Argam Hovsepyan, PhD
Director of the National Bureau of Expertises, National Academy of Sciences, Yerevan, Armenia
Rouben Hovhannesyan PhD
Professor, Head of the Chair of Biomedicine, Yerevan State University, Yerevan, Armenia
Karen Mkhitaryan
Head of Forensic Medical Department of the National Bureau of Expertises, National Academy of Sciences, Yerevan, Armenia

Cause-effect relations between defects of medical care and lethal outcome

Summary

The article discusses the issues of identifying and determining the cause-effect relations between defects in the provision of medical care and lethal outcome based on the materials of commission forensic medical expertise. In the presence of defects in the provision of medical care in 30.3% of cases a cause-effect relation was detected between the frequency of defects in medical care and the likelihood of lethal outcome. The likelihood of the occurrence of lethal outcome was most influenced by defects in diagnosis (RR = 2.41) and treatment (RR = 15.65).

Key words: defects in diagnosis, defects in treatment, defects in the organization of medical care; defects in maintenance of medical records, lethal outcome, inadequate medical care, relative risk

The problem of proper, as well as inadequate medical care (MC) is actual both for the world forensic medical science and for domestic healthcare practice.

Speaking of inadequate MC, we consider it necessary to firstly refer to the definitions of “medical error” and “defects in medical care”, which are directly related to the sought problem.

“Medical error is an accidental harm to the life or health of a patient caused by erroneous actions or inaction of a medical worker, characterized by his conscientious delusion with a proper attitude towards professional duties and absence of signs of intent, negligence, carelessness or incautiousness. Defect in the provision of medical care is an improper implementation of diagnostics, treatment of the patient, organization of the process of providing MC, which has led or could lead to an adverse outcome of medical intervention” (Sharabchiev Yu.T., 2013, p. 17; Hovhannisyan R.A., 2016, p. 107).

According to Sergeev Yu.D. (2016) the issues of legal liability of medical personnel for professional offenses are one of the most difficult problems that medical practice has raised before the law.

According to Shevchuk E.P. (2009) the most difficult task in this case is to establish a cause-effect relation (CER) between the professional actions of doctors and the occurrence of adverse consequences. Simple and complex CER are distinguished. A simple relation is a chain of actions (inactions) of a medical worker. A complex relation is a random combination of several actions of a medical worker, which together are a necessary condition for the occurrence of adverse consequences.

Shevchuk E.P. (2012) considers that the difficulty in establishing CER between actions of a medical worker and occurrence of harm to health is due to the fact that several doctors and even several medical and prophylactic institutions are involved in the treatment and diagnostic process.

Unfortunately, the issues of identifying CER between professional violations of medical workers and subsequent occurrence of harm to health or lethal outcome (LO) of the patient are rather complicated, insufficiently studied and defined in the available domestic scientific and medical publications. In our opinion, this can also be explained by the well-known postulate: «post hoc non propter hoc» – «after this, therefore because of this».

Thus, the problem of proper/inappropriate MC dictates the need for large-scale research in various areas of the sought problem, which, of course, will help to reduce the number of medical errors and various defects in the provision of MC.

Table 1. Structure and frequency of defects in MC.

Type of defect in MC	absolute number	%
Defects in diagnosis	87	34.8
Defects in treatment	78	31.2
Defects in the organization of MC	30	12.0
Defects in the maintenance of medical records	55	22.0
In total	250	100.0

Table 2. CER between defects in MC and LO.

Test	Value	Degree of freedom	Significance level		
			Asymptotic (2-sided)	Exact (2-sided)	Exact (1-sided)
χ^2 Pearson	17.618	1	0.000	–	–

Table 3. RR of likelihood of LO depending on the presence of defects in MC.

Test	Value	95% confidence interval	
		Lower limit	Upper limit
RR	0.697	0.623	0.780

Table 4. CER between defects in diagnosis and LO.

Test	Value	Degree of freedom	Significance level		
			Asymptotic (2-sided)	Exact (2-sided)	Exact (1-sided)
χ^2 Pearson	8.987	1	0.003	–	–

The purpose of the study

Based on the abovementioned, the purpose of this study is to identify and determine the cause-effect relation between defects in provision of medical care and occurrence of lethal outcome based on the materials of the commission forensic medical expertise.

The material and research methods

The object of the study are 177 conclusions of the commission forensic medical expertise (CFME), based on the archival material of the Department of forensic medical expertise of the National Bureau of Expertises of the National Academy of Sciences of the Republic of Armenia for the period from 2013 to 2018.

To analyze the structure of defects in provision of MC, we classified them as follows: defects in diagnosis, defects in treatment, defects in the organization of medical care; defects in the maintenance of medical records.

The research results were statistically processed using the SPSS-22.0 program.

The results of the research

According to the conclusions of 177 CFME, in 132 (74.6%) cases, various defects in the provision of MC were detected, and in 45 (25.4%) cases, such defects were not registered. Therefore, further analysis was carried out by us for data sampling including defects in the provision of MC (132 conclusions of the CFME).

As it can be seen from the Table 1, according to the 132 conclusions of the CFME, 250 defects in the provision of MC were detected. Defects in diagnosis (34.8%) and defects in treatment (31.2%) were the most frequent and defects in the organization of the MC (12.0%) were the least common.

At the next stage of our research, we analyzed the CER between defects in the provision of medical care and the likelihood of lethal outcome. The nominal data using the Pearson χ^2 test was analyzed according to the recommendation of A.M. Grzhibovsky (2008).

CER between defects in MC and the likelihood of LO was detected among 40 (30.3%) of 132 patients in our cohort with defects in MC, while this relation was absent among 92 (69.7%) patients.

As it can be seen from the Table 2, Pearson's χ^2 test is χ^2 (1) = 17.618 (p = 0.000). This value of the χ^2 criterion is greater than the critical one (3.841; α = 0.05); therefore, there is a statistically significant relation between defects in MC and the probability of LO.

We have also calculated the relative risk (RR) of LO depending on the existing defects in MC.

As it can be seen from the Table 3, the RR is 0.697 at a 95% CI from 0.623 to 0.780, which indicates a low probability of LO at the given values of MC defects.

Table 5. RR of the likelihood of LO depending on the presence of defects in diagnosis.

Test	Value	95% confidence interval	
		Lower limit	Upper limit
RR	2.414	1.313	4.437

Table 6. CER between defects in diagnosis and LO.

Test	Value	Degree of freedom	Significance level		
			Asymptotic (2-sided)	Exact (2-sided)	Exact (1-sided)
χ^2 Pearson	49.181	1	0.000	–	–

Table 7. RR of the likelihood of LO depending on the presence of defects in treatment.

Test	Value	95% confidence interval	
		Lower limit	Upper limit
RR	15.654	5.014	48.874

Table 8. CER between defects in the organization of MC and LO.

Test	Value	Degree of freedom	Significance level		
			Asymptotic (2-sided)	Exact (2-sided)	Exact (1-sided)
χ^2 Pearson	0.011	1	0.916	–	–

Table 9. RR of the likelihood of LO depending on the presence of defects in the organization of MC.

Test	Value	95% confidence interval	
		Lower limit	Upper limit
RR	1.039	0.509	2.124

Of considerable interest was the question of which specific MC defects most of all affect the probability of LO occurrence. Tables 4–11 show the values of Pearson's χ^2 test and RR, indicating the presence/absence of a relation between MP defects and the probability of the occurrence of lethal outcome.

As it can be seen from the Table 4, Pearson's χ^2 test is χ^2 (1) = 8.987 (p = 0.003). This value of the χ^2 criterion is greater than the critical one (3.841; α = 0.05), therefore, there is a statistically significant relation between defects in diagnosis and the likelihood of LO.

As it can be seen from the Table 5, the RR is 2.414 at 95% CI from 1.313 to 4.437, which indicates a high likelihood of LO with these values of defects in diagnosis.

As you can see from the Table 6, Pearson's χ^2 test is χ^2 (1) = 49.181 (p = 0.000). This value of the χ^2 criterion is greater than the critical one (3.841; α = 0.05); therefore, there is a statistically significant relation between defects in treatment and the likelihood of LO.

As it can be seen from the Table 7, the RR is 15.654 at 95% CI from 5.014 to 48.874, which indicates a very high probability of LO with these values of defects in treatment.

As it can be seen from the Table 8, Pearson's χ^2 criterion is χ^2 (1) = 0.011 (p = 0.916). This value of the χ^2 criterion is less than the critical one (3.841; α = 0.05), therefore, there is no statistically significant relation between the defects in the organization of MC and the likelihood of LO.

As it can be seen from the Table 9, the RR is 1.039 at 95% CI from 0.509 to 2.124, which indicates that the presence of defects in the organization of the MC has practically no effect on the likelihood of lethal outcome.

As it can be seen from the Table 10, Pearson's χ^2 test is: χ^2 (1) = 4.680 (p = 0.031). This value of the χ^2 criterion is slightly higher than the critical one (3.841; α = 0.05), therefore, there is a statistically significant relation between defects in the maintenance of medical records and the likelihood of LO.

As it can be seen from the Table 11, the RR is 1.815 with a 95% CI from 1.062 to 3.100, which indicates the likelihood of LO at these values of defects in the maintenance of medical records.

Conclusion

Thus, we can conclude that according to the data of 132 conclusions of the CFME in forensic medical practice, defects in diagnosis (34.8%) and defects in treatment (31.2%) are the most common, and the least common defects are defects in the organization of medical care (12.0%). In the presence of defects in the provision of

Table 10. CER between defects in defects in the maintenance of medical records and LO.

Test	Value	Degree of freedom	Significance level		
			Asymptotic (2-sided)	Exact (2-sided)	Exact (1-sided)
χ^2 Pearson	4.680	1	0.031	–	–

Table 11. RR of the likelihood of LO depending on the presence of defects in the maintenance of medical records.

Test	Value	95% confidence interval	
		Lower limit	Upper limit
RR	1.815	1.062	3.100

MC, CER is detected between the frequency of defects and the likelihood of LO occurrence, and in case of absence of the defects CER is also missing, while the frequency of its detection is 30.3%. The likelihood of LO occurrence mostly depends on defects in diagnosis and treatment. Thus, the RR is 2.41 at 95% CI from 1.31% to 4.44% and 15.65 at 95% CI from 5.01% to 48.87%, respectively.

Sources of tables: Authors

Bibliography

1. Grzhibovski, A.M. (2008). Analiz nominal'nyh dannyh (nezavisimye nabljudenija). *Ekologija cheloveka*, *6* [in Russian]. Available at: https://cyberleninka.ru/article/n/analiz-nominalnyh-dannyh-nezavisimye-nablyudeniya. Accessed April 20, 2020.
2. Hovhannesyan, R.A. (2016). Problemy standartizacii i kontrolja kachestva medicinskoj pomoshhi v otechestvennoj sisteme zdravoohranenija. *Armjanskij medicinskij referativnyj zhurnal*, *12* [in Russian]. Available at: http://www.medlib.am/Jurnal/2016/RU/7.pdf. Accessed April 20, 2020.
3. Sergeev, Ju.D. (2016). Nenadlezhashhee okazanie medicinskoj pomoshhi – vazhnejshaja nauchno-prakticheskaja problema dlja specialistov v oblasti medicinskogo prava. *Medicinskoe pravo: teorija i praktika*, *2*(4) [in Russian]. Available at: http://www.med-law.ru/files/348/2016-2-4-tom-2.pdf. Accessed April 20, 2020.
4. Sharabchiev, Ju.T. (2013). Vrachebnye oshibki i defekty okazanija medicinskoj pomoshhi: social'no-jekonomicheskie aspekty i poteri obshhestvennogo zdorov'ja. *Mezhdunarodnye obzory: klinicheskaja praktika i zdorov'e*, *6*(6) [in Russian]. Available at: https://cyberleninka.ru/article/n/vrachebnye-oshibki-i-defekty-okazaniya-meditsinskoy-pomoschi-sotsialno-ekonomicheskie-aspekty-i-poteri-obschestvennogo-zdorovya. Accessed April 20, 2020.
5. Shevchuk, E.P. (2009). Prichinno-sledstvennaja svjaz' kak uslovie deliktnoj otvetstvennosti pri okazanii medicinskih uslug. *Sibirskij juridicheskij vestnik*, *2* [in Russian]. Available at: https://cyberleninka.ru/article/n/prichinno-sledstvennaya-svyaz-kak-uslovie-deliktnoy-otvetstvennosti-pri-okazanii-meditsinskih-uslug. Accessed April 20, 2020.
6. Shevchuk, E.P. (2012). «Vrachebnaja oshibka» i «Neschastnyj sluchaj» v objazatel'stvah po vozmeshheniju vreda pri okazanii medicinskih uslug. *Sibirskij juridicheskij vestnik*, *2* [in Russian]. Available at: https://cyberleninka.ru/article/n/vrachebnaya-oshibka-i-neschastnyy-sluchay-v-obyazatelstvah-po-vozmescheniyu-vreda-pri-okazanii-meditsinskih-uslug. Accessed April 20, 2020.