The seventh pandemic of cholera in the USSR, 1961–89

M.I. Narkevich,1 G.G. Onischenko,2 J.M. Lomov,3 E.A. Moskvitina,4 L.S. Podosinnikova,5 & G.M. Medinsky6

Over the period 1961–89 a total of 1 713 057 cases of cholera were reported to WHO from 117 countries in all continents. The course of the epidemic fell into three periods: in period I (1961 to 1969), 24 countries (predominantly in Asia) reported about 419 968 cholera cases; in period II (1970 to 1977), 73 countries from Asia, Africa, Europe, and the Americas reported 706 261 cases; and in period III (1978 to 1989), 83 countries reported 586 828 cases. The global epidemic was at its most severe in 1967–74. Subsequently morbidity declined and up to 1989 had remained high and stable, with 44 000–52 000 cases per annum.

In the USSR 10 723 cholera cases and carriers were reported between 1965 and 1989 from 11 republics (but not Latvia, Lithuania, Estonia, or Armenia). In 1965 and 1970–74 large-scale outbreaks of imported cholera were characteristic of the epidemic in the USSR. Thereafter morbidity declined, and sporadic cases were reported along with environmental, predominantly nontoxigenic strains of cholera vibrio. Most of the outbreaks in the 1970s were waterborne, and virulent strains containing the vct-gene were isolated from samples of water. Large-scale outbreaks continued that were associated with seafood and dairy produce that were contaminated with cholera vibrio. Clinical cases of cholera as well as a considerable number of carriers of avirulent nontoxigenic strains were reported.

The epidemiological situation in the USSR is unstable, with cases of cholera and virulent strains from surface water being reported every year. Cholera control measures in the USSR have been modified considerably over the period of the pandemic, resulting in a reduction in the socioeconomic costs of preventive and anti-epidemic measures. The USSR has been regionalized into three epidemic types based on the risk of outbreaks and spread of cholera, intensity of migration, and the type and severity of epidemic. Also the control and preventive measures have been differentiated, taking into account the virulence (vct-gene) of cholera vibrio strains isolated from cholera patients and carriers.

Introduction

The global cholera situation is still far from satisfactory, as evidenced by reports in the WHO Weekly epidemiological record of epidemics, outbreaks, and sporadic episodes of imported infections in different countries. It is now time to summarize the lessons learned from this seventh pandemic of cholera (9). We report the results of an analysis of the general cholera situation in the world and, in particular, in the USSR, using data from WHO and the Ministry of Health of the USSR, and of the changing patterns of epidemics. For the USSR we have attempted to characterize the 28-year epidemic in order to regionalize the country with regard to the disease risk and differentiation of preventive measures, including epidemiological surveillance.

The seventh global pandemic of cholera began in 1961. Over the period 1961–89 a total of 1 713 057 cases of cholera were reported to WHO from 117 countries. The most infected areas appeared to be Asia and Africa where 1 265 906 and 473 659 cases, respectively, were reported. Epidemics and outbreaks were also reported from Europe (4879 cases), the Americas (93 cases), and Australia and Oceania (4516 cases). However, these figures do not necessarily reveal the real spread of the pandemic, since the data reported to WHO were for identified cases only and not the total number of individuals affected.

1 Chief, Epidemiological Department, in former USSR Ministry of Health, Moscow, Russian Federation.
2 Deputy Chief, Epidemiological Department, in former USSR Ministry of Health, Moscow, Russian Federation.
3 Director, Rostov Anti-plague Research Institute, Rostov-on-Don, Russian Federation.
4 Senior Research Worker, Rostov Anti-plague Research Institute, Rostov-on-Don, USSR. Requests for reprints should be sent to this author at the following address: M. Gorkogo 117, 344007 Rostov-on-Don, Russian Federation.
5 Senior Research Worker, Rostov Anti-plague Research Institute, Rostov-on-Don, Russian Federation.
6 Consultant, Rostov Anti-plague Research Institute, Rostov-on-Don, Russian Federation.
Reprint No. 5373
The pandemic fell into three general periods: period I — from 1961 to 1969; period II — from 1970 to 1977; and period III — from 1978 to 1989 (Fig. 1).

The severity was highest over the period 1967–74. Morbidity then declined until 1985, and up to 1989 it remained rather high and stable. WHO reported about 44 000–52 000 cholera cases from 26–36 countries over the period 1985–89. In period I, 24 countries, predominantly in Asia, reported about 419 968 cases of cholera to WHO, while during period II, 73 countries (27 in Asia, 32 in Africa, 12 in Europe, and 2 in the Americas) reported about 586 828 cases.

These data show that the cholera situation is still far from satisfactory, especially in Asia and Africa, where new centres of endemicity became established and large-scale epidemics and outbreaks were reported.

Epidemiologically the seventh pandemic of cholera has lasted longer than the previous six pandemics. The causative agent is 

\textit{Vibrio cholerae} biotype eltor (5), although outbreaks caused by \textit{V. cholerae} were reported from Bangladesh in 1981, 1983 and 1988 (16). The large number of affected countries is characteristic of spread by intensified migration (12).

**Cholera in the USSR**

Between 1965 and 1989 a total of 10 723 cases of cholera and carriers of the disease were reported from 11 Soviet Republics, but not from Latvia, Lithuania, Estonia, or Armenia (Table 1).

The epidemic falls into three periods, which coincide with those of the world pandemic; period I: 1965–69; period II: 1970–77; and period III: 1978–89 (Fig. 1).

The pandemic in the USSR was preceded in 1964 by large-scale epidemics of cholera in a number of Asian countries, some of which have a common border with the Soviet Union. In the USSR itself the first outbreak was reported in 1965 in the Karakalpakskaya ASSR and the Khorezm region of Uzbekistan. The epidemic in Uzbekistan was caused by infection imported from Afghanistan (1). Local outbreaks and sporadic cases of cholera occurred subsequently in Uzbekistan (1968), Turkmenistan (1969) and some regions of Russia (1969). During this period a number of cholera strains were isolated, mainly from surface water in these territories as well as in Azerbaijan and in the Krasnodar region.

In the period 1970–77 cholera spread intensively, with outbreaks being reported from more than 80 regions of the country.

The peak occurred in 1970 when 3989 cases and carriers were reported; this coincided with intensification of the global pandemic. The infection was introduced to Odessa, Kerch, Astrakhan (8, 10), and Batumi in 1970, followed by its spread from these foci to 38 cities in the same year, despite cholera control measures. Cholera was also imported to Azerbaijan from India, Jordan, and Iran (1970–72), and to the Kemerovo region from Egypt (1975).

Large-scale outbreaks occurred in 1970–71 along the river Volga (5584 cholera cases and carriers) and in the Ukraine (785), Georgia (53), Azerbaijan (42), and Tajikistan (41). Subsequently, cholera spread into new territories, causing outbreaks in the north Caucasus (1090 cases and carriers), in the region of the rivers Volga and Viatka (594), and in western Siberia (226). The annual incidence of cholera in the USSR varied from 0.001 per 100 000 in 1977 to 0.8 per 100 000 in 1979.

The intensity of the epidemic depended upon the mode of transmission. Most outbreaks in the 1970s were waterborne (water for recreation purposes, drinking-water and surface water contaminated with untreated sewage). A characteristic of the waterborne epidemics in the 1960s and 1970s was that virulent strains of \textit{V. cholerae} containing the toxigenic \textit{v}et\-gene were repeatedly isolated from patients and samples of water.

Large-scale outbreaks of cholera were also asso-
associated with the consumption of seafood and dairy produce contaminated with cholera vibrios (8). Foodborne infection was prevalent in the Caucasus and Transcaucasus areas, where clinical cases caused by virulent toxigenic strains of cholera vibrio occurred and a considerable number of carriers of avirulent nontoxigenic strains were recorded.

Since 1977 the number of cases of cholera has declined. Local outbreaks have, however, been reported from Uzbekistan (in 1982), Azerbaijan (in 1985 and 1989), Ukraine (in 1986), and Russia (in 1981 and 1990).

Between 1970 and 1980 environmental strains of cholera vibrio were isolated from 134 districts and 13 Soviet republics (Table 2). In recent years virulent and toxigenic strains of cholera vibrio have been isolated only in some regions of Uzbekistan, Russia, Ukraine, and Kazakhstan, and the proportion of virulent toxigenic strains declined from 48.9–74.5% in the 1970s to 4.0–0.8% in 1984–89. In the absence of cases of cholera in the majority of territories, these data suggest that the causative agent is persisting in undiagnosed carriers of patients with mild cases of the diseases.

In 1987 the importation of cholera to Moscow, Leningrad and Sochi did not cause the spread of infection.

In 1990 several outbreaks of cholera were reported in the USSR. In Stavropol, a waterborne outbreak occurred caused by the underground contamination of a spring with sewage. The cholera control measures that were taken prevented the spread of the epidemic although the infection was carried out of the initial focus to Perm, Moscow, Krasnodar, Volgograd, and to Altai Territory.

A local outbreak of cholera in the Rostov region in 1990 occurred after water from the river Don that had been drawn downstream from an emergency outlet for untreated sewage was drunk and used for household purposes. In view of this, and the increasing occurrence of environmental pollution, the cholera situation for some regions of the country can be considered to be unstable. This makes surveillance and the development of a cholera control strategy more important.

### Cholera control

#### Development of control measures in the USSR

During the seventh pandemic the system of cholera control and prevention changed significantly in the USSR. Expensive, low-efficacy measures were abandoned or limited. For example, in 1965 during the cholera epidemic in Afghanistan, the Soviet-Afghan frontier was closed, with the result that the economies of both countries suffered. Also the quarantine regulations for preventing the importation of cholera and the dissemination of the disease from foci were not always epidemiologically adequate, and had significant economic consequences. For example, in 1965–70 the transportation of foodstuffs and of food parcels was not allowed.

#### Table 1: Cholera in the republics of the USSR, 1965–89

<table>
<thead>
<tr>
<th>Russia</th>
<th>Ukraine</th>
<th>Uzbekistan</th>
<th>Kazakhstan</th>
<th>Turkmenistan</th>
<th>Tajikistan</th>
<th>Kirghizia</th>
<th>Georgia</th>
<th>Azerbaijan</th>
<th>Moldavia</th>
<th>Bolorussia</th>
</tr>
</thead>
<tbody>
<tr>
<td>7720 (72.0)*</td>
<td>1337 (12.5)</td>
<td>820 (7.5)</td>
<td>192 (1.8)</td>
<td>170 (1.6)</td>
<td>56 (0.5)</td>
<td>7 (0.06)</td>
<td>73 (0.7)</td>
<td>253 (2.4)</td>
<td>72 (0.7)</td>
<td>23 (0.2)</td>
</tr>
</tbody>
</table>

* Figures in parentheses are percentages.

#### Table 2: Environmental Isolates of cholera vibrio in the USSR, 1970–89

<table>
<thead>
<tr>
<th></th>
<th>Surface water</th>
<th>Sewage</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>142</td>
<td>116</td>
<td>258</td>
</tr>
<tr>
<td>1971</td>
<td>249</td>
<td>192</td>
<td>441</td>
</tr>
<tr>
<td>1972</td>
<td>370</td>
<td>383</td>
<td>753</td>
</tr>
<tr>
<td>1973</td>
<td>470</td>
<td>535</td>
<td>1005</td>
</tr>
<tr>
<td>1974</td>
<td>1162</td>
<td>667</td>
<td>1829</td>
</tr>
<tr>
<td>1975</td>
<td>1134</td>
<td>281</td>
<td>1415</td>
</tr>
<tr>
<td>1976</td>
<td>1355</td>
<td>445</td>
<td>1800</td>
</tr>
<tr>
<td>1977</td>
<td>1450</td>
<td>637</td>
<td>2087</td>
</tr>
<tr>
<td>1978</td>
<td>1423</td>
<td>735</td>
<td>2158</td>
</tr>
<tr>
<td>1979</td>
<td>1573</td>
<td>104</td>
<td>1677</td>
</tr>
<tr>
<td>1980</td>
<td>1143</td>
<td>190</td>
<td>1333</td>
</tr>
<tr>
<td>1981</td>
<td>1066</td>
<td>76</td>
<td>1142</td>
</tr>
<tr>
<td>1982</td>
<td>847</td>
<td>16</td>
<td>863</td>
</tr>
<tr>
<td>1983</td>
<td>969</td>
<td>32</td>
<td>1001</td>
</tr>
<tr>
<td>1984</td>
<td>735</td>
<td>17</td>
<td>752</td>
</tr>
<tr>
<td>1985</td>
<td>1187</td>
<td>75</td>
<td>1262</td>
</tr>
<tr>
<td>1986</td>
<td>1017</td>
<td>118</td>
<td>1135</td>
</tr>
<tr>
<td>1987</td>
<td>1074</td>
<td>49</td>
<td>1123</td>
</tr>
<tr>
<td>1988</td>
<td>1027</td>
<td>45</td>
<td>1072</td>
</tr>
<tr>
<td>1989</td>
<td>1252</td>
<td>16</td>
<td>1268</td>
</tr>
</tbody>
</table>

Total 19 645 4729 24 374
In the 1970s serious attention was paid to the bacteriological examination and medical-surveillance of persons who had travelled from cholera-affected regions. For example, in 1970–74 a total of 19,041 Soviets and 722,781 foreigners arrived in the USSR from cholera-infected countries; of these, 18,289 Soviets and 2,765 foreigners were examined bacteriologically for cholera, while 18,826 and 13,228, respectively, underwent medical surveillance. Although it appeared that 0.07% of the Soviets and 1.2% of the foreigners had signs of diarrhoea, no cholera cases or vibrio carriers were documented.

In the 1980s this strategy was modified to examination of Soviets and foreigners who developed signs of acute intestinal disease within 5 days of arrival in the USSR from cholera-infected countries.

The provision of strict quarantine barriers about cholera foci and the close observation of people who left such areas proved to be unnecessary (10). Thus, use of such measures to prevent the dissemination of cholera in 1965 in Uzbekistan and in 1970 in Odessa, Kerch, Astrakhan, Novorossiyskiy, Makhach-Kala and other territories did not always match the epidemiological situation. In particular, the quarantine measures in Novorossiyskiy and Makhach-Kala were not appropriate, since only local outbreaks (13 and 12 cases, respectively) were reported. As a rule, the measures suppressed the economies of the regions affected; for example, as a result of an 18-day quarantine, the port of Novorossiyskiy was fined 1.5 million roubles caused by the associated delays in cargo operations.

The costs of quarantine measures in Karakalpak ASSR in 1965 and in Odessa in 1970 were 73.6% and 72.6%, respectively, of all expenses resulting from the cholera outbreaks in these areas. In Odessa from the observational measures and checkpoints at the border of the focal areas accounted for most of the costs, while demurrage and cancellation of sea trips amounted to 11.9 million roubles. The socioeconomic expenses of quarantine in Karakalpak ASSR in 1965 amounted to 26.9 million roubles.

These data support Cvjetanović’s statement that the economic losses caused by cholera are greater than might be expected, because of the use of irrational control measures (15).

The one consistent feature of the quarantine regulations was the medical observation of people who left the focus of the infection. Thus, in Kerch 37,524 people were observed and examined bacteriologically, in Odessa, 211,583, in Makhach-Kala, 17,622, and in Novorossiyskiy, 2,387; the proportion of carriers was 0.07%, 0.05%, 0.01% and 0%, respectively.

Taking into account lessons gained from cholera epidemics elsewhere, the quarantine measures in the USSR were replaced by several restrictive measures which depended upon the type and intensity of the epidemic (6, 8). Bacteriological examinations of people in order to identify vibrio carriers, which had been practised in the 1970s on a large scale during and soon after outbreaks, appeared to be unnecessary. From 1975 onwards more attention was paid to epidemiological surveillance directed towards locating cholera cases and carriers in a reasonable length of time, detecting cholera vibrios in the environment, identifying the factors that influenced the spread of an epidemic, and drawing up recommendations for planning and fulfilling preventive measures as well as evaluating their effect.

Analysis of the clinical and bacteriological data accumulated over many years permitted a reduction (from 1 year to 3 months) in the period of medical surveillance for patients who had recovered and for vibrio carriers.

The approach to emergency antibiotic treatment of cholera in the USSR also changed during the seventh pandemic. Although Zukov-Verezhnikov & Kovaleva considered that mass emergency treatment was the principal reason for the elimination of the cholera epidemics in Karakalpak ASSR in 1965 and in Odessa in 1970 (4), this measure is, however, questionable, in view of the possible emergence of drug-resistant strains (9, 14), its short-term effects, and its ineffectiveness for treating waterborne cholera (11). Only the selective emergency treatment of contacts and persons with the same risk of illness as the patient (carrier) is advisable, and emergency treatment with antibiotics is therefore now used only as an auxiliary means of preventing cholera.

Since the epidemiological and immunological effects of the whole-cell cholera vaccine and of the cholera-gene-anatoxin used in the USSR in the 1970s appeared to be rather low, potent, safe vaccines are required.

The evolution of the main cholera control measures in the USSR over the period 1965–91 is shown in Fig. 2.

The improvement in the control measures and the establishment of an epidemiological surveillance system reduced the costs of eliminating outbreaks. For instance, the socioeconomic costs of anti-cholera measures were 36.6 million roubles in 1965 in Karakalpak ASSR (Uzbekistan), 57 million roubles in 1970 in Odessa, and 484,240 roubles in 1989 in Azerbaijan.

The next step was the differentiation of preventive measures (and of epidemiological surveillance) on a territorial basis, depending on the virulence (toxigenicity) of the isolated cholera vibrios.
Regionalization of the USSR based on the type of cholera epidemic

Retrospective epidemiological analysis of cases of cholera and of environmental cholera vibrios reported from 117 territories of the USSR over the period 1965–89, as well as a study of the presence of the vct-gene in cholera vibrios, permitted three main types of cholera epidemic to be identified.

Epidemics of type I. In type I territories the import of cholera in 1965 and in the early 1970s caused acute outbreaks of 100–500 cases followed by spread of the disease to other regions. In the 1980s sporadic cases and local outbreaks were repeatedly reported in these territories.

A total of 66.2% of all cholera cases were reported from type I territories and the annual incidence of the infection was 68.7 per 100 000 population.

WHO Bulletin OMS. Vol 71 1993 193

The water supply and sewage facilities in most towns and villages in the USSR are unsatisfactory. Epidemiological analysis of the water supply and of water for recreational purposes revealed that in a number of territories there is still a high risk of waterborne spread of cholera (7). The Escherichia coli index was 1000–10 000 times higher than normal in water intended for recreational purposes, and the discharge of untreated sewage into surface water reservoirs is still taking place.

Cholera vibrios have been repeatedly isolated from some surface waters for up to 24 years and from sewage for up to 16 years. For most of the territories involved, seasonal recovery of cholera vibrios from surface water occurs from May to October, while for other territories cholera vibrios are isolated for 9 months of the year. The period over which cholera vibrios were recovered from surface waters exceeded that for the recovery from sewage in all territories. The conditions in some surface water reservoirs were therefore suitable for the survival of cholera vibrios (2). In some territories there is evidence for the established persistence of cholera.

Type I territories still have a high risk of outbreaks of cholera and of the imported infection. The spread of infection is influenced to a great extent by climatic, geographical, sanitary and social conditions. Some territories have a high transient population—at ports, through international tourism, health resorts, extensive transport connections—as well as surface waters that originate from abroad, including cholera-affected countries.

In the 1970s most cholera vibrios isolated from patients and carriers in type I territories were toxigenic, while in the 1980s toxigenic as well as non-toxigenic strains were isolated. The proportions of toxigenic strains isolated from patients during various outbreaks were as follows: 95% in Odessa (1970), 70% in Kerch (1970), 100% in the Mary region of Turkmenistan (1972), 5.4–15% in Uzbekistan (1987 and 1988), and 100% in Nakhichevan ASSR (1989) and the Rostov region (1990). Both toxigenic and nontoxigenic cholera vibrios are repeatedly isolated from samples of surface water and sewage.

It should be noted that type I territories occupy only 3.3% of the total area of the USSR (775 100 km²) and that their population is 20.9 million (7.6% of that of the USSR).

Epidemics of type II. In type II territories, the import of cholera in the 1970s resulted in local outbreaks of 10–100 cases; in the 1980s mainly sporadic episodes together with a few outbreaks were reported.

Type II territories consist of two subtypes — type A, the more common, where the spread of cholera is predominantly waterborne, and type B,
where the spread is attributed to contamination of food and household items.

In 1965–89, the proportion of cholera cases from type II territories was 16% of the total in the USSR (9% from subtype A and 7% from subtype B) and the annual incidence was 11.9 and 1.5 per 100,000, respectively.

In subtype A territories cholera vibrios have been repeatedly recovered from June to September from surface waters for periods of 12–14 years and from sewage for 5 years. Persistent outbreaks of cholera did not become established. Predominantly toxigenic strains were isolated from individuals, while both nontoxigenic and several toxigenic strains were found in the environment.

In subtype B territories mainly nontoxigenic strains of cholera vibrio have been recovered from June to August from surface waters over a 2–11-year period and from sewage for periods of up to 3 years. Toxigenic as well as several nontoxigenic strains of cholera vibrio were isolated, and the risk of outbreaks and of infection spread was high.

Type II territories occupy 8.2% of the total area of the USSR (1.83 million km²) and their population amounts to 66.7 million (24.1% of that of the whole country).

Epidemics of type III. Type III territories occupy 19.8 million km² (88.5% of that of the USSR) and their population is 188.734 million (68.3% of that of the USSR). There are three subtypes: subtype A, where cholera is imported without its subsequent spread to other regions; subtype B, where cholera vibrios are isolated from surface waters; and subtype C, where there are no cholera cases and no cholera vibrio has been isolated from the environment.

A total of 17.8% of the cases were reported from subtype A territories, and the annual incidence of cholera was 1.0 per 100,000.

Seasonal recovery of cholera vibrio from surface waters has occurred in July and August over a 1–3-year period. Generally cholera vibrios are isolated from the environment only during epidemics, illustrating the absence of the conditions necessary for their persistence in surface waters.

Toxigenic strains of V. cholerae were isolated from patients and carriers, while from surface waters predominantly nontoxigenic strains were isolated.

In the subtype B territories isolates of predominantly nontoxigenic cholera vibrios from surface waters have been made in July and August for 1–23-year periods. Some such territories exhibit conditions where cholera vibrios persist in surface waters, while the ecological conditions of rivers and other water reservoirs are poor.

Delineation of territories in this way is important for understanding future outbreaks of cholera and their spread. Nevertheless, it should be borne in mind that in any region (autonomous republic, district, city, part of a town, etc.) the type or subtype of its epidemic potential can change.

The most comprehensive set of preventive measures are used in type I territories. In type II territories the measures are less comprehensive. In particular, the bacteriological control of the environment is differentiated according to subtype. Preventive measures for type III territories are planned according to the epidemic situation, but include the measures for type I and II territories.

Conclusions

The seventh global pandemic of cholera, which began in 1961 and is still continuing, has lasted much longer than the previous six pandemics. The large number of countries that are affected all over the world is a characteristic feature of the current pandemic.

In the USSR, large-scale outbreaks of imported cholera occurred in 1965 and 1970–74 followed by a reduction in morbidity (sporadic episodes prevailing) and environmental circulation of nontoxigenic avirulent, predominantly cholera vibrios (Fig. 3).

Compared with the situation that prevailed during the early period of the pandemic (in 1961 and 1965), the intensity of the epidemic in the USSR subsequently declined, while that in the rest of the world increased nearly every year (except for 1967, 1969, and 1984). The situation in the USSR is, however, unstable since in some regions cholera cases occur every year and virulent toxigenic cholera vibrios are recovered from surface waters.

The cholera situation in countries that border the USSR is far from satisfactory. Large-scale outbreaks occurred in Iran between 1970 and 1985, and in China in 1988 and 1989, while cholera was imported into the USSR more than once. The change in the approach to epidemiological surveillance in the regions of the USSR (preventive and control measures for imported pestilential infections, including cholera) is epidemiologically justified (3).

Three types of cholera epidemic were defined, and the USSR was regionalized according to the type of epidemic, risk of outbreaks and mode of spread. This permitted the differentiation of preventive measures, including epidemiological surveillance, according to the type of territory, while control was differentiated with respect to the virulence (presence of the vct-gene) of the isolated strains of cholera vibrio. These measures should improve prevention and control of cholera and reduce their cost.
Seventh pandemic of cholera in the USSR, 1961–89

Fig. 3. Distribution of a) cholera cases and carriers and b) environmental isolates of cholera vibrios in the USSR, 1969–89.

Acknowledgements

Résumé
La septième pandémie de choléra en URSS, 1961–1989


La situation épidémiologique en URSS est instable, des cas de choléra et la présence de souches virulentes dans les eaux de surface étant
enregistrés chaque année. Les mesures de lutte ont été considérablement modifiées au cours de la pandémie, ce qui a entraîné une diminution des coûts socio-économiques des mesures préventives et des mesures de lutte contre l'épidémie. L'URSS a été découpée en régions selon trois types d'épidémie caractérisés par le risque de flambées et de propagation du choléra, l'intensité des mouvements migratoires, et le type et la gravité de l'épidémie. Les mesures de prévention et de lutte ont été également différenciées compte tenu de la virulence (gène vcf) des souches de vibrions isolées chez les malades et les porteurs.

References