

Research Paper

Head or skull injury? Consequences of using mistranslated ICD diagnosis category: Multicenter, blinded, randomized controlled analysis

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ABSTRACT

Emergency care units in Hungary treat approximately 140–180 thousand head injuries of varying severity each year. These head injuries are mainly caused by traffic accidents, assaults, or domestic accidents. The outpatient care record contains details about the circumstances and underlying mechanisms of the head injury, the results of physical and imaging examinations, and therapeutic recommendations. The record also contains standardized codes for the diagnoses and the interventions performed, using the BNO (Betegségek Nemzetközi Osztályozása) classification, the Hungarian version of the international diagnostic classification system ICD (International Classification of Diseases). These records are important for financial reasons and for statistical purposes. The injury diagnoses consist of the ICD codes with the related diagnostic categories and in most cases also the corresponding Latin diagnoses describing the injuries sustained. The ICD categories often appear as Hungarian translations of the Latin diagnoses in the detailed Medical Diagnostic Reports on Injuries (MDRI). In Hungary, MDRI reports are prepared by physicians at the request of criminal prosecutors for forensic evaluation. In practice, however, MDRI reports are usually based on the primary outpatient records. Head injuries are diagnosed using the codes in ICD Chapter 19, S00-S09. Translation errors may occur when ICD is adapted for different languages, resulting in different applications of certain diagnostic codes.

The present study investigates the use and frequency of the ICD-10 code S07.1 in Hungarian MDRI reports issued for forensic evaluation. The results of our study show that, due to an inaccurate translation, superficial head injuries (specifically, bruises) are incorrectly coded in Hungary with S07.1, which in ICD-10 is reserved for severe head injuries (crushing injury of the skull).

1. Introduction

The International Classification of Diseases (ICD), published by the World Health Organization on January 1, 1993, is the most important classification in clinical medicine. It has also been translated into the official languages of the United Nations.^{1,2} Its Hungarian translation is called BNO (Betegségek Nemzetközi Osztályozása).

In the 10th version of the ICD classification (used since 1994), the codes S00-S09 are used to code head and neck injuries. Compared to the previous version 9, several changes have been made with regard to these injury types; for example, superficial injuries to the soft parts of the head and face are now coded separately. The diagnoses describing superficial

head injuries are coded by the S00 category (e.g. S00.9: “Superficial injury of the head, part unspecified”); while severe crushing injuries of the head are coded by the S07 category, where S07.0 is the crushing injury of the face and S07.1 is the crushing injury of the skull. In the Hungarian translation of the ICD-10, S07.1 is translated as “a koponya zúzódása”, which in English means “bruise of the skull”. An article published in 2019 examined the equivalence of the German and Hungarian translations of the original English ICD-10 from a linguistic and criminal law perspective. The study was based on the 2010 Hungarian translation of the ICD classification, as this translation is still used in the data processing software of most healthcare providers in Hungary. The comparison of the German and Hungarian translations of the ICD-10

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showed that the Hungarian translation differs in several cases, and, in the case of the BNO code S07.1 it contains a serious translation error, as it translates “crushing injury of the skull” as “bruising of the skull”.^{3,4} The content of ICD-10 S00 was correctly translated into Hungarian as “felületes sérülés”, which translates into English as “superficial injury”. The word “zúzódás” [bruise or contusion] in relation to head injuries can only be found in the BNO under S07. The result of a retrospective linguistic study of medical diagnostic reports of injuries and related forensic expert opinions published in 2012 revealed the following: in the processed material, 23 % of the Hungarian diagnoses were taken directly from the Hungarian version of the ICD-10 (BNO-10) classification, of which the code S07.1 (“koponya zúzódása”; “crushing injury of the skull”) was detected in 7 %.⁵

In Hungary, when a criminal procedure is initiated, the prosecution requests a special, detailed report on the injuries (medical diagnostic report of injuries, MDRI) from the primary treating physicians to facilitate forensic assessment. Although MDRI should include a thorough morphological description of the injuries followed by the diagnoses in both Hungarian and Latin⁶, in practice, they are usually based on the primary outpatient report issued at the time of the treatment.⁵ Our study aimed to investigate whether the mistranslation of the ICD code S07.1 influences the classification (coding) of injuries in general clinical practice and in MDRI issued specifically for forensic assessment in Hungary. The quality of injury descriptions and their relation to the ICD codes were also analyzed.

2. Material and methods

This is a retrospective study on the use of BNO code S07.1, including two analyses: The occurrence of BNO code S07.1 in clinical documentation was examined (first analysis) and the quality of injury descriptions and their correspondence with the BNO codes in MDRI was examined (second analysis).

In the first analysis, data was collected on the frequency of the BNO code S07.1 in clinical documentation from the Hungarian National eHealth Infrastructure from 2017 to 2022 throughout Hungary. This is nationwide data, including all the data from all healthcare providers financed by state social security. Two forms of data were acquired this way: the number of patients who received the code in their documentation and the number of occurrences of the code in different medical documentation. Also examined was the occurrence of this code in the medical e-Medsol system of the Emergency Department, Clinical Center of the University of Pécs, Hungary, from 2017 to 2022. e-Medsol was used to conduct a concordance analysis of the medical reports for the given BNO code on this data set. The injuries to which this code was associated were also examined.

The second part of the analysis involved the examination of 470 MDRI issued for subsequent forensic medical evaluation of injuries in criminal cases involving bodily harm in different regions of Hungary, selected from the institutions' databases based on simple random sampling. The reports were obtained from the period between 2013 and 2020: 100 from the Department of Traumatology and Hand Surgery of the University of Pécs, 98 from the Department of Emergency Medicine of the University of Pécs, 25 from the Department of Forensic Medicine of the University of Debrecen, 10 from the Department of Traumatology of the University of Debrecen, 106 from the Traumatology Department of Kanizsai Dorottya Hospital in Nagykanizsa, 98 from the Traumatology Department of Balassa János Hospital in Tolna County, and 33 from the Traumatology Department of Szent Rafael Hospital in Zala County. The sampling was performed in a retrospective randomized manner; neither the sex nor the age of the patients was considered. The MDRI were anonymized and then analyzed manually, using corpus linguistic and statistical methods to analyze the injury descriptions and the related diagnoses. The contrastive analysis was compared with previous research results and with the results of recent international studies. IBM SPSS 26 data editor was used for statistical analysis. The injuries

recorded in the description sections of the MDRI, as well as the diagnoses in both Hungarian and Latin, were processed in a statistical database in Microsoft Excel, and numerical codes were assigned based on the underlying mechanisms. The present study examined the terminological correspondence between the Hungarian and Latin diagnoses, as well as between the diagnoses and the injury descriptions, with a special focus on the injuries of the head and neck region and the use of BNO categories as Hungarian language diagnoses. Considering the known mistranslation of the BNO code S07.1, its use in the collected corpus was also investigated. The results of the statistical analysis were interpreted from a terminological, medical, and forensic medical point of view.

3. Results

Analyzing the usage frequency of BNO code S07.1 in patient documentation throughout Hungary revealed the following: Between 2017 and 2022, the number of patients recorded in the Hungarian National eHealth Infrastructure with BNO code S07.1 (mistranslated as “bruise of the skull” but based on the original code “crushing injury of skull”) was 386862 (Fig. 1a). During the study period, the S07.1 code was recorded in 604510 medical documentations (Fig. 1b). In the emergency database of the University of Pécs between 2017.01.01. and 2022.10.31., 7735 cases with the BNO code S07.1 as diagnosis were recorded. From 2017 onwards, the number of cases shows a discrete increase (Fig. 2).

Concordance analysis of the reports mentioning code S07.1 revealed the following head and neck injuries: skull fracture in only 0.1 % of cases (N = 7), presence of subcutaneous swelling in 0.72 % of cases (N = 56), and tenderness in 0.45 % of cases (N = 35). The medical records referencing this code showed 12.87 % of cases (N = 996) were for wounds and 0.31 % of cases (N = 24) were for lacerations in the anatomical region of the head and neck. Suture closure was required in 26 cases. Intracranial hemorrhage was recorded in 109 cases (Fig. 3).

In the second part of the study, the MDRI examined were issued for medical treatment following traffic accidents (N = 225) and assaults (N = 237), while in 8 other cases it was not possible to categorize the cause of the injury based on the recorded data. The 470 reports contained 1588 injury descriptions, with 1285 associated Hungarian diagnoses and 1100 associated Latin diagnoses. There were 457 Hungarian and 438 Latin diagnoses associated with head and neck injuries. In the anatomical region of the head and neck, there was significantly (P = 0.001) less terminological equivalence found between the Latin and Hungarian diagnoses compared to the other body regions. A significant (P = 0.000) correlation was found between the body regions and the types of terms detected in the Hungarian diagnoses: a significantly higher number (ASR = 4.9) of Hungarian diagnoses contained BNO categories (ASR = 4.9) in the head and neck region (N = 399), whereas individually formulated diagnoses were more frequently (ASR = 3.5) connected to injuries to the lower extremities (Fig. 4).

The occurrence of terminological errors related to the use of BNO categories as Hungarian language diagnoses was also investigated. The types of terminological errors found were analyzed and then categorized according to medical and terminological criteria as follows: “terminological errors of medical consequence”; “overgeneralized category”; and “understandable, or terminologically appropriate, despite the terminological error”. Considering injuries to all parts of the body, terminologically inaccurate diagnoses were significantly (P < 0.02) more common for soft tissue injuries than for bone injuries.

In the head and neck region, terminologically unambiguous BNO categories as Hungarian language diagnoses (N = 200) were found in only 25 % of the cases, and in 25.5 % of the cases BNO categories were overgeneralized or inaccurate with respect to location. In the head and neck region, a terminological error of a medical consequence occurred significantly (P = 0.000) more often (ASR = 9.1): in all cases (N = 69) “a koponya zúzódása” (“bruise of skull”) belonged to the Latin diagnosis “contusio capitis” (“bruise of head”). This number represents 18.3 % of

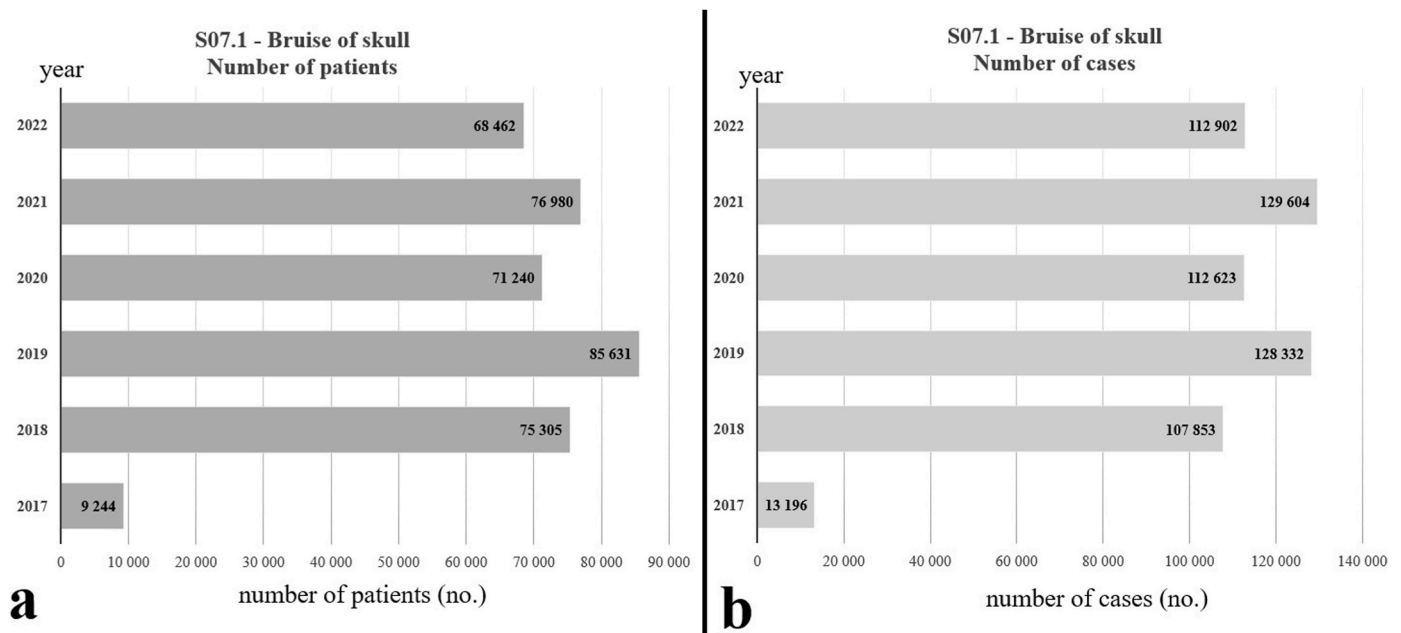


Fig. 1. Distribution of patient numbers (a) and case numbers (b) by year for BNO code S07.1. Note: 2017 represents only two months since Hungarian National eHealth Infrastructure was started on Nov 1, 2017.

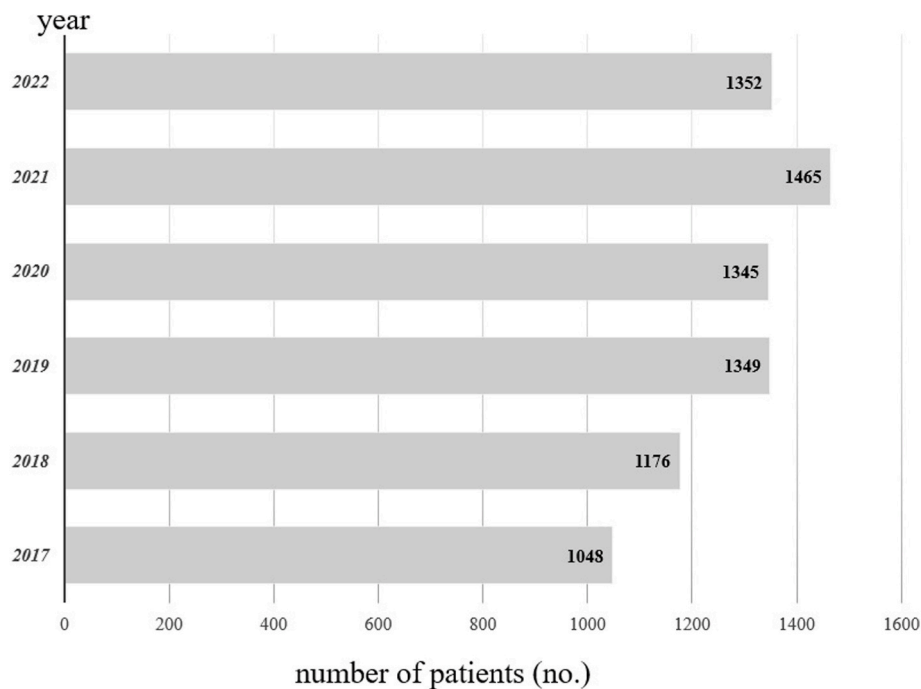


Fig. 2. Annual distribution of the number of patients with code S07.1 in the Emergency Department of the University of Pécs between 2017 and 2022.

all soft tissue injuries in this body region.

The Latin diagnosis of “contusio capitis” was used in 19.8 % of cases (N = 93), and in 72 % of the corresponding Hungarian-language diagnoses it was recorded as “bruise of skull”, corresponding to the mistranslated BNO category S07.1. In the opinion of the primary treating physicians of the injuries who wrote the MDRIs, 64.5 % of the cases were classified as slight bodily injury for criminal legal purposes. In cases involving head injuries classified as grievous bodily injuries (healing after 8 days according to Hungarian criminal law), the healing period determined for criminal legal purposes was not based on the severity of the head injury but on that of additional injuries to other body parts (e.

g., bones, tendons, or parenchymal organs).

In the Hungarian MDRIs issued in emergency care and trauma surgery practice, the S07.1 BNO category was mostly used for soft tissue injuries (abrasion, suffusion, hematoma, laceration). In other cases, it was included in the diagnoses, mainly to justify diagnostic tests, when there were no external injuries and the medical history suggested possible head injuries. Bilateral cranial radiographs were included as diagnostic tests were included in 16.1 % of the medical reports that contained the BNO category S07.1 as the Hungarian diagnosis. In 93 % of these cases, the head injury was the result of assault.

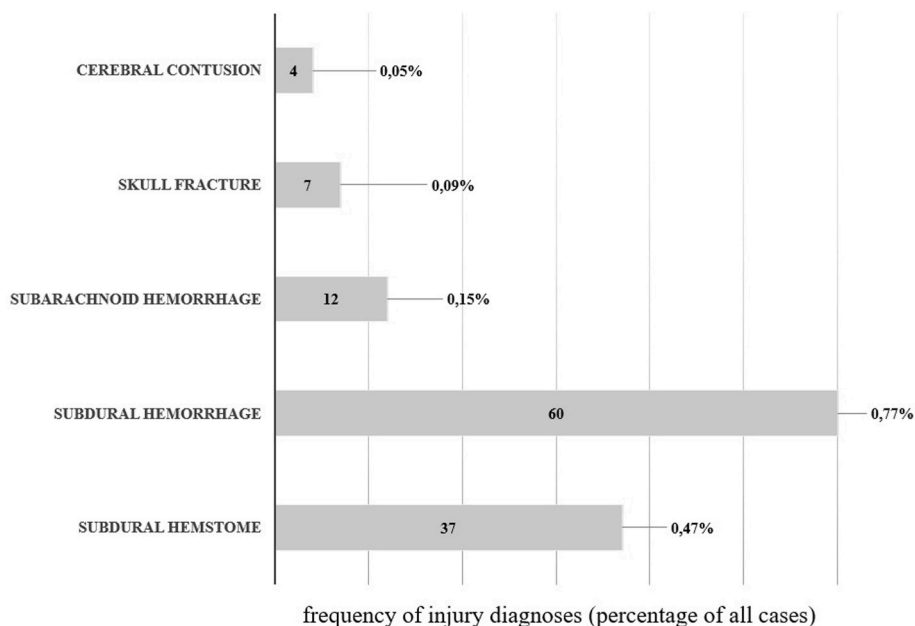


Fig. 3. Frequency of head injury diagnoses in medical records of the University of Pécs with BNO code S07.1 between 2017 and 2022.

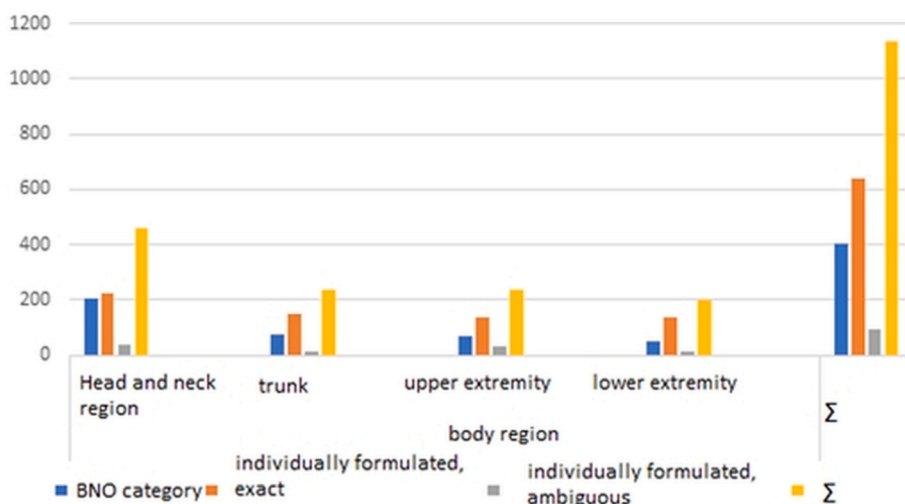


Fig. 4. Types of terms in the Hungarian language diagnoses according to body regions.

4. Discussion

Accurate documentation of head and neck injuries is of particular importance for both forensic and insurance purposes, as the head and neck are frequently injured in assaults and traffic accidents.⁷ A retrospective review of emergency department visits suggests that injuries to this region are common, with more than 40 % of cases (N:147) described as having some other bone and/or soft tissue injury in the head and neck region.⁸ According to a survey conducted between 1997 and 2003, the incidence of head injuries is 2000/100,000 persons per year, and only a quarter of the injured (180,000 in 2001 and 140,000 in 2002) are hospitalized.⁹ International data estimate the number of outpatient visits after a head injury at 100–900/100,000 per year. Diagnostic tests reveal severe head and/or brain injury in only 10–15 % of adult patients and 2.3 % of child victims.^{10,11}

Based on the analysis of a multicenter database of this study, it can be stated that the diagnostic categories adopted from the BNO classification (the Hungarian version of the ICD) were used significantly more often for diagnosing head and neck injuries than for other parts of the body.

The recording of BNO categories is essential for the financial accounting of medical care in all cases in Hungary. However, the original ICD classification was designed for statistical purposes. For this purpose, it consists of general statistical categories rather than specific diagnoses concerning the underlying mechanisms and exact locations of injuries or the affected side of the body. Because MDRI can be evidence in criminal proceedings, using statistical categories as diagnoses is objectionable from a terminological, medical, insurance medical, forensic medical and criminal law perspective.

Since the BNO codes and categories are also recorded for accounting purposes related to treating injuries, it is convenient to specify the diagnoses based on the same classification. Given the over-generalizing nature of the BNO classification and the Hungarian translation error that confused severe crushing injury of the cranial bone with a soft tissue injury of the head in relation to code S07.1, the subsequent assessment of injuries by forensic experts may rely primarily on the injury descriptions. However, previous studies emphasize that the injury descriptions created by clinicians are inaccurate, which further augments the significance of incorrectly used diagnostic codes^{3,5,8,12,13}.

Since medical reports can be used as evidence in criminal investigations, the recording of a cranial injury can significantly affect the course and outcome of a criminal case. When a documentation error resulting from a mistranslation is coupled with an incomplete description of the injury, it can significantly complicate the criminal procedure. In addition, the inappropriate use of code S07.1 in the documentation of a foreigner injured in Hungary, where the physician means a mere bruise of the head, can have serious medical insurance consequences, as the original ICD code refers to a much more severe crushing injury of the skull.³

The number of patients affected by the diagnosis code S07.1 provided by the National Directorate General of Hospitals is the sum of the unique patient identifiers recorded between 2017 and 2022. It does not include the number of medical treatments recorded for re-injury. In addition, the number of cases is the sum of all treatments (outpatient findings, radiology findings, patient records) in which the principal diagnosis was the BNO code S07.1. In summary, the number of patients is slightly underrepresented, and the number of cases is overrepresented based on the actual data. The number of cases recorded at the Emergency Care Unit of the University of Pécs can be considered as representative data regarding the frequency in the care area of the institution, as the Emergency Care Unit does not perform a control study and only BNO codes relevant to each current care are recorded in the medical reports. In the concordance study, skull fracture, intracranial hemorrhage, or concussion was recorded with the BNO code S07.1 in approximately 1.55 % of cases. Although the number of soft tissue injuries (abrasion, swelling, tenderness, wound) was higher, the software used for this study did not allow for screening by body region.

The medical reports analyzed in this study were randomly selected. Our investigation did not include injuries that were not relevant to the administration of criminal legal procedures and, therefore, were not the subject of an MDRI. This leads us to conclude that the misuse of code S07.1 due to translation error is much more common than our results suggest.

In the analyzed reports of a previous linguistic study,³ the Latin term ‘contusio capitis’ (‘bruise of head’) and its Hungarian translation ‘bruise of skull’, were also frequently used in the diagnoses. Based on the injury descriptions, the diagnosis ‘contusio capitis’ was not related to fractures or a compression of the cranial bones, but to various soft tissue injuries.^{3,5} In the medical reports examined in the present study, ‘contusio capitis’ always indicated a soft tissue injury, similar to the linguistic study conducted in 2012.⁵ When a facial skull fracture was also present, it was indicated with a separate diagnosis. Injuries diagnosed with code S07.1 were most often referred to in the injury descriptions as ‘pain’ or ‘tenderness to pressure’, which are not considered external signs of injuries but may indicate a single-force injury. Epithelial injuries and skin

lacerations were also associated with this diagnosis. In everyday practice, therefore, the Latin term ‘contusio capitis’ can be considered a ‘summary’ diagnosis of several different soft tissue injuries, most of which are mild, and which heal within eight days (for a criminal/legal classification). This translation error is not found in certain European countries (Table 1) but may be present in some other countries (and in other diagnoses, too), which can be a source of confusion when evaluating and comparing medical documentation from different countries.

The Hungarian term ‘koponya’ (‘skull’), according to the Hungarian dictionary, means ‘the bony skeleton of the head of a human being or animal’.⁴ Therefore, the mistranslated Hungarian BNO category ‘bruise of skull’ is neither terminologically nor medically correct and may be misleading in criminal proceedings, while the use of incorrect coding may have medical insurance consequences for a foreigner.³ The 2009 translation of the BNO-10 by the Institute for Health Strategy Research now correctly refers to the injury code S07.1 as a crushing injury of the skull.¹⁴ However, hospitals and healthcare providers continue to use the old translation.

The new ICD (ICD-11) came into effect on January 1, 2022,^{15,16} and its national adaptations are underway. With our study, we would like to draw attention to the importance of the accurate translation and adaptation of the ICD to avoid inaccuracies that may have unforeseen consequences to treatment, statistics, medical insurance, and legal matters.

5. Conclusion

In conclusion, translation errors can significantly complicate the forensic, criminal and insurance medical assessment of injuries when medical reports and/or MDRIs do not clearly record the diagnoses of injuries. In the case of the national implementation of international classifications, we believe it is of the utmost importance that translations be prepared in collaboration with terminology experts and medical professionals, in order to avoid translation errors with medical and criminal legal consequences.

Ethical approval

The present study was conducted under the permission of the Regional and Institutional Research - Ethics Committee of the University of Pécs PTE/53707/2017 and the Hungarian Scientific and Research Ethics Committee IV/7235–4/2020/EKU.

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Table 1
Translations and everyday usage of ICD codes S07-S07.1 in selected countries.

Country	ICD code	Translated name	English translation	Everyday usage
ICD10	S07	Crushing injury of the head	High energy injury (compression) of head	severe soft tissue damage and bone fracture of the head
	S07.0	Crushing injury of the face	High energy injury (compression) of face	severe soft tissue damage and bone fracture of the head
	S07.1	Crushing Injury of skull	High energy injury (compression) of skull	severe soft tissue damage and bone fracture of the head
Hungary	S07	A fej zúzódásos sérülése	Contusion injury of the head	minor bruises of the head
	S07.0	Az arc zúzódása	Contusion of face	minor bruises of the face
	S07.1	A koponya zúzódása	Contusion of skull	minor bruises of the head
Austria	S07	Zerquetschung des Kopfes	High energy injury (compression) of head	severe soft tissue damage and bone fracture of the head
	S07.0	Zerquetschung des Gesichtes	High energy injury (compression) of face	severe soft tissue damage and bone fracture of the head
	S07.1	Zerquetschung des Schädels	High energy injury (compression) of skull	severe soft tissue damage and bone fracture of the head
Germany	S07	Zerquetschung des Kopfes	High energy injury (compression) of head	severe soft tissue damage and bone fracture of the head
	S07.0	Zerquetschung des Gesichtes	High energy injury (compression) of face	severe soft tissue damage and bone fracture of the head
	S07.1	Zerquetschung des Schädels	High energy injury (compression) of skull	severe soft tissue damage and bone fracture of the head
Russia	S07	РазМозЖение головы	High energy injury (compression) of head	severe soft tissue damage and bone fracture of the head
	S07.0	РазМозЖение лица	High energy injury (compression) of face	severe soft tissue damage and bone fracture of the head
	S07.1	РазМозЖение черепа	High energy injury (compression) of skull	severe soft tissue damage and bone fracture of the head
Czech Republic	S07	Drtivé poranění (rozdrčení) hlavy	High energy injury (compression) of head	severe soft tissue damage and bone fracture of the head
	S07.0	Drtivé poranění (rozdrčení) obličeje	High energy injury (compression) of face	severe soft tissue damage and bone fracture of the head
	S07.1	Drtivé poranění (rozdrčení) lebky	High energy injury (compression) of skull	severe soft tissue damage and bone fracture of the head

Declarations of interest

The authors declare no conflict of interest. No funding was received.

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