

Received: 03 July 2024 / Accepted: 27 October 2024 / Published online: 30 December 2024

DOI 10.34689/SH.2024.26.6.003

UDC 340.6:004



STUDY OF ISSUES AND PROSPECTS FOR THE IMPLEMENTATION OF DIGITAL FORENSIC DIAGNOSTICS INTO PRACTICE

Sapargali B. Rakhmanov¹, <https://orcid.org/0000-0002-0561-5931>**Aru D. Balmagambetova**², <https://orcid.org/0000-0003-1151-5651>**Gazim N. Smagulov**^{1,2}, <https://orcid.org/0000-0001-7330-5292>¹ RSME «Aktobe Interregional Center for Forensic Examinations», Aktobe, Republic of Kazakhstan;² West Kazakhstan Medical University named after Marat Ospanov, Department of Normal and Topographic Anatomy with Operative Surgery, Aktobe, Republic of Kazakhstan.

Abstract

Aim: To study the prerequisites for the introduction of virtopsy into practice, as the main component of digital forensic diagnostics.

Materials and Methods: In order to conduct research to determine the role of virtual autopsy in forensic examination, an effective bank of questions has been created for application, including its comprehensiveness (the issues were discussed and approved at the methodological council of 06.10.2023 Protocol No. 1). In order to determine the prerequisites for the introduction of virtual autopsy, the Aktobe Interregional Center for Forensic Examinations conducted a study consisting of two stages: an online questionnaire and an interview method (focus group) among several specific groups. The answers received at two stages were statistically processed in the programs SPSS Statistics 22, graphpad Prism, classified into groups based on the similarity of answers, and prerequisites related to the introduction of virtopsy into practice were formed.

Results: A survey on the introduction of virtual autopsy into practice, conducted among those persons who are not related to the production of forensic examination (as recipients of services), showed their full support for the introduction of virtual autopsy into practice. As established by the survey, for religious reasons, they are of the opinion that it is necessary to carry out the last journey without autopsy and any damage to the corpse. When asked about receiving virtual autopsy services on a paid basis, 60% of participants noted that they fully approve, and 29.4% indicated that they partially support. According to residents, the introduction of a virtual autopsy will reduce the number of misunderstandings among the population. Data conducted with a focus group among law enforcement officers closely associated with forensic medical examination showed that 89.3% of the study participants are confident that the introduction of virtual autopsy into practice will shorten the time of examination, and 7.2% remained of the opinion that this is due to the complexity of the examination.

Keywords: digital technology, forensic medical examination, corpse examination, virtual autopsy, traditional autopsy, focus group.

Резюме

ИЗУЧЕНИЕ ВОПРОСОВ И ПЕРСПЕКТИВ ВНЕДРЕНИЯ В ПРАКТИКУ ЦИФРОВОЙ СУДЕБНО-МЕДИЦИНСКОЙ ДИАГНОСТИКИ

Сапарғали Б. Рахманов¹, <https://orcid.org/0000-0002-0561-5931>**Ару Д. Балмагамбетова**², <https://orcid.org/0000-0003-1151-5651>**Газим Н. Смагулов**^{1,2}, <https://orcid.org/0000-0001-7330-5292>¹ РГКП Актюбинский межрегиональный центр судебных экспертиз, г. Актобе, Республика Казахстан;² НАО Западно Казахстанский медицинский университет имени Марата Оспанова, Кафедра нормальной и топографической анатомии с оперативной хирургией, г. Актобе, Республика Казахстан.

Цель: Изучение предпосылок для внедрения в практику виртопсии, как основного компонента цифровой судебно-медицинской диагностики.

Материалы и методы: В целях проведения исследования для определения роли виртуальной аутопсии в судебной экспертизе создан эффективный для применения банк вопросов, включающий ее всесторонность (вопросы были обсуждены и утверждены на методическом совете от 06.10.2023 протокол №1). В целях определения предпосылок для внедрения виртуальной аутопсии Актюбинским межрегиональным центром судебных экспертиз проведено исследование, состоящего из двух этапов: онлайн анкетирование и метод интервью (фокус-группа) среди нескольких определенных групп. Ответы, полученные при двух этапах, статистически обработаны в программах SPSS Statistics 22, graphpad Prism, классифицированы в группы по сходству ответов, сформированы предпосылки, связанные с внедрением в практику виртопсии.

Результаты: Опрос по поводу внедрения в практику виртуальной аутопсии, проведенный среди тех лиц, которые не имеют отношения к производству судебной экспертизы (в качестве получателей услуг), показал их полную поддержку внедрения в практику виртуальной аутопсии. Как установлено анкетированием, по религиозным соображениям придерживаются мнения, что необходимо проводить в последний путь без вскрытия и каких-либо повреждений трупа. На вопрос о получении услуг по виртуальной аутопсии на платной основе 60% участников отметили, что полностью одобряют, а 29,4% указали, что поддерживают частично. По мнению жителей внедрение виртуальной аутопсии сократит количество фактов непонимания среди населения. Данные проведенные с фокус-группой среди сотрудников правоохранительных органов, тесно связанных с судебно-медицинской экспертизой показали, что 89,3% участников исследования уверены, что внедрение в практику виртуальной аутопсии сократит срок производства экспертизы, а 7,2% остались при мнении, что это связано со сложностью экспертизы.

Ключевые слова: цифровая технология, судебно-медицинская экспертиза, экспертиза трупа, виртуальная аутопсия, традиционная аутопсия, фокус-группа.

Түйіндеме

ЦИФРЛЫҚ СОТ-МЕДИЦИНАЛЫҚ ДИАГНОСТИКАНЫ ПРАКТИКАҒА ЕНГІЗУДІҢ МӘСЕЛЕЛЕРІ МЕН ПЕРСПЕКТИВАЛАРЫН ЗЕРДЕЛЕУ

Сапарғали Б. Рахманов¹, <https://orcid.org/0000-0002-0561-5931>

Ару Д. Балмагамбетова², <https://orcid.org/0000-0003-1151-5651>

Газим Н. Смагулов^{1,2}, <https://orcid.org/0000-0001-7330-5292>

¹ «Ақтөбе өңіраралық сот сараптамалары орталығы» РМҚК, Ақтөбе қ., Қазақстан Республикасы;

² «Марат Оспанов атындағы Батыс Қазақстан медицина университеті» КЕАҚ, Қалыпты және топографиялық анатомия мен оперативтік хирургия кафедрасы, Ақтөбе қ., Қазақстан Республикасы;

Мақсаты: Сандық сот-медициналық диагностиканың негізгі құрамдас бөлігі ретінде виртопсияны тәжірибеге енгізудің алғышарттарын зерттеу.

Материалдар мен әдістер: Сот сараптамасында виртуалды аутопсияның рөлін анықтау үшін зерттеу жүргізу мақсатында оның жан-жақтылығын қамтитын тиімді сұрақтар банкі құрылды (мәселелер талқыланып, әдістемелік кеңесте 06.10.2023 жылғы №1 хаттамада бекітілді). Ақтөбе өңіраралық сот сараптамалары орталығы виртуалды аутопсияны енгізу үшін алғышарттарды айқындау мақсатында бірнеше анықталған топтар арасында онлайн сауалнама және сұхбат әдісі (фокус-топ) екі кезеңнен тұратын зерттеу жүргізді. Екі кезеңде алынған жауаптар SPSS Statistics 22, graphpad Prism бағдарламаларында статистикалық түрде өңделеді, жауаптардың ұқсастығы бойынша топтарға жіктеледі, виртопсияны тәжірибеге енгізуге байланысты алғышарттар қалыптастырылады.

Негізгі нәтижелер: Сот сараптамасын жүргізуге қатысы жоқ адамдар (қызмет алушылар ретінде) арасында жүргізілген виртуалды аутопсияны тәжірибеге енгізу туралы сауалнама олардың виртуалды аутопсияны тәжірибеге енгізуге толық қолдау көрсеткенін көрсетті. Сауалнамада анықталғандай, діни себептер бойынша мәйітті аутопсиясыз және қандай да бір зақымдамай соңғы жолға шығару керек деген пікірді ұстанады. Ақылы негізде виртуалды аутопсия қызметтерін алу туралы сұраққа қатысушылардың 60% - ы толық мақұлдағанын, ал 29,4% - ы ішінара қолдайтынын атап өтті. Тұрғындардың пікірінше, виртуалды аутопсияны енгізу халық арасында түсінбеушілік фактілерінің санын азайтады. Сот-медициналық сараптамамен тығыз байланысты құқық қорғау органдарының қызметкерлері арасында фокус-топпен жүргізілген деректер зерттеуге қатысушылардың 89,3% - ы виртуалды аутопсияны тәжірибеге енгізу сараптама жүргізу мерзімін қысқартатынына сенімді екенін көрсетті, ал 7,2% - ы бұл сараптаманың күрделілігімен байланысты деген пікірде қалды.

Түйінді сөздер: цифрлық технология, сот-медициналық сараптама, мәйіт сараптамасы, виртуалды аутопсия, дәстүрлі аутопсия, фокус-топ.

For citation / Для цитирования / Дәйексөз үшін:

Rakhmanov S.B., Balmagambetova A.D., Smagulov G.N. Study of issues and prospects for the implementation of digital forensic diagnostics into practice // *Nauka i Zdravookhranenie* [Science & Healthcare]. 2024. Vol.26 (6), pp. 21-27. doi 10.34689/SH.2024.26.6.003

Рахманов С.Б., Балмагамбетова А.Д., Смагулов Г.Н. Изучение вопросов и перспектив внедрения в практику цифровой судебно-медицинской диагностики // *Наука и Здравоохранение*. 2024. Т.26 (6). С. 21-27. doi 10.34689/SH.2024.26.6.003

Рахманов С.Б., Балмагамбетова А.Д., Смагулов Г.Н. Цифрлық сот-медициналық диагностиканы практикаға енгізудің мәселелері мен перспективаларын зерделеу // *Ғылым және Денсаулық сақтау*. 2024. Т.26 (6). Б. 21-27. doi 10.34689/SH.2024.26.6.003

Introduction

Forensic medical examination is a very complex, large-scale area in the production of general expertise. Research and examination of the corpse occupy a large place in the field of forensic medical examination. The complexity of the examination of the corpse, the volume of questions posed to the expert by the parties appointing the examination, create a number of difficulties in organizing the expert's work. Based on the current legislative documents in the Republic of Kazakhstan, mandatory autopsy of the corpse increases the expert's workload and in some cases leads to a delay in the case regarding this examination. During the review of the literature devoted to the examination of the corpse, its problems, there are scientific works on the introduction of virtual autopsy in the practice of forensic examination, on its advantages and disadvantages, on activities aimed at resolving the issue, as well as on other macrodiagnostic areas in forensic medicine [4,15]. Today, one of the priority areas is the introduction of new methods and advanced technologies in the field of forensic medicine. In forensic medicine, when examining living persons, i.e. in determining the degree of harm caused to health, the use of high-tech methods takes place, resorting to information from such X-ray methods as computed tomography or magnetic resonance imaging. In this regard, the use of such methods is relevant today and is widely used in practice in a number of countries, with a comprehensive study of its capabilities. According to some scientists, a virtual autopsy (virtopsy) performed before an autopsy is the basis for the expert to properly plan further examination of the corpse. At the same time, it turned out that the use of virtopsy along with traditional autopsy is very effective in some types of corpse examination when an expert makes a conclusion [3, 5].

Thus, when reviewing the literature, there are works devoted to the applied significance of virtual autopsy (virtopsy), on studies conducted in the areas of introducing digital diagnostics into forensic medicine. Despite a number of studies conducted to determine the applied significance of virtual autopsy, information on its results remains varied. At present, in the Republic of Kazakhstan, the implementation of this method has not found a specific solution during discussions between bodies related to forensic examination.

Aim. Study of prerequisites for the introduction of virtopsia into practice as the main component of digital forensic diagnostics.

Materials and methods of the study. Study design: mixed quantitative and qualitative research, online questionnaires and interviews via Google -form, in the period from December 2023 to January 2024.

In order to conduct a study to determine the role of virtual autopsy in forensic examination, an effective bank of questions was created, covering all the necessary points (the questions were discussed and approved at the methodological council on 06.10.2023, protocol No. 1). The study was approved by the Local Ethics Committee of the NAO ZKMU named after Marat Ospanov on 24.11.23 No. 11-11.27 / 03. In order to determine the prerequisites for the implementation of virtual autopsy, the Aktobe Interregional Center for Forensic Expertise conducted a study consisting of two stages: an online questionnaire and an interview

method among several specific groups. The total number of surveyed participants was 138. At the first stage, an online questionnaire was conducted among forensic experts (number - 44), law enforcement officers directly related to the production of corpse examination (number - 41), instrumental research specialists (11), residents and persons not working in the field of forensic examination (number - 42). The validity of the questionnaires was checked with experts from the Aktobe Interregional Center for Forensic Expertise and teachers of the Department of Normal and Topographic Anatomy with Operative Surgery of the NAO ZKMU named after Marat Ospanov, the questionnaire was conducted in Russian and informed consent was obtained immediately before the online questionnaire itself, in order to answer the questions of the questionnaire, participants receive full information after checking the consent item, after which the questionnaire becomes available. At the second stage, a total of 34 participants took part in the focus group, who were divided into three groups: 1 - experts of the general expert department of the Aktobe interregional center of forensic examinations, directly carrying out the examination of the corpse (number - 12); 2 - radiologists and computer tomograph specialists in order to determine the applied value of instrumental studies (number - 10); 3 - employees of the investigative department of the Police Department of the Aktobe region (number - 12).

For the online survey, the number of questions was 18, starting with a simple question about whether you know what virtopsy is and covering issues determining its necessity and significance. At the end of the survey, there is a separate line for recording the opinion of the research participant. Interviewing among focus groups was conducted in the form of a round table among small groups (covering 5-12 people) with a discussion of the advantages and disadvantages of virtual autopsy, legislative principles. The answers received in two stages were statistically processed in SPSS Statistics 22, graphpad Prism programs, classified into groups by similarity of answers, and prerequisites related to the introduction of virtopsia into practice were formed.

The data obtained through questionnaires and interviews were analyzed using qualitative and quantitative data analysis methods. Qualitative analysis included a generalization of the general characteristics of the data that were obtained in the responses of forensic experts, employees of the Police Department of the Aktobe Region, residents and individuals not working in the field of forensic examination. The practical value, need, features of the implementation of virtopsia, etc., which were most often mentioned in the responses of the study participants, were assessed.

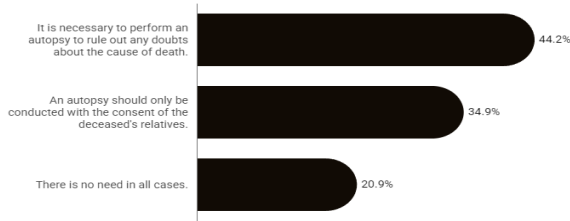
Study results

As a result of the survey among forensic experts, 39 (87.9%) positively assessed the introduction of virtual autopsy into practice. 4 (10.3%) participants found it difficult to answer, and 1 (1.8%) participants were against this method. When asked about approval of autopsy, 20 (44.7%) experts supported the need for mandatory autopsy to dispel doubts about the cause of death, 15 (34.9%) supported the need for autopsy with the consent of relatives, and the remaining 9 (20.9%) participants put

forward the opinion that there is no need for autopsy in all cases (Figure 1). In the Republic of Kazakhstan, forensic examination institutes for conducting X-ray computer studies of corpses are insufficiently provided with specialists (some institutes have specialists - radiologists working in the practical healthcare system). In this regard, to the question "are you ready to improve your qualifications in virtual autopsy?" 27 (61.2%) participants from among the experts answered positively. 25 (58.3%) experts expressed the opinion that virtual autopsy will improve the quality of

examination, 16 (35.7%) are of the opinion that the implementation will partially affect the improvement of quality. In particular, 21 (48.8%) participants indicated that virtual autopsy has great potential in cases of sudden death. "What challenges may arise in implementing virtual autopsy in forensic medical examination?" many are concerned about the shortage of specialized facilities/rooms in forensic centers (35.7%) and the lack of qualified specialists (41.7%), a smaller number of respondents (22.6%) point to the financial aspect (Figure 2).

What is your point of view on autopsy?



What challenges may arise in implementing virtual autopsy in forensic medical examination?



Figure 1,2. Online survey indicators.

The survey conducted among law enforcement officers, study participants, noted the importance of introducing a digital database into forensic medicine. 102 (74.1%) of the study participants were positive about the introduction of virtual autopsy, while only 11 (8.2%) were against it. The remaining participants found it difficult to answer (Figure 3.4). However, most of them support the introduction of this technique into practice. To the question "Can virtual autopsy completely replace traditional autopsy?" 62 (45.1%)

of the participants answered that it can in some cases, and 57 (41.5%) said that it can partially replace it. Only 18 (13.4%) answered that virtual autopsy cannot completely replace traditional autopsy. To the question "Do law enforcement officers support virtual autopsy?" 91 (65.9%) participants supported, 34 (24.7%) partially supported, and 13 (9.4%) indicated that they were completely against this method.

What is your point of view on autopsy?



Are you ready to take virtual autopsy training?

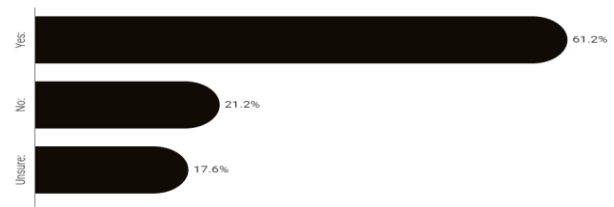
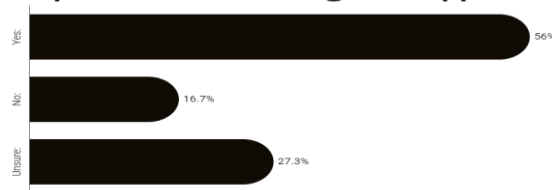


Figure 3,4. Online survey indicators.

A survey on the introduction of virtual autopsy into practice, conducted among those individuals who are not involved in forensic examination (as recipients of services), showed their full support for the introduction of virtual autopsy into practice. When asked about receiving virtual autopsy services on a paid

basis, 83 (60%) participants indicated that they fully approve, and 40 (29.4%) indicated that they partially support. According to residents, the introduction of virtual autopsy will reduce the number of cases of misunderstanding among the population (Figure 5.6).

Do you think that the introduction of virtual autopsy in the examination of a corpse will receive religious support?



Do you think the introduction of virtual autopsy on a paid basis will be supported by service recipients?

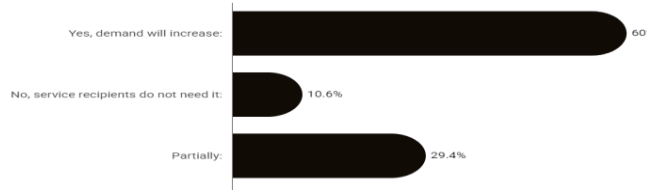


Figure 5,6. Online survey indicators.

Also, as a result of working with a focus group of law enforcement officers closely associated with forensic medical examination, real preconditions for the practical value, application features and regulatory requirements of virtual autopsy were determined. 30 (89.3%) of the study participants are confident that the introduction of virtual autopsy into practice will reduce the time of examination, and only 2 (7.2%) remain of the opinion that this is due to the complexity of the examination. Important information established during the work with the focus group is large financial costs. In this context, due to financial costs, 30 (90.2%) participants have no doubt that the introduction of this method will find great support from service recipients. According to the experts who conducted the instrumental studies, with the help of a computer tomograph, it is possible to fully identify injuries, including 32 (96%) participants agree that bone fractures and even small bone cracks can be visualized, and 1 (4%) participants believe that it is difficult to answer when examining a corpse, since this method has not been used in practice before.

Thus, the judgments obtained as a result of the study about the relevance of virtual autopsy, the difficulties and advantages of its implementation are varied, and there is also interest in the introduction of virtopsia into practice by specialists conducting instrumental studies, who expressed the opinion that their result will be high.

Discussion

Forensic medical examination of a corpse occupies a special place and is considered difficult in the production of general forensic examinations. The introduction of new methods in the production of forensic examinations, including the optimization of forensic medical research, amendments to regulatory legal acts in accordance with modern demand is relevant today. In this regard, the introduction of the virtual autopsy technique or its elements is actively carried out in a number of countries, but to date, this technique has not yet been introduced in the Republic of Kazakhstan and requires comprehensive research. The results of the study, conducted between various groups in order to determine the prerequisites for the introduction of this technique, led to the formation of opinions on the importance of conducting a virtual autopsy and some of its problems. That is, it can be concluded that by specifically defining cases when there is no need for an autopsy and if it is possible to establish the cause of death or a full description of injuries without an autopsy, it is possible to introduce a virtual autopsy [2,6]. To solve the tasks set in this study, an online survey was conducted. The questionnaire method is an effective quantitative method in a public survey, and the advantage is that it covers a large group of subjects in a short period of time. In particular, some literary data on the practical application of virtual autopsy indicate the advantages of the questionnaire method [10,12,17]. The focus group method is a qualitative method that allows for a deep understanding of the audience's position and many aspects of a decision on specific issues that are more quantitative than the method [1,9]. The basis for the survey of employees of the Investigative Department of the Police Department is that often, when a person dies in a traffic accident, the injured party opposes an autopsy and residents protest against the decision of the Investigative Department in cases of non-violent death. An important factor for the implementation of virtual autopsy is the availability of an appropriate specialist (CT and other

specialist). Today, despite the lack of specialists in the required number at the Institutes of Forensic Examinations, some centers have specialists in computed tomography and magnetic resonance imaging (for example, the AMCSE has a specialist - a radiologist / computed tomographer). This is a prerequisite for the introduction of virtual autopsy [13,20]. It can be established that there are different opinions among law enforcement officers who participated in the study. Basically, the majority is not against the introduction of this method. When asked about the introduction of virtual autopsy, respondents answering this question noted that they find it difficult to answer, which may be due to the fact that the concept of virtual autopsy is not widely used among law enforcement officers. Most law enforcement officers who do not approve of this method believe that most fatal cases are resonant, which can lead to delays in the case.

Law enforcement officers noted that their support for the introduction of this method into practice is due to the large number of residents who want to receive a body without an autopsy (for religious reasons). In accordance with the issued resolution and regulatory legal acts of the Republic of Kazakhstan, an autopsy is considered mandatory. In this regard, law enforcement agencies do not have the competence to return the resolution. Therefore, the majority of participants (82.1%) supported the question that determined their views on the use of virtual autopsy along with traditional autopsy [8,11].

The conducted study among service recipients on the introduction of virtual autopsy, predominantly the majority of participants received positive answers, which indicates the relevance of introducing this technique into practice. As established by the questionnaire, for religious reasons, they are of the opinion that it is necessary to conduct the last journey without an autopsy and any damage to the corpse. In particular, virtual autopsy has shown that it has a wide range of applications in the death of patients with chronic diseases, in forensic examinations of children's corpses, as well as in road accidents. According to the research group, in these cases, the importance of psychological support among the relatives of the deceased was noted. On the other hand, it is assumed that forensic examination can be a factor reducing the burden on experts if it is introduced in specific cases.

Today's problem of the party appointing an examination is the duration of the examination. Therefore, if we take this problem into account, it has been established that the introduction of the virtopsia method is the only way to solve this issue. In addition, as the results of the study show, the use of virtual autopsy in practice, according to literary data, increases the objectivity of forensic examination due to good visualization, which is effective for some types of injuries compared to traditional autopsy, and in general, when additional questions arise regarding its results (additional examination), it is considered very high in terms of the evidence base [7,14,21]. And if we take it from the point of view of the dependence on the complexity of the examination, the use of virtual autopsy in all types of corpse examination can give rise to doubt, i.e. it is predicted that the rate of appointment of repeated examinations may increase due to the fact that an autopsy is not performed. It is also noted that amendments and additions to some points of the current procedural documents of the Republic of Kazakhstan are mandatory.

The study conducted at the first stage on the implementation of virtual autopsy in forensic medicine was characterized by features and opinions on the applied significance of this method are diverse and require comprehensive study. As a result of the study, it was found that the implementation of virtual autopsy in the field of forensic medical examination from a practical point of view is a valuable and necessary method in our country. The value of this method is the optimization of the production of forensic medical examination in the modern direction. The implementation of this method will reduce the time of production of forensic examination and misunderstandings on the part of recipients of services, reduce the workload of medical experts and is a convenient method in conditions of especially dangerous infectious diseases [16,18,19]. It is also possible to improve the quality of the examination in the expert's activities (including evidence), facilitate expert work in the examination of a corpse using percutaneous postmortem biopsy, by determining the state of internal organs.

Conclusions

The introduction of virtual autopsy into practice is the only means of introducing a digital base into forensic medical examination. The digital forensic database is based on storing all data, from external examination to internal examination of the corpse, the results of chemical and histological studies. Long-term storage of this information in the digital database will make it possible to re-examine additional issues that arise during the examination and will reduce the rate of appointment of repeated examinations.

Conflict of Interest. The authors declare that they have no conflict of interest.

Contribution of authors. All authors were equally involved in the writing of this article.

Funding: No funding was provided.

Литература:

1. Гордеева Е.Н. Использование метода фокус-групп в исследовании процесса развития эстетической культуры сотрудников органов внутренних дел. Академическая мысль. 2019.9.С.113-117.
2. Горлова В.А., Зарипова Э.Р. К вопросу о внедрении виртуальной аутопсии в России. Современная юриспруденция: актуальные вопросы, достижения и инновации. Сборник статей XXIV Международной научно-практической конференции. 2019. С.182-184.
3. Кинле А.Ф., Коков Л.С., Сеницын В.А., Фетисов В.А., Филимонов Б.А. Реальные возможности лучевой диагностики в практике судебно-медицинского эксперта. *Consilium medicum*. 2016. 18:13. С.9-25.
4. Клевно В.А., Чумакова Ю.В., Курдюков Ф.Н., и др. Возможности посмертной компьютерной томографии (виртуальной аутопсии) в случае смерти от механической асфиксии. *Судебная медицина*. 2018. 4:4. С. 22-26.
5. Клевно В.А., Тархнишвили Г.С., Спицына Л.И., Мирзонов В.А., Баланик Э.А., Виртопсия смертельно травмированного человека на взлетно-посадочной полосе стойкой шасси при взлете воздушного судна BOEING 737. *Судебная медицина*. 2019.2:5. С. 32-36.
6. Клевно В.А., Чумакова Ю.В. Виртопсия – новый метод исследования в практике отечественной

судебной медицины. *Судебная медицина*. 2019. № 2(5). С. 27-31.

7. Ковалев А.В., Кинле А.Ф., Коков Л.С., Сеницын В.А., Фетисов В.А., Филимонов Б.А. Реальные возможности посмертной лучевой диагностики в практике судебно-медицинского эксперта. *Consilium Medicum* 2016. №18(13). С. 9–25.

8. Коков Л.С., Кинле А.Ф., Сеницын В.Е., Филимонов Б.А. Возможности посмертной визуализации в судебно-медицинской экспертизе трупа: обзор и критический анализ литератур. *Лучевая диагностика. Судебная медицина* – 2015. №1. С.1-28.

9. Макарова Н.С., Дроботенко Ю.Б. Фокус-групповое исследование изменений образовательного процесса в современном вузе. *Науковедение*. 2014. С.1-14.

10. Пасечник Я.В., Кривошеева Д.А. Анкетирование как метод исследований. Проблемы и перспективы развития науки в России и мире. Сборник статей международной научно-практической конференции: в 7 частях. 2016. С. 157-159.

11. Туманова У.Н., Федосеева В.К., Ляпин В.М., Щеголев А.И., Сухих Г.Т. Выявление скоплений газа в телах плодов, мертворожденных и умерших новорожденных при посмертном компьютерно-томографическом исследовании. *Consilium medicum*. 2016. № 13(18). С.26–33.

12. Чумаченко А.П., Орешкова В.В. Анализ особенностей аттестации руководящих кадров главного управления МЧС России по Московской области с использованием метода анкетирования. Особенности организации аналитической работы в органах государственной власти и местного самоуправления (по тематике гражданской обороны, профилактики ЧС и ликвидации их последствий). Сборник трудов XXVIII Международной научно-практической конференции. 2018. С. 272-277.

13. Chawla H., Yadav R.K., Griwan M.S., Malhorta R., Paliwal P.K. Sensitivity and specificity of CT scan in revealing skull fracture in medico-legal head injury victims. *Australasian Medical Journal*. 2015. Vol.8(7). P. 235-238.

14. Graziani G., Tal S., Adelman A., Kugel C., Bdoolah-Abram T., Krispin A. Usefulness of unenhanced post mortem computed tomography – Findings in postmortem non-contrast computed tomography of the head, neck and spine compared to traditional medicolegal autopsy. *Journal of Forensic and Legal Medicine*. 2018. Vol.55. P. 105-111.

15. Jan Frishons, Stepanka Kucerova, Mikolas Jurda, Milos Sokol, Tomas Vojtišek, Petr Hejna. Current macrodiagnostic trends of forensic medicine in the Czech Republic. *National library of Medicine*. 2017. 156:7. P. 384-390.

16. Jan Frishons, Vatslav Novotny, Pavel Rejtar, Petr Hejna et al. Virtopsy in the Czech Republic. *Russian Journal of Forensic Medicine*. 2020. 6:2. P.44-48.

17. Jun-Wei Gao, Yang Lu, Yan-Jun Li, Dong-Hua Zou, Guang-Long. Survey on the Construction Status of Forensic Virtual Autopsy Laboratory and the Applicability of Laboratory Accreditation. *National Library of Medicine*. 2023. 39:2. P.186-192.

18. Laura Filograna, Luca Pugliese, Massimo Muto et al. A Practical Guide to Virtual Autopsy: Why, When and How. *National Library of Medicine*. 2019. 40:1. P.56-66.

19. Li R., Yin K., Zhang K. et al. Application Prospects of Virtual Autopsy in Forensic Pathological Investigations on COVID-19. *Journal of forensic medicine*. 2020. 33:2. P.149-156.

20. Lally PJ, Arthurs O, Addison S, Alavi A, Sebire NJ, Taylor A, et al. Estimating maceration severity using whole body magnetic resonance T2 relaxometry. *Arch Dis Child Fetal Neonatal*. 2014. Vol.1. P.92–95.

21. Sifaouia I., Nedelcu C., Beltran G., et al. Evaluation of unenhanced post-mortem computed tomography to detect chest injuries in violent death. *Diagnostic and Interventional Imaging*. 2017. Vol.98(5). P. 393- 400.

References: [1-12]

1. Gordeeva E.N. Ispol'zovanie metoda fokus-grupp v issledovanii protsessa razvitiya esteticheskoi kultury sotrudnikov organov vnutrennikh del [The use of the focus group method in the study of the process of development of aesthetic culture of employees of internal affairs bodies]. *Akademicheskaya mys' [Academic thought]*. 2019. 9. pp.113-117. [in Russian]

2. Gorlova V.A., Zaripova Je.R. K voprosu o vnedrenii virtual'noi autopsii v Rossii [On the issue of the introduction of virtual autopsy in Russia]. *Sovremennaya yurisprudentsiya: aktual'nye voprosy, dostizheniya i innovatsii Sbornik statei XXIV Mezhdunarodnoi nauchno-prakticheskoi konferentsii* [Modern jurisprudence: current issues, achievements and innovations. Collection of articles of the XXIV International Scientific and Practical Conference]. 2019. pp.182-184. [in Russian]

3. Kinle A.F., Kokov L.S., Sinicyan V.A., Fetisov V.A., Filimonov B.A. Real'nye vozmozhnosti luchevoj diagnostiki v praktike sudebno-meditsinskogo jeksperta [The real possibilities of radiation diagnostics in the practice of a forensic medical expert] // *Consilium medicum* [Consilium medicum]. 2016. 18:13. pp.9-25. [in Russian]

4. Klevno V.A., Chumakova Ju.V., Kurdjukov F.N., i dr. Vozmozhnosti posmertnoi komp'yuternoj tomografii (virtual'noi autopsii) v sluchae smerti ot mekhanicheskoi asfiksii [Possibilities of postmortem computed tomography (virtual autopsy) in case of death from mechanical asphyxia]. *Sudebnaya meditsina* [Forensic medicine]. 2018. 4:4. pp. 22–26. [in Russian]

5. Klevno V.A., Tarhishvili G.S., Spicyana L.I., Mirzonov V.A., Balanjuk Je.A., Virtopsiya smertel'no travmirovannogo cheloveka na vzletno-posadochnoi polose stoikoi shassi pri vzlete vozdušnogo sudna BOEING 737 [Virtopsy of a fatally injured person on the landing gear runway during take off a BOEING 737 aircraft]. *Sudebnaya meditsina* [Forensic medicine]. 2019.2:5. pp. 32-36. [in Russian]

6. Klevno V.A., Chumakova Ju.V. Virtopsiya – novyi metod issledovaniya v praktike otechestvennoi sudebnoi meditsiny [Virtopsy is a new research method in the practice of domestic forensic medicine]. *Sudebnaya*

meditsina [Forensic medicine]. 2019. № 2(5). pp. 27-31. [in Russian]

7. Kovalev A.V., Kinle A.F., Kokov L.S., Sinicyan V.A., Fetisov V.A., Filimonov B.A. Real'nye vozmozhnosti posmertnoi luchevoj diagnostiki v praktike sudebno-meditsinskogo eksperta [The real possibilities of postmortem radiation diagnostics in the practice of a forensic medical expert]. *Consilium Medicum*. 2016. №18(13). pp. 9–25. [in Russian]

8. Kokov L.S., Kinle A.F., Sinicyan V.E., Filimonov B.A. Vozmozhnosti posmertnoi vizualizatsii v sudebno-meditsinskoi ekspertize trupa: obzor i kriticheskii analiz literatury [Possibilities of postmortem imaging in the forensic medical examination of a corpse: a review and critical analysis of the literature]. *Lucheвая diagnostika. Sudebnaya meditsina* [Radiation diagnostics. Forensic medicine]. 2015. №1. pp.1-28. [in Russian]

9. Makarova N.S., Drobotenko Ju.B. Fokus-grupповое issledovanie izmenenii obrazovatel'nogo protsessa v sovremennom vuze [Focus group study of changes in the educational process in a modern university]. *Naukovedenie* [Naukovedenie]. 2014. pp.1-14. [in Russian]

10. Pasechnik Ja.V., Krivosheeva D.A. Anketirovanie kak metod issledovaniya. Problemy i perspektivy razvitiya nauki v Rossii i mire [The questionnaire as a research method. Problems and prospects of science development in Russia and the world]. *Sbornik statei mezhdunarodnoi nauchno-prakticheskoi konferentsii: v 7 chastyakh* [Collection of articles of the international scientific and practical conference: in 7 parts.]. 2016. pp. 157-159. [in Russian]

11. Tumanova U.N., Fedoseeva V.K., Ljapin V.M., Shhegolev A.I., Suhin G.T. Vyyavlenie skoplenii gaza v telakh plodov, mertvorozhdennykh i umershih novorozhdennykh pri posmertnom komp'yuterno-tomogra- ficheskom issledovanii [Detection of gas accumulations in the bodies of fetuses, stillborn and deceased newborns during postmortem computed tomographic examination]. *Consilium medicum*. 2016. № 13(18). pp.26–33. [in Russian]

12. Chumachenko A.P., Oreshkova V.V. Analiz osobennostei attestatsii rukovodyashchikh kadrov glavnogo upravleniya MChS Rossii po Moskovskoi oblasti s ispol'zovaniem metoda anketirovaniya. Osobennosti organizatsii analiticheskoi raboty v organakh gosudarstvennoi vlasti i mestnogo samoupravleniya (po tematike grazhdanskoi oborony, profilaktiki ChS i likvidatsii ih posledstviy) [Analysis of the features of certification of senior personnel of the Main Directorate of the Ministry of Emergency Situations of Russia in the Moscow region using the questionnaire method. Features of the organization of analytical work in public authorities and local self-government (on the subject of civil defense, emergency prevention and elimination of their consequences)]. *Sbornik trudov XXVIII Mezhdunarodnoi nauchno-prakticheskoi konferentsii* [Proceedings of the XXVIII International Scientific and Practical Conference]. 2018. pp. 272-277. [in Russian].

Corresponding author:

Balmagambetova Aru Dyusenovna, PhD, Associate Professor, Department of Normal and Topographic Anatomy with Operative Surgery, Marat Ospanov West Kazakhstan Medical University, Aktobe, Kazakhstan.

Post address: Kazakhstan, 030019, Aktobe, Maresyev street 68.

E-mail: aru.b.84@mail.ru

Phone number: +7 776 760 88 78