Ecology and health of the population in the city of Tselinograd in 1964 (the case of infectious hepatitis and typhoid fever outbreak)

Valeria Kozina[1], *Svetlana* Yeleukhanova[1], *Zhanna* Mazhitova[2*], *Aigul* Zhalmurzina[2] and *Dina* Kurbanova[2]

[1] Buketov Karaganda University, 100024, 28, University str, Karaganda, Kazakhstan
[2] Astana Medical University, 010000, 49a, Beybitshilik str, Astana, Kazakhstan

Abstract. The article examines the outbreak of infectious hepatitis and typhoid fever in 1964 in the city of Tselinograd. During the development of virgin and fallow lands a large number of people arrived in northern Kazakhstan. The urban infrastructure that existed at that time was not always able to provide the population with the necessary services, which often led to failure and the emergence of a difficult epidemiological situation. On the basis of statistical materials, the authors show an increase in the incidence of hepatitis and typhoid fever in the population in a short time, and also analyse the accompanying reasons. It is concluded that a gross violation of sanitary rules when choosing a place for the technical water intake and its connection to a drinking water supply on the territory of the railway junction was the main cause of the epidemic.

1 Introduction

Undoubtedly, the virgin lands campaign of the Khrushchev decade was controversial [1–12]. Today no one doubts major accomplishments in the development of the healthcare system in Kazakhstan during the reclamation of fallow lands [13–14].

The culture of a settlement is determined by its sanitary condition. This broad sanitary complex includes everything that directly or indirectly affects the life and health of the population of the city in recent years. The city of Tselinograd during the development of virgin and fallow lands in the 1950s – 1960s has grown significantly, but its sanitary condition remained unsatisfactory, as evidenced by the significant infectious morbidity of the population. Unsanitary condition of households, lack of sanitary installations, unauthorized dumps, old water intake system, and lack of sewage are the main reasons that created environmental and epidemic disadvantages in the city.

The city's water intake network was in a dilapidated state, as evidenced by the water analyses regularly studied by the city's sanitary and epidemiological services. There were 9 wells and 16 water intake boxes in the city. The equipment was old, the premises were

* Corresponding author: mazhitova_69@mail.ru

dilapidated, and none of the wells had chlorinators, which could be used to improve water quality if needed. Only 2 wells had protection zones. Four wells and 11 boxes required repair and improvement of the surrounding area. There were no public latrines in the city. Workers' settlements of the pumping plant and Kazakhselmash plant were in unsanitary condition. Such an unfavourable sanitary and epidemiological situation regularly provoked outbreaks of infectious diseases, one of which occurred in the city in 1964 [15].

2 Materials and Methods

The article is based on the general scientific principle, systematicity, and comparative-experimental analysis. In a methodological arsenal based on scientific and applied methods, we grouped the research into a chronological and thematic system. Interdisciplinary research principles have been taken into account for a full and comprehensive analysis of the problem. Statistical material is used extensively, with particular emphasis on comparative research and data.

3 Discussion of the results

3.1 The beginning of the epidemic

In the early 1960s, the incidence of infectious hepatitis in the city of Tselinograd stabilized at the same level, not exceeding 25–29 people per 1000 population. It was characterized by inherent epidemiological patterns of this infection, common to all countries. Until 1964, children's age groups accounted for 60–70% of the total morbidity. Monthly dynamics were characterized by a pronounced autumn-winter seasonality. These patterns were characteristic both for the territory of the railway junction, where the epidemic of infectious hepatitis and typhoid fever originated, and for the main part of the city [16]. See Table 1.

Table 1. Main indicators of the incidence of infectious hepatitis in the city of Tselinograd in 1961–1953.

	1961	**1962**	**1963**
Number of cases in the city	343	406	373
Indicators per 1,000 population	26.1	29.0	24.9
The share of children under 15 years old	70.2%	67%	65.8%
The share of fall and winter morbidity	62%	59%	68%

Until December 1963, the monthly morbidity rate did not exceed its level for 1962. From the second decade of December, an intensive increase in monthly morbidity in the city area was outlined. There were 35 cases (59 cases in 1962), in the area of the railway junction – 40 cases (10 cases in 1962).

In January 1964 the morbidity took on an epidemic character and for 3 months was expressed in the following data. See Table 2.

Table 2. Incidence of infectious hepatitis during the epidemic in the city of Tselinograd.

Number of cases	**December (Five Days period)**						**Total for December**
	I	**II**	**III**	**IV**	**V**	**VI**	
	9	10	13	17	34	39	122
	January (Five Days period)						Total for January
Number of cases	I	II	III	IV	V	VI	
	44	24	18	39	52	101	278
	February (Five days period)						
Number of cases	I	II	III	IV	V	VI	Total for February
	225	343	350	396	441	261	2016
Total							2416

Instead of the usual decrease in incidence in these months, it increased 16.5-fold in February compared to December, indicating interference in the epidemic process of factors of transmission unusual for the city. The intensity of the growth confirmed what was said. In some five-day periods more than 100 people fell ill: eight days in February were registered, when between 95 and 125 infectious hepatitis patients were detected daily.

It should be noted that the morbidity increased mainly among the adult population. While in the pre-epidemic years children under 15 years of age accounted for 60–70% of the total, in December 1963 this figure dropped to 30.3%, in January 1964 it was 19.8%, in February it was 12.7%. Within 3.5 months the morbidity of this group of children was only 14.7% of the total. See Table 3.

Table 3. Age structure of patients with infectious hepatitis during the epidemic.

Age groups (in years)								**Overall**
3 years old	**from 3–6 y.o.**	**7–14**	**15–19**	**20–29**	**30–39**	**40–49**	**50 years old and over**	
34	62	334	526	1185	428	155	100	2824
1.2%	1.9%	11.6%	18.5%	41.9%	15.1%	6.4%	3.4%	100

It should also be noted that in the most affected part of the city (the railway junction area) children accounted for only 13.2% of the total morbidity, and in the rest of the city this indicator was 32.8% [17–18].

According to the age peculiarities of the epidemic a slight spread of hepatitis in preschool organized groups was observed: 9-day care centres had one case each, 3-day care centres had 2–3 cases each, 18 kindergartens had 1–3 cases each, 10 child care centres had 1–4 cases each. Considering the driving forces behind the epidemic, it should be assumed that such an age structure of patients and low prevalence of infection in children's groups were predictable. Preschool children drink milk more often than water, and the latter is almost always boiled for them. This was especially true for organized children.

At the same time, it should be noted that a high incidence of disease in schools was also recorded in the territory of the railway junction:

School No. 63 – 76 cases
School No. 64 – 68 cases
School No. 22 – 63 cases
School No. 62 – 41 cases
School No. 20 – 40 cases
School No. 21 – 39 cases.

A characteristic feature of the epidemic was also the dispersion of diseases throughout the railway junction, the simultaneous involvement in the epidemic process of most of the streets in this area and the massive spread of disease in houses located on sections of the railroad. Streets of Monina, Sportivnaya, Moskovskaya, Rabochaya, Lininaya, Lesozavodskaya, Vodoprovodnaya, Kartalinskaya, Kommunalnaya, Sovetskaya Konstitutsii, Mir, Schmidt (those near the railroad) were particularly affected by hepatitis.

When analysing the incidence of disease in enterprises and institutions of the city high levels in teams located on the territory of the railway junction drew attention to its:

depot No 1 – 130 cases
timber works – 60 cases
road service administration – 60 cases
building and assembly train – from 30 to 53 cases
station – 41 cases and others.

In addition, a high incidence of the disease was noted among drivers and workers of construction sites working near the railway junction:

motor depot number one – 24 cases
motor car park – 15
motorcade – 11
construction sites – 22 to 43 cases.

Analysis of the incidence of infectious hepatitis depending on the source of water supply indicated a clear difference between the incidence rates in the two parts of the city, which differed only in water supply. See Table 4.

Table 4. Incidence of infectious hepatitis depending on water sources during the pandemic.

Total number of patients	Get water from the city water supply system (live and work in the city)	Get water from water supply system		Get mixed water (live in town, work on the railways)	Get imported water	
		live and work on the railroad	live on railways work in the city		on the railroad	in the city
2824	224	1649	652	79	17	203
100.0%	7.9	58.4	23.1	2.8	0.6	7.2

Thus, in 84.3% of cases, the disease was associated with water obtained from the railway water supply system. In 7.8% of cases, people used imported water. It should be noted that the conditions of water delivery were completely unsatisfactory from a sanitary and hygienic point of view, i.e., passportisation of the vehicles that delivered technical and drinking water was not done; the persons working on the water delivery were not medically examined and investigated; water was often delivered to boiler rooms, where both technical and tap water were stored simultaneously; disinfection of the container after the technical water was not performed; when interviewing sick people it was found that water was often delivered mixed from the station or directly from the Ishim River and city stand-pipes (224 patients) [18].

Only 7.9% of cases were among those working and living in the city and using the city's water supply. Of this number, 163 patients were interviewed. It was found out that in 107 cases the patients indicated the occasional use of tap water (from relatives, casual friends due to work, change of the place of residence); in 44 cases patients indicated the occasional use of imported water and only in 12 cases there were no diseases related to poor quality of tap water.

The increase in the incidence of infectious hepatitis was accompanied by some growth in the whole group of acute intestinal diseases, which is typical for these epidemics. In this case this growth was not pronounced. According to statistics, the maximum of acute

intestinal infections in 1963 was noted in August, but it was also lower than in previous years. After a slight decrease in September, the level remained stable and during October-December the morbidity was higher than in the same months of previous years. See Table 5.

Table 5. Incidence of acute intestinal infections in the city of Tselinograd.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Over all
1961	70	57	49	102	159	207	301	591	455	217	93	89	4390
1962	43	90	111	107	116	156	398	841	411	266	151	107	2817
1963	74	144	166	166	171	214	289	469	272	261	214	190	2603

Thus, according to the official registration in 1963, the growth of acute gastrointestinal infections was noted, as in previous years, in August, but, nevertheless, their number was lower than in previous years. However, after some decrease in September-December months, it should be stated that the morbidity rate was still higher than in the same months of previous years.

In addition, a significant number of acute gastrointestinal infections and intoxication were also reported by emergency care in the second half of the year. See Table 6.

Table 6. Acute intestinal infections, food intoxications and poisonings reported by ambulance and emergency services in 1963.

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Overall
110	110	129	148	196	219	346	282	233	151	258	226	2408

Some of those who fell ill did not seek medical help, while others had other diagnoses (gastritis, etc.).

As for typhoid morbidity, during this epidemic, there were regularities that distinguished the development of this infection from known epidemics and outbreaks. Such a main distinguishing feature of typhoid fever in the city of Tselinograd was that the growth of morbidity, contrary to assumptions, did not begin before infectious hepatitis. Not even isolated cases were detected during a month and a half of hepatitis epidemic. Only in the period of maximum development of the epidemic, that is, in early February, during the unusual season for typhoid, this infection manifested itself with a high rise. Such delayed development of an epidemic outbreak of typhoid fever in the city of Tselinograd can be explained by the following circumstances. Tselinograd can be explained by the following circumstances. Firstly, during the 3 preceding years the city of Tselinograd was free from typhoid fever. During 1963, 2 cases of the disease and 2 cases of bacterial carriage were registered. In previous years, the incidence did not exceed 8–12 cases per year. Consequently, the number of sources of infection to the city territory was limited in comparison with other cities of the republic [19].

Secondly, the joint course of the two epidemic outbreaks of typhoid and epidemic hepatitis, the homogeneous onset of both diseases in a few cases complicated the diagnosis of typhoid fever.

Thirdly, apparently, later manifestations of typhoid fever rise depended to some extent on the properties of the causative agents of the two infections, especially in the harsh winter conditions of the city of Tselinograd.

Since the last days of January 1964 cases of typhoid fever were registered almost daily. During this period 92 persons were hospitalized with suspected typhoid fever, of whom 47 cases of typhoid fever were confirmed and 10 of whom the diagnosis was cancelled.

The attachment of the majority of cases to the territory of the railroad is characteristic. Of the total number of patients – 39 people lived in the territory, which received water from

the railway water supply system, 2 studied in the same territory, 4 – indicated the use of imported water for drinking.

Of the total number of patients in 14 cases there were mixed infections, that is, a parallel disease of typhoid fever and infectious hepatitis. In one case there was hepatitis with dysentery. In 8 cases, when analysing medical records, the presence of concomitant acute intestinal diseases, the etiology of which remained unclear, was found. The case records indicated that these patients had frequent liquid stools for 2–3 days, some of them had mucus and blood.

Based on the analysis of morbidity, epidemiological and sanitary examination of the outbreaks, interviews with patients, laboratory tests, we can conclude that the epidemic of infectious hepatitis and typhoid fever in the city of Tselinograd was of waterborne nature. Spread of hepatitis and typhoid fever through food products was excluded, since the population of the city and the railway junction were provided with food products from common enterprises. Milk and dairy products were supplied to the population from a single urban dairy plant. Children, who were the main consumers of milk, accounted for 3% of the total number of patients; in preschool children's groups hepatitis cases were sporadic.

An epidemic of infectious hepatitis and typhoid fever resulted from the connection of the technical water supply system to the drinking water supply system on the territory of the railway junction, which is confirmed by epidemiological and sanitary and hygienic analysis data.

The emergence of a significant number of typhoid fever patients in a relatively short period of time against a background of previous well-being with respect to this infection, its rapid increase mainly in a certain area, the dispersion of diseases – all this indicated the commonality of causes, which caused the epidemics of infectious hepatitis and typhoid fever under consideration.

3.2 Epidemiological data confirming the aquatic nature of the epidemic

1. A sharp increase in the incidence of the disease in a short period of time, observed against the background of the beginning of the seasonal decline in the incidence of infectious hepatitis.
2. Emergence of the epidemic in an unusual season of the year for the area.
3. Limited territorial spread of morbidity and attachment of 83.4% of cases to the railroad water supply system.
4. One-stage involvement in the epidemic process of the majority of the city streets supplied by the railway water supply system.
5. One-stage occurrence of infectious hepatitis outbreaks in schools, enterprises, institutions supplied by railway water supply (up to 100–130 cases).
6. Insignificant morbidity in young children and limited spread of disease in preschool groups.

Parallel some growth of the whole group of acute intestinal diseases and the occurrence of an epidemic outbreak of the typhoid type.

3.3 Sanitary and hygienic and laboratory data confirming the aquatic nature of the epidemic

1. Establishing the fact of existence of 13 places of connection of technical water pipeline to drinking water pipeline on the territory of the railway junction, through which technical water was systematically released (from June for several hours a day), releasing up to 2–2.5 thousand cubic meters of technical water.

2. The highest incidence in those places, where there were connections: depot No 1, timber processing plant, Lesozavodskaya and Kommunalnaya streets and others. Due to the lack of documentation on the places of connections, connection of technical water pipeline with the drinking water pipeline was made for more than a month since the prohibition.
3. Unsatisfactory laboratory indicators of the quality of water supplied to the population from the technical water supply system, as well as from the water supply network of the railway drinking water supply system (50% of analyses in January-February did not meet GOST standards).
4. The sanitary service of the railroad performed unsatisfactory control over the quality of water supplied to the population. There was no production laboratory for water analysis on the railroad. The existing chlorination system on the technical water supply line did not provide the required contact of water with chlorine, the required exposure and sufficient quantity of residual chlorine. As a result, the coli-titer of water before and after chlorination was 0.0004, which indicated the absence of a minimal bactericidal effect in the process of water chlorination.
5. Gross violation of sanitary rules when selecting the location of water intake of technical water pipeline, used for drinking purposes for a long time. The place of water intake was the Ishim River, downstream of the city's household fecal drains. Each day through the influx of Sary-Bulak in Ishim discharged up to 6000 cubic meters of sewage. Wastewater flooded by filtration fields of the territory, with a slope towards Ishim was also discharged here. The first breakthrough of filtration fields took place on December 25, 1963, the second – January 10, 1964. These, in fact, were the moments of the most massive fecal pollution of the river Ishim.
6. On November 27, 1963 the Ishim River was covered with ice, under which the water intake of the technical water pipeline was located. In the depression formed in the river, wastewater accumulated, which in connection with the freeze-up was not diluted, and in fact in the technical water pipeline received concentrated effluents.
7. Interviews with 842 patients and analysis of epidemiological cards of more than 1000 cases of epidemic hepatitis showed that in January and February 1964 the population noted particularly unsatisfactory quality of drinking water: smell of excrement, putrid smell (especially when heating such water), unpleasant taste, yellow colour, appearance of mold after a few hours, sometimes colour grayish-green. It was impossible to cook food with such water.
8. When interviewing patients, it was found that in those houses where there was a water supply system, the water was intermittent. As a result, residents were forced to turn to random water sources: imported water, boiler house, etc. The water here was of questionable quality, brought from the station, directly from the river Ishim and other places. Transport for bringing technical and drinking water was not passported. Persons working on water delivery were not examined and examined.

In general, water supply to the population in the city of Tselinograd was unsatisfactory. In general, the water supply to the population in the city of Tselinograd was unsatisfactory: water was insufficient, and there were almost daily interruptions in water supply. The available water supply network did not meet the minimum sanitary requirements, and accidents often occurred.

3.4 Organizational arrangements

Immediately after the outbreak of typhoid and hepatitis, the health authorities provided information to the local executive committees about the state of the disease and the causes of the outbreak. In January, emergency anti-epidemic commissions were established in the city and on the railroad, with the task of investigating the causes of the outbreak and gross

violations of water supply to the population of the city of Tselinograd. The sanitary-epidemiological service team conducted an in-depth epidemiological analysis of the incidence of infectious hepatitis and acute intestinal diseases and developed a map of outbreaks with the mapping of the water supply network. All this made it possible to clarify the causes and formulate conclusions about the nature of the outbreak [19–20].

3.5 Laboratory activities

During the outbreak of hepatitis in the city of Tselinograd a biochemical laboratory was organized at the 2nd Infectious Disease Clinical Hospital in Tselinograd for the purpose of laboratory diagnosis of Botkin's disease. From February 4 to 11 the biochemistry tests were carried out for bilirubin by Van Der Berg method. From February 13, aldolase, transaminase, and bilirubin tests by the Jendrashik method started. The aldolase studies were organized by doctors arrived from the Moscow Institute of Virology. Under the guidance of senior researcher E.A. Pactoris and laboratory assistant J.M. Demina, they conducted a series of studies. They also brought reagents to study aldolase. Studies on bilirubin (Jendrashik method), transaminase and thymol sample were helped by local sanitary and epidemiological workers of Almaty Tuberculosis Institute under the guidance of L.B. Shefer and biochemist N.L. Chepur.

With the emergence of cases of typhoid fever, mass work was carried out to identify patients, contact and bacteriostainers of typhoid type, and tests of water, foodstuffs and washouts for pathogenic microflora were organized. In order to carry out this work, a group of bacteriologists arrived in the city of Tselinograd. Work on laboratory diagnosis of typhoid fever was carried out on the basis of the laboratory of the city sanitary and epidemiological station and the 2nd clinical united hospital.

During the outbreak 94 inpatients were tested for blood culture (of whom 19 were positive), while 180 outpatients were tested for blood culture (no positive results). It should be noted that blood tests for blood culture in febrile outpatients were not conducted in January, in February only 12 were tested in the city.

There was late timing of blood sampling (in the 2nd and 3rd weeks), and in the hospital – after antibiotic treatment had started. Blood was taken in small amounts, the blood-to-media ratio was not observed. Over time, all these shortcomings were eliminated. Biliary bile tests were organized, which had not been done before.

A significant disadvantage that could not help but have an impact on the ability to detect the presence of the disease was the improperly organized sampling of material due to the lack of a sanitary unit (sampling point) in the city laboratory. As a consequence, there was no possibility of control.

13 isolated typhoid cultures were prototyped. Phagotypes prevailed (8 such cultures), 5 cultures were not typable. 6 cultures were sent for phagotyping to Almaty. 108 Vidal reactions were performed (of which 13 were positive).

Since March 8, 1964, water testing for the presence of typhoid paratyphoid and dysentery bacteria using membrane filters for bacteria concentration was organized and conducted.

During this period, a total of 41 water samples from various water sources of the city (mainly water pipes and wells of large food facilities) were tested; no pathogenic flora was isolated [18].

Water was tested for coli-titer. Out of 495 bacteriological tests of water with low coli-titer 58 samples were examined, including: 178 (positive – 24) from the city water supply system, 140 (positive – 12) from the well water – 20 (positive – 9), 44 (positive – 13) from the drinking cisterns, 13 (positive) from the open reservoirs. Water with low coli-titer was mainly found in oil refrigerator, drinking cisterns of kindergartens and schools.

The most unfavourable among the children's institutions surveyed was secondary school No. 22, where E. coli was detected in the washouts even from drinking cisterns and mugs.

It should be noted that the measures organized by the city sanitary and epidemiological service (hospitalization and disinfection, instruction of medical personnel, chamber treatment of patients' belongings and bedding, reprofiling of hospitals, creation of disinfection stations, etc.) eventually stabilized the difficult epidemiological situation and eliminated the focus of the epidemic.

4 Conclusion

The commission consisting of sanitary doctors and epidemiologists of the Republican Sanitary and Epidemiological Station investigated the causes of the epidemic of infectious hepatitis and typhoid fever in the city of Tselinograd. The commission established to investigate the causes of an epidemic of infectious hepatitis and typhoid fever in the city of Tselinograd, by interviewing patients and the population, found complaints of unsatisfactory organoleptic quality of drinking water supplied by the water supply system of the railway junction. The laboratory examination of the water from the railway water supply points showed a low coli-titer (0.0004 as of February 12, 1964) and unsatisfactory organoleptic quality. Inspection of the water intake of water facilities (softening stations) was found that the technical water intake took water from the river Ishim below the city, at a distance of 1400 meters from the place of discharge of municipal sewage. The supplied water was not treated, chlorination was not systematic and uncontrolled. Consumption of drinking water mixed with heavily contaminated technical water by the population had a negative impact on the ecology and health of the urban population and caused an epidemic of infectious hepatitis and typhoid among the population living in the areas supplied with water from the railway water supply system.

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