epidemiological dynamics.

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1958–1961-жылдардағы Қазақ КСР-дегі дифтерия: эпидемиологиялық динамика және жаппай иммундаудың бастапқы нәтижелері

Мақалада балаларды жаппай иммундауға көшу жағдайында 1950-1960-жылдар тоғысындағы Қазақ КСР-інің эпидемиологиялық ахуалының өзгеруі зерттелді. Зерттеудің мақсаты 1958-1961-жылдардағы дифтериямен сырқаттанушылық динамикасының қарқынын, аумақтық ерекшеліктерін және факторларын анықтау, сондай-ақ вакциналық профилактиканың алғашқы нәтижелерін бағалау. Зерттеудің дереккөздік негізін денсаулық сақтау органдары мен санитариялық-эпидемиологиялық қызметтің мұрағаттық статистикалық есептері құрайды, оларда облыстық, қалалық және ауылдық жерлер, жас топтары, егілу мәртебесі, ауру ошақтары, зертханалық растау және аурудың нәтижелері туралы мәліметтер көрсетілген мұрағаттық есептік-статистикалық құжаттар қамтылған. Салыстырмалы-тарихи, проблемалық-хронологиялық және статистикалық әдістер қолданылды. Материалды түсіндіру эпидемиологиялық нәтижелерді республикалық денсаулық сақтау жүйесінің ішкі мүмкіндіктермен байланыстыратын эндогендік-примарлық тәсіл негізінде жүзеге асырылды. Зерттеудің ғылыми жаңалығы аз зерттелген статистикалық кестелерді ғылыми айналымға енгізіп, жалпыодақтық және орташа республикалық көрсеткіштерде көрінбеген өңірлік үдерістерді анықтау. 1950 ж. соңында эпидемиологиялық жағдайдың шиеленісті күйде қалғаны анықталды. Науқастар санының біршама азаюынан кейін 1959 ж. 10733 дифтерия жағдайы тіркелді. 1960 ж. олардың саны 7500-ге дейін төмендеп, ал 1961 ж. алдыңғы жылмен салыстырғанда шамамен екі есе қысқарды. Алайда оң динамика барлық аумақта бір мезгілде байқалған жоқ: 1959-1960 ж. жекелеген облыстарда сырқаттанушылықтың өсуі жалғасты, ал қалалық және ауылдық жерлердегі өзгерістердің бағыттары көбіне бір-біріне сәйкес келмеді. 1961-жылы көрсеткіштердің барлық жерде төмендегеніне қарамастан, бірқатар аумақтардағы сырқаттанушылық деңгейі орташа республикалық көрсеткіштен әлі де жоғары болды. Жас ерекшеліктері мен егілу мәртебесі бойынша деректерді салыстыру вакцинацияның профилактикалық маңызын растады, сонымен бірге екпемен формальды қамту халықтың қорғалуын бағалаудың жеткілікті өлшемі болмағанын көрсетті. Егілген және ревакцинацияланған балалар арасындағы ауру жағдайлары вакцинация курсының толықтығын, ревакцинация мерзімдерін және екпелердің сапасын ескеруді талап етті. Ұйымдастырылған балалар ұжымдарындағы ауру жағдайлары бірнеше ошақтың қалыптасуының және тіркелген өршулер инфекцияның белсенді таралуының жалғасқанын көрсетті. Жаппай иммундау эпидемиологиялық бетбұрыстың шешуші шартына айналғанымен, оның нәтижелері біртіндеп және аумақтар бойынша әркелкі көрініс тапқаны туралы қорытынды жасалды. 1961 ж. қарай республика дифтериямен сырқаттанушылықтың тұрақты төмендеу кезеңіне өтті, алайда инфекцияны толық бақылауға әлі қол жеткізген жоқ. Иммундау науқанының нәтижелілігі вакцинациямен қамту деңгейімен, оны ұйымдастыру сапасымен, зертханалық қадағалаумен, ауруды ерте анықтаумен, уақытылы ауруханаға жатқызумен және емдеумен ұштасуына байланысты болды.

Кілт сөздер: Қазақ КСР, дифтерия, инфекциялық аурушандық, санитариялық-эпидемиологиялық қызмет, медициналық кадрлар, санитариялық инфрақұрылым, эндогендік-примарлық тәсіл, жаппай иммундау, вакцинация, эпидемиологиялық динамика.

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Дифтерия в Казахской ССР в 1958–1961 гг.: эпидемиологическая динамика и первые результаты массовой иммунизации

В статье исследуется изменение эпидемиологической ситуации в Казахской ССР на рубеже 1950–1960-х гг. в условиях перехода к массовой иммунизации детского населения. Цель исследования состоит в выявлении темпов, территориальных особенностей и факторов динамики заболеваемости в

1958–1961 гг., а также в оценке первых результатов вакциннопрофилактики. Источниковую базу составили архивные отчетно-статистические документы органов здравоохранения и санитарно-эпидемиологической службы, содержащие сведения по областям, городской и сельской местности, возрастным группам, прививочному статусу, очаговости, лабораторному подтверждению и исходам заболевания. Использованы сравнительно-исторический, проблемно-хронологический и статистический методы. Интерпретация материала осуществлена с позиций эндогенно-примарного подхода, связывающего эпидемиологические результаты с внутренними возможностями республиканской системы здравоохранения. Научная новизна заключается в комплексном введении в исследовательский оборот малоизученных статистических таблиц, позволивших реконструировать региональные процессы, не отраженные общесоюзной и среднереспубликанской динамикой. Установлено, что в конце 1950-х гг. положение оставалось напряженным. После некоторого сокращения числа больных в 1959 г. было зарегистрировано 10733 случая. В 1960 г. их число уменьшилось до 7500, а в 1961 г. сократилось примерно вдвое по сравнению с предшествующим периодом. Однако положительная динамика не была синхронной: в 1959–1960 гг. в отдельных областях сохранялся рост, а направления изменений в городах и сельской местности нередко различались. Даже при повсеместном снижении в 1961 г. ряд территорий продолжал превышать среднереспубликанский показатель. Сопоставление возрастных и прививочных данных подтвердило профилактическое значение вакцинации, но показало, что формальный охват не являлся достаточным критерием защищенности. Заболевания среди привитых и ревакцинированных детей требовали учета полноты курса, сроков ревакцинации и качества прививок. Случаи в организованных коллективах, многоочаговость и зарегистрированные вспышки свидетельствовали о сохранении активной передачи инфекции. Сделан вывод, что массовая иммунизация стала решающим условием эпидемиологического перелома, однако ее действие проявилось постепенно и территориально неравномерно. К 1961 г. республика вступила в фазу устойчивого снижения заболеваемости, но еще не достигла полного контроля над инфекцией. Результативность кампании определялась сочетанием охвата вакцинацией с качеством ее организации, лабораторным надзором, ранней диагностикой, госпитализацией и своевременным лечением.

Ключевые слова: Казахская ССР, дифтерия, инфекционная заболеваемость, санитарно-эпидемиологическая служба, медицинские кадры, санитарная инфраструктура, эндогенно-примарный подход, массовая иммунизация, вакцинация, эпидемиологическая динамика.

Introduction

Diphtheria was one of the most dangerous infectious diseases, posing a serious threat to public health, particularly among children. The severity of its clinical course, the possibility of complications, and the relatively high mortality rate meant that the timely identification of patients, their mandatory hospitalisation, and preventive immunisation received special attention from Soviet health authorities [1]. In the fight against diphtheria, the Republic of Kazakhstan has achieved epidemiological stability and is approaching the national elimination of the infection. However, it is currently incorrect to speak of its complete elimination.

Before the revolution, diphtheria was widespread in Kazakhstan and one of the main causes of death among young children [2], [3], [4], [5]. From 1904 to 1913, the incidence of diphtheria in Russia fluctuated between 15 and 43 cases per 100,000 people [6]. In 1939, the incidence of diphtheria in the USSR decreased by 7 times compared to 1914. However, this infection remained quite widespread for many years [7].

In 1940, a law was passed on making immunisation against diphtheria compulsory across the Soviet Union. However, the capabilities of the native diphtheria toxoid used for these purposes in those years turned out to be limited, as 10–15 % of children immunised with this drug were refractory. As a result, the decline in incidence proved unstable, continuing until 1946–1947, after which another epidemic wave began, ending in 1955. A major campaign to reduce the incidence of diphtheria was launched in the USSR that year [8].

The development of a method for producing purified adsorbed diphtheria toxoid and associated medications (such as the DTP and DT vaccines), as well as the improved organisation of preventive vaccinations and immunisation schedules, led to a sharp reduction in the incidence of diphtheria in the country. According to official data, 1,101 cases of diphtheria were registered in the country in 1970, amounting to 0.45 cases per 100,000 people. This was 131.3 times lower than in 1958, 206.7 times lower than in 1940, and 764.4 times lower than in the pre-revolutionary year of 1913 [9].

However, the All-Union indicator was aggregated and concealed significant differences between the Union Republics and individual regions. Therefore, the downward trend in the USSR cannot be considered as evidence of a simultaneous and uniform improvement in the epidemiological situation throughout the country. The introduction of vaccination did not immediately mean the achievement of sustainable epidemic control. Therefore, the study of the dynamics of diphtheria incidence in the Kazakh SSR at the turn of the

1950s and 1960s allows us to assess not only the scale of the spread of the infection, but also the first practical results of mass immunisation, which began in the Kazakh SSR in 1959.

Materials and Methods

The study was based on a set of archival reports and statistical documents from All-Union, republican and regional health authorities for the period 1958–1961. It included annual reports of the Ministry of Health of the USSR and the Kazakh SSR, and sanitary-epidemiological institutions, analytical reports, information on the implementation of preventive vaccinations, laboratory diagnostics, hospitalisation and treatment of patients. Summary statistical tables containing data on incidence by region, urban and rural areas, age group and vaccination status are of particular importance, as are tables containing data on disease focality, outbreaks, clinical forms of the disease, and fatality and mortality rates.

In historical and medical research, such tables are often used only to confirm a general trend and rarely become an independent object of analysis. Meanwhile, they contain multivariate information which enables processes to be identified that cannot be detected using average national indicators. Their interpretation is complicated by the large volume of numerical data, the variety of units of measurement used, the combination of absolute and intensive indicators, and, in some cases, incomplete information and discrepancies between final and regional figures. Therefore, the materials were subjected to source criticism, with the following being checked: arithmetic consistency; comparability of indicators; methods of calculation; and completeness of records. It was also considered that the statistical tables reflected not only the actual spread of the infection, but also the state of diagnostics and laboratory confirmation, as well as administrative registration of cases.

The primary research methods employed were comparative-historical, problem-chronological and statistical. The comparative-historical method was employed to analyse data from various years, regions, urban and rural areas, and age and vaccination groups. Using it made it possible to identify regional differences in the epidemiological process. The problem-chronological method enabled changes in sequence to be examined, from the tense situation of the late 1950s to the first results of mass immunisation in 1960–1961. The statistical analysis involved comparing absolute and intensive indicators, calculating growth and decline rates, and analysing fatality and mortality rates.

The results were interpreted using the endogenous-primary approach. It involves examining epidemiological dynamics, primarily through the internal capabilities of the healthcare system: the organisation of vaccination, the completeness and quality of immunisation, personnel and laboratory capacity, the timeliness of diagnosis, hospitalisation and serotherapy, as well as the availability of medical care in cities and rural areas. The All-Union policy of mass vaccination is seen as an important external institutional impetus, while its actual effectiveness was determined by implementation mechanisms at the republican and regional levels. This approach helps to explain why a coordinated preventive campaign was accompanied by uneven rates of decline in incidence in individual regions.

All diagrams have been reconstructed using artificial intelligence technology from a low-quality original photograph.

Results

In 1952–1961, in the Kazakh SSR, diphtheria occupied a significant place among childhood infections with an upward trend (Diagram 1). As can be seen from Diagram 1, the intensive incidence rate per 10,000 people fluctuated between 5.7 and 11.3 during the specified period. The highest incidence rate was recorded in 1959, at 11.3. In 1959, following the order of the USSR Minister of Health No. 323 of June 23, 1959, the republic's health authorities undertook significant work to fight diphtheria and, primarily, to establish specific prevention measures [10; 135].

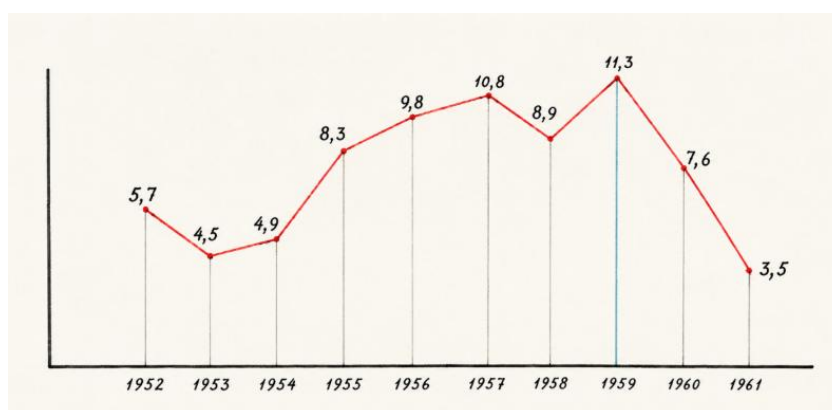


Diagram 1. The intensive incidence rate of diphtheria per 10,000 population in the Kazakh SSR for 1952–1961

The anti-epidemic and immunisation measures implemented resulted in a significant decrease in the incidence of diphtheria in the republic. In 1960, the incidence of diphtheria decreased by 30.2 % compared to 1959 [11]. In 1961, the incidence rate decreased by 50.6 % compared to 1960, and by 65.5 % compared to 1959.

The figures presented show a general downward trend in the incidence of diphtheria. At the same time, a graphical representation of long-term dynamics inevitably smooths out short-term increases, differences in the rate of decline, and territorial heterogeneity of the epidemiological process. Therefore, the general downward curve should not be taken as proof of uniform and simultaneous improvement in all republics and regions.

The non-linear and regionally differentiated nature of this process is best illustrated by the departmental reporting statistics. Unlike generalised charts, they enable us to identify periods of temporary increases in incidence, pinpoint areas with consistently high rates, compare urban and rural areas, and evaluate the level of hospitalisation of patients. Meanwhile, such tables often remain on the fringes of research attention, being used primarily as illustrative material. In this study, they are analysed as an independent historical source. This enables us to reconstruct the internal heterogeneity of the epidemiological process and the practical implementation of anti-diphtheria measures in the Kazakh SSR.

In the late 1950s, the dynamics of diphtheria incidence in the Kazakh SSR differed significantly from the All-Union average. In 1956, the number of registered cases in the republic was 8,283, and the following year it increased by 13.3 % to 9,385. At the same time, in the USSR the number of people infected decreased from 149,378 to 125,508, or by 16.0 % (see Table 1). Thus, while there was an All-Union decline, the opposite trend was observed in Kazakhstan, indicating continued epidemiological distress [12; 4].

Table 1

Comparative data on infectious diseases in 1956–1957

Republics	Diphtheria		
	1956	1957	The ratio of 1957 to 1956
Russian Soviet Federative Socialist Republic (RSFSR)	99538	81447	81.8
Ukrainian SSR	7956	5594	70.3
Byelorussian SSR	11367	7887	69.4
Uzbek SSR	9938	10521	105.9
Kazakh SSR	8283	9385	113.3
Georgian SSR	2513	2287	91.0
Azerbaijan SSR	1620	1273	78.6
Lithuanian SSR	881	610	69.2
Moldavian SSR	433	629	145.3
Latvian SSR	1024	618	60.4
Kirghiz SSR	1383	1069	77.3
Tajik SSR	1383	869	62.8
Armenian SSR	1215	1173	96.5
Turkmen SSR	1542	1941	125.9
Estonian SSR	302	205	67.9
Total for the USSR	149378	125508	84.0

According to the Central Research Institute of Epidemiology of the USSR Ministry of Health, the number of registered cases decreased by 5.1 % to 8,902 in 1958 compared to the previous year. However, this figure was still 7.5 % higher than in 1956, so it was premature to talk about a stable trend towards decreased incidence. A total of 8,711 patients were admitted to hospital, with rural institutions accounting for 3,161 cases (35.5 % of the total) (see Table 2) [13; 1].

Table 2

Infectious diseases and preventive vaccination in 1958 (by republic)

Republics	Diphtheria		
	Registered	Of them, hospitalized	Of the total number registered in rural institutions
RSFSR	79874	79118	18394
Ukrainian SSR	5558	5529	1389
Byelorussian SSR	7473	7432	4197
Uzbek SSR	8349	8327	3233
Kazakh SSR	8902	8711	3161
Georgian SSR	3160	3141	1097
Azerbaijan SSR	1474	1465	438
Lithuanian SSR	468	457	118
Moldavian SSR	769	762	503
Latvian SSR	211	209	68
Kirghiz SSR	1460	1452	777
Tajik SSR	1244	1212	626
Armenian SSR	1347	1335	416
Turkmen SSR	1847	1837	316
Estonian SSR	122	120	26
Total for the USSR	122258	121107	34750

In 1959, which coincided with the start of the «mass campaign to combat diphtheria» [8; 153] and immunisation programs, 10,733 cases of diphtheria were recorded in the Kazakh SSR — 20.6 % more than in 1958. The national average reached 11.5 per 10,000 population. The most unfavourable situation developed in the following regions: Pavlodar (24.2 per 10,000 people), Karaganda (16.2), Semipalatinsk (15.7), Kokshetau (14.8), South Kazakhstan (13.5) and North Kazakhstan (13.1) [8; 153].

In 1960, the number of cases decreased by 30.1 % to 7,500 people, and the incidence rate fell from 11.5 to 7.6 per 10,000 people [14; 24]. The largest decrease was observed in the Semipalatinsk region (58.0 %), followed by Alma-Ata (2.3 times), the Pavlodar region (49.0 %), the Karaganda region (42.4 %) and the South Kazakhstan region (36.5 %). However, the decline was not universal: in the Guryev region, the number of cases increased from 257 to 319 people, and the rate increased from 8.9 to 10.6 per 10,000 people.

Thus, the epidemiological situation at the end of the 1950s was characterised by a high incidence rate and an absence of consistent downward trends. The rise in cases in 1959 should not be interpreted as evidence of the ineffectiveness of immunisation, given that the development of mass immunity requires time and adequate coverage of the population with full vaccination courses. However, the persistence of 7,500 cases, the high rates in several regions and the increase in incidence in the Guryev region indicated unevenness across the regions and that the achieved epidemiological effect was not fully sustainable.

The significant decline in incidence in 1960 may have reflected the initial positive results of the vaccination campaign. In this regard, the indicators of the early 1960s are of particular research interest [15]. Their analysis enables us to ascertain the sustainability of the emerging decline in incidence and whether the expansion of mass immunisation improved the epidemiological situation in all regions of the republic. An examination of data for 1960–1961 makes it possible to evaluate the first practical results of the vaccination campaign, as well as to highlight the remaining differences in the levels of incidence, hospitalisation, and mortality.

It should be noted that a decrease in the incidence of diphtheria was observed in all regions of the republic in 1961. The decline in incidence in 1961 was more significant than in 1960 and varied by region within the range of 1.2 %-6.9 % (see Diagram 2) [10; 141].

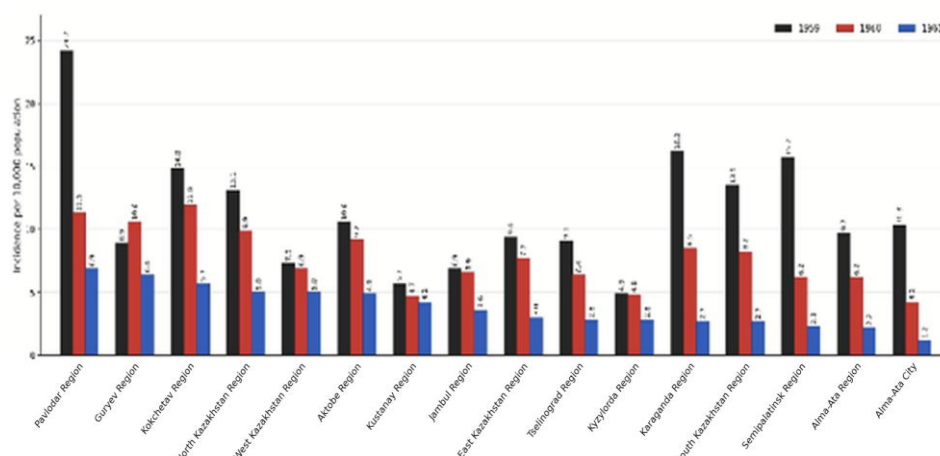


Diagram 2. Dynamics of annual incidence in each region of the republic in intensive indicators

As can be seen from diagram 2, the incidence rate decreased most rapidly in the Pavlodar, Karaganda, South Kazakhstan, Semipalatinsk and Alma-Ata regions, as well as in Alma-Ata, in both 1960 and 1961. The incidence rate only decreased significantly in 1961 in the following regions: Guryev, Kokshetau, North Kazakhstan, Aktobe, Jambul, East Kazakhstan, Tselinograd and Kyzylorda [16]. A slight decrease in intensive indicators was observed in two regions in both 1960 and 1961: Kustanay and West Kazakhstan.

Although national indicators enable us to identify the general trends in diphtheria incidence, they do not reveal the territorial differences and uneven nature of the epidemiological process in urban and rural areas. To identify this heterogeneity, the annual growth and decline rates in incidence were compared across regions, cities and rural areas. The chart below shows the percentage change in the number of registered cases compared to the previous year. Shades of red indicate an increase, while shades of blue indicate a decrease. This method of visualisation enables us to trace the general direction of epidemiological dynamics and regional differences in the rate of change between 1959 and 1961 (see Diagram 3) [10; 145].

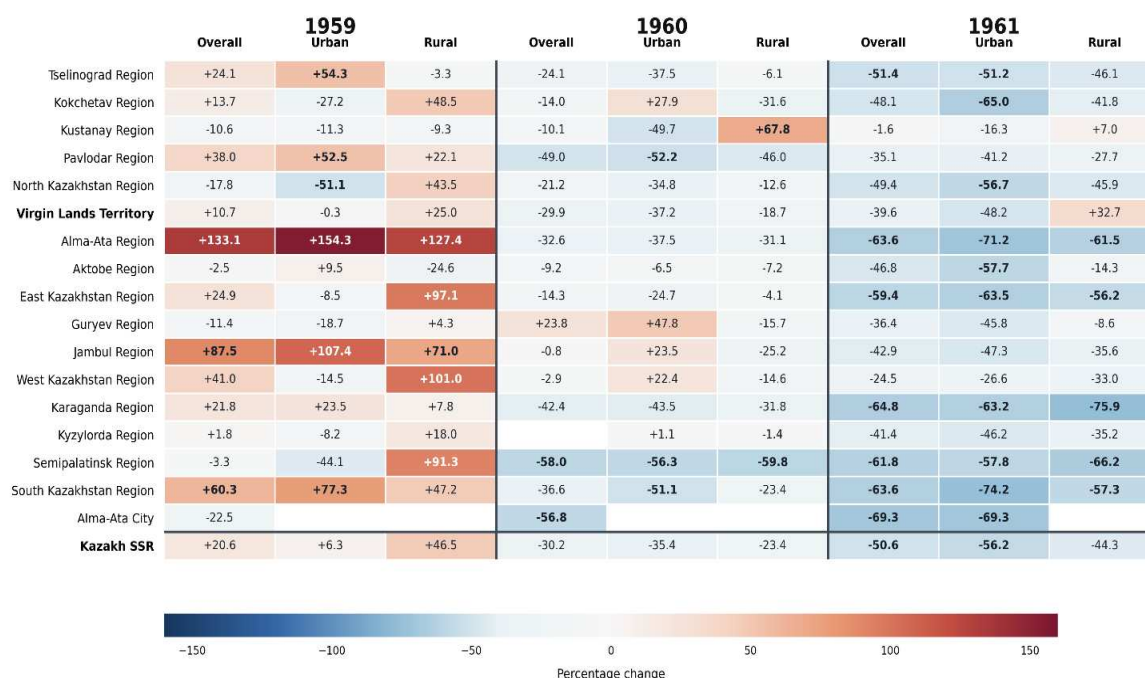


Diagram 3. Increase and decrease in the incidence of diphtheria in urban and rural areas by region in 1959–1961 (in %)

The diagram shows a marked change in the dynamics of diphtheria: from an increase in incidence in 1959, to a broad and accelerating decline in 1960–1961.

In 1959, the republic recorded a 20.6 % increase, which was significantly higher in rural areas (+46.5 %) than in cities (+6.3 %). The incidence rate increased most sharply in the Alma-Ata (+133.1 %), Jambul (+87.5 %) and South Kazakhstan (+60.3 %) regions. This indicates significant regional unevenness in the epidemic process.

In 1960, the situation changed: the republican figure fell by 30.2 % [17]. However, the decline had not yet been sustained across the board. In the Guryev region, overall growth continued (+23.8 %), and increases were also observed in the cities of Kokshetau, Jambul, and West Kazakhstan regions. In particular, the rural areas of the Kustanay region stood out, with an increase of 67.8 %. Consequently, anti-epidemic measures were not uniform in their effect across different regions and settlement types.

In 1961, the decline became virtually nationwide, with a 50.6 % decrease in the Kazakh SSR, 56.2 % in cities, and 44.3 % in rural areas. The most significant decline was observed in the regions of Alma-Ata, Karaganda, South Kazakhstan and Semipalatinsk. The decline in the Kustanay, West Kazakhstan, and Guryev regions was weaker, suggesting that areas of high epidemic risk persisted.

The identified territorial differences suggest that the dynamics of diphtheria incidence depended on both the place of residence and the demographic structure of the population. Therefore, to gain a more complete understanding of the epidemiological process, it is necessary to move from spatial analysis to consideration of the age composition of those infected. This approach facilitates the identification of the most vulnerable population groups and the determination of the extent to which mass immunisation has altered the distribution of the disease among individual age groups.

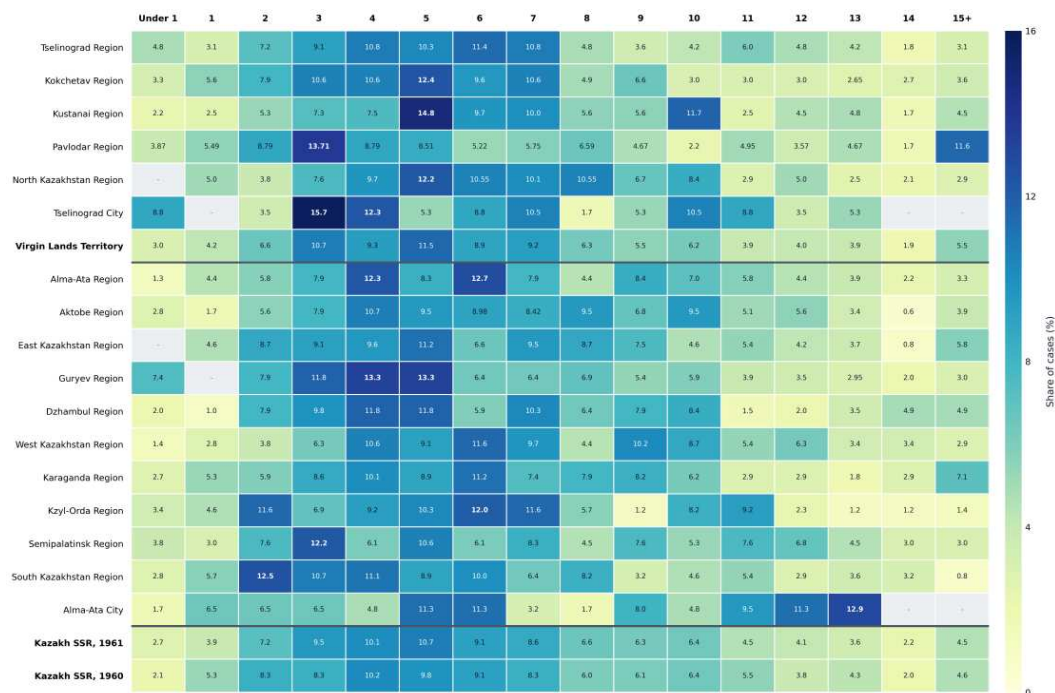


Diagram 4. The proportion of diphtheria incidence in each age group in the annual incidence for 1961 by region and for the republic as a whole [10; 160].

Note. The colours of the cells indicate the proportion of each age group within the total number of registered diphtheria cases: green — 4-8 %; turquoise — 8-12 %; dark blue — 12-16 %. The numbers inside the cells represent exact percentages. A dash indicates that the value was either missing or not listed in the archival source.

The data presented indicate a stable number of registered diphtheria cases among children of preschool and primary school age. In 1961, in the Kazakh SSR, children aged 3-7 years accounted for 48.0 % of all cases. Children aged 2-7 years accounted for 55.2 % of cases, while the total proportion of children under eight years of age reached 61.8 %. The largest proportion was 5-year-olds — 10.7 %, followed by 4-year-olds at 10.1 % and 3-year-olds at 9.5 %. A similar age structure was observed in 1960: 45.7 % of those infected were aged 3-7 years, 54.0 % were aged 2-7 years, and 61.4 % were under eight years old.

Consequently, the age profile of diphtheria in the republic remained relatively stable in 1960–1961, despite changes in the proportion of cases in specific age groups.

At the same time, the diagram reveals marked regional differences. In Tselinograd, the proportion of 3-year-olds reached 15.7 %, in the Kustanay region, the proportion of 5-year-olds was 14.8 %, and in the Pavlodar region, 3-year-olds accounted for 13.71 % of registered cases. A different age profile was observed in Alma-Ata, where a significant proportion of those infected were older school-age children: the proportion of thirteen-year-olds reached 12.9 %. The revealed territorial heterogeneity indicates that the formation of the age structure of incidence was dependent on the specific epidemiological situation in the regions, the timeliness and completeness of vaccination and revaccination, the intensity of contacts in children's groups, the migratory mobility of the population, as well as the quality of detection and statistical registration of cases of the disease.

In order to make a more direct assessment of the preventive effect of vaccination, a comparison must be drawn between the incidence of the disease among vaccinated and unvaccinated children. Calculating intensive indicators per 1,000 children in each group eliminates the influence of differences in group size and enables us to determine the extent to which disease risk depended on vaccination status (Table 3) [10; 171].

Table 3

Incidence of diphtheria in 1961 among vaccinated and unvaccinated children, expressed as indicators per 1,000 children in each group

Name of regions	Among those vaccinated			Among the unvaccinated		
	Quantity of vaccinated children	Quantity of infected among vaccinated children	Per 1000 of this group	Quantity of unvaccinated children	Quantity of infected among unvaccinated children	Per 1000 of this group
North Kazakhstan	112608	119	1.1	30635	114	3.7
Kokshetau	82999	136	1.6	72538	166	2.3
East Kazakhstan	159559	130	0.8	43917	111	2.5
Karaganda	248013	173	0.7	69217	141	2.0
Semipalatinsk	9545	50	5.2	46409	82	1.8
South Kazakhstan	184281	130	0.7	83097	159	1.9
Alma-Ata city	97430	29	0.3	16442	38	2.3
Jambul	31672	90	2.8	42137	131	3.1
Kustanay	52269	114	2.2	117998	224	1.9
Total	978376	971	0.9	522390	1166	2.2

Note: The number of vaccinated children includes only revaccinated children.

The table data indicate a strong link between revaccination and a reduction in the incidence of diphtheria among children. According to the final indicators, in 1961 the incidence rate among revaccinated children was 0.9 cases per 1000 people in the corresponding group, while among unvaccinated children it was 2.2. Therefore, unvaccinated children fell ill around 2.4 times more often. The benefits of revaccination were observed in seven out of nine of the administrative-territorial units represented. The most significant disparities were observed in the North Kazakhstan, East Kazakhstan, Karaganda and South Kazakhstan regions, where the incidence rate among unvaccinated children was approximately 2.7-3.4 times higher than among revaccinated children. In the Kokshetau and Jambul regions, the differences were less significant, indicating that the epidemiological effectiveness of the vaccination campaign was not uniform across the regions.

Conversely, data from the Semipalatinsk and Kustanay regions demonstrate a contrasting relationship, with incidence rates among revaccinated children exceeding those observed among unvaccinated children. Such deviations must not be interpreted as evidence of the ineffectiveness of immunisation. These differences could be due to variations in the age composition of the groups being compared, the timing and completeness of revaccination, the length of the post-vaccination period, the location of outbreaks within organised children's groups and shortcomings in statistical recording. Consequently, the table demonstrates

not only the protective value of revaccination, but also the regional heterogeneity of the organisation of immunisation, epidemiological monitoring and registration of vaccination status. From the standpoint of the endogenous-primary approach, the identified differences indicate that the results of the fight against diphtheria depend on the internal capabilities of the regional healthcare system. These include the timeliness and completeness of revaccination, the quality of registration, the work of the district service and the effectiveness of anti-epidemic control.

The presence of information about vaccination did not necessarily indicate the completeness of immune protection. Its effectiveness depended on completing the immunisation course, adhering to established regulations, and following the correct sequence of vaccinations and revaccinations. Therefore, to explain cases of diphtheria among vaccinated children, it is necessary to analyse the quality of the vaccinations they received (see Table 4) [10; 174].

Table 4

The quality of vaccinations received by children who contracted diphtheria in 1961

Name of regions	Total number of cases	Of these		Of these	
		Fully vaccinated in %	Inadequately vaccinated in %	Those who had an infectious disease during vaccinations	Those who didn't get infected
Tselinograd	86	30.2	69.8	15.3	84.7
Kokshetau	136	77.2	22.8	72.6	27.4
Pavlodar	165	82.8	17.2	-	-
Alma-Ata	123	22.0	78.0	13.1	86.9
North Kazakhstan	109	83.9	16.1	-	-
Guryev	70	72.9	27.1	41.6	58.4
Jambul	90	26.5	73.5	78.9	21.1
East Kazakhstan	58	70.7	29.3	35.9	64.1
Karaganda	173	31.8	68.2	16.8	83.2
Kyzylorda	31	61.3	38.7	35.5	64.5
Semipalatinsk	50	44.0	56.0	50.8	49.2
South Kazakhstan	132	93.1	6.9	35.6	64.4
Alma-Ata city	29	55.2	44.8	6.9	93.1
Total for the republic	1252	54.4	45.6	35.4	64.6

Note: of the 1,558 vaccinated patients, 1,250 were subjected to vaccination quality testing, for which all necessary documentation was prepared.

The data in the table show that the effectiveness of diphtheria immunisation depended not only on the proportion of the child population that had been vaccinated, but also on the quality of the full vaccination course. Of the 1,558 children vaccinated against diphtheria who fell ill in 1961, the quality of the vaccination could only be determined in 1,250 people (80.2 %). The fact that almost one in five infected children lacked the necessary documentation indicates shortcomings in the recording and control of vaccination work. Overall in the republic, 54.4 % of children under surveillance received full vaccinations, while 45.6 % were vaccinated inadequately. Consequently, almost every second case of diphtheria among vaccinated children included in the study occurred against a background of incomplete or improperly carried out immunisation.

The table shows that the quality of vaccination varies significantly across different territories. The regions with the highest proportion of inadequately vaccinated children were the Alma-Ata region (78.0 %), the Jambul region (73.5 %), the Tselinograd region (69.8 %), the Karaganda region (68.2 %), and the Semipalatinsk region (56.0 %). Across all these regions, the indicator surpassed the national average. Conversely, the lowest proportion of inadequately vaccinated people was recorded in the South Kazakhstan region (6.9 %), North Kazakhstan region (16.1 %), Pavlodar region (17.2 %) and Kokshetau region (22.8 %). The discrepancy between the minimum and maximum figures was 71.1 percentage points. This range cannot be explained solely by individual medical contraindications and indicates differences in the organisation of vaccination work, the maintenance of medical records, compliance with vaccination regulations, and monitoring of the completion of the vaccination course.

The information regarding the causes of inadequate immunisation is particularly informative. Overall, 35.4 % of children with suboptimal vaccination rates in the republic contracted an infectious disease during the vaccination period, while 64.6 % did not become ill. Consequently, in most cases, failure to complete the vaccination course was not directly due to a concomitant infectious disease. The highest proportion of such children was recorded in Alma-Ata (93.1 %), followed by the Alma-Ata region (86.9 %), the Tselinograd region (84.7 %) and the Karaganda region (83.2 %). This suggests that organisational issues played a leading role, including violations of calendar deadlines, inadequate control over revaccination, ineffective dispensary monitoring and deficiencies in medical records. The situation was different in the Jambul and Kokshetau regions, where 78.9 % and 72.6 % of children with incomplete vaccinations, respectively, contracted an infectious disease during the vaccination process. However, in such cases, the ability of medical institutions to resume and complete immunisation after the child's recovery was of great importance.

Particular attention should be paid to the incidence of infection among organised groups of children, since constant contact in nurseries, kindergartens, schools and boarding schools could lead to clusters of infections emerging. To identify the territorial distribution of the disease, the information was systematised by region and the republic as a whole (see Table 5) [10; 182].

Table 5

Incidence of diphtheria among organised children's groups in 1961, by region and for the republic as a whole (absolute data)

Name of regions	Total number of cases	In open-type childcare institutions				In closed-type childcare institutions							
		Nurse ry	Kinder gartens	Schools	Total	Orph infant t	Infant home s	Tub. sanato rium	Fung. hospitals	Reum . sanat orium	Ven. dispen sary	Boardi ng school s	Total
Tselinograd	75	4	5	64	73	-	2	-	-	-	-	-	2
Kokshetau	103	2	8	93	103	-	-	-	-	-	-	-	-
Kustanay	156	4	7	145	156	-	-	-	-	-	-	-	-
Pavlodar	139	9	17	106	132	5	2	-	-	-	-	-	7
North Kazakhstan	121	2	23	96	121	-	-	-	-	-	-	-	-
Alma-Ata	103	5	11	85	101	2	-	-	-	-	-	-	2
Aktobe	84	5	6	72	83	-	-	1	-	-	-	-	1
East Kazakhstan	118	6	14	98	118	-	-	-	-	-	-	-	-
Guryev	81	8	9	64	81	-	-	-	-	-	-	-	-
Jambul	107	6	15	82	103	1	-	1	2	-	-	-	4
West Kazakhstan	108	2	8	98	108	-	-	-	-	-	-	-	-
Karaganda	157	5	13	117	135	-	-	-	-	22	-	-	22
Kyzylorda	37	2	4	29	35	-	-	2	-	-	-	-	2
Semipalatinsk	68	4	10	54	68	-	-	-	-	-	-	-	-
South Kazakhstan	114	8	14	89	111	-	-	-	-	-	3	-	3
Alma-Ata city	38	3	6	28	37	-	-	-	-	-	-	1	1
Total for the republic	1609	75	170	1320	1565	8	4	4	2	22	3	1	44

The data in the table characterises the scale and structure of diphtheria incidence among organised children's groups in the Kazakh SSR in 1961. A total of 1,609 cases of the disease were recorded in children's institutions across the republic. Most cases (1,565, or 97.3 %) were found in open-type institutions. In closed-type institutions, 44 cases were identified, constituting 2.7 % of the total incidence of disease among children in organised institutions. As this ratio primarily reflects the numerical predominance of children attending schools, kindergartens and nurseries, it cannot automatically be considered as evidence of a lower epidemiological risk in closed-type institutions.

In terms of incidence, schoolchildren played a leading role: 1,320 cases were registered among them, accounting for 82.0 % of all diphtheria cases in organised children's groups and 84.3 % of cases in open-type institutions. Kindergarten children accounted for 170 cases, or 10.6 %, and children attending nurseries accounted for 75 cases, or 4.7 %. Therefore, the majority of those infected were school-age children. However, the fact that schoolchildren make up most of the absolute structure does not prove that the risk of illness in schools was higher than in kindergartens. Such a conclusion would require information on the total

number of children attending each type of institution. Furthermore, the registration of a child as part of a school group does not necessarily indicate that the infection occurred directly at school.

The largest number of cases among organised children was recorded in the Karaganda region (157), followed by the Kostanay region (156) and the Pavlodar region (139). These three regions accounted for a total of 452 cases, representing 28.1 % of the national total. The next regions were North Kazakhstan (121 cases), East Kazakhstan (118 cases), South Kazakhstan (114 cases), West Kazakhstan (108 cases), and Jambul (170 cases). The lowest absolute figures were observed in the Kyzylorda region (37 cases), followed by Alma-Ata (38) and the Semipalatinsk region (68). However, these differences cannot be directly interpreted as indicators of the epidemiological well-being or distress of regions, since the table does not take into account the size of the child population, the number of organised children, and their coverage by preschool and school institutions. The territorial distribution of the absolute number of cases is reflected, but not the intensity of the disease.

In most regions, cases were concentrated in schools. The proportion of schoolchildren among the infected organised children was especially high in the Kustanay region — 92.9 %, West Kazakhstan region — 90.7 %, and Kokshetau region — 90.3 %. This concentration could be attributed not only to the size of the school population, but also to the characteristics of the anti-diphtheria immunity of school-age children, adherence to the timing of age-related revaccinations, and the intensity of daily contacts. By combining data from the Schick test with information on the quality of vaccinations, we can conclude that certain groups of schoolchildren were inadequately protected against toxins.

44 cases of diphtheria were recorded in closed-type institutions. Of these cases, 22 were identified in rheumatological sanatoriums in the Karaganda region. A further eight cases were identified in orphanages. Then, four cases were identified in infant homes; four in tuberculosis sanatoriums; three in venereal disease clinics; two in institutions for patients with fungal diseases; and one in a boarding school. The 22 cases in the rheumatological sanatoriums of the Karaganda region may indicate the presence of a disease spot or several related episodes of the disease.

Despite the small proportion of cases, closed-type institutions were of particular epidemiological significance. The children's close and prolonged contact over a 24-hour period, as well as their shared sleeping and living spaces, created conditions for the rapid spread of infection when an infectious source appeared. Therefore, the fact that most cases occurred in open-type institutions should not distract from the increased vulnerability of communities in boarding schools, hospitals and sanatoriums.

In order to establish whether isolated cases of diphtheria predominated or whether the disease spread among contact persons in families and organised groups, the territorial characteristics of the incidence rate must be supplemented by an analysis of focality. Comparing these data by region enables us to identify areas with the most significant intra-focal spread of infection and indirectly assess the timeliness of the anti-epidemic measures taken (see Table 6) [10; 188].

Table 6

Information on the incidence of diseases by region and by the republic as a whole in 1961

Name of regions	Total number of cases	The total number of disease foci	Number of foci with the following number of cases							
			with 1 case		with 2 cases		with 3-5 cases		with 6 or more cases	
			absolute	% of total	absolute	% of total	absolute	% of total	absolute	% of total
Tselinograd	166	138	115	83.3	20	14.5	3	2.2	-	-
Kokshetau	302	241	202	83.8	23	9.6	15	6.2	1	0.4
Kustanay	359	302	264	87.4	26	8.6	11	3.6	1	0.4
Pavlodar	364	330	301	91.2	24	7.3	5	1.5	-	-
North Kazakhstan	238	212	191	90.5	16	7.6	5	2.4	-	-
Alma-Ata	227	201	180	89.6	16	7.9	5	2.5	-	-
Aktobe	178	146	126	86.0	15	10.3	4	3.0	1	0.7
East Kazakhstan	241	204	180	88.3	16	7.8	8	3.9	-	-
Guryev	203	171	154	90.1	10	5.8	6	3.5	1	0.6
Jambul	203	180	162	90.0	14	7.8	4	2.2	-	-

West Kazakhstan	207	135	101	74.8	21	15.6	9	6.7	4	2.9
Karaganda	338	299	273	91.3	21	7.0	3	1.0	2	0.7
Kyzylorda	87	81	77	95.0	2	2.5	2	2.5	-	-
Semipalatinsk	132	118	107	90.7	8	6.9	3	2.5	-	-
South Kazakhstan	289	260	240	92.3	13	5.0	7	2.7	-	-
Alma-Ata city	62	60	58	96.7	2	3.3	-	-	-	-
Total	3596	3077	2731	88.7	247	8.1	90	2.9	10	0.3

Note: the study did not include patients under the supervision of departmental medical institutions in some regions.

The data in the table not only reflect the scale of diphtheria incidence, but also how it spreads within epidemiological foci. In 1961, a total of 3,596 cases of the disease were recorded across 3,077 foci in the Kazakh SSR. On average, there were 1.17 cases per focus. Consequently, there were 519 more patients than foci, indicating the presence of intra-focal group incidence.

The majority of foci were single-disease foci, accounting for 2,731 cases (88.7 %). Foci involving two cases accounted for 8.1 % of cases, those involving three to five cases accounted for 2.9 %, and those involving six or more cases accounted for 0.3 %. Consequently, multiple foci accounted for only 11.3 % of the total number. However, 865 cases were recorded in these areas, accounting for 24.1 % of all diphtheria cases. Consequently, this relatively small group of multiple foci accounted for nearly a quarter of the republic's cases, highlighting their importance in the fight against the epidemic.

The West Kazakhstan region was the most unfavourable in terms of focality. Of the 135 foci, 101 (74.8 %) were accidental, compared to a national average of 88.7 %. The proportion of foci with two cases was 15.6 %; with three to five cases, it was 6.7 %; and with six or more cases, it was 2.9 %. With an average of 1.53 patients per focus, this region had the highest figure of all. Furthermore, four out of ten major foci in the republic with six or more cases were in the West Kazakhstan region. These figures show the areas where the disease was most prevalent and where the spread of infection was least effectively limited following the appearance of the first case.

A different pattern was observed in the Pavlodar and Karaganda regions. The highest number of cases was recorded here, with 364 and 338 cases respectively. However, the proportion of single-case foci was 91.2 % and 91.3 % respectively. The average number of cases per focus was 1.10 in the Pavlodar region and 1.13 in the Karaganda region. Consequently, the high incidence rate in these regions was determined primarily by the large number of individual foci, rather than the infection spreading widely in each of them. At the same time, the presence of two foci with six or more cases in the Karaganda region indicates that, alongside predominantly dispersed incidence, there were also individual large-scale epidemic episodes.

The focality rate was lowest in the city of Alma-Ata and the Kyzylorda region. In Alma-Ata, single-case foci accounted for 96.7 % of cases, with an average of 1.03 cases per focus. In the Kyzylorda region, the respective figures were 95.0 % and 1.07. This may indicate the timely identification and isolation of patients, as well as the prevention of further transmission of the infection. However, the high proportion of single-case foci may also indicate an insufficient identification of epidemiological links between cases.

Overall, the table shows that there were two different types of epidemic process: dispersed incidence, characterised by single-case foci, and group spread of infection within these foci. From an endogenous-primary perspective, significant interregional differences may be attributed to the intrinsic capabilities of regional healthcare systems, including the timeliness of diagnosis and hospitalisation, the efficacy of epidemiological surveillance, contact tracing, emergency vaccination implementation, and the efficiency of ongoing disinfection. At the same time, the size of the foci was influenced by overcrowding in housing, the number of families and the intensity of daily contacts. Therefore, focality should be considered the result of the interaction between the social conditions that facilitated the spread of infection, and the medical system's ability to promptly localise the epidemic process.

To identify the specific mechanisms of outbreak occurrence and spread, it would be appropriate to supplement the summary indicators of outbreak incidence with materials from local epidemiological investigations. In 1961, two outbreaks were registered in the Tselinograd region, affecting 15 people. Their share of the total regional incidence increased from 2.9 % in 1960 to 6.7 % in 1961. Archival materials indicate that the Tselinograd district was the most affected area, with the number of diphtheria cases increasing by 10. In four settlements, the disease took on epidemic proportions.

The epidemic episode at Tastak station, where five people fell ill with diphtheria from September 7 to 13, is an illustrative example. The investigation revealed that, back in August, a girl in the family of a

railway worker S. fell ill. She underwent treatment in the city and was discharged from hospital in early September. Following her return, the disease spread successively to two children in the Ya. family and, five days later, to three children in the B. family, who lived in the same house. The time interval between the last cases was one to two days. Thus, the archival document enables the sequential development of the outbreak to be traced, from the initial case to the spread of the infection within households.

The outbreak was made worse by the lack of timely information. The medical district only became aware of the cluster of illnesses on 14 September, whereas the district's sanitary and epidemiological department received the emergency notification on 15 September. No anti-epidemic measures had been taken prior to the arrival of the specialists. In addition, neither the railway medical station nor the rural health post had any diphtheria antitoxin, so the children did not receive it before being hospitalised.

Following the deployment of the epidemiological team, a door-to-door visitation of the settlement was organised, contacts were identified and monitored, the outbreak sites were disinfected, and laboratory testing of schoolchildren and individuals who had been in contact with the sick was conducted. No new cases were registered after these measures were carried out. Thus, the spread of the outbreak was not so much associated with a lack of effective anti-epidemic methods, but rather with a delay in their implementation, an insufficient supply of medical centres, and a lack of coordination between railway and territorial healthcare institutions.

This episode illustrates the position of the endogenous-primary approach. The scale of the outbreak depended on the system's internal organisational capabilities: how quickly cases were identified and registered, how well the emergency notification mechanism functioned, whether diphtheria antitoxin was available, and how well various medical services were coordinated. Concurrently, the elimination of diseases following the intervention of the district sanitary and epidemiological service demonstrates the efficacy of the implemented measures when applied in a timely manner.

To gain a fuller understanding of the epidemiological situation, it is important to establish the relationship between the different forms of the disease. This is because the clinical presentation reflects not only the characteristics of the disease's progression, but also the effectiveness of early diagnosis and preventive measures (see Table 7) [10; 208].

Table 7

Clinical structure of diphtheria cases, statistically analysed in 1961

Clinical forms	Absolute number of cases	As a percentage of the number of cases included into the study
Total number of cases included into the study	1906	100
Of them:		
Pharyngeal diphtheria, including:	1699	89.1
a). Localised (membranous, punctate, insular, catarrhal)	1076	63.3
b). Common	81	4.8
c). Subtoxic	167	9.9
d). Toxic, grade 1	156	9.3
Toxic, grade 2	112	6.6
Toxic, grade 3	98	5.9
e). Hypertoxic	9	0.6
2. Diphtheritic croup (laryngeal)	150	7.8
3. Nasal diphtheria	24	1.3
4. Combined diphtheria of the pharynx and nose	8	0.4
5. Uncommon localisation of diphtheria	25	1.3

The clinical characteristics of 1906 statistically analysed cases show a marked predominance of pharyngeal diphtheria, which was diagnosed in 1699 patients, or in 89.1 % of observations. Diphtheric croup accounted for 150 cases (7.8 %), nasal diphtheria for 24 cases (1.3 %), the combined form for eight cases (0.4 %), and uncommon localisations for 25 cases (1.3-1.4 %). Thus, forms of the disease that were not exclusively related to pharyngeal diphtheria accounted for 207 cases in total, representing 10.9 % of the analysed material.

Of the cases of pharyngeal diphtheria, the localised form was predominant, accounting for 63.3 % of the 1699 patients in this group (1076 cases). The common form was identified in 81 patients (4.8 %). Consequently, non-localised forms of diphtheria were detected in 623 people in this clinical group, equating to 36.7 patients. This shows that, despite a general predominance of localised progression, the disease extended beyond its limits or was accompanied by signs of a toxic process in more than a third of patients.

Subtoxic and toxic forms of varying degrees were recorded in 542 patients. They accounted for 31.9 % of all cases of pharyngeal diphtheria and 28.4 % of the total number of statistically analysed cases. A total of 219 people were found to have toxic forms of the second and third grades, as well as the hypertoxic form. This equates to 12.9 % of patients with pharyngeal diphtheria and 11.5 % of the entire population examined. The cause of death was primarily cardiac dysfunction, specifically toxic myocarditis [10; 223]. Consequently, alongside localised variants, a significant number of severe clinical forms of the disease persisted. Consequently, it is not feasible to characterise the epidemic solely as a predominance of mild diphtheria.

The issue of the representativeness of the presented data is of particular significance. A total of 1,906 cases were processed clinically, whereas in previous summary tables the total number of cases in 1961 was determined to be 3,596 or 3,708 people. Therefore, the table accounts for around 51-53 % of the reported incidence.

The analysis of the clinical features must be supplemented by an assessment of the reliability of diagnoses and statistical records. Indicators of coverage of patients with laboratory testing and the proportion of confirmed cases characterise the capabilities of the bacteriological service and the validity of registered diagnoses. However, the absence of laboratory confirmation did not preclude a clinical diagnosis, since test results depended on the timing and quality of sample collection and the commencement of treatment (see Table 8) [10; 210].

Table 8

Laboratory testing coverage and confirmability of diphtheria cases in 1961

Name of regions	Total number of cases	Including				Of those tested			
		Those tested	%	Those untested	%	The diagnosis was confirmed	%	The diagnosis was not confirmed	%
Tselinograd r.	223	220	98.6	3	1.4	136	61.8	84	38.2
Kokshetau r.	302	293	97.1	9	2.9	199	67.9	94	32.1
Kustanay r.	359	297	82.7	62	17.3	183	61.7	114	38.4
Pavlodar r.	364	341	93.7	23	6.3	127	37.2	214	62.8
North Kazakhstan r.	238	222	93.1	16	6.9	136	61.3	82	38.7
Alma-Ata r.	227	198	87.2	29	12.8	64	32.3	134	67.7
Aktobe r.	178	150	84.3	28	15.7	73	48.7	77	51.3
East Kazakhstan r.	241	226	93.8	15	6.2	150	66.4	76	33.6
Guryev r.	203	181	89.2	22	10.8	64	35.3	117	64.7
Jambul r.	221	199	90.0	22	10.0	115	57.9	84	42.1
West Kazakhstan r.	207	204	98.6	3	1.4	145	71.1	59	28.9
Karaganda r.	338	326	96.7	11	3.3	195	59.6	131	40.4
Kyzylorda r.	95	90	94.7	5	5.3	51	56.7	39	43.3
Semipalatinsk r.	132	123	93.2	9	6.8	96	78.1	27	21.9
South Kazakhstan r.	289	276	95.5	13	4.5	132	47.8	144	52.2
Alma-Ata	62	61	98.3	1	1.7	44	72.1	17	27.9
Total	3679	3404	92.5	281	7.5	1911	56.1	1493	43.9

Note: the total number of cases does not include patients from departmental medical institutions of the Aktobe region.

The data presented characterise the coverage of patients undergoing laboratory testing and the effectiveness of confirming clinically diagnosed cases of diphtheria. The table contains 3,679 cases. This is 29 fewer than the figure in the previous summary table, which was 3,708 cases. According to the note, this is because patients in medical institutions of the Aktobe region were not included in the calculation. Consequently, the difference in the final indicators is explained by changes in statistical observation coverage rather than by incidence dynamics.

The final line states that 3,408 patients underwent laboratory testing, which is more than 92 % of the registered cases. The highest coverage was observed in the Tselinograd and West Kazakhstan regions — 98.6 % each, the city of Alma-Ata — 98.3 %, the Kokshetau region — 97.1 %, and the Karaganda region — 96.7 %. The lowest rates were observed in Kustanay — 82.7 %, Aktobe — 84.3 %, Alma-Ata — 87.2 % and Guryev regions — 89.2 %. Thus, despite the high national average coverage, there were significant territorial differences in the availability and organisation of laboratory testing.

Laboratory confirmation of the diagnosis was obtained for approximately 56 % of patients tested, while confirmation was not obtained for more than 43 % of patients. This indicates that approximately half of the reported cases lacked laboratory confirmation. The highest confirmation rates, calculated based on absolute data, were observed in the following regions: Semipalatinsk — 78.0 %, the city of Alma-Ata — 72.1 %, West Kazakhstan — 71.1 %, Kokshetau — 67.9 %, and East Kazakhstan — 66.4 %. The lowest rates were in the Alma-Ata region (32.3 %), followed by the Guryev region (35.4 %) and the Pavlodar region (37.2 %). The difference between the extreme regional values exceeded 45 percentage points, indicating significant heterogeneity in laboratory diagnostics.

The Pavlodar region was a particularly illustrative region where high test coverage was combined with low confirmability. While 93.7 % of patients were covered by laboratory testing, the diagnosis was confirmed in only 37.2 % of those tested. In the Guryev region, the corresponding figures were 89.2 % and 35.4 %. In the Alma-Ata region, they were 87.2 % and 32.3 %. This ratio may be associated with factors such as extended clinical diagnostics, late collection of material, initiation of treatment before testing, violation of sample transportation conditions, deficiencies in laboratory methods, or a combination of these factors.

From the perspective of the endogenous-primary approach, the table reveals one of the Soviet anti-epidemic system's most significant internal constraints: the uneven state of the laboratory service. The nominal existence of a laboratory test did not guarantee a reliable diagnosis. The final result depended on the qualifications of the medical and laboratory personnel involved, how promptly materials were collected, whether nutrient media were available, whether transportation conditions were complied with, and how medical institutions interacted with sanitary and epidemiological stations. Consequently, laboratory verifiability served not only as a medical but also as an organisational and institutional indicator of the effectiveness of regional healthcare.

The timeliness of the administration of diphtheria antitoxin was of significant importance to the clinical course of diphtheria. According to the archival document, 60.3 % of patients who received serotherapy received it in the first 8 hours. Consequently, nearly 40 % of patients received their specific treatment more than 8 hours later. Furthermore, due to an erroneous initial diagnosis, 5.6 % of patients were administered the antitoxin on the second day after seeking medical help, while 1.2 % received it on the fourth day and a further 1.2 % received it on the fifth day or later. These figures do not cover all delay options, since the document does not provide separate information on administering antitoxin after the first eight hours or on the third day. Therefore, they should be regarded as the minimum recorded scale of late serotherapy.

Significant delays were particularly evident in certain regions. In the Semipalatinsk region, only 3.1 % of patients received the serum in the first three hours. In the Karaganda region, this figure was 38.2 %. It is important to note that these figures cannot be directly compared with the national average of 60.3 % calculated for an eight-hour interval. However, they do demonstrate significant regional differences in the speed of treatment initiation. The reasons for this could be late presentation of patients, errors in initial diagnosis, delayed hospitalisation, insufficient training of primary care healthcare workers, and the lack of the drug in district departments.

The centralisation of specific treatment is evident from the fact that 85.1 % of patients received diphtheria antitoxin only in hospital, compared to just 14.9 % at the pre-hospital stage. According to an archival source, this is due to patients being hospitalised immediately after diagnosis, or to the fact that the diagnosis was often made in hospital. Consequently, the local medical network did not always ensure the early recognition of diphtheria or the timely initiation of serotherapy. The reliance on hospitalisation for antitoxin administration led to an increased risk of delay in specific treatment, particularly among residents of remote settlements.

Another limitation was the shortage of diphtheria antitoxin at certain medical stations, first aid stations and rural health posts. Therefore, the issue was found to be influenced by both diagnostic errors and the structure of drug distribution. Sometimes, even when patients did seek medical attention, health workers did

not have the resources to start treatment straight away. The archival document assessed this situation as «unacceptable under the conditions of a centralised antitoxin supply system».

The epidemiological situation can only be properly assessed if disease outcomes are analysed. A comparison of fatality and mortality rates enables the identification of interannual dynamics of severe outcomes, as well as territorial differences in the timeliness of diagnosis and provision of medical care (see Table 9) [10; 214].

Table 9

Fatality and mortality rates in the republic as a whole and by region in 1961 compared to 1960

Name of regions	1960					1961				
	Absolute number of those infected	Absolute number of those deceased	Proportion of those deceased by region in %	Fatality	Mortality per 10,000 population	Absolute number of those infected	Absolute number of those deceased	Proportion of those deceased by region in %	Fatality	Mortality per 10,000 population
Tselinograd r.	344	39	8.0	11.3	0.57	203	21	6.6	10.34	0.37
Kokshetau r.	627	40	8.2	6.3	0.76	302	23	7.23	7.6	0.41
Kustanay r.	365	36	7.4	9.8	0.47	359	36	11.32	10.0	0.43
Pavlodar r.	561	33	6.8	5.8	0.67	364	21	6.6	5.7	0.39
North Kazakhstan r.	470	32	6.5	6.8	0.67	238	17	5.34	7.1	0.34
In the Virgin Lands Territory	2457	180	37.5	7.3	0.61	1486	118	37.09	7.9	0.37
Alma-Ata r.	623	45	9.3	7.2	0.44	227	27	8.49	12.7	0.25
Aktobe r.	389	16	3.2	4.1	0.38	207	19	5.97	10.5	0.43
East Kazakhstan r.	503	52	10.7	8.7	0.68	241	16	5.04	7.4	0.2
Guryev r.	319	20	4.0	6.2	0.66	203	23	7.24	11.3	0.73
Jambul r.	387	13	2.6	3.8	0.22	221	19	5.97	9.3	0.31
West Kazakhstan r.	274	17	3.4	6.2	0.42	207	20	6.29	9.7	0.48
Karaganda r.	956	50	10.3	5.2	0.44	338	17	5.35	5.2	0.14
Kyzylorda r.	162	18	3.6	11.1	0.53	95	18	5.68	19.5	0.52
Semipalatinsk r.	345	21	4.3	6.0	0.38	132	13	4.09	9.8	0.12
South Kazakhstan r.	792	47	9.7	5.9	0.49	289	26	8.18	8.9	0.24
Alma-Ata	203	1	0.2	0.4	0.21	62	2	0.62	3.2	0.03
Total	7320	480	100	6.5	0.48	3688	318	100	8.6	0.3

The data in the table illustrate the multidirectional dynamics of diphtheria mortality and fatality rates. Compared to 1960, the number of registered cases of the disease decreased by 50.6 % in 1961, falling from 7,320 to 3,688. The absolute number of deaths also fell, by 33.8 %, from 480 to 318. At the same time, the mortality rate fell by 37.5 %, from 0.48 to 0.30 per 10,000 people. However, while the incidence and mortality rates decreased, the fatality rate among those infected increased from 6.5 % to 8.6 %, a rise of 2.1 percentage points — approximately one third.

This discrepancy is not a statistical paradox because mortality and fatality rates characterise different aspects of the epidemiological process. Mortality is calculated relative to the entire population and reflects the overall demographic impact. In contrast, case fatality shows the proportion of deaths among registered cases. Therefore, a decrease in mortality indicates a fall in the prevalence of diphtheria and the number of deaths caused by it. Conversely, an increase in fatality suggests that the number of deaths fell more slowly than the number of cases identified. In other words, although advances in prevention and immunisation had probably reduced the overall incidence of disease, they had not resulted in similar improvements for people who were already infected.

The highest fatality rate was observed in the Kyzylorda region in 1961, at 19.5 %. This was more than twice the national average. High indicators were also observed in the following regions: Alma-Ata region (12.7 %), Guryev (11.3 %), Aktobe (10.5 %), Tselinograd (10.34 %) and Kustanay (10.0 %). The lowest

figures were recorded in Alma-Ata city (3.2 %), the Karaganda region (5.2 %), and the Pavlodar region (5.7 %).

The combination of fatality and mortality is particularly important. The Guryev region had the highest mortality rate in 1961, at 0.73 per 10,000 people. The Kyzylorda region followed with 0.52, the West Kazakhstan region with 0.48, and the Aktobe and Kustanay regions with 0.43 each. The Guryev and Kyzylorda regions had high rates of both mortality and fatality simultaneously, allowing them to be classified as territories with the most unfavourable epidemiological and treatment-diagnostic situation.

Unfavourable dynamics were particularly evident in the Aktobe, Guryev, Jambul and West Kazakhstan regions, where the absolute number of deaths increased despite a decrease in the number of cases. For example, the number of registered patients in the Jambul region decreased by 42.9 %, while the number of deaths increased from 13 to 19. In the Aktobe region, the incidence rate decreased by 46.8 %, while the number of deaths increased from 16 to 19. In the Guryev region, the number of deaths increased from 20 to 23. Such dynamics may indicate delayed detection of the disease, errors in initial diagnosis, untimely hospitalisation and delayed administration of diphtheria antitoxin.

In 1961, the Virgin Lands Territory accounted for 37.09 % of all deaths from diphtheria in the republic, with 118 deaths being registered there. Furthermore, the fatality rate here was 7.9 %, which is lower than the national average. However, the mortality rate of 0.37 per 10,000 population was higher than the national level. This shows that the Virgin Lands Territory's significant contribution to overall mortality was primarily determined by the scale of the disease rather than the severity of clinical outcomes.

Discussion

The first stage of research into diphtheria commenced in the 1950s and early 1960s, at a time when it was considered to be one of the most dangerous childhood infections. A.B. Aleksanyan [7], A.I. Titova [18] and V.I. Molchanov [19] have systematically reviewed the epidemiology, clinical picture and prevention of diphtheria in their works. The article by K.A. Kostina and F.G. Dardik provides a direct presentation of Kazakhstani material by offering an analysis of the state of the fight against diphtheria in the republic [20]. These works have a primarily practical medical and epidemiological focus and reflect the problems encountered at the start of the period of mass immunisation.

In the 1960s–1980s, the outcomes of anti-epidemic policy were summarised in the works of O.V. Baroyan [6] and in a collective monograph under the direction of L.A. Favorova [21]. The researchers examined the decline in incidence in the context of the development of sanitary and epidemiological services, the expansion of vaccination, and the formation of herd immunity. However, in such generalisations, Kazakhstan was usually presented as part of the All-Union dynamics, so intra-republican differences and statistical tables by region were not given full prominence.

A new stage in historiography is being marked by the epidemic resurgence of diphtheria in the post-Soviet space. Foreign authors C. Vitek and M. Wharton [22], as well as S. Dittmann and co-authors, analysed the causes of the outbreak and measures to overcome it [23]. G. Kembabanova and her colleagues conducted a special study of the 1990–1996 epidemic in Kazakhstan [24]. In the contemporary Kazakhstani literary corpus, the dynamics of the period spanning from 1990 to 2012 have been examined by A.B. Daniyarova and co-authors [25], while the state of vaccine-preventable infections has been examined by R.Kh. Begaidarova and co-authors [26]. While these publications are important for evaluating the long-term effects of immunisation, they focus primarily on the late Soviet and post-Soviet periods.

The works of Kazakhstani researchers are of particular importance for the subject. A. Zhalmurzina and colleagues employed archival material from the Akmola region from 1954–1965 to establish a correlation between the dissemination of infections, including diphtheria, and migration, personnel shortages, sanitary infrastructure, and the organisation of medical care [27]. The work of V. Kozina and colleagues provides a valuable complement to the regional aspect, offering insights into the sanitary and epidemiological situation in Tselinograd [28]. At the same time, the historiography contains practically no special republican analysis of diphtheria from 1958 to 1961 that combines regional and urban/rural data, age and vaccination data, clinical and laboratory indicators, and mortality data. The present study aims to address this gap in the existing literature.

Conclusions

The conducted analysis allows us to characterise the years 1958–1961 as a turning point, but internally contradictory stage in the fight against diphtheria in the Kazakh SSR. By the end of the 1950s, the

epidemiological situation remained tense. The reduction in cases in 1958 was not sustained, with 10,733 cases registered in 1959. Although mass immunisation did not immediately reduce the incidence of the disease, the number of cases decreased to 7,500 by 1960. In 1961, the rate of decline accelerated significantly. Therefore, rather than talking about the absence of a vaccination result, we should be talking about the gradual and uneven manifestation of its epidemiological effect.

However, the national average figures concealed significant territorial differences. Between 1959 and 1960, while the incidence was declining in some regions, it was increasing or declining slowly in others. There were also discrepancies in dynamics between urban and rural areas. Even in 1961, when the decline was almost universal, the intensive indicators remained above the national average in a number of regions. This demonstrates that a unified trend has emerged from various regional trajectories, influenced by differences in the timing and effectiveness of preventive measures, settlement patterns and the capacity of local healthcare systems.

The age distribution of those infected indicates that diphtheria remained a serious threat, particularly to children. The clinical structure of the disease, uneven coverage of laboratory testing, persistent cases of late diagnosis, and untimely administration of diphtheria antitoxin explain the presence of severe and fatal outcomes, including differences between urban and rural populations.

From the standpoint of the endogenous-primary approach, the effectiveness of mass immunisation was determined not only by the All-Union decision to implement it, but also by the internal capabilities of the republican (regional and district) healthcare systems, such as the organisation of vaccination, personnel and laboratory capacity, and the timeliness of diagnosis, hospitalisation and treatment. Thus, mass immunisation created the preconditions for a turning point in the epidemiological situation. However, 1961 should not be viewed as the moment of final victory over diphtheria, but rather as the beginning of the transition to the long-term control of the infection.

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