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Assessing Intensive Care Nurses' and Physicians' Proficiency in Ante-Post Mortem Changes: A Comprehensive Evaluation

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ABSTRACT

Objective: This study aims to evaluate the knowledge levels of intensive care nurses and physicians regarding the natural and unnatural changes that occur before and after death. **Materials and Methods:** This descriptive study was conducted from March-May 2024, in the intensive care units of three hospitals in northern Türkiye. The participants included healthcare professionals from these units. Data were collected through a 32-question questionnaire developed by the researchers, based on a literature review. **Results:** The study found that 78.4% of the participants were female, and 93.3% were nurses. On average, the participants reported encountering 4.9 ± 0.2 deaths per month. In the questionnaire, the highest correct answer rate (81.35%) was observed for questions related to brain death, while the lowest correct answer rate (45.95%) was for questions about post-mortem changes. **Conclusion:** Correctly interpreting the changes that occur before and after death requires both knowledge and experience. Understanding these changes is critical to medical, legal and ethical decision-making processes. In order to improve the quality of care, basic education programs for health professionals need to be updated. It is important that these trainings are integrated into continuous professional development programs with an interdisciplinary approach and based on current scientific evidence.

Keywords: Death, Intensive care, Post mortem changes.

Yoğun Bakım Hemşireleri ve Hekimlerinin Ölüm Öncesi ve Sonrası Değişiklikler Konusundaki Yeterliliklerinin Değerlendirilmesi: Kapsamlı Bir İnceleme

ÖZ

Amaç: Bu çalışma, ölüm öncesi ve sonrası meydana gelen doğal ve doğal olmayan değişikliklere ilişkin yoğun bakım hemşireleri ve hekimlerinin bilgi düzeylerini değerlendirmeyi amaçlamaktadır. **Gereç ve Yöntem:** Araştırma, Mart-Mayıs 2024 tarihleri arasında Türkiye'nin kuzeyindeki üç hastanenin yoğun bakım ünitelerinde gerçekleştirilmiştir. Çalışmaya, bu ünitelerde görev yapan sağlık çalışanları katılmıştır. Veriler, araştırmacılar tarafından literatür taramasına dayanarak geliştirilen 32 soruluk bir anket aracılığıyla toplanmıştır. **Bulgular:** Araştırmaya katılanların %78.4'ünün kadın, %93.3'ünün hemşire olduğu belirlenmiştir. Katılımcılar, ayda ortalama 4.9 ± 0.2 ölüm vakasıyla karşılaştıklarını bildirmiştir. Anket sonuçlarına göre en yüksek doğru yanıt oranı (%81.35) beyin ölümü ile ilgili sorularda, en düşük doğru yanıt oranı ise (%45.95) post-mortem değişikliklere ilişkin sorularda belirlenmiştir. **Sonuç:** Ölüm öncesi ve sonrası meydana gelen değişikliklerin doğru şekilde yorumlanması hem bilgi hem de deneyim gerektirmektedir. Bu değişikliklerin anlaşılması, tıbbi, hukuki ve etik karar alma süreçleri açısından kritik öneme sahiptir. Bakım kalitesinin artırılabilmesi için sağlık profesyonellerine yönelik temel eğitim programlarının güncellenmesi gerekmektedir. Bu eğitimlerin disiplinlerarası bir yaklaşımla, güncel bilimsel kanıtlara dayalı olarak sürekli mesleki gelişim programlarına entegre edilmesi önem arz etmektedir.

Anahtar Kelimeler: Ölüm, Yoğun bakım, Ölüm sonrası değişiklikler.

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INTRODUCTION

Intensive care units (ICUs) are specialized areas in hospitals equipped with complex devices, and they differ from other clinics in terms of overall appearance, operations, and atmosphere. Due to the severe clinical conditions of patients admitted to these units and their need for prolonged medical support and interventions, mortality rates in ICUs are significantly higher compared to other clinical departments (de Takao Kaneko-Wada et al., 2015). In this context, intensive care physicians and nurses frequently provide care and treatment to patients in critical condition and near death, and they often encounter death as well (Ceyhan, Özen, Zincir, Şimşek, & Başaran, 2018). Some studies conducted in intensive care units have focused on healthcare professionals' practices regarding death and the dying process (Boissier et al., 2020; Gerritsen et al., 2013; Kentish-Barnes et al., 2016; Osborn et al., 2012). Witnessing death in the Intensive Care Unit, caring for a patient who is dying or has experienced brain death, informing patient families, and accurately interpreting medical findings can often be challenging. Particularly for newly graduated healthcare professionals, who have limited practical experience and inadequate knowledge about the dying process, they may not be sufficiently prepared for these situations (Caton & Klemm, 2006; Sherman, Matzo, Pitorak, Ferrell, & Malloy, 2005). Brain death is a relatively rare condition in intensive care units, but healthcare professionals may encounter ethically complex cases involving brain death. Continuing medical care for patients diagnosed with brain death, up to and including organ donation, poses one of the most significant challenges. Brain death typically results in changes in cardiovascular, respiratory, endocrine, and metabolic systems, often leading to pronounced hemodynamic instability. Therefore, caring for and monitoring these patients can be highly demanding (Gordon & McKinlay, 2012). Healthcare professionals working in intensive care units should have detailed knowledge about agonal phase (the dying process), rare findings about to death, brain death, early and late post-mortem natural changes, and rare conditions related to death. This is crucial because certain death-related situations can bring complex legal questions and issues. For example, the agonal phase can sometimes last hours and culminate in death, during which there may be variability in mental activity alongside organ function deterioration, potentially leading individuals to disclose significant information (such as estate matters or confessions). Legally deemed invalid, reports from healthcare personnel who observe the ante-mortem period regarding whether the patient was in the agonal phase are significant evidence concerning such information and actions (Ersoy, 2024). With all these reasons in mind, this study aimed to determine the knowledge levels of healthcare professionals working in intensive care

regarding ante-mortem and post-mortem changes, assess their frequency of encountering death, identify any educational needs they may have, and contribute to the literature on this topic.

MATERIALS AND METHODS

Study type

The study was designed as a descriptive design to assess the knowledge of healthcare professionals working in intensive care units regarding ante and post-mortem changes. The study adhered to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines. The study was carried out in the intensive care units of three hospital's located in northern Türkiye, within the period from March -May 2024.

Study group

The study population consisted of nurses and doctors working in intensive care units of 3 different hospitals in a province in the north of Türkiye between March and May 2024 (N=210); The population was calculated as 134 participants in the study using the known sampling method with a standard error 0.05, a confidence interval of 95% and a type 2 error of 20%. Ultimately, the study was completed with 134 participants.

Dependent and independent variables

Procedures

The data were collected by a questionnaire form that was prepared by the researchers the literature review (Koç, 2016). The form consists of two sections and 32 questions. The questionnaire included questions related to the descriptive characteristics of healthcare professionals (age, gender, educational background, profession, years of working in the profession, prior training on forensic cases, frequency of death) and their knowledge regarding ante-and post-mortem changes (25 questions). Participants were informed that their involvement was entirely voluntary and that the data would only be used for scientific research purposes. The questions are responded to as "True", "False", and "I don't know" and are Those who answered the question correctly were given 1 point, those who did not know were given and those who answered incorrectly were given 0 points in the knowledge question form. The lowest score that can be obtained from the ante- and post-mortem changes questionnaire varies between 0 and 25. The survey does not have a cut-off score. High score indicates a high level of knowledge about the changes before and after death. After the survey form was prepared, opinions were received from three experts (Forensic medicine specialist). After receiving information about the study's scope, the questionnaire forms were distributed to those who agreed to participate, including healthcare professionals. Participants were given a specific time to respond to the survey questions and filled out the form face-to-face. Once they completed the questionnaires, they were directed to designated collection points in each intensive care

unit. The researchers made regular visits to these areas to gather the completed questionnaires. It took participants approximately 3-5 minutes to complete the questionnaire. Cronbach Alpha reliability coefficient of the questions was calculated as 0.836.

Statistical analysis

Statistical analysis was conducted using the IBM SPSS 25.0 (IBM Corp., Armonk, NY, USA) software package. In the evaluation of the data, Nonparametric categorical data were compared using X² (chi-square) analysis, descriptive statistical methods such as percentage, mean, standard deviation, and Kolmogorov-Smirnov distribution test were used for the normal distribution. For the two-group comparison of quantitative variables, independent group t-test, and correlation analysis were used. Statistical significance was accepted at the level of $p < 0.05$.

Ethical approval

Ethics committee approval was obtained from the Ethics Committee of Giresun University Hospital (Date:21/02/2024, Issue No:02). Additionally, written permission was obtained from the relevant hospital after explaining the scope of the study. Once volunteers were informed and had filled out the voluntary consent form, the study was initiated. The study was conducted in accordance with the principle of voluntary participation as outlined in the Helsinki Declaration.

RESULTS

The average age of healthcare professionals is 33.7 ± 0.7 , and 78.4% of them are female. The average length of service is 10.6 ± 0.8 years. It was determined that 85.8% of healthcare professionals did not receive forensic event training (Table 1).

Table 1. Descriptive information (n =134).

Descriptive Information	n	%
Gender		
Female	105	78.4
Male	29	21.6
Education		
High school	7	5.2
Bachelor	114	85.1
Master	13	9.7
Occupation		
Physician	9	6.7
Nurse	125	93.3
Receiving Forensic Medicine Training		
Yes	19	14.2
No	115	85.8
Years of experience in the profession		10.6 ± 0.8
Age		33.7 ± 0.7
The frequency of encountering death cases (per month)		4.9 ± 0.2

In Table 2, numerical and percentage values for the responses provided by healthcare professionals to the questions are presented. The average knowledge scores regarding ante- and post-mortem changes among intensive care healthcare professionals participating in the study were determined to be 13.5 ± 3.9 (Minimum=1, Maximum=23) (Table-2).

Table 3 presents the status of forensic event training among healthcare professionals working in intensive care, as well as a comparison of their ante- and post-mortem knowledge levels and the impact of forensic training on these knowledge levels, along with statistical analyses and comparison results. It was determined that 8.9% of the nurses participating in the study had received forensic medicine training, whereas this rate was 88.9% among physicians. A statistically significant difference was found between

nurses and physicians regarding their attendance in forensic medicine courses ($P < 0.00$). When ante- and post-mortem knowledge scores were analyzed by profession, it was found that nurses had an average score of 13.4 ± 4.1 , while physicians had an average score of 16.0 ± 2.8 . A statistically significant difference was observed between the two professional groups in terms of their ante- and post-mortem knowledge scores ($p < 0.05$). Furthermore, when knowledge levels were examined based on whether participants had received forensic case training, the average score of those who answered "yes" was 15.2 ± 3.0 , whereas the average score of those who answered "no" was 13.3 ± 4.2 . A statistically significant difference was found between the average scores of those who had received forensic case training and those who had not (Table 3).

Table 2. Ante-Post mortem information.

	Yes n (%)	No n (%)	Don't know n (%)
Ante-Post Mortem Information Mean Score	13.5±3.9	(Min=1, Max=23)	
1. The agonal (death throes) period is a process that always accompanies deterioration in the clinic, lasting seconds and minutes.	*119(88.8)	2 (1.5)	13 (9.7)
2. Among the symptoms of agonal (death throes), the most misleading are those related to mental activity.	*77 (57.5)	6(4.5)	51(38.1)
3. During the agonal (death throes) period, a person can provide legally valid significant information.	44(32.8)	*47(35.1)	43(32.1)
4. The consciousness of a person during the agonal (death throes) period is completely closed.	21(15.7)	*95(70.9)	18(13.4)
5. Spontaneous movement in the arms and legs can be observed in a subject where death has occurred.	*77(57.5)	43(32.1)	14(10.4)
6. When a person's respiration, circulation, and central nervous system functions have not yet ceased and a detailed examination has not been performed, the incorrect diagnosis of death.	*68 (50.7)	22 (16.4)	44 (32.8)
7. A patient who does not respond to resuscitation after arrest is considered dead, but circulation and respiration can spontaneously return in the patient after resuscitation.	*58(43.3)	57(42.5)	19(14.2)
8. If a patient is in a coma, it means that brain death has occurred.	10(7.5)	*115(85.8)	9(6.7)
9. In cases where brain death has occurred, recovery can occur after many years, and consciousness can return.	10(7.5)	*103(76.9)	21(15.7)
10. Unresponsiveness of the pupils to bright light, being in the midline, and being dilated (4-9mm) are criteria for brain death.	*115(85.8)	7(5.2)	12(9.0)
11. Normothermia, normovolemia, and normotension are ensured as prerequisites for the apnea test applied in brain death.	*103(76.9)	6(4.4)	25(18.7)
12. Immediately upon death, all striped, smooth, and sphincter muscles relax.	*77(57.5)	44(32.8)	13(9.7)
13. With the muscle relaxation that occurs with death, urination, defecation, and ejaculation can occur. Gastric contents can come into the mouth.	*130(97.0)	-	4(3.0)
14. In the state of cadaveric spasm, the tiny muscles and muscle movements at the moment of death can remain fixed due to intense psychological impact.	*76(56.7)	6(4.5)	52(38.8)
15. Brown parchment plaques develop due to dehydration. Especially in men, brown-colored plaques are seen in the scrotum, and in women, they are seen in the labia. It is a late sign of death.	57(42.5)	*5(3.7)	72(53.7)
16. Facial hair and nails continue to grow after death.	37(27.6)	*62(46.3)	35(26.1)
17. Cooling of the dead body is called Algor Mortis and is an early sign of death.	*92(68.7)	15(11.2)	27(20.1)
18. The thrombus formed postmortem is a late sign of death.	57(42.5)	*32(23.9)	45(33.6)
19. The thrombus formed postmortem is called aleka. It occurs after death and is highly likely to be confused with thrombosis.	*51(38.1)	3(2.2)	80(59.7)
20. Hemolysis and autolysis are early signs of death.	*57(42.5)	13(9.7)	64(47.8)
21. Livor mortis, rigor mortis, and decomposition are late signs of death.	*87(64.9)	18(13.4)	29(21.6)
22. Livor mortis begins to appear around the 2nd hour after death, occurring passively in body areas close to the ground.	*77(57.5)	9(6.7)	48(35.8)
23. Rigor mortis begins to appear immediately after death.	68(50.7)	*53(39.6)	13(9.7)
24. Decomposition usually begins with a green color change in the lower right abdomen.	*32(23.9)	12(9.0)	90(67.2)
25. Decomposition may not occur in all deaths.	*31(23.1)	35(26.1)	68(50.7)

*The correct answers.

Table 3. Comparisons between descriptive factors and ante-postmortem knowledge scores (n=134)

Receiving Forensic Case Training		
	Yes	No
Occupation	n (%)	n (%)
Nurse	11 (8.9)	113 (91.1)
Physician	8 (88.9)	1 (11.1)
	$X^2=43.87$	$P=0.00$
Knowledge (Mean±SD)		
Occupation		
Nurse		13.4±4.1
Physician		16.0±2.8
	$t=2.53$	$P=0.02$
Knowledge (Mean±SD)		
Receiving Forensic Case Training		
Yes		15.2±3.0
No		13.3±4.2
	$t=2.37$	$P=0.02$

Table 4 shows a positive but low-level statistically significant correlation between the frequency of

encountering death and the knowledge score ($r=0.28$, $P<0.00$) (Table-4).

Table 4. The relationship between frequency of encountering death and knowledge score.

		Frequency of encountering death
Knowledge	r	0.28
	p	0.00
	n	134

*r:pearson correlation $p<0.05$.

Table 5. Correct Answer Rates by Survey Sections.

Correct Answer Rates by Survey Sections	
Agonal phases and ante-mortem changes	63.07%
Rare findings about to death	50.5%
Brain death	81.35%
Post-mortem changes	45.95%

DISCUSSION

In intensive care units, healthcare professionals are routinely confronted with patient deaths; in this study, participants reported experiencing an average of 4.9 deaths per month. These professionals play a vital role in diagnosing death, recognizing ante- and post-mortem changes, managing special conditions such as brain death, and providing care to patients nearing the end of life (Can et al., 2020). A strong knowledge base regarding ante- and post-mortem changes is essential for nursing and intensive care practices. Post-mortem care, in particular, requires an ethical and professional approach, and adequate knowledge in this area enables healthcare professionals to provide higher-quality care to both patients and their families. Low knowledge scores highlight the need for education and awareness programs on this subject (Çelik, 2004). Similar studies have shown that

insufficient knowledge of post-mortem changes among healthcare professionals can negatively impact patient care and lead to ethical challenges. When compared with existing literature, the findings of this study appear to be consistent (Uzun & Cerit, 2024). However, the wide variation in participants' knowledge levels suggests that factors such as professional experience, educational background, and work environment may significantly influence knowledge acquisition. Therefore, further research is needed to examine these factors in greater detail. In this study aimed at assessing healthcare professionals' knowledge levels of ante-mortem and post-mortem phenomena, the first four questions addressed agonal phases and ante-mortem changes, questions 5-7 focused on rare findings about to death, questions 8-11 covered brain death, and questions 12-25 were

related to understanding post-mortem changes. The percentages of correct answers provided by section are presented (Table-5). In questions related to agony, the lowest correct answer pertains to the legal validity of information provided by a person during the agonal phase. There is a misconception that individuals might make significant confessions or disclose important information due to their psychological state just before death (Ersoy, 2024). However, due to metabolic changes and impaired cerebral blood flow during the agonal phase, the person's capacity for rational thought is compromised. Therefore, any information provided during this phase is not legally considered valid (Koç, 2016). Looking at the overall participant scores, it is observed that questions related to brain death received the highest correct answer rate. This could be attributed to increased awareness stemming from frequent in-service training sessions and seminars on organ transplantation and brain death. Brain death is a topic that requires specialized knowledge, including technical details. It is still not fully understood by the general public, which can lead to social and ethical challenges when providing temporary care or deciding to withdraw medical support for patients diagnosed with brain death (Russell et al., 2019). In a study, it was found that some nurses did not know the difference between medical treatment and care they should provide to patients diagnosed with brain death who are still being sustained. Additionally, they were unsure how to communicate the condition to family members of patients diagnosed with brain death, which is a significant issue (Joffe, Anton, Duff, & deCaen, 2012). Despite the optimistic results regarding brain death in our study, it was observed that participants' knowledge levels were insufficient regarding rare findings related to death and post-mortem changes. This situation can be attributed to participants not receiving training in "forensic medicine" and likely never encountering this rare results in their clinical experiences. Furthermore, the rapid removal of patients from the intensive care unit after death (transfer to the morgue) may contribute to the lack of post-mortem observation opportunities, which is another reason for the clinical experience and knowledge gaps regarding post-mortem changes. Similar studies measuring knowledge levels like ours have not been found in the literature. However, there are studies on healthcare professionals' attitudes towards death and the dying process. It has been reported that alongside the lack of knowledge on death-related topics, there is also confusion among healthcare professionals regarding end-of-life care and management (Ferrand et al., 2008, 2003). In a meta-synthesis study, it was found that newly graduated nurses express that witnessing death and the experience of death are complex and challenging processes (Zheng, Lee, & Bloomer, 2018). Many intensive care professionals do not receive specific training on death and post-mortem changes (Allen,

2018) In our country, while "forensic medicine" courses are included in medical education, nursing and other healthcare personnel typically lack formal training in this field. In this context, consistent with the literature, only 14.2% of the participants in our study were found to have received forensic medicine training (Köktürk Dalcalı & Taş, 2021). Our findings highlight a significant disparity in forensic medicine education among intensive care healthcare professionals, particularly between nurses and physicians. The lower rate of forensic training among nurses suggests a critical gap in educational exposure to forensic-related topics. This discrepancy may stem from differences in undergraduate curricula, limited professional development opportunities, or institutional policies that prioritize forensic training for physicians over nurses. Given the frequent occurrence of forensic cases in intensive care units, it is essential to ensure that all healthcare professionals, including nurses, receive adequate forensic medicine training. Enhancing educational programs in this area is necessary for accurate documentation, legal compliance, and ethical patient care. The statistically significant difference in ante- and post-mortem knowledge scores between nurses and physicians reinforces the impact of formal education on professional competency in forensic-related matters. Physicians' higher average scores compared to nurses likely reflect their greater exposure to forensic topics during medical training. However, given nurses' critical role in patient care and post-mortem procedures, their limited forensic knowledge may present challenges in effectively recognizing, documenting, and managing forensic cases. This gap highlights the need for integrating forensic education into nursing curricula and providing continuing professional development programs tailored to nurses working in intensive care settings. Additionally, the impact of forensic case training on knowledge levels is noteworthy. Participants who had received forensic training had significantly higher knowledge scores than those who had not, indicating that targeted training programs effectively enhance competency in ante- and post mortem care. This finding underscores the necessity of structured forensic training programs for all healthcare professionals in intensive care settings. Implementing standardized training sessions, workshops, and simulation-based learning opportunities could help bridge knowledge gaps and ensure that nurses and other healthcare professionals are well-equipped to handle forensic cases. (Köktürk Dalcalı, Can, & Durgun, 2022; Kudubes, Akıl, Bektas, & Bektas, 2021; Smith et al., 2018). The positive, low significant relationship found between the frequency of encountering death and knowledge scores can be interpreted in several ways. Healthcare professionals working in intensive care units and other high-acuity settings may become more attuned to the processes surrounding death, such as post-mortem care and documentation, simply due to the

frequency of these encounters. Repeated exposure to situations involving death could provide informal learning opportunities, prompting professionals to seek additional knowledge or improve their understanding of the ethical, legal, and medical aspects of death and post-mortem care. However, as suggested by previous studies, the frequency of exposure alone may not be enough to ensure a thorough understanding (Çelik, 2004). The American Association of Colleges of Nursing (AACN) developed a statement in 2004 outlining essential care competencies for undergraduate nursing students, which include areas such as population dynamics, comfort care, communication, cultural diversity, collaboration, symptom management, holistic care, and ethical and legal issues (Schwill et al., 2020). However, a systematic review highlights that many nursing students are often academically and experientially unprepared to handle the complexities of end-of-life care, which involves providing compassionate and emotionally supportive care to patients nearing death. These experiences can be emotionally challenging and traumatic for nurses, who frequently encounter death and dying patients in their professional roles. To address this gap, nursing education curricula should be revised to strengthen knowledge and skills related to end-of-life care, including effective communication, collaboration, and ethical decision-making (Zheng et al., 2018). Moreover, death-related issues are critical both medically and legally, necessitating that healthcare professionals, including nurses, possess a thorough understanding of death and its associated processes. Specialized fields such as forensic nursing, forensic midwifery, and forensic pathology are particularly important in addressing legal aspects of death, as they play a vital role in forensic case examinations and death investigations (De Vries, Dorn, Eppink, & Reijnders, 2019; Drake, Tabor, Hamilton, & Cannon, 2020). The findings of our study further emphasize the need to integrate end-of-life care regulations and training into undergraduate education and/or in-service training programs for intensive care professionals, ensuring they are better equipped to manage these sensitive and complex situations.

Limitations of the research

The form used to assess the knowledge level of healthcare professionals consists of basic knowledge questions and questions related to rarely encountered scenarios, but it is not standardized. There is no similar knowledge assessment tool found in the literature; hence it was developed with input from Forensic Physicians working in the field. In addition, the relatively low number of physicians participating in the study may be considered a limitation in terms of generalizability of the findings.

CONCLUSION

Death holds a special place in medicine as a philosophical concept, and all healthcare

professionals may find themselves managing the dying process. Especially prevalent in intensive care settings, death is a comprehensive area of study encompassing subtopics such as cellular death, somatic death, brain death, and post-mortem changes. The agonal process preceding death and the natural or unexpected changes following it can only be accurately interpreted with knowledge and experience. Therefore, considering the medical, legal, and ethical aspects of death, we believe that all healthcare professionals should have their basic training programs appropriately structured to address this issue. Additionally, some individuals within this profession should receive advanced specialized training (such as Forensic Nursing) in this area.

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Conflict of Interest

There is no conflict of interest in the study.

Author Contributions

Plan, design: E.Ö, H.İ.A; **Material, methods and data collection:** E.Ö, H.İ.A; **Data analysis and comments:** E.Ö, H.İ.A; **Writing and corrections:** E.Ö, H.İ.A.

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Ethical Approval

Institution: Giresun Training and Research Hospital Scientific Research Ethics Committee

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