

About Ukraine Data on Causes of Death

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General

The organization responsible for the collection and primary processing of demographic statistics in Ukraine is the State Statistics Service (*Державна Служба Статистики*). The history of the Ukrainian Statistical Agency starts as early as 1920, when a Central Statistics Bureau of Ukraine was established. It had certain autonomy, which was depressed in the 30s because of the pressure from the bureaucratic system. Thus, in the 30s and later decades, the analytical functions of statistics were employed to serve a totalitarian system. The Ukrainian statistics division was incorporated into the USSR statistics system, and it very often had to adapt itself to any re-adjustments in economic resources and supervision, as well as in planning and control methods (Osaulenko et al., 1999). The years of war seriously tested the Ukrainian statistics division, because many statisticians had to leave for the war. In the post-war period,

the elder generation of statisticians worked at reviving and restoring the official statistics system. Hence, important changes occurred in 1941 and 1948, as well as in 1959 with the launch of the Khrushchev reforms, which were marked by cuts in the number of ministries.

In 1987, the Central Statistics Bureau of Ukraine was reorganized into the State Committee of Statistics of the Ukrainian SSR. In 1991, it became the Ministry of Statistics, but only until 1997, when it then became the State Statistics Committee of Ukraine. The final change was made in 2010, when it was renamed once again into the State Statistics Service of Ukraine¹ (SSS).

During Soviet times, statistical reports with aggregated data had to be sent first to the Statistics Committee of the USSR, which after certain corrections (especially to the migration component in order to make migration flows coherent with other republic data), data was sent back to the Statistics Committee of the Ukrainian SSR – but only in limited versions (Figure 1). Because of these corrections, there are a lot of inconsistencies between officially published data and other data that remained in Ukraine. In 1991, when Ukraine became independent, it became deprived of a large part of the dataset, as well as of methodological base. Hence, it had to start building its own national system for demographic statistics (Gladun et al., 2000).

In 1992, a Ukrainian law “On the State Statistics of Ukraine” was approved, which aimed to adopt national statistics to the current needs of the economy and to international standards (Supreme Council of Ukraine 17.09.1992 No. 2614-XII).

The SSS has 25 regional and 495 district subdivisions that collect census and micro-census data at the regional level and which conduct various statistical surveys as well. The information about individual life events (births, marriages, divorces, and deaths) is collected by the bureaus of civil registration. They do not belong to the structure of the statistical organization and are included in the structure of the Ministry of Justice of Ukraine (Pyrozhev et al., 2015). Primary information is kept at the regional level. Aggregated information in table form with absolute numbers is sent out at the all-Ukraine level (Gladun et al., 2000).

¹ Official page of the SSS: <http://www.ukrstat.gov.ua/>

Since 1993, vital statistics data have been published annually in a publication titled “Population of Ukraine.” Under the same title, the State Statistics Service of Ukraine – in collaboration with the Institute for Demography and Social Studies (IDSS) – has published the annual analytic reports since 2003 (Pyrozkhov et al., 2006). Moreover, since 2011, all analytical reports and data on population number and composition, as well as on demographic processes detailed by sex, age, years (since 1989), causes (since 2005), and regions (since 1989), and in certain cases by districts (since 2013) became available at the web-page “Population of Ukraine”². This web-page is maintained by the SSS and IDSS in Ukrainian and English versions.



Figure 1: The scheme of treating statistical reports during Soviet times

As for cause-specific information, the statistical series were distorted by discontinuities that appeared after each revision of the International Classification of Diseases. During the period from 1965 to 2004 – for which reconstructed cause-of-death series are available – four versions of the Soviet classification of diseases were in use. The work on creating transitions from one revision to another since 1965 up to 2004 was done by France Meslé and Jacques Vallin (2003, 2008, 2012).

After declaring independence in 1991, Ukraine continued using the Soviet classification of 1988, though they called it the Ukrainian Classification. Some minor modifications were introduced over time: 1) in 1989, 10 detailed cerebrovascular causes were added as additional items after the end of the list (after the total); 2) in 1994, AIDS was added as an extra 177th item to the main list of causes; and 3) in 1995, 32 detailed cancers were also added as additional items after the end of the list.

The implementation of ICD-10 was on the agenda beginning in 1993, when the Ministry of Health issued the official order on “Developing the national statistics and switching to international standards” (Ministry of Health of Ukraine Order of 11.10.1993), followed by another order in 1998, “About the transition of all health establishments to the new statistical classification” (Ministry of Health of Ukraine Order of 08.10.1998). The latter obligated that new rules be implemented beginning on 1 January 1999. The task of translation from English to the Ukrainian language and preparation of the International Classification publication was assigned to the Ukrainian Institute of Public Health. However, the actual transition to ICD-10 recommended by WHO was done only in 2005. Before the actual switch in 2000, a report was published on the *Implementation of the International Classification of Diseases (ICD-10) into the mortality statistics* (Gladun et al., 2000), which included recommendations on the coding of old items from the classification of 1981 into the new classification (ICD-10) for the abridged version.

²Population of Ukraine: <http://database.ukrcensus.gov.ua/PXWEB2007/index.htm>

Territorial coverage

Ukraine is divided into 27 territorial units: 24 regions (oblasts), the Autonomous Republic of Crimea (AR of Crimea), and two cities with special status: Kyiv (the capital city) and the Sebastopol agglomeration. However, since 2014 the AR Crimea (together with Sebastopol) and certain districts of the Donetsk and Luhansk regions have become temporarily occupied by Russia. Moreover, Russian aggression against Ukraine provoked a sharp increase in mortality within the zone of military operations, as well as a vast migration of Crimea and Donbass citizens to the non-occupied continental part of Ukraine and other countries, which distorts all the demographic trends. The lack of data from military occupied territories makes the total all-Ukraine sum for 2014 inconsistent with other years; so, all statistical series break in 2013 until these territories will be liberated. Therefore, instead of a 50-year time span (from 1965 to 2014), the data is provided only for a 49-year time period, from 1965 to 2013.

Part I – Vital statistics and population censuses

Ukraine takes part in the Human Mortality Database (HMD). Data for Ukraine dates back as far as 1959. The quality of the data for 1959-1969 is lower than in later years and should be used with caution.

The information about individual life events (births, marriages, divorces and deaths) in Ukraine is collected by the bureaus of civil status registration (RAGS – *Reestratsiia Activ Gromadskogo Stanu*), in accordance with the Law of the Supreme Council of Ukraine (01.07.2010 No. 2398-VI). They belong to the structure of the State Registration Service operating under the Ministry of Justice of Ukraine. The civil status registration is confirmed by producing related certificates.

1. Death count data

Coverage and completeness

By law, the registration of death must be done no later than three days after death or discovery of a dead body. In cases where it is impossible to obtain the certificate from a medical institution or judicial-medical expert, the registration must be completed within five days (Pyrozshkov et al., 2015). Death is confirmed by the medical certificate of death issued by the medical institution, a court decision about the fact of death, a notification from the state archives or from correctional institutions, etc. (Article 17, Law # 2398-VI, 2010).

In regard to the territorial aspect, registration of death is performed according to the place of residence, place of death or place of burial. Confusion might occur in situations where death happens in the city and relatives bury the deceased in a rural area. Having a medical certificate, they do not apply for the death certificate in the city. The lack of a death certificate is revealed much later in matters involving inheritance or social help. In this case, registration is normally made according to the place of burial³. There are also reverse situations, such as the case for the city of Kyiv in 2010, for example, when the total population at age 99+ was zero while 69 deaths were registered for this age group. This happens because children don't register their parents who live with them at their place of residence but register the deceased at the end according to the place of death.

Individual mortality data registered in bureaus of civil status registration are summed up in the regional statistical subdivisions as a complex of tables that reflect detailed mortality structure by sex, age, type of residence (urban or rural area) and cause of death. The State Statistics Service compiles and analyzes these data and issues annual reports (Pyrozshkov et al., 2015). According to Pirozshkov and his colleagues (2015), death registration in Ukraine was reliable until 1990. Since 1990, because

3 <http://www.gazeta.rv.ua/articles/view/2009-11-12/15179.html>

of the total liberalization in all spheres of life in Ukraine, the controls on gathering primary death information weakened and the quality of death statistics decreased (Pyrozhhkov et al., 2015).

Specific details: infant mortality

For a long time, Ukraine used the Soviet definition of live birth, which had restrictions on weight and height in classifying a birth as live: an infant had to be at least 35 centimetres long, to weigh at least 1000 grams at birth and to be born after 28 weeks of gestation in order to be counted as a live birth. If such an infant died during the course of the first week of life, it was counted as a stillbirth. This excluded many of the most vulnerable infants from Ukraine's infant mortality measure, and it gave rise to the under-estimation of neonatal mortality.

New rules on defining live birth and stillbirth (which correspond to the rules recommended by WHO) came into force in 2007 (Ministry of Health of Ukraine Order of 29.03.2006). According to the WHO definition, an infant is considered live-born (regardless of gestational stage) if, after exiting its mother's body, it "breathes or shows any other evidence of life such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles".

Though Ukraine officially adopted the new definition only in 2007, regional trends reveal a jump in infant mortality in 2005, which might be explained by the transition to the 10th revision of the International Classification of Diseases in 2005 and by the more careful coding of death, in particular for infant cause of death. These changes started in 2005, and the maximum figure was observed in 2007, 11 deaths per 1000 live births (compared with 9.5 in 2004) for all of Ukraine.

In general, the share of newborns with low body weight in Ukraine is around 10-12% (Ministry of Health of Ukraine Order from 29.08.2006). According to different assessments, the underestimation of infant mortality was around 15-20%. Anderson and Silver (1986) projected an underestimation of infant mortality because of the restricted definition of live birth at around 22-25%. Kingkade and Sawyer (2001) estimated adjustment factors at the level of 50-60%. According to Levchuk (Pirozhkov, 2006), the level of unregistered deaths of newborn babies was about 23%.

To correct the infant mortality rate, we used correction coefficients proposed by Meslé and Vallin (2012). The method envisages the correction of infant mortality for under-registration by focusing on neonatal deaths (0-28 days), as these are the most vulnerable babies that were referred to as stillbirths. Besides this correction, there was another adjustment to infant mortality in 1974. The detailed description of these two corrections can be found in Chapter 4.1 "Infant Mortality" of the research monograph *"Mortality and Causes of Death in 20th Century Ukraine"*. The total average underestimation of infant mortality according to this method was nearly 13% in 2005 and 2006, and roughly 20% in the years 1989-2004.

2. Population count data

Coverage and completeness

The first census after World War II was conducted in Ukraine on 15 January 1959 as part of the USSR population census. Subsequent censuses were conducted every 10 years: 15 January 1970, 17 January 1979, and 12 January 1989. Only the 1959 and 1970 censuses were published and their contents made widely available. The materials from the 1979 and 1989 censuses were published as special statistical collections with the restriction "for service use only." After the collapse of the Soviet Union, the first Ukrainian population census was carried out on 5 December 2001. The results of this census were published in their entirety and are available as a special statistical collection in both electronic and printed forms (Pyrozhhkov et al., 2006).

The census of 2001, as well as previous censuses, counted population according to the actual place of residence and hence produced figures that described the actual population of Ukraine at that moment. The permanent population was obtained by subtracting temporarily present persons and adding temporarily absent persons. The census form included questions about sex, age, date and place of birth, as well as about family status, ethnic origin, language, citizenship, education, income

sources, employment, and migration activity. The census questions permit learning about the number of people living in a given place permanently since their birth (not counting military service, business trips and absences of less than 12 months), as well as about the number of migrants. The problem with census data is that it fixes a migration event at the moment of census and not at the moment of movement. And, since censuses are rarely organized, the data become obsolete.

For the remaining years, the State Statistics Service provides estimates of population in inter-censal periods using the inter-censal survival method and data about vital events and migration. At the end, it produces an estimate of the size of each population cohort on January 1st of each inter-censal year. The main statistical form on population is the RN-2, "Population count by sex and age at the beginning of the year". Data in this form is obtainable by 1-year age groups. As soon as a new census is organized, the population number in the inter-censal period is recalculated.

Unfortunately, there have been no censuses taken in recent times, even though ten years have already passed. The next census was scheduled for 2012, and even this census was postponed to 2013 (according to the Decree of the Cabinet of Ministers #581-p from 2008), which was justified by parliamentary elections and the Euro cup organized for the same year. A sample census was organized in the Kharkiv region. However, there was another change and the year was postponed to 2016. Eventually this date was cancelled as well, because of the events that happened in 2014 and the ongoing war in the East of Ukraine. According to Ella Libanova (interview for *Hromadske radio* 2015)⁴, possible years for the next census may be: 2019, 2020 or 2021, with preparations starting in 2017. Nevertheless, the situation in regards to organizing a census is alarming.

3. Birth count data

Coverage and completeness

The registration of birth is made according to the actual place of birth or according to the parents' place of residence. The registration of birth should be made within one month or, in the case of foetal death, within three days. The registration of birth is a document confirming the fact of birth issued by the health care institution; and when a birth happens outside of the health care institution, the document is issued by a medical advisory committee (Article 13, Law #2398-VI, 2010).

There are also strict instructions from the Ministry of Health about the medical care of newborns. In particular, this is the protocol on principles of neonatal care (Ministry of Health of Ukraine Order of 04.04.2005), issued in line with WHO recommendations. There also exists a protocol on medical care of newborns with a low body weight (Ministry of Health of Ukraine Order of 29.08.2006). During the first five minutes of an infant's life, a paediatric doctor or neonatologist evaluates the baby according to the Apgar scale. A low score on the one-minute test may show that the neonate requires medical attention, but it is not necessarily an indication that there will be long-term problems. If the Apgar score remains below 3 at later times – such as 10, 15, or 30 minutes – there is a risk that the child will suffer longer-term neurological damage. However, the purpose of the Apgar test is to determine quickly whether a newborn needs immediate medical care.

In cases where a baby is born dead, the registration of birth is made without issuing the certificate of birth. For confirmation of such an event, the bureau of civil state registration produces a document (Act) indicating the fact of stillbirth. The registration of death in such cases is not made. In cases where the baby's death occurred in the first weeks of life, the registration of birth is made with the issuance of the document (Act) stating that the baby died. The registration of the newborn's death is made in the prescribed manner with the issuance of the death certificate, in accordance with the Law of the Ministry of Justice of Ukraine (Ministry of Justice of Ukraine Order from 18.10.2000).

The HCD database contains the number of live births after re-estimating infant mortality rates, for reasons of under-reporting due to changes in definitions of live birth.

⁴ <http://hromadskeradio.org/na-svizhu-golovu/v-2010-mu-ne-provely-perepys-naselennya-lyshe-ukrayina-ta-sudan-libanova>

Part II – Information on CoD collection

4. Death certificate

The physician fills out the death certificate by describing the diseases, health conditions and damages found in the deceased. The Ukrainian version of the death certificate includes 35 pieces of information. It consists of two parts: the certificate itself (with personal data of the deceased, place of residence and place of death) and the annex (which gives information on cause of death). To be more precise, the personal information includes only the name, sex, and age (for infants, also parameters of weight and height).

Information on cause of death – as recommended by WHO – is divided into two blocks (Annex):

- 1) Sequence of events leading to death, proceeding backwards from the direct cause of death at (a).
- 2) Other significant conditions contributing to death but not related to the disease or condition causing it.

The certificate also includes some multiple choice questions:

- Whether death happened: (a) in a hospital, (b) at home, (c) other.
- Death happened as a result of: (a) disease, (b) domestic accident, (c) accident at work, (d) homicide, (e) suicide, (f) undetermined cause.
- The cause of death is established by: (a) doctor who established the fact of death, (b) doctor who treated the deceased, (c) pathologist, (d) medical court expert.
- The grounds on which cause is established: (a) examination of the body, (b) records in medical card, (c) preceding surveillance, (d) autopsy.
- The place of accident, poisoning or injury: (a) home, (b) street, (c) transport, (d) school, (e) sports facility, (f) other.
- If the death happened to a pregnant women, it should be indicated whether it was: (a) death during delivery, (b) death during pregnancy, (c) other.
- And the last particular of the Ukrainian questions is whether the deceased was registered among persons who suffered the consequences of the Chernobyl accident and, if yes, the attestation number needs to be indicated.
- If death happened to an infant, the Medical Certificate of Perinatal Death must be filled out.

The alternative to the Medical Certificate of Death is the Feldsher Certificate of Death, if the former cannot be provided. The primary paper documents are archived at the regional level during one year.

5. Cause-of-death coding

The processing of information by SSS is divided into several stages (Figure 2).

- 1) The primary information database consists of documents called the “Act of death”. These acts are issued based on the Medical Certificate of Death (not always) and include information on cause of death. Causes are coded at the regional level by regional sub-divisions of the SSS. The coding is done either manually, automatically, or if the cause is already coded, the code is recopied.

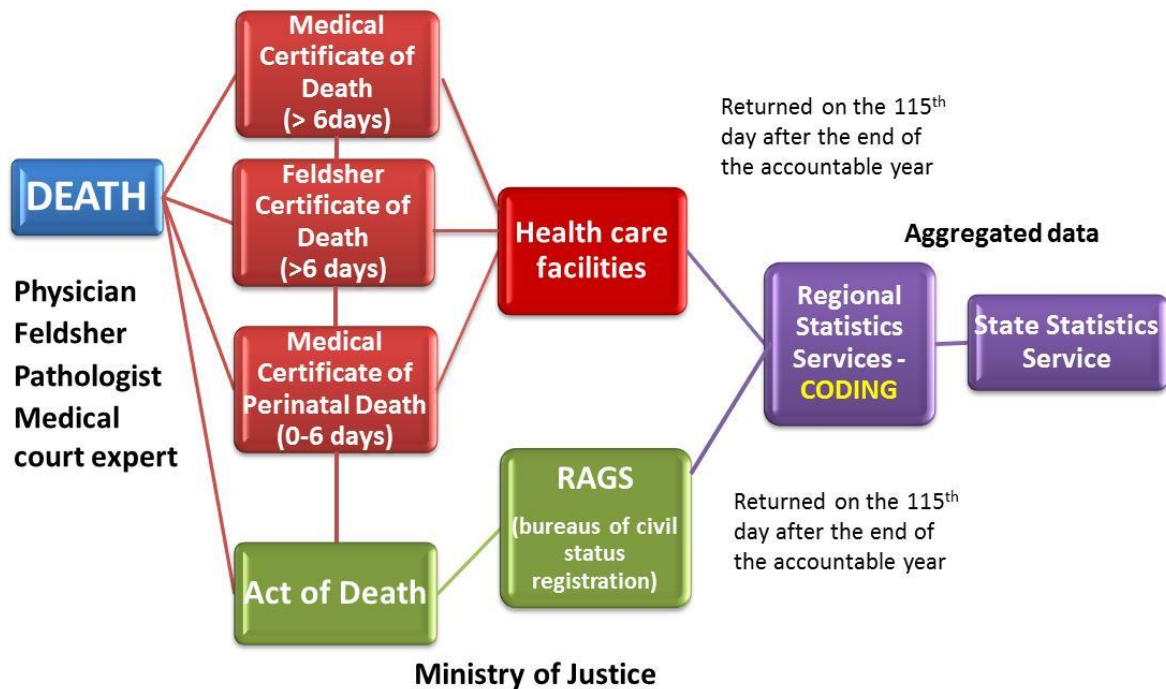


Figure 2: The transmission of the Ukrainian death certificate

Some problems exist regarding manual coding. First, economists that work in the SSS divisions often lack the medical education for correctly using the ICD. For example, there are 3 main rules and 6 additional rules for modifying the underlying cause of death. Because of this, different regions may have different practices in manual coding and may assign up to 18 different codes to the same cause (Gladun et al., 2000).

When a code is already assigned to the cause in the Medical Certificate of Death, there is still a risk that it could have been influenced by a doctor's subjectivity, depending on his or her medical qualification. Experience shows that only pathologists assign codes correctly, while doctors who instead deal with morbidity apply rules for coding diseases to coding causes of death, which are actually different (Gladun et al., 2000).

The obligation to code causes of death on the death certificate was established by the order of the Ministry of Health; however, after examination, it was discovered that only 5 regions fully provided medical certificates with codes already assigned. Moreover, there exist medical establishments that are not under the jurisdiction of the Ministry of Health and which do not follow its orders. In addition, there is a number of deaths that are registered according to a court decision and, in such cases, the causes are also not coded either (Gladun et al., 2000).

To solve this problem, it was decided to implement an automatic system of coding through the use of the program ACME (Automatic Classification of Medical Entities), which was developed in the USA and is open access. This program should help with coding the entire information provided by the Act of death, as well as with selecting the underlying cause of death.

- 2) The next stage is the logical and mathematical control of information. If needed, data is adjusted.
- 3) Further data is sent to the state level.

- 4) Finally, SSS analyzes differences in defining underlying causes of death by doctors and by the computer program.

6. Classifications in use and collected data

6.1 Classification changes

Comparability of cause-of-death statistics has been affected by each revision of the classification. In the past, Ukraine used the Soviet classification of diseases, which was similar to an abridged list of the International Classification of Diseases. During Soviet times, starting in 1965 – for which information is available – four versions of the Soviet classification of diseases were in use, with revisions in: 1965 (210 items), 1970 (185 items), 1981 (185 items), and in 1988 (176 items). The problem of distortions in mortality trends was resolved by France Meslé and Jacques Vallin (2003, 2008, 2012), who reconstructed retrospective data.

As mentioned above, Ukraine was supposed to switch to the ICD-10 in 1999; however, diseases continued to be coded in statistical accounts according to the old version (the Soviet system, re-named Ukrainian) until 2005. The reason for this was a simple lack of guiding rules and technical recommendations (on how to perform the transition). These used to be issued in Moscow, but the Statistics Committee in Kyiv had no appropriate structural department. Therefore, doctors continued reporting causes of death on the Medical Certificate of Death, while the Statistic Service grouped and coded causes referring to the old classification of diseases.

Ukraine switched to the 10th revision of the International Classification of Diseases (ICD-10) in 2005. This report deals with changes that happened during the period 1988-2004, and with the last transition between the Ukrainian version of the Soviet classification (which corresponds to ICD-9) and ICD-10 (the Ukrainian version), as shown in Figure 3.

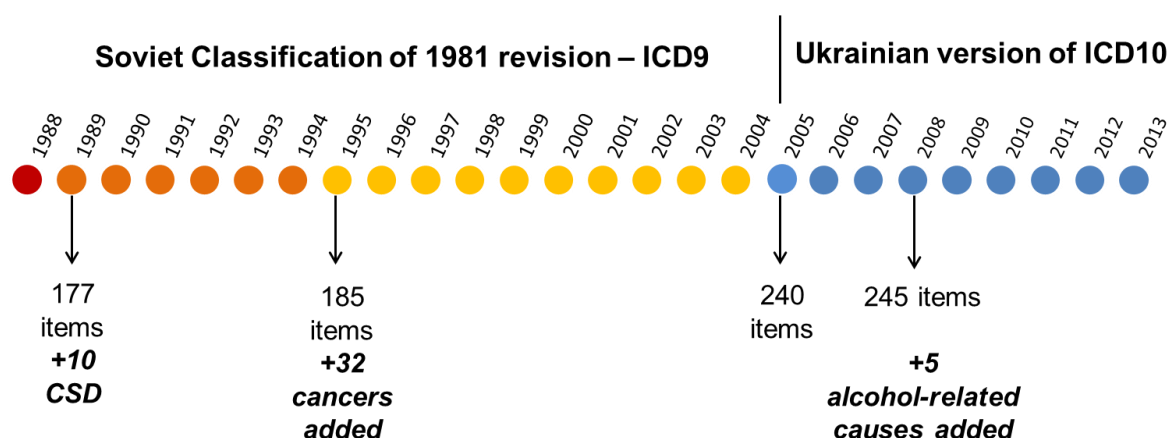


Figure 3: Changes in the classifications and revisions

6.2 Collected data

Table 2 summarizes information on the history of ICD revisions and collected cause-specific data in Ukraine. Nowadays, the main sheet consists of information on causes of death and is called C8. Some modifications have been made to it. First, AIDS was added as an extra cause in 1994; second, the division on age groups became more detailed in 1995; third, the number of deaths at unknown age

started to be redistributed by the SSS after the census of 2001. Moreover, on two occasions the list of main items was supplemented by more precise information detailing the items in the main list: 10 cerebrovascular causes appeared at the end of the list in 1989; and 32 cancers were added in 1995 (Figure 3). This detailed information is very useful for transitions, so we somewhat modified the main lists to include all the information (for a more detailed description, see Part III of this report).

Table 2: Overview of classifications and collected data in Ukraine

Period	Classification	Sheet	No. classes	No. items	Age grouping	Comments	Data type
1965-1969	Soviet Classification of 1965 – ICD-7	Forma No. 5		210 (+13)	0, 1, 2, 3, 4, 1-4, 5-9, 10-14, 15-19... 80-84, 85+, unknown		<i>Paper data</i>
1970-1980	Soviet Classification of 1965 – ICD-8	Forma No. 5		185 (+10)	<i>ditto</i>		<i>ditto</i>
1981-1987	Soviet Classification of 1981 – ICD-9	Forma No. 5		185 (+10)	<i>ditto</i>		<i>ditto</i>
1988-1990	Soviet classification of 1988 – ICD-9	C-51 “Deaths by age, sex & cause of death”	17 (18)	176 (+10)	<i>ditto</i>		<i>ditto</i>
1991-1994	Ukrainian version of Soviet Classification of 1988 – ICD-9	C-8 “Deaths by age, sex & cause of death”	17 (18)	177 (+10)	<i>ditto</i>	AIDS added	<i>ditto</i>
1995-2001		C-8 “Deaths by age, sex & cause of death”	17 (18)	177 (+10)	0, 1, 2, 3, 4...19, 20-24, 25-29... 95-99, 100+, unknown	More detailed age groups	Electronic data
2001-2004		C-8p “Deaths by age, sex & cause of death with unknown redistributed”	17 (18)	177 (+10)	0, 1, 2, 3, 4...19, 20-24, 25-29... 95-99, 100+	Number of deaths with unknown age are redistributed	<i>ditto</i>
2005-2007	Ukrainian version of ICD-10	C-8p “Deaths by age, sex & cause of death with unknown redistributed”	19 (20)	240 (+11)	<i>ditto</i>		<i>ditto</i>
2008-2012			19 (20)	245 (+11)	<i>ditto</i>	Alcohol-related causes added	<i>ditto</i>

With the switch to ICD-10 in 2005, a new list of causes (though without any codes assigned) replaced the old list in C8. In 2008, a small change was applied when five additional causes related to alcohol were added. For example, accidental poisoning was split into “poisoning by and exposure to alcohol” and the remaining poisonings.

The class “External causes of morbidity and mortality” is (as a rule for each classification) doubled. In first ordering, accidents are classified according to the type of external cause that provoked the death; and in second ordering, according to the nature of the injury. The number of items in the second version of ordering of external causes is indicated in brackets in the column “No. items” in Table 2.

The final total number of items is 207 in the old version and 245 in the new version, which is very far from the whole spectrum of causes envisaged by the International Classification of Diseases. However, with the transition to the new classification, another useful statistical sheet was issued. It is named AC1 and it includes almost 10,000 items. The shortcoming of this sheet is that it gives the number of deaths only for all ages combined.

Table 3: Data available for the complete list of diseases, according to ICD-10

Period	Classification	Sheet		No. classes	No. items	Age grouping	Comments	Data type
2005-2007	Ukrainian version of ICD-10	AC1	Deaths sex, place of residence and cause of death	19 (20)	9197	Total		Electronic data
2008-2012				19 (20)	9232	Total	Alcohol-related causes added	Electronic data

6.3 Data sources

The data for the period 1989-2000 come from statistical form C-8, “Distribution of deaths by sex and age”. Finally, the data for the years 2001-2013 originate from a new version of this form titled C-8p, “Distribution of deaths by sex and age accounting for deaths with unknown age”.

6.4 Specific treatment of the raw data

Some additional changes were introduced to the raw data while inspecting the series. First, a discrepancy was observed between cause-specific data and all-cause totals. Because the all-cause death counts are represented more in official statistics, it was decided to correct some cause-specific death counts, as shown in Table 4.

Table 4: Changes to raw data in 2006, males only (according to the list f in Annex)

Code in the final list	Code in ICD-10	Old figure	Corrected figure
237	(X40-X44, X46-X49)	3509	3508
241	(Y10-Y14, Y16-Y34)	8437	8433
258	(W75-W84)	2204	2206
269	(W20-W64, W85-W99, X10-X39, X50-X59, Y85-Y89)	5529	5536

Another small correction was done to the raw data in 1989: 5629 deaths were transferred proportionally from item 204 to item 203 (according to the current list in use).

7. Specific transition documents

For the transition between the Ukrainian Soviet version and the Ukrainian WHO version, there is a sheet called “*AC correspondence ICD-9-ICD-10*”, which resembles a bridge coding, though it is not certain that double coding was performed at the primary stage of codifying the cause of death. More likely, it was developed by the statistical service afterwards in order to establish correspondences. This table was used as an initial correspondence table, though some changes were introduced to it in the process in order to harmonize the transition for all time-series.

Part III – Reconstruction information

8. Reconstruction of coherent time series

For years 1965 to 1988, we are using results of reconstruction performed previously by France Meslé and Jacques Vallin (Meslé and Vallin 2012, Annex VI).

In the recent work, only one big transition to ICD-10 in 2005 was the subject of the latest reconstruction, there were however several important stages in harmonizing the data. These changes occurred at different times, and will be referred to as mini-transitions or stages. The following reconstruction procedures were applied:

A. From the side of the old classification (the initial version included 177 items with AIDS):

- In 1989, 10 supplementary cerebrovascular items replace 2 items in the main list, so the list includes 185 items.
- In 1995, 32 supplementary cancer items replace 10 items in the main list, so the list sums up to 207 items.

B. From the side of the new classification (the initial abridged version included 240 items):

- In 2008, 9 new items replace 4 items in the main list in order to split CoD on alcohol and non-alcohol related causes. The list sums up to 245 items.
- Since one of the goals of this project was to create commonality for the intermediate list of all countries, some CoDs needed to be split in order to insure that all categories on the intermediate list could be produced. So, 37 more detailed items replace 13 items in the main list, and the resulting list sums up to 269 items.

Thus, in the final transition, we established correspondences between 207 items of the old classification and 269 items of the new classification. The stages of this work are visualized in the table below.

Table 5: Five major stages of reconstruction

	1965-1988 (old classification: n=177)	Changes in 1989 (cerebrovascular causes)	Changes in 1995 (cancers)	2005-2007 (new classification, n=240)	Changes in 2008 (alcohol causes)	2005 (intermediate list)
Stage 1	1965-1994 (n=185)					
Stage 2	1965-2004 (n=207)					
Stage 3				2005-2008 (n=245)		
Stage 4				2005-2013 (n=269)		
Stage 5	1965-2013 (n=269)					

It can be seen from the table that, while working with the old classification data moves forward, the new changes approach the data at the point of 2004 until the total list includes 207 items. In contrast, while working with the new classification, we moved backward. First, the changes in 2008 were applied to the years 2005, 2006, and 2007. Then, changes that needed to be applied in order to produce the HCD intermediate list were applied to all the years of the new classification, 2005-2013. Each mini-transition will be described in detail below.

All the reconstructions were done by following the approach proposed by France Meslé and Jacques Vallin (1996). At the end, we obtained 1965-2013 cause-of-death time series by sex and 5-year age groups, which were classified into an abridged ICD-10 list consisting of 269 items.

Stage 1: Mini-transition to the revision of 1989

In this mini-transition, only one association was presented: two categories of cerebrovascular disorders (with and without hypertensive disease) from the main list were split into five specific diseases each from the supplementary list. Thus, categories 098-099 were taken out and replaced by new items 196-205 (see Annex).

The transition coefficients were calculated automatically with the help of a VBA Macro developed by Olga Penina. The macro provides visually friendly tables and a resulting column of coefficients by ICD-10 items. The calculation is done separately for each of the 19 age groups. Then the coefficients were made at the age-scale and smoothed in order to avoid random fluctuations. The smoothing was rather soft for ages 0 to 15, and stiffer for the remaining age spans. The shape of each curve was judged subjectively, and regression lines were chosen individually. Such procedure was done for all the mini-transitions as well, except the transition from the national to the full list.

The distribution of the associations by type with the corresponding death counts in a year of transition to the newer version of classification can be found in Table 6.

Table 6: Distribution of fundamental associations of items by type and death counts between revisions of 1988 & 1989

Association type	1989 Revision			
	Associations		Deaths (in 1989)*	
	Number	Proportion, %	Number	Proportion, %
type 1:1	175	99.4	493 573	82
type 1:n	0	0	0	0
type n:1	0	0	0	0
type n:n	1	0.6	107 017	18
Total	176	100.0	600 590	100

**Before correction for infant mortality*

Stage 2: Mini-transition to the Revision of 1995

This mini-transition accounts for 9 associations. Similarly, as in the case with cerebrovascular disorders, items from the main list (045-066) are replaced by supplementary items (207-250) (see Annex).

Table 7: Distribution of fundamental associations of items by type and death counts between revisions of 1989 & 1995

Association type	1995 Revision			
	Associations		Deaths (in 1995)*	
	Number	Proportion, %	Number	Proportion, %
type 1:1	175	95	755 741	95
type 1:n	0	0	0	0
type n:1	9	5	36 846	0
type n:n	0	0	0	5
Total	184	100	792 587	100

**Before correction for infant mortality*

Stage 3: Mini-transition to the revision of 2008

This mini-transition was not made in the traditional way. The change aimed at splitting 4 larger categories into alcohol and non-alcohol related items. Such a split was implemented in 2008 but also existed in the old classification. For this reason, it appeared meaningful to first find values for 2005-2007, in order to make the main transition from the Soviet to the WHO classification easy. The good news is that detailed information for these causes is available in statistical sheets AC-1, although only in total numbers for males and females and not by age. So, transition coefficients were first calculated for each year and each age group: 2005, 2006 and 2007. Second, they were adjusted in such a way that by multiplying them in the age structure we could obtain the known total sums by sex and also the total-by-association sums by age. This was done by using non-linear equations and an optimization procedure. Four associations related to this mini-transition are presented in the Annex.

Table 8: Distribution of fundamental associations of items by type and death counts between revisions of 2005 & 2008

Association type	2008 Revision			
	Associations		Death (in 2008)*	
	Number	Proportion, %	Number	Proportion, %
type 1:1	236	98	726 883	96
type 1:n	0	0	0	0
type n:1	4	2	27 577	4
type n:n	0	0	0	0
Total	240	100	754 460	100

**Before correction for infant mortality*

Stage 4: Mini-transition from the revision of 2008 to the full ICD-10 list

This was the most unusual procedure. As was said above, 37 categories needed to be introduced by extracting them from existing list. Thanks to the already mentioned above statistical sheet AC-1, the totals for this categories were known (by sex as well). The problem was age distribution. It was not

possible to do the same procedure as was done with alcohol causes since there was no reference to depend on (in case of alcohol items it was data for 2008). Therefore, transition coefficients were calculated only at the level of total, and applied the same to all age groups. Secondly, the adjustments were made to receive correct totals for males and females since there are known from the AC-1.

Table 9: Distribution of fundamental associations of items by type and death counts between revisions of 2008 & “full” list

Association type	2008 Revision			
	Associations		Death (in 2005)*	
	Number	Proportion, %	Number	Proportion, %
type 1:1	232	95	621 911	80
type 1:n	0	0	0	0
type n:1	13	5	160 050	20
type n:n	0	0	0	0
Total	245	100	781 961	100

**before correction for infant mortality*

The 13 associations related to this mini-transition as well as the lists of causes are presented in the Annex.

It should be also noted that the “full” list is not the same as the “national” list. The “full” list includes 269 items (together with 37 that were made up artificially), while the “national” list includes only 245 items. The advantage of the full list is that it can be collapsed easily into either the national or intermediate lists.

Stage 5: Main transition from 1995 revision of Ukrainian classification to the full ICD-10 list

The final (most important) transition was made using standard reconstruction methodology. After the medical and statistical balance was established, transition coefficients were calculated separately for 19 age groups. Each curve of the transition coefficients was smoothed.

The reconstruction itself was done by multiplying coefficients to the data by items of the old revision for the years 1965-2004. The received result was checked by using Giancarlo Camarda’s program, “Check Disruption”, which helps to detect statistically significant disruptions in the year of transition. Such a check was done for the total deaths for each cause, as well as for separate age groups: 0-4, 5-19, 20-59, and 60+ years old. If the result was unsatisfactory, a change was made to either the correspondence in the association or to a transition coefficient at the given age, after which all stages were repeated.

Table 10: Distribution of fundamental associations of items by type and death counts between revisions of 1995 & the “full” ICD-10 list

Association type	Full list			
	Associations		Deaths (in 2005)*	
	Number	Proportion, %	Number	Proportion, %
type 1:1	111	70	173 369	22
type 1:n	4	3	21 080	3
type n:1	21	13	38 357	5

type n:n	23	14	549 155	70
Total	159	100	781 961	100

*Before correction for infant mortality

The reconstructed series as well mortality surfaces were thoroughly inspected in order to whether transition coefficients were applicable to the age groups in the common pattern. These surfaces were created also thanks to the code provided by Giancarlo Camarda.

A posteriori corrections

After completing all 5 stages of the transition, several *a posteriori* corrections were applied. The first correction concerned only items 163 and 159 of the “full” list. The excess deaths from item 163 in 2005-2008 (6351 deaths) were attributed to item 159.

Another correction was based on comparing the all-cause totals with data from the Human Mortality Database (HMD). Some differences arose because of the different ways of redistributing deaths with “unknown age”. For the HMD, the redistribution was done proportionally among all ages for all causes together, while the statistics by cause-of-deaths perform the same procedure but by each cause of deaths. And since there are causes that have higher weights at adult ages (for instance, external causes), the absolute number of “unknown” deaths attributed to these items is higher than if we redistribute them in a simply proportional way for total causes. This is especially true for the years before 2001. To adjust for these deviations, we corrected differences in order to be coherent with HMD data.

9. Redistribution of ill-defined causes of death

In their monograph, France Meslé and Jacques Vallin (2012) highlighted a big change in the trend of death rates from ill-defined causes due to the definition change, particularly in defining cause 245 (according to the “full” list), which is Senility. In 1989, the Soviet Health Minister issued a directive, according to which “any death occurring at age 80 had to be registered as due to senility, unless the person’s medical history or an autopsy report made it possible to diagnose a precise cause of death or mentioned death from injury, poisoning or another external cause” (Meslé and Vallin, 2012; p.150).

As soon as the directive was issued, the number of deaths classified under “senility” rose dramatically, as shown in Figure 4. The maximum was observed in 1992 when the total absolute number of deaths from this cause reached 73.7 thousand deaths.

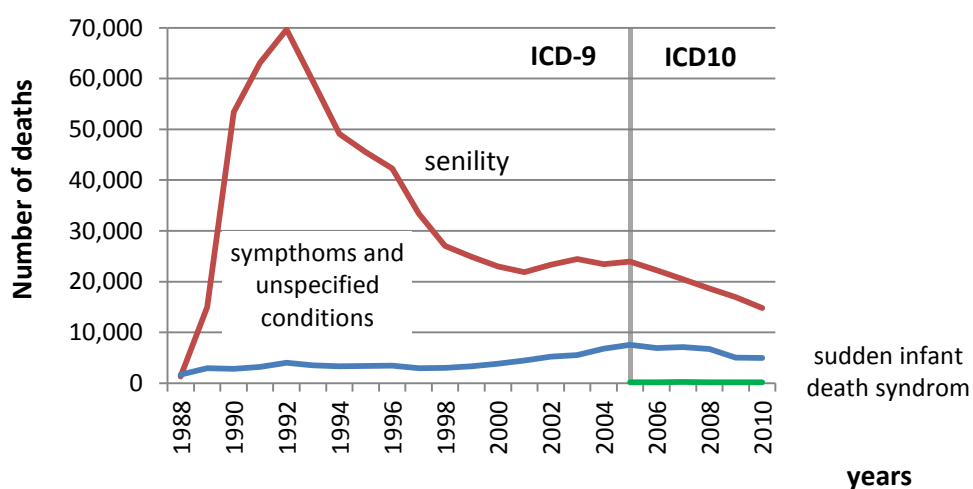


Figure 4: Annual number of deaths classified under “senility”, “symptoms and other unspecified conditions”, and “sudden infant death syndrome”

With the switch to a new classification of diseases, this class of deaths was spread into three categories, which added deaths from sudden infant death syndrome to the total amount of ill-defined causes of death (Figure 4). In any case, this does not have any impact on the number of deaths from senility, which started to shrink again in 2005. This could be explained perhaps by a more attentive attitude in defining the cause of death after the new law and new instructions came into force.

It should be noted that, before the reform of 1989, there were not many deaths classified under senility. For example, in 1988, the total number of Ukrainian deaths in this category was half that of “other ill-defined” (1331 vs. 2632). Meslé and Vallin (2012) reasoned that a lot of ill-defined deaths were classified under “sudden cardiac death” or “health failure”, which led to overestimation of mortality from circulatory system diseases.

To solve the problem of consistency, we redistributed ill-defined deaths among other causes of death. Unfortunately, as was proven by France Meslé and Jacques Vallin (2012), a proportional distribution was not applicable because that overestimates deaths from certain causes and it underestimates those from others. They proposed a different way of redistribution for two items that belong to the class of ill-defined causes (“senility” and “other ill-defined”⁵). First, “Senility” should be redistributed among items of the circulatory system diseases. Secondly, “other ill-defined” are to be redistributed proportionally among all other causes.

References

Anderson B. & Silver B. D. (1986) *Infant Mortality in the Soviet Union: Regional Differences and Measurement Issues*. Population and Development Review, (284), pp. 705-737.

Cabinet of Ministers of Ukraine (2008) Про проведення у 2013 році Всеукраїнського перепису населення [About organising in 2016 All-Ukraine's population census]. (Decree No. 581-p from 9 April). http://www.ukrcensus.gov.ua/ukr/laws/2008/kmu_581_20080409.pdf.

Gladun O., Gonchar I., Zadoenko L., Luschyk L., Nevzorov B., Palian Z., Perova T., Sarioglo V., Stelmah L., Romanchuk T., Tkachenko L. & Chebanova B. (2000) *Звіт про науково-дослідну роботу. Запровадження в статистику смертності населення Міжнародної класифікації хвороб та споріднених проблем охорони здоров'я Десятого перегляду (МКХ-10) [Report on scientific research. Implementation of the International Classification of Diseases (ICD-10) into the mortality statistics]*. State Statistics Committee of Ukraine, Scientific-Research Institute of Statistics.

Kingkade W. & Sawyer C. C. (2001) *Infant Mortality in Eastern Europe and the Former Soviet Union Before and After the Breakup*. US Census Bureau, p. 24. http://www.iussp.org/Brazil2001/s40/S44_02_kingkade.pdf.

Meslé F. & Vallin J. (1996) *Reconstructing Long-Term Series of Causes of Death. The Case of France*. Historical Methods: A Journal of Quantitative and Interdisciplinary History, 29(2), pp 72-87.

Meslé F. & Vallin J. (2003) *Mortalité et causes de décès en Ukraine au XXe siècle*. Paris: INED, 396 p.

Meslé F. & Vallin J. (2008) *Смертність та причини смерті в Україні у XX столітті [Mortalité et causes de décès en Ukraine au XXe siècle]*. . Kiev: INED and IDSS, 416 p.

Meslé F. & Vallin J. Max Planck Institute for Demographic Research (2012) *Mortality and Causes of Death in 20th-Century Ukraine*. Springer, 280 p.

⁵ In „full“ list „other ill-defined“ (R96, R98-R99) include „other ill-defined and unspecified causes of mortality“ (R96) and „unknown cause“ (R98, R99).

Ministry of Health of Ukraine (Order from 04.04.2005) Про затвердження Протоколу медичного догляду за здоровою новонародженою дитиною [*About the organization of medical care for a healthy newborn baby*]. (152).

Ministry of Health of Ukraine (Order from 08.10.1998) Про перехід органів і закладів охорони здоров'я України на Міжнародну статистичну класифікацію хвороб і споріднених проблем охорони здоров'я десятого перегляду [*About the transition of establishments of the health care system of Ukraine to the tenth revision of the International Statistical Classification of Diseases and Related Health Problems*]. (297). http://uazakon.com/documents/date_a1/pg_ivwxsj.htm.

Ministry of Health of Ukraine (Order from 11.10.1993) Про створення національної статистики та переходу на міжнародну систему обліку і статистики [*About developing of national statistics and adopting international standards*]. (215).
http://www.uazakon.com/documents/date_73/pg_ignyxs.htm.

Ministry of Health of Ukraine (Order from 29.03.2006) Про затвердження Інструкції з визначення критеріїв перинатального періоду, живонародженості та мертвонародженості, Порядку реєстрації живонароджених і мертвонароджених [*On approval of the Instruction on criteria of perinatal period, live birth and stillbirth, Procedure for registration of live births and stillbirths*]. (179).

Ministry of Health of Ukraine (Order from 29.08.2006) Про затвердження Протоколу медичного догляду за новонародженою дитиною з малою масою тіла при народженні [*About the organization of medical care for a newborn baby with a low birth weight*]. (584).

Ministry of Justice of Ukraine (Order from 18.10.2000) Про затвердження Правил державної реєстрації актів громадянського стану в Україні [*About rules of civil status registration*]. (52/5).

Osaulenko O. G., Karpov V. I., Pugacheva M. V., Artemiev M. M., Sivko B. A., Daragan M. V., Izotenko O. I., Vasylevskyi F. V., Poburko Y. O., Andel I. V. & Zlupko S. M. (1999) *Написи з історії статистики України [Essays on history of statistics in Ukraine]*. Kyiv: State Statistics Committee of Ukraine, Scientific-Research Institute of SSC of Ukraine, 187 p.

PyrozHKov S. (2006) Стан здоров'я та тривалість життя населення [Health and life expectancy]. In: *Людський розвиток в Україні: можливості та напрями соціальних інвестицій (колективна науково-аналітична монографія [Human development in Ukraine: opportunities and directions for social investments (collective monograph)]*. Kyiv: IDSS NAS, pp. 75-110.

PyrozHKov S., Foygt N. & Jdanov D. (2015) *About mortality data for Ukraine*.
<http://www.mortality.org/cgi-bin/hmd/country.php?cntr=UKR&level=1>.

Supreme Council of Ukraine (01.07.2010 No. 2398-VI) Про державну реєстрацію актів цивільного стану [*About civil status registration*] [Закон України].

Supreme Council of Ukraine. (17.09.1992 No. 2614-XII) "Закон України "Про державну статистику" [*The Law of Ukraine "On State Statistics"*]."

List of acronyms

IDSS – Institute for Demography and Social Studies

SSS - State Statistics Service of Ukraine