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# Table of Contents

**Prevention of Terrorist Attacks during the Transport of Dangerous Goods by Road in Hungary**

*Csaba, ALMÁSI[1], Zsolt CIMER[2], Lajos, KÁTAI-URBÁN[3], Gyula, VASS[4]*

**Terrorist financing through the hawala money transfer system and its legal sanction in Hungary**

*Éva Ladányi5, Ádám Balázs Szabó6, Erika Marek7, PhD.,István Kobolka8, PhD.*

**THE PLACE AND ROLE OF TELEMEDICINE IN HUNGARIAN HEALTH CARE**

*Fejes Zsolt, Gyula Kóródi*

**Construction accidents of reinforced concrete structures due to formwork collapse**

*Zsolt Huszár; Majorosné Lublóy Éva Eszter*

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# Prevention of Terrorist Attacks during the Transport of Dangerous Goods by Road in Hungary

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**Abstract**

The authors present the ADR regulations and Hungarian practice on the prevention of terrorist acts involving the transport of dangerous goods by road. Dangerous goods appearing in road transport can be optimal to implement a terrorist action, because the proportion is very good of the devastation or/and disturbing the public order that can be committed by the certain material and the overcoming of the obstacle of seizing it. The ADR Chapter 1.10 was worked out after 9/11 in order to prevent the planned and deliberate release of hazardous materials. In this paper, we examine the consequences of the misuse of a dangerous good, which is very common in road transport, but which is exempted from the requirements for high consequence dangerous good when transported in a package.

**Keywords: ADR, Security Provisions, dangerous goods, terrorist attack, package**

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## 1. Introduction

The September 11, 2001 hijacking attacks opened a new era of terrorist operations using vehicles and means of transport. In response to the security challenge, the UN Economic and Social Council have incorporated provisions into the UN Model Regulations to help prevent terrorist acts. These provisions are contained in Chapter 1.10, which have been known as the Security Provisions since 2005, of the regulations of transport of dangerous goods, also known as the "Orange Book". The new regulations were designed to prevent the unauthorised possession and misuse of dangerous goods, particularly their use in terrorist acts. With the inclusion of Chapter 1.10, companies dealing with dangerous goods posing a high risk to public safety were required to implement security planning.

On 6 March 2016, 47 people were killed in a suicide attack in Hilla, Iraq, when a fuel tanker was blown up at a police checkpoint. On 16 July 2016, a man of Tunisian origin killed 84 people in Nice, France, when he drove a 19-tonne truck into a crowd. On 19 December 2016, 12 people were killed and 48 injured in Berlin after a Tunisian immigrant killed the driver of a tractor-trailer and drove his truck into a Christmas market.

Mass population movements are particularly convenient for targeting terrorist groups and individuals and carrying out acts.

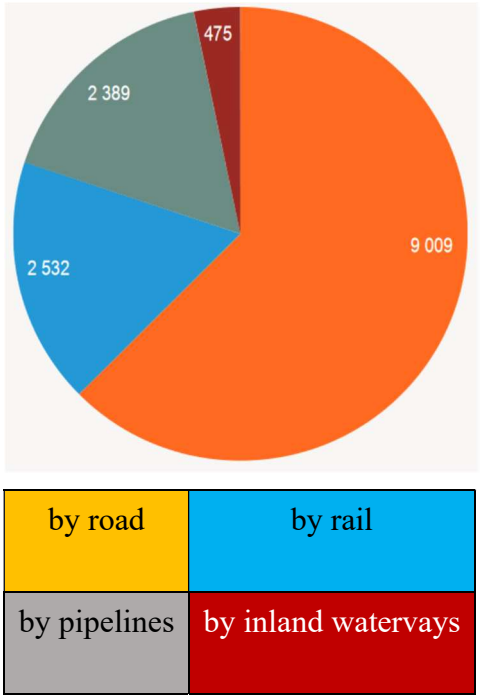
In this paper we overview the Security Provisions of the regulations of transport of dangerous goods by road, which could have significance in the future again.

## 2. Transportation of dangerous goods in Hungary

In Hungary, dangerous goods are mainly transported by road and rail. In most cases, the transport route passes through residential areas, in which case the population is at increased risk due to the quality of the dangerous goods transported. Main lines are not only used for domestic transport, but also for transit traffic in Europe due to our geographical location. Around 20% of rail transport in Hungary is hazardous goods transport. A major advantage over road transport is the more economical transport of large quantities over long distances. In 2011, Hungary accounted for 33 700 million tonne-kilometres of main road transport and 8 800 million tonnes of rail transport. As 20% of the Hungarian rail transport capacity is dangerous goods transport, disaster situations are a real problem and their solution requires careful preparation. In our country, waterborne transport is a less important

part of transport. Utilisation of port infrastructure is low and their services are well below European standards. The Danube's waterways need to be significantly improved to ensure safer and more economical transport. On the Hungarian part of the Danube waterway, seven ports are dangerous for the storage of goods. There are approximately 1500-1600 km of waterways in Hungary which can be navigated by boat. Our main rivers carry both passengers and goods - the latter accounting for 5% of national freight transport. In air transport, two civil airports can receive and send dangerous goods. The airports are licensed to handle land goods and dangerous goods. The volume of air transport in Hungary is not outstanding in Europe: our largest airport has about 100 000 landing and take-off (LTO) events. The volume of these has, moreover, been steadily declining in recent years, falling by around 15% since 2005. Despite this, it is said to be remarkable, which is why we must be prepared for a disaster resulting from an aircraft accident.[13]

According to the Figure 1 below it can be stated in 2019, that 67% of the goods are transported by road, 16% by pipeline and 15% by rail, 2% by inland waterways.




1. *Figure: Distribution of freight transport performance, Q3 2019 in Hungary, million tonne-km of goods.*[14]

[13] Kátai-Urbán L.: Establishment and Operation of the System for Industrial Safety within the Hungarian Disaster Management. ECOTERRA: JOURNAL OF ENVIRONMENTAL RESEARCH AND PROTECTION (ISSN: 1584-7071) 11: (2) pp. 27-45. (2014) (Download: 2022-03-26)
[14] Hungarian Central Statistics Office. Online: https://www.ksh.hu/docs/hun/xftp/stattukor/sza/sza1909.pdf (Download: 2022-03-26)

## 3. The place of security planning in the international and national legal framework

The European Agreement concerning the International Carriage of Dangerous Goods by Road was done in Geneva on 30 September 1957 and entered into force with its Annexes on 29 January 1968.

Hungary acceded to the ADR Agreement in 1979, which is now promulgated by Government Decree No. 387/2021 (30 June) on the promulgation of Annexes A and B to the Agreement concerning the International Carriage of Dangerous Goods by Road and on certain aspects of its domestic application. Further additions are contained in ITM Decree No. 39/2021 (30 July) on the domestic application of Annexes A and B to the Agreement concerning the International Carriage of Dangerous Goods by Road (ADR).

It provides for the application of the rules applicable to the road, rail and inland waterway transport sectors in the Member States of the European Union, in a consolidated form, in Directive 2008/68/EC on the inland transport of dangerous goods.

After the events of September 11, 2001, great attention was paid to improving security to improve transport and logistics security. Initial measures focused on air and sea transport; the focus is now on the entire logistics and supply chain, which includes all modes of transport.[15]

The definition of dangerous goods in Chapter 1.10 of the UN Model Regulations, which has been included in the ADR since 2005, states that "*"High consequence dangerous goods" are those which have the potential for misuse in a terrorist incident and which may, as a result, produce serious consequences such as mass casualties or mass destruction.*"[16]

ADR Chapter 1.10 defines the goods and modes of transport that are subject to the obligation to prepare a security plan. According to 1.10.3.2.1, carriers, shippers, consignors and other parties involved in the transport of dangerous goods or radioactive material presenting a high risk to public safety shall prepare, implement and act in accordance with a security plan.

A group of eleven industry experts (AEGPL, AISE, CEFIC, CEPE, ECTA, EIGA, FEA, FECC, Fertilizers Europe, FIATA, IRU) has developed guidelines for the practical implementation

[15] IRU Road Transport Security Guidelines. Geneva, 2005. Online: https://www.iru.org/sites/default/files/2016-01/en-security-guide-goods.pdf (Download: 2022-03-26)
[16] ADR 1.10.3.1.1 Online: https://njt.hu/jogszabaly/2021-387-20-22 (Download: 2022-03-26)

and application of security provisions. The document is called "Industry Guidelines for the Security of the Transport of Dangerous Goods by Road" and was first published in April 2005 and last revised in 2016. The Guidelines are not aligned with changes to the ADR, and the above-mentioned professional body has been working on their update and harmonisation since 2013.[17]

**4. Security provisions in the regulations of transport of dangerous goods by road**

The ADR contains general requirements for the safe transport of dangerous goods by road. These requirements include the identification and training of the person carrying the goods and the requirements for temporary storage. Each participant in the transport process - consignor, consignee, packer, loader, etc. - has different activities and responsibilities, and therefore different security requirements.

A specific section of the ADR deals with the definition of dangerous goods posing a high risk to public safety. According to the ADR, dangerous goods presenting a high risk to security are those which could be misused in terrorist acts with serious consequences, e.g. mass casualties or mass destruction, or, in particular in the case of Class 7, serious socio-economic disruption.[18] The dangerous goods with a high risk to security and their associated quantities are presented in Table 1.10.3.1.2 (ADR).

Dangerous goods in Class 7 are radioactive material presenting a high risk to security where the activity of a package is at or above the security transport threshold of 3000A2, excluding radionuclides with other thresholds. The public transport safety threshold for each radionuclide is presented in Table 1.10.3.1.3 (ADR).

Operators involved in the transport of dangerous goods involving a high risk to public safety must prepare a security plan and act accordingly.[19]

The mandatory content of the security plan:

[17] Industry Guidelines for the Security of the Transport of Dangerous Goods by Road. CEFIC. Online: https://cefic.org/app/uploads/2018/12/Guidelines-for-the-security-of-the-transport-of-dangerous-goods-by-road-2016-GUIDELINES-ROAD.pdf (Download: 2022-03-26)
[18] ADR 1.10.3.1.1 Online: https://njt.hu/jogszabaly/2021-387-20-22 (Download: 2022-02-18)
[19] Kátai-Urbán Lajos. – Kozma Sándor – Vass Gyula: Veszélyes szállítmányok felügyeletével kapcsolatos jog- és intézményfejlesztési tapasztalatok értékelése (Evaluation of Legal and Institutional Development Experience in the Control of Dangerous goods), Hadmérnök, X. Évfolyam 3. szám - 2015. szeptember. Online: http://hadmernok.hu/153_08_katayul_ks_vgy.pdf (Download: 2022-03-02)

- A detailed allocation of responsibility for security provisions and precautions among persons with appropriate authority and qualifications.
- An inventory of the dangerous goods or types of dangerous goods involved.
- Review of ongoing activities and assessment of the security risk, including interruption of transport operations as necessary, the holding of dangerous goods on board, in tanks or containers before, during and after transport, and the temporary storage of dangerous goods during intermodal transport or inter-unit transfers.
- A clear definition of the measures to be taken to reduce the risk to public safety, including:
    - training,
    - public security procedures (e.g. actions to be taken in the event of a serious threat; checks on new or transferred staff, etc.),
    - operational procedures (e.g. selection/use of routes where known; access to dangerous goods in temporary storage areas (as defined in (c)); proximity to sensitive infrastructure, etc.),
    - the means and resources to be used to reduce the risk to public safety.
- Effective, up-to-date procedures for managing and reporting public security threats, breaches of public security or incidents affecting public security.
- Procedures for the evaluation, monitoring, periodic review and updating of the public security plan.
- Measures to ensure the physical protection of transport information contained in the public security plan.
- Measures to ensure that only interested parties have access to the transport information contained in the public security plan. However, these measures shall not prevent the provision of information required elsewhere in the ADR.[20]

As a result of a dangerous goods transport accident or other incidents, dangerous goods stored in a classified packaging may be released into the environment. Depending on the properties of the dangerous substance, various effects should be expected, including toxic cloud dispersion, fire,

[20] Definition of high consequence dangerous goods, Government Decree No. 387/2021 (30 June) on the promulgation of Annexes "A" and "B" of the Agreement concerning the International Carriage of Dangerous Goods by Road and on certain issues of its domestic application, Annex 1. Online: https://njt.hu/jogszabaly/2021-387-20-22 (Download: 2022-03-02)

explosion, other environmental hazards, so that if the incident occurs in a populated area, significant loss of life cannot be excluded.[21]

## 4. Conclusions

In Hungary, as regards the control of the transport of dangerous goods, the presence of the disaster management authorities in all transport sub-sectors will continue to be of paramount importance which will make a major contribution to transport safety and, through this public safety.[22]

The transport of dangerous goods is an integral part of the functioning of the economy, and it is impossible to avoid that large quantities of them come into close proximity to the public. The transport of dangerous goods, which carries a high risk to public safety, is encoded in the execution of terrorist acts, and the study of this subject is topical and of great importance.

The dangerous goods transport sector and the authorities have the task of developing and operating procedures to protect both the material and the external environment. Besides the risk of accidents the possibility of misuse can be a real danger again.

[21] Kátai-Urbán Lajos Habilitációs Tézisek veszélyes üzemekkel kapcsolatos iparbiztonsági jog- és intézmény és eszközrendszer fejlesztése Magyarországon, (Kátai-Urbán Lajos Habilitation Theses Development of Industrial Safety Law, Institutions and Instruments Related to Hazardous Plants in Hungary), Nemzeti Közszolgálati Egyetem, Budapest, 2014.

[22] Vass gyula, Balogh Róbert, Kátai-Urbán Lajos, Kozma sándor: Veszélyes áru szállítás felügyelete Magyarországon (2015) (Supervision of transportation of dangerous goods In hungary, 2015). Online: https://tolna.katasztrofavedelem.hu/application/uploads/documents/2020-04/70644.pdf (Download: 2022-03-26)

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7. **IRU Road Transport Security Guidelines. Geneva, 2005. Online: https://www.iru.org/sites/default/files/2016-01/en-security-guide-goods.pdf (Download: 2022-03-26)**
8. **ADR 1.10.3.1.1 Online: https://njt.hu/jogszabaly/2021-387-20-22 (Download: 2022-03-26)**
9. **Industry Guidelines for the Security of the Transport of Dangerous Goods by Road. CEFIC. Online: https://cefic.org/app/uploads/2018/12/Guidelines-for-the-security-of-the-transport-of-dangerous-goods-by-road-2016-GUIDELINES-ROAD.pdf (Download: 2022-03-26)**
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13. **Kátai-Urbán Lajos Habilitációs Tézisek veszélyes üzemekkel kapcsolatos iparbiztonsági jog- és intézmény és eszközrendszer fejlesztése Magyarországon, (Kátai-Urbán Lajos**

**Habilitation Theses Development of Industrial Safety Law, Institutions and Instruments Related to Hazardous Plants in Hungary), Nemzeti Közszolgálati Egyetem, Budapest, 2014.**

14. **Vass gyula, Balogh Róbert, Kátai-Urbán Lajos, Kozma sándor: Veszélyes áru szállítás felügyelete Magyarországon (2015) (Supervision of transportation of dangerous goods In hungary, 2015). Online: https://tolna.katasztrofavedelem.hu/application/uploads/documents/2020-04/70644.pdf (Download: 2022-03-26)**

# Terrorist financing through the hawala money transfer system and its legal sanction in Hungary

**Éva Ladányi[23], Ádám Balázs Szabó[24], Erika Marek[25], PhD.,István Kobolka[26], PhD.**

## Abstract

The authors of this article examine the Hawala money transfer system, which has spread mainly in the Middle East and Asia.

It is an alternative money transfer system that operates in parallel with and outside the traditional banking system. The article focuses on why and how these systems work in practice and how their uncontrollability can be exploited by criminal or terrorist groups for their purposes. Hawala, or hundi, is a method of money transfer in which the movement of money does not take place. Transactions between hawaladars or hawala operators take place without the need for bills of exchange, as the system is largely based on trust. According to Interpol, one definition of hawala is "money transfer without movement of funds".

**Keywords**: Hawala, Hawaladar, informal money transfer (IFT), terrorism,

## Introduction

The roots of Hawala are to be found in classical Islamic law. It is mentioned in Islamic jurisprudential texts as early as the 8th century. It is assumed to have been formed in the early Middle Ages, most probably in the context of financing long-distance trade around the emerging capital city trading centres. It later developed into a full-fledged money market instrument in South Asia and was

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gradually replaced by formal banking instruments in the first half of the 20th century. Nowadays, hawala is probably mostly used by migrant workers to transfer money to their country of origin.

The word comes from the Arabic root *h-w-l*, which has the basic meaning „change, transform . When the word came into Hindi and Urdu languages it retained the meanings, but it also gained the additional meaning „trust" and „reference", which reflect how they system operates.

**Background**

Hawala is both a traditional and an alternative system of transferring money without relying heavily on trust. It has spread mainly in the Middle East, North Africa, South Asia and the Horn of Africa[27].

It is a parallel system to the traditional banking, financial channels and remittance systems, following Islamic traditions and not limited to Muslims.

Several terms are used to describe hawala, such as "informal value transfer system", "alternative money transfer system", "underground banking" or "ethnic banking".

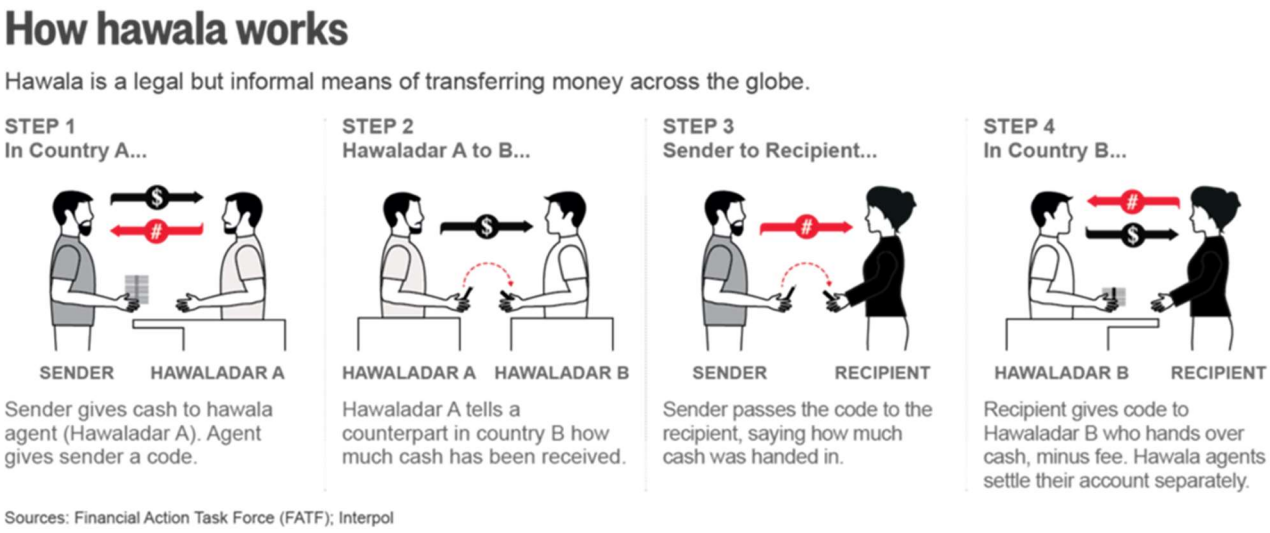
These informal funds transfer (IFT) schemes are used to transfer money in many regions, both domestically and internationally. The hawala system is one of several IFT systems that exist under different names in different regions of the world. It is known as hundi in Pakistan, padala in the Philippines, hawala in India, fei qian in China, phei kwan in Thailand, and hui kuan in Hong Kong.

**Operating scheme of the Hawala system**

In the hawala system, money is transferred through a network of hawala brokers (hawaladars)[28] to facilitate transactions between communities living in the hawala or other parts of the world.

The sending customer gives cash to the hawalaradar, who gives him a code. The hawalaradar notifies the partner broker in the destination country by phone or fax of the amount of cash received. The receiving client receives the code from the sending client and, in possession of it, receives the money from the hawalaradar (the commission is also settled here).

[27] Éva Ladányi, István Kobolka, The Hawala System, Interdisciplinary Management Research, 2014, vol. 10, 413-420
[28] The term of „Hawala dealers" or „Hawala operator" are used, too.




Forrás: FATF, Interpol

**Why does the hawala system work?**

Hawala „works" because of its cost-effectiveness. One reason for hawala's cost-effectiveness is low overhead. The second reason is exchange rate speculation.

These are the main operational features that make hawala attractive:

- speed,

-convenience,

-cheapness and

-the possibility of anonymity.

The system is accepted in some countries and prohibited in others. Many countries where hawaladars are allowed require brokers to have a bank account. This is to their advantage, as many hawaladars are involved in businesses where money transfers are required, and the provision of money transfer services fits well with the hawala's activities.

The funds from hawala transfers and business transfers are managed through the same bank account, and the hawaladar providing remittance services incurs little or no additional operating costs. This is due to the limited overheads of the system and the virtual absence of regulation and taxation. The

infrastructure required for hawaladars to conduct business is simple compared to that of banks or even money changers involved in international payments.

There is an array of advantages for users:

- The system is cost-effective. Hawala brokers take a small commission and usually practice more advantageous exchange rates than the official rates. Hawala operators have low overheads and generate profit through small commissions and exchange rate speculations.

- The system is safe. In countries plagued by political insecurity such as Afghanistan, it is one of the most convenient, safe, reliable and inexpensive ways to move funds within the country.

- The system is efficient. A Hawala remittance transaction takes place within one or two days.

The system is reliable. The system is based on trust and there are no reported instances of customers being cheated in the literature.

A breach of trust would keep the customers away.

- The system is flexible and not bureaucratic. The informal nature of the transactions makes them very attractive to users with tax, immigration or other legal concerns. Illegal immigrants, for example, may not have proper identity documents, may be under-educated or illiterate, or may not speak the host country's language and thus would not be able to use the formal banking system to send money home.

- The system is anonymous. It facilitates the transfer of money without records or documentation.

- The system doesn't leave a paper trail. As it is rare that Hawala brokers keep records after the transaction is completed, it is unlikely that the transaction will be identified or detected.

- The system is culture friendly. For migrant workers, ethnic or kinship ties with the Hawala brokers make this system particularly convenient and easy to use.

**The link between the hawala system and terrorism**

Today, hawala and conventional banks exist as parallel but intertwined economic systems in the regions listed above. The main attractions of the system for money launderers and terrorist financiers

are the difficulty of tracking transactions and the limited means of regulatory enforcement. In many countries, it is not authorised because it is considered a form of money laundering. Hawala, for example, is illegal in Pakistan, India and several US states.

It is popular because it is based on trust and relies heavily on family and regional ties. It is cheap, fast and unbureaucratic.

It can be predicted that as the number of refugees increases, the number of people using the hawala system will increase proportionately.

Similar underground systems can be found in China (chop or chit system, "flying money") and in South America (Black Market "Peso Exchange").

Criminal and terrorist groups exploit weaknesses in the international trading system to move value for illicit purposes. The inherent vulnerabilities of the international trading system, including the huge volume of trade that obscures individual transactions, provide ample opportunity for criminal organisations and terrorist groups to transfer value across borders.

This is complicated by the fact that in many countries the hawala system is legal.

It is difficult to identify or locate hawaladars for regulatory and enforcement purposes, and the money exchange dealers have no incentives to declare theirs. However, terrorist financing is not a primary concern for hawala traders. The big money comes from circumventing trade rules: an importer agrees with a supplier to charge a fraction of the real price on the invoice and pays the difference through hawala. Drug traffickers and corrupt officials also use the system to launder money.

Criminal or terrorist groups can easily and undetectably become embedded in humanitarian organisations. In cases such as Afghanistan and Somalia, where the formal financial system is not functioning, most aid agencies use the informal financial sector to provide international or domestic remittance services for humanitarian, emergency and relief operations, as this is the only option for countries at war or in the process of recovering from war.

**Organisations against money laundering**

Many organisations are working at the international level to detect money laundering and fight terrorism.

One of the most important is the Financial Action Task Force[29] (FATF)[30], a "policy-making" intergovernmental body set up in 1989.

Its purpose is to combat money laundering and terrorist financing, protect the financial system from the risks of money laundering and terrorist financing, and promote the effective implementation of legislative, regulatory and operational measures to counter threats to the integrity of the international financial system. It will establish national legislative and regulatory reforms in these areas. The FATF has developed several recommendations that are considered the international standard for combating money laundering, terrorist financing and the proliferation of weapons of mass destruction.

To better comply with the international fight strategy, the FATF identifies countries with strategic AML/CFT weaknesses. The organisation calls on these countries to develop an action plan and to address the identified shortcomings within a timeframe. It continuously assesses and monitors the actions taken and the results achieved and regularly calls for action against high-risk and non-cooperative countries.

According to international standards, each state is required to designate a central unit to receive so-called "suspicious money laundering" reports, examine them in the course of its analytical assessment activities and forward the results of its analytical assessment (operational analysis) to law enforcement purposes, including in particular to combat money laundering and terrorist financing.

**Hungary's strategy**

In Hungary, the Money Laundering and Counter-Terrorist Financing Bureau of the NAV Central Administration performs the tasks of the Financial Information Unit, an authority acting as a financial information unit under the Act on the Prevention and Combating of Money Laundering and Terrorist Financing.

[29] https://www.fatf-gafi.org
[30] It currently represents 36 Member States and 2 regional organisations. Hungary is not a member of the FATF.

In Hungary, the above offence is covered by Act LIII of 2017 on the Prevention and Suppression of Money Laundering and Terrorist Financing (Pmt.) (Published: 26 May 2017).

The purpose of this Act is to prevent and prevent the laundering of money or property of monetary value derived from the commission of criminal offences through activities vulnerable to money laundering and the support of terrorism using money or property of monetary value, in order to effectively enforce the prohibition of money laundering and the financing of terrorism.

*Scope of the law:*

The scope of the Act covers credit institutions, financial service providers, pension service institutions, voluntary mutual insurance funds, international postal giro collection and delivery, real estate activities, auditing activities, accounting (accountants), tax consultants, chartered accountants, etc. This Act shall apply to any person who is a client of a service provider or a person authorised to act on behalf of a client, representative, agent, manager, employee or assisting a family member of a service provider, and to any person who acts as a legal rapporteur or legal adviser.

This Act imposes customer due diligence obligations and notification requirements on certain persons and entities.

In Hungary, terrorism and terrorist acts as a crime against public security are covered by the Criminal Code.

According to Article 9 of Government Decree 485/2015 (XII. 29.) on the powers and competencies of the bodies of the National Tax and Customs Administration, the Government shall designate the Anti-Money Laundering and Counter-Terrorist Financing Office operating within the organisation of the Central Administration:

a) an authority acting as a financial information unit under the Act on the Prevention and Combating of Money Laundering and Terrorist Financing,

(b) the Financial and Property Restriction Authority under the Law on the Enforcement of Financial and Property Restriction Measures by the European Union and the United Nations Security Council

(ba) financial and property and

bb) the transfer of funds,

(c) financing, financial assistance and financial assistance related to goods subject to export restrictions in international sanctions adopted by the European Union and the United Nations Security Council the body responsible for the implementation of the restrictive measures.

According to Section 26/A (1) of Government Decree No. 13/2011 (II. 22.) on the Authorisation of the Foreign Trade Circulation of Dual-Use Items, the financing and financial assistance related to items subject to foreign trade restrictions imposed by international sanctions is authorised by the Anti-Money Laundering and Counter-Terrorist Financing Bureau.

**Summary**

Due to Hungary's migration situation, the incidence of this specific case of money laundering is not yet as high in Hungary /as far as I know, no criminal proceedings have been initiated in this respect/ as in those EU countries where the number of illegal or already settled migrants is extremely high.

The right to free movement of people is a fundamental principle of the EU. Therefore, it is necessary to be prepared for the possibility of an increase in the number of migrants in Hungary who have already obtained citizenship in Europe and who, as citizens of the European Union, are already entitled to move and settle freely in the territory of any EU country, including Hungary, under the conditions laid down in the EU Treaties. This could increase the development of the hawala system in our country.

Therefore, it is important to build and develop links with relevant international organisations and to coordinate the different branches and areas of expertise of the anti-money laundering and counter-terrorist financing institutional systems at the national and international levels. It is necessary to monitor criminal, regulatory, operational and strategic analytical and evaluative activity in this area, in particular those cases which may have an impact on the development of the law in the fight against money laundering and terrorist financing.

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Act C of 2012 on the Criminal Code

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Act LIII of 2017 on the Prevention and Suppression of Money Laundering and Terrorist Financing (Pmt.) (Published: 26 May 2017).

Section 26/A (1) of Government Decree No. 13/2011 (II. 22.) on the Authorisation of the Foreign Trade Circulation of Dual-Use Items

# THE PLACE AND ROLE OF TELEMEDICINE IN HUNGARIAN HEALTH CARE

**Fejes Zsolt**
**Gyula Kóródi**

**ABSTRACT**
During the coronavirus pandemic, the intensive expansion of telemedicine came to the fore of the authors' attention, which during this period became an important tool for health care worldwide. It has been applied in many areas of medicine, thanks to its effective solutions to specific challenges, and its multidisciplinary and cross-border versatility. The user side, which quickly recognized the advantages of the system, which can work even under limited conditions, greatly helped and continues to help the further development and growth of telemedicine today. In their study prepared from the synthesis of domestic publications, the authors analyze the Hungarian and international situation and summarize the development of the trend.

**DEFINITIONS**
Telehealth: refers to the use of health information and communication technologies, not only in the field of healing, but also in the field of operation, management and data provision.
e-Health: A reduced form of telehealth based specifically on the use of the Internet. While recently widespread eHealth is an expanded definition of telemedicine, it includes, in addition to remote diagnostics and remote monitoring, general health education, prevention, and therapeutic sessions.
mHealth: the application of systems and services used within the framework of e-Health on a mobile device. (1)
Telemedicine: the transmission of medical information from one place to another by means of electronic communication, the purpose of which is to provide services related to the patient's health." A structured healthcare service in which the recipient and the provider do not meet directly, the connection between them is established through some remote data transmission system. A diagnostic, therapeutic, or remote monitoring procedure supported by an info-communication device, in which the necessary presence of medical personnel next to the patient is carried out remotely via an online electronic connection, and medical professionals operating far from each other exchange medical data in order to provide better care for a given person. (2)

## INTRODUCTION

The dynamic development of computer technology, mobile technology and infocommunications characteristic of the past years and today, and the rate of technological innovations characteristic of the field, have resulted in a significant change in the entire spectrum of the healthcare sector. It has become certain that this is not just a temporary phenomenon, but a confident growth trend featuring many, many innovations. Without the widespread use of information and communication technologies, it is almost unimaginable for healthcare to function today, and most of the developments in healthcare are based on these technological foundations. This kind of transformation of technology also brought with it a change in doctor-patient interactions based on traditional foundations.(3)
The words e-health, e-health or telemedicine entered the public consciousness just a few years ago as foreign-sounding terms, while nowadays government strategies, an increasing number of publications, scientific research and analysis deal with the present, future application and development of e-health. with its possibilities (4).
The use of telemedicine devices and capabilities in diagnostics, treatment or patient monitoring cannot be considered new in an absolute sense, however, the coronavirus pandemic highlighted its role from the range of systems that can prove and effectively support healthcare even under special circumstances, thus strengthening its place and role in many areas of medicine. The pandemic accelerated the need for developments on the governmental, sectoral and specialist side, so today we already have government concepts, strategies and policy programs that prescribe and finance these development programs.
According to the provisions of the relevant documents, the digitalization of healthcare must serve the interests of the healthcare system and the population at the same time. The burdens of healthcare workers should be eased, it is expected that they can perform their daily work more efficiently with the help of digitization, paper-based documentation should be reduced, treatment should be directed towards the opportunities provided by telemedicine instead of face-to-face meetings, there should also be more effective resource management tools and administrative burdens should be reduced. Overall, the goal is to ensure higher quality healthcare in all its components for the Hungarian population (5).

## THE EARLY DEVELOPMENT OF TELEMEDICINE IN HUNGARY

Digitization of the health industry appears as a top priority in more and more domestic government documents. This is supported by the gradual transition to the Health Services Area (EESZT), or the continuous appearance of laws and regulations providing increasingly detailed guidelines for the domestic regulation of telemedicine. The overarching goal of these programs is that digital-based information and communication technologies, which are equally suitable for optimizing, monitoring, supporting or carrying out preventive activities, diagnostic, healing and discharge tasks, are increasingly used in healthcare. The government's expectation regarding the use of system components is clear, since their application
- the efficiency of the healthcare sector can be increased,
- access to care can be facilitated,

- and the security and quality of services can be improved.
In general, it can be said that telemedicine, although it is increasingly involved in "ordinary" healing work, before the coronavirus epidemic was relatively insignificant even in those countries where very serious steps were taken to put healthcare on a digital path, and where the large geographical distances absolutely justified the introduction of telemedicine (6).
In their research conducted in 2014, Bán et al. examined the territoriality of telemedicine in Hungary. It was found that in the year of the investigation, almost half of the healthcare institutions in Hungary already used various procedures related to the field of telemedicine(7).
On November 1, 2017, the first e-health service provider platform, the Health Service Square, was activated in Hungary, which has now been joined by general practitioner services, outpatient and inpatient care institutions, as well as all domestic pharmacies, as well as a large number of private health care providers. . The basis of the operation of the health service renewal system is the provision of a continuous electronic connection between the care institutions, the treating doctors and pharmacies, during which the written and image information generated during the care is made available online to all eligible participants in digitized form. It can be used to track care pathways, performed examinations, written prescriptions, specialist referrals, and individual, so-called eProfile. The goal of creating the system is for the population to receive fast, efficient and service-oriented care (8).
Attempts have already been made to introduce telemedicine in Hungarian healthcare practice in many areas: there are telecardiology, teleradiology, teledermatology, telepsychiatry and telepathology applications. The launch of the aforementioned Electronic Health Services Space created favorable conditions for the use of "storage and transmission" type technological solutions, teleconsultation and telediagnostics. In connection with these, the State Health Care Center (ÁEEK) also organized a Telemedicine pilot program, while several players in the private sector offer remote monitoring services, for example for the care of elderly or chronically ill patients, but we can even mention the remote fetal monitoring system. In our country, the system of telecardiology introduced by the National Ambulance Service, which is also available at the level of primary care and should be highlighted in terms of applied telemedicine solutions, where ECG-based telediagnostic devices help with rapid diagnosis and directing the patient to the appropriate care facility. (6). In 2019, organized by the Semmelweis University Health Management Training Center, the accredited training course entitled "Effect of Telemedicine on Practical Healing Processes" began in 2019 - in the form of a free-to-choose, point-scoring course for doctors.

## GOVERNMENT ASPIRATIONS IN HUNGARY

In response to the economic and social effects of the coronavirus pandemic in Hungary, the Government of Hungary prepared its Recovery and Adaptation Plan consisting of 9 components. The estimated resource requirement for financing the program is HUF 5,760 billion, of which approximately one-sixth is intended for health development. The development of telemedicine services was named in connection with two components (Digitalization reform component, Health component).

The aim of the provisions of the Health component is to improve the accessibility of quality health services through the creation of infrastructural, human resources and IT conditions.

According to the contents of the document prepared by the government, the Hungarian healthcare system is characterized by excessive hospitalization, opaque patient journeys, a high average number of days spent in hospital, the underutilization of active beds, a poor wealth of data on the operation and performance of the care system, as well as regional access inequalities, and the obsolescence of the infrastructure and equipment. Based on the results of this complex survey, a commitment to a comprehensive structural change was born at the government level. Accordingly, the goal of the government program is to develop interventions aimed at improving primary care, strengthening the role of general practitioners, expanding services close to residence, and relieving the burden of specialist care, within the framework of which practice communities and group practices can be established, as well as expanding the powers of general practitioners in accordance with their professional exams. Health promotion, screening and care activities, the care of chronic patients, and telemedicine activities would be more emphasized in primary care, as a result of which the burden of specialized outpatient care would be reduced, patients would receive care close to their place of residence and patient journeys would be simplified. However, in order to implement these, it is necessary to provide nursing, medical-technical and IT tools, as well as to modernize the new professional management system of primary care. (9)

## THE EFFECT OF THE CORONAVIRUS PANDEMIC ON THE HUNGARIAN HEALTHCARE SYSTEM

The COVID-19 epidemic, which was officially declared a pandemic by the WHO on March 11, 2020, presented and continues to present significant challenges to modern healthcare worldwide. The prevention, diagnosis and treatment of a disease with variable characteristics is the task of modern health care, which has been the cause of social, political and economic changes on a global level for more than two years.

Since the beginning of the coronavirus pandemic, it has placed an increased burden on the entire spectrum of health care systems, making great use of all its resource components (financing, equipment, human resources). As a result of the infections caused by the virus, the number of patients to be cared for has increased several times, while the population's previous demand for health care and the number of acute and chronic cases awaiting care have not significantly

decreased. This trend characterized global events all along and quickly showed the serious discrepancy between the need for care and the ability to provide care, to which countries with the most advanced health infrastructure were no exception. The pandemic resulted in a workload affecting all areas of the healthcare sector, so it was no longer possible to provide the usual level of care at a continuous and adequate level. New and new waves of infection did not allow the regeneration of the system, so the service options became more and more limited. In order to prevent the complete collapse of health care systems, most of the European governments - relatively soon - introduced restrictive measures during which elective care was postponed for an indefinite period. Despite the physical restrictions, a part of the population still wanted to use the benefits, so they - satisfying the growing social demand - began to appear in larger volumes in the online space. (10)

The attention of healthcare professionals has therefore increasingly turned to telemedicine - as a form of care based on a remote physical connection between doctor and patient - as this form of care was able to offer a safe alternative to non-coronavirus infection despite the strict measures taken during the epidemic. for the care of patients who consult a doctor. At the same time, the needs that arose in order to ensure care predicted the importance of the development of measures at the governmental level, which could appear as an effective alternative in the rapidly changing environment.

Similar to international practice, countless measures were introduced in Hungary that were able to ensure patient care in a safe form even in the changed environment. In 2020, restrictions were introduced, including in primary dental care, where care was temporarily limited to emergency dental treatments only. This emergency procedure led to the introduction of "teledentistry" in Hungary. In order to ensure continuity of care for cardiology patients, the György Gottsegen National Institute of Cardiology has launched a telephone cardiology specialist consultation. A new domestic initiative was the teledermatology service launched at Semmelweis University's Dermatology, Genitourinary and Dermatology Clinic, the aim of which is to provide free online dermatology care to patients in an emergency caused by the coronavirus epidemic, avoiding the doctor-patient meeting. receive them as part of state-financed care. Telemedicine played a prominent role in those social institutions, nursing homes, nursing homes, and homeless care institutions, where the primary care service typically operated 4-8 hours a week, but the demand for health care services multiplied due to the spread of the epidemic. During the epidemic, telemedicine also played an important role in the remote monitoring and care of patients living with chronic diseases cared for at the institute, as well as in the reconnection of vulnerable or elderly healthcare workers to care. International experience shows that during the current epidemic, for example, important steps were taken in the fields of urology, dermatology, diabetology, and pediatrics in making better use of telemedicine opportunities. On the other hand, with the help of tele¬medical triage, it is possible to inform and screen patients who really need immediate care or who require a personal visit. (6)

As a result of the pandemic, the government's efforts to improve the quality of regulation have clearly increased. The actors in the health sector started to use the

available technical possibilities with much greater intensity than before and in a wider area, and the number of studies and publications related to telemedicine forms of care increased significantly, while due to the restrictions introduced, there was a continuous increase in the demand from doctors and the general public.

## TECHNICAL PLATFORMS AND SKILLS

The basic condition for the introduction of telemedicine is the compatibility of healthcare IT systems and the telecommunications equipment park, henceforth their joint application.

One of the most important shared platforms for telemedicine data and information exchange in Hungary is the Electronic Health Service Square, which is available in all primary care general practitioners' offices, specialized outpatient clinics, and inpatient hospital wards across the country. The platform is widely able to provide all users access to official documents based on authorization. (10)

A wide range of solution options are available in the form of smart-phone applications and services, video-conferencing options, and telecommunications devices suitable for use in call centers, which enable the continuous exchange of data and information despite the physical location of the doctor and patient being separated in space. With the use of external sensors, it is now possible to measure many physiological parameters that were previously only possible to monitor in hospital conditions. The vast majority of the software in use today is also capable of performing evaluation functions, facilitating the establishment of a diagnosis and, where appropriate, thus helping to determine the related and necessary therapy. (4)

When using the various platforms, in addition to the patient's identifiability, it is also of great importance that the data and images uploaded to the given interface are retrievable and suitable for long-term follow-up. According to the recommendation of the AMA, in view of the epidemic situation, in addition to the official channels, FaceTime (Apple, Inc., Cupertino, CA, USA), Skype (Microsoft Corporation, Redmond, WA, USA), Facebook Messenger (Facebook, Inc. , Menlo Park, CA, USA) or the video platform of Google Hangouts (Google LLC, Mountain View, CA, USA) can also be used. Other telemedicine experts also find the WhatsApp application (WhatsApp, Inc., Mountain View, CA, USA) suitable. (6)

## APPLICATION FORMATS

The tasks that can be performed with telemedicine devices can be grouped in several ways according to their methods. Synchronized and asynchronous supply are distinguished according to the time of supply. During synchronized care, audio and video communication takes place in real time, which connects the doctor and the patient at the same moment. Certain tasks - the storage and transmission of medical data, findings, recordings - do not require the simultaneous presence of both parties during the exchange of information between them, in which case we speak of asynchronous care. Telemedicine services can also be grouped based on the equipment required. Their common point is the exchange of data in the digital space, using suitable digital devices. Remote monitoring of a given parameter - e.g.

blood pressure, blood sugar -, home dialysis, as well as the use of various wearable accessories, trackers, applications, sensors and the transmission of measured data can be done in this form, synchronously or asynchronously. This group can also include telephone consultation or e-mail counseling, but also medical-themed audio material (podcast) available on the Internet or counseling on "question-and-answer" medical websites, but these are by definition the the use of sensors listed above is not required.

Telemedicine visits can be performed in real time or asynchronously (non-real time). The essential element of this is the exchange of health data and information between doctor and patient, the content of which in each case is specific to the person and the medical condition. In this format, the imaging and/or laboratory diagnostic results are transmitted, analyzed and discussed, the E-prescription is written, further tasks related to the patient are assigned or the patient journey is managed in the same way as in outpatient care in an institution or hospital.

During telediagnosis, the person conducting the examination that forms the basis of the diagnosis and the person making the diagnosis are spatially separated from each other, but they are in an interactive relationship. The diagnostic activity itself is primarily based on the analysis of the results of laboratory and imaging examination procedures transmitted in electronic/digital form on the selected platforms. The efficiency of the ability is greatly influenced by the range of diagnostic elements that can be included: traditional imaging procedures (X-ray, ultrasound), high-resolution scans (CT, MRI, PET CT), laboratory test results, digitized histological results, endoscopic test images, digital ECG findings, analytical blood tests results and photo documentation of other medical conditions.

Remote supervision and telemonitoring can take place in real time or non-real time form. Currently, programs for monitoring blood pressure, pulse, blood sugar or blood partial oxygen levels, analyzing body weight, body fat and body composition data, as well as a wide variety of activity measurement or sleep analysis applications are available on several platforms and in several applications.

Telemedicine provides the same opportunity to monitor mild and moderate cases of COVID-19 as it does to monitor patients with chronic diseases in a completely safe manner without the additional risk of going to the doctor's office, or to give advice. to solve the simpler problems of needy patients at home. (6).

The teleconference as a function can help in the process of establishing a diagnosis and as an optional supporting element can be part of the analytical process of diagnosis. Remote manipulation: the person performing the examination or intervention relies on remote sensors to remotely control, carry out the examination that requires interaction (e.g. endoscopy) or intervention (e.g. remote manipulation with a robot or a device suitable for remote control in addition to video control). Telesurgery, robotic surgery, is a relatively new branch of surgery where surgical interventions are performed with the help of robots, either with the surgeon and the patient staying in the same place, or from a distance between them, even a continent away. The best-known robotic surgery system is the da Vinci surgical/operating system developed by Intuitive Surgical. (11).

Distance education for patients can also be realized in the form of general information and advice regarding a disease or medical condition, but the direction of their data content is not person-specific, mostly in the form of electronic transmission of informative materials, podcasts, Frequently Asked Questions (FAQ), sharing of information by specialist staff.

The goal of operating the internet-based patient management application and system is patient traffic, along with the reduction of the administrative burden of doctors and medical professionals. With its help, some sub-processes that do not justify a personal appearance can be carried out at the level of assistance, even without the need for the patient to appear, so only problems falling within the medical competence are treated in the context of a personal meeting. Some of the patient management programs already have a customizable medicine loss calculation capability, which enables e-prescriptions to be written and delivered to the patient via the EESZT system without delay with the help of a built-in automatic warning function. (12)

The application formats listed above can be used together to form a complex system in accordance with current professional conditions, independently of each other, or in interconnected modular form.

**ADVANTAGES PROVIDED BY TELEMEDICINE**

By using telemedicine elements, the spatial physical distance between providers and patients can be bridged, and diagnostic, therapeutic and remote monitoring interventions can be performed safely.

The use of telemedicine increases the safety of the healthcare service by enabling the possibility of doctor-doctor consultation and maintaining the doctor-patient relationship even under limited circumstances.

As a result of direct contact, the time between the diagnosis and the proposed therapy is shortened. By using it, the patient's health status and parameters can be continuously monitored, ensuring the possibility of immediate intervention if necessary.

With its help, the efficiency of care can be increased, waiting and travel time can be reduced, and the planning and execution of control tests can become more efficient.

When using it, the electronically stored data in chronological order is continuously available and can be retrieved, the possibility of data loss is reduced, and at the same time, data storage and access are secure thanks to the code system protection.

By applying it in a critical situation similar to a pandemic, the number of doctor-patient encounters can be reduced, as a result of which the professional staff and the physical safety of service users can be further increased.

Research shows that if the technical conditions are fully met, doctor-patient communication takes place in a similar way to a personal meeting. Based on the available studies, it can be said that both patients and caregivers are satisfied with doctor-patient consultation based on telemedicine, and compared to traditional patient care, these studies do not report any significant improvement in care or

progression. about differences. Telemedicine can positively influence the patient's sense of security, health awareness and adherence. (6)

**AUTHOR'S FINDINGS**

- - The goal of the integration of telemedicine system elements based on standards, professional guidelines and protocols into health care is to effectively support the health care provider system.
- - The primary design aspect of telemedicine capabilities is maximum patient safety and quality patient care.
- - A progressive approach to the health care process must prevail during telemedicine services as well.
- - The health diagnostic and therapeutic system elements of the near future will operate on a digital platform.
- - Organizational and individual training related to telemedicine - in sync with the pace of technical development - is expected to appear as a continuous demand among service providers using telemedicine.
-

Based on the trends taking place in the world and in our country, as well as the phenomena described above, the authors determined during the preparation of this study that telemedicine will most likely play a prominent role even in the short term in supporting the healthcare tasks of the future, in some cases replacing them. In order to reduce the risk of infection to the maximum, we must be prepared both at the strategic and executive level to set up as soon as possible standardized telediagnosis and teletherapy methods and platforms that are able to guarantee and maintain safe patient care in the long term. A telemedicine system integrated into the framework of professional and technical criteria may be able to support the diagnostic and therapeutic interventions that define health care in the long term, it may meet the professional expectations of remote monitoring systems, and it may play an important role in the provision of prevention and rehabilitation, as well as health education and training tasks.

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# Construction accidents of reinforced concrete structures due to formwork collapse

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**Abstract**

When we hear about formwork accidents, we primarily think of when we hear or see the collapse of a slab in the news, but there are also many cases that are not necessarily accidents involving personal injury, but the material damage caused can be significant. Of course, this does not only cause damage to the contractor, but in general all participants of the project will be affected by such an event, in terms of cost burden and deadline. The article would like to draw attention to the causes of accidents and the prevention phases that can be used to avoid these technical and human disasters.

***Keywords:*** accident, slab formwork, one-sided formwork, beam slab systems, anchoring of formwork

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**Introduction**

Accidents involving formwork can usually be divided into two large groups:

- collapse of horizontal structures,
- destruction or rupture of vertical formwork structures.

*Horizontal formwork* generally includes slab and cantilever formwork, beam formwork or stair formwork. [1] Among slab formwork, the most common formwork system in Hungary is the timber durable slab system. Its structure is based on a simple, main and drawer support system, where the final load transfer is carried out through steel supports to the lower slab. As a rule, the main and drawer holders are glued wooden supports of the same cross section with an "I" profile design. Main supports are usually characterized by shear failure, while drawer holders are characterized by bend failure in case of overload. [2] The concrete surface of the formwork is made up of wooden formwork boards with a three-layer glued pine design, but phenol-coated plywood is also commonly used. Since the joining and connection of the wooden supports is not fixed-bonded, only laid or interlaced, the formwork of structures with different geometry can be followed very well. Of course, the aluminium-framed slab formwork system and its drop-head version are also used, but due to its framework, its geometric possibilities are more limited.

*The group of vertical formwork* includes wall and pillar formwork. Thinking about the modern formwork system, wall formwork can be divided into two main groups based on their structure: large-panel formwork with timber durable system [3] and framed formwork systems:

- Large-panel formwork with wooden durability: in terms of its structural principle, it rather evokes the past, in a modern guise. This means that instead of the classic wall supports, modern glued I section wooden supports take up the load and transfer it to modern double U profile crossbars. Its shell is glued plywood board, coated with phenol, but with free edges.
- Framed formwork systems: typically enclosed in a steel support frame with plywood formlining. From a wide variety of board widths (usually in raster jumps of 10-15 cm), level high (270-300-330 cm) to half-element height (120-150 cm), systems can be fitted with quick-clamping clips. Movable structures with cranes or manual power (in the case of level-high boards, these are aluminium frames).

Similarly to pillar formwork, pillar formwork can be divided into two large groups based on their structure: timber-durable and framed. In the frame system, the boards have a special jumper. This means that not only is there a possibility of jumping at the edges, but the boards are perforated one after the

other with 5 cm divisions. Thus, with a butterfly knitting, it is possible to make a pillar 30x30 cm or even 60x60 cm with the same board, for example, 75 cm wide.

The most striking case is when the entire slab formwork collapses. This usually happens when concreting. In such a case, both formwork and iron installation works are already completed, and they are already visually inspected and checked by technical inspectors. Nevertheless, such accidents can occur, which can happen due to material fatigue, unforeseen previous material damage, but human error is the most common cause of these accidents.

**Casestudies**

***1. Gyöngyös slab collapse 2006***

One of the well-known accidents of the past decades occurred in Gyöngyös in 2006 *(Figure 1).* During the construction of a prefabricated reinforced concrete hall structure at the plant of an automobile parts manufacturer, a monolithic slab field broke off during concreting. .[4] Unfortunately, four people died at the scene as a result of the accident and two workers were taken to hospital with serious injuries [5]. According to the expert examination, they were nearing the end of the concreting of the slab structure, when in an instant the slab formwork collapsed under the load of tens of tons of concrete. The investigation found that the supports, i.e. the steel lofts, moved out of their vertical plane, causing first the main girders and then the drawer holders to fall into the depths, capturing the shell structure of the formwork, including the rebar armature, fresh concrete and the unfortunate workers. But what could have been the reason for the displacement of the supports?

In the construction of monolithic reinforced concrete structures, the formwork works of the lowest slab structure are typically made either from reinforced concrete base slabs or reinforced floor concrete, [6] as they usually say: the formwork is installed in a culture pit. In such cases, the supports may move out of their plane only if the horizontal floor loads are not absorbed. In contrast, structural construction works of prefabricated reinforced concrete hall structures are usually carried out on fertile ground. The leading activity here is the crane of prefabricated reinforced concrete elements, which is typically done by a car crane, the transport and lifting route of which is the field between the pillar frames, inside the hall nave. In order to prevent such a 50-100 ton crane from destroying the concrete substrate or to avoid oversizing the base plate, these concreting works are carried out only after the structural construction has been completed, while the crane moves on the grown ground. This is how it happened that the supports of the formwork of the torn off, intermediate monolithic slab field were placed on the ground, without a load-distributing beam or plank. When the supports received the half-to-one-ton load per loft during the

concreting, they sank into the ground and tilted the entire structure, which led to the collapse of the formwork.

**1.** *Figure: The Gyöngyösi hall after the accident* **(Source: http://index.hu/cikkepek/0611/bulvar/omlos/.gdata/a6_00.jpg)**

***2. Nyíregyháza slab accident 2017***

During the concreting of a residential property in Nyíregyháza, the slab formwork with a timber durable system collapsed during concreting *(Figure 2).* The two workers in the collapsed slab field fell, but fortunately they were only slightly injured. [7] According to the expert examination, the stability of the formwork was not ensured, which is how the system could collapse during the concreting process. This means that the structure was not suitable for horizontal loads, which is unfortunately a typical defect for pillar frame structures. In the case of floor formwork, as a general rule, the formwork must be wedged to absorb horizontal loads. It is not a problem in the case of wall construction systems, because the shell structure of the formwork is automatically wedged out by tailoring the edges to the size[8], but in the case of pillar frame structures, wedging only to pillars is often not enough. Of course, it helps a lot if, for example, there is a monolithic reinforced concrete stiffening wall or staircase wall on the slab, to which the structure can be wedged well, i.e. supported. In the absence of these, St. Andrew's crosses should be used, made of scaffold tubes with a clamp connection.

This is often abandoned by the contractor because while the tripod tube and the clamp are 48", only the inner tube of the supports is 48, the outer one is usually 63, so the oblique stiffening cannot be cuffed at the bottom. Therefore, when constructing formwork and setting up supports, one support should be deliberately installed upside down in a raster division, so that the Andrew's Cross can be fixed with clamps at the bottom. If they are not met, then the above formwork collapse disasters could happen.

*2. Figure: The slab accident in Nyíregyháza (Source: https://www.police.hu/sites/default/files/styles/751x500/public/N3834536.jpg?itok=lDIRTnlP)*

### *3. Collapsed slab formwork in Balatonföldvár 2019*

During formwork work on the slab above the second floor of a multi-storey apartment building, the formwork collapsed before concreting, during iron installation. [9] As a result of the collapse of the slab formwork, some of the ironfitters working on the slab fell on the already finished slab below, others fell to the ground three stories deep [10]. Five were seriously injured, usually broken bones, but four suffered permanent injuries.

During *the analysis of Figure 3*, it can be clearly seen that the formwork of the cantilever balcony slab was not anchored to absorb horizontal loads, so either the movement of the workers or the pulling of the fiber irons on the slab could create those horizontal loads that the incorrectly installed formwork could no longer absorb, and the structure collapsed.

3. Figure: The formwork accident in Balatonföldvár (Source: https://www.sonline.hu/helyi-kek-hirek/2019/06/baleset-torten-egy-epitkezesen )

***4. Budapest, XIII. district slab accident 2018***

During a tooth gap installation in Budapest, XIII. district, a slab field above ground level collapsed during concreting *(Figure 4).* The accident was fortunate, only one worker was lightly injured, whose leg got stuck between the torn rebar armature.

In the base plate, a mounting shaft with an area of almost 10 m2 was built, with a depth of about one and a half meters. During the construction of the slab formwork, the open manhole was covered with pallets on the grounds of labor and accident protection. When distributing the slab supports, 4-5 supports were placed on the pallets, which were also thoughtlessly placed on them. [11] The pallets could still support the weight of the formwork and the weight of the reinforcing steel, but during concreting they could no longer support the weight of 700-800 kg of concrete per square meter and broke in. As a result, the legs fell into the shaft and dragged the entire formwork with it, along with iron and concrete.

*4. Figure: The formwork accident in District XIII (Source: own recording)*

***5. Budapest, II. district one-sided formwork breakthrough 2016***

The accident occurred during the construction of the reinforced concrete structure of a new condominium in Kisrókus Street, District II, Budapest *(Figure 5).* When concreting a new reinforced concrete wall bordering the firewall of an old neighboring building, the concrete broke into one of the bedrooms of the apartment building next door. The formwork was made as one-sided formwork, which means that one side of the reinforced concrete wall was given by the formwork, while the other side was given by the old firewall of the neighboring building. Before the concreting, there was no condition assessment of the neighboring building, so it could not be revealed that the firewall was not made of load-bearing bricks, but masonry filled with slag between two partition 6s. After World War II, when there was a shortage of building material, load-bearing bricks were often used this technique, often filling the space between the two masonry with prokni and construction debris.

In the case of one-sided formwork, the side of the concrete wall opposite the formwork is subjected to the same pressure as the formwork when concreting. In this case, if the load capacity of the neighboring firewall is not certain, it must be concreted with a limit on the speed of concreting. This means

that despite the fact that the formwork capacity is suitable for absorbing high hydrostatic concrete pressure, e.g. 60-80 kN/m2, due to the weak firewall, it has to be concreted on a scheduled basis, for example with a concrete height of one meter every half hour.

5. Figure: Unilateral wall formwork accident (Source: own recording)

**Analysis of the causes of accidents**

***Collapse of slab formwork***

*During floor formwork*

The most common accident when building formwork occurs due to ignoring horizontal loads during construction. Both timber-durable and framed formwork systems can only absorb horizontal loads by wedging them to the vertical structures that have been built. These horizontal loads are usually caused by the combined movement of workers, pumping concrete or wind load. If it is not possible to wedge the formwork with sufficient density, the supports must be stiffened with Andrew's Crosses. When construction, horizontal loads should be picked up using so-called three-legged bollards that can be attached to supports. They must be fixed on the extreme legs of the main supports with their own clamp and wedge system. On average, 6-7 pieces per square meter should be per slab surface. Their absence or reduced quantity causes accidents due to formwork collapses during construction.

In wood-bearing systems, inaccurate installation of drawer holders on the main supports is common, as a result of which the formwork lining will not have an extreme support and stepping on it will tip the board down together with the worker. This can happen because, unlike framed slab formwork, timber formwork is covered from above, from the starting board of the formwork, so workers under the formwork board can no longer see from above if the lower bed is inaccurate.

In frame systems, four framed board corners sit on a special head on each slab support. If a prop is missed during careless construction, the system will not collapse. It will be like taking out an inner table leg in case of tables pushed together, they do not collapse while supporting each other, they just should not be loaded. The same thing happens with formwork, and after they are built from below, from the existing floor level, the defect is only revealed when the workers go up to the formwork. Stepping on such a board node lacking support, the formwork immediately collapses, dragging the occupants with it.

After concreting is completed, when the appropriate concrete strength value is reached, accidents similar to those caused by the absence of a three-legged buck during construction occur during formwork. When formworking, formwork boards lowered by 3-5 cm can no longer wedge out the structure, and if there are few or no three-legged bucks underneath, the formwork collapses on workers working underneath.

*Rebar during installation*

Slab collapse accidents during rebar installation are typical for timber formwork systems. The reason for this is that the supports transferring the load of the slab to the subsoil or to the lower slab level are installed only sparsely in the first phase of construction. E means that there are only supports at the ends of the main supports and their splices. This is enough to carry the self-weight of the structure, as well as the weight of construction workers. After laying the entire shell, the supports are thickened, which is capable of carrying all dimensioned loads (reinforcing steel + concrete). If the rebar to be installed on the slab is deposited in bundles with a crane before the supports are thickened, it creates a serious point or lineside load on the slab, which cannot withstand in this condition, and the structure collapses due to overload. This additional load can be up to 1.5-2 tons per square metre compared to the final concrete weight of 500-600 kg/$m^2$.

*When concreting*

Most slab accidents occur during the concreting of the structure. One of the reasons is the inadequate absorption of horizontal loads, which have already been mentioned several times. In this case, in the absence of wedges or St. Andrew's crosses, the formwork moves horizontally sideways and collapses. Another reason may be sudden overload, which can occur with concrete of dense consistency, if for some reason the concrete pump is not in continuous motion, and it can squeeze out in one place, even half a meter or a cubic meter of concrete, which can cause an overload of the slab 3-4 times. In such cases, most often the bearing capacity of wooden supports is exhausted and simply breaks, dragging the formwork boards along with the reinforcing steel and concrete. A similar accident can happen if the formwork is not installed on site, the supports are distributed according to the static plans, overload is created and the slab breaks off.

A common case is the tearing off of cantilever balcony slabs due to the lack of horizontal anchoring of the formwork. In the case of brackets, the formwork cannot be wedged out in two directions in the plane, the structure can only be stabilized by andrás or, in the case of a plate above ground level, by inclined supports. Many times, the contractor assumes that the bracket irons with negative torque, which are connected back to the slab, can act as anchors, taking on the horizontal loads of the formwork. It is strictly forbidden to use the rebar installation to absorb any kind of load during construction. Especially dangerous are cantilever solutions where thermal bridge breaker elements are installed between the plate and the slab. This is because the iron length without splicing into the bracket or plate is minimal, meaning that they cannot function as anchors before or during concreting.

In the case of above-ground brackets, it happens that the supports are placed on the cultivated ground in the absence of a base plate or subfloor concrete. In this case, if no load-distributing plank or beam with a suitable surface is inserted under the supports, the support will sink under the concreting load, the formwork will move out and the structure will collapse. A similar result occurs when, in case of higher headroom, the support lengths do not reach the desired height, and block bricks are placed under the supports as an extension. The bricks are not designed for such a concentrated load as the concreting load coming down on one support, so when crushed, they drag the entire slab structure under concrete with them *(Figure 6).*

*Figure 6: Irregular floor support and its consequences (Source: own recording)*

***Disasters of wall formwork***

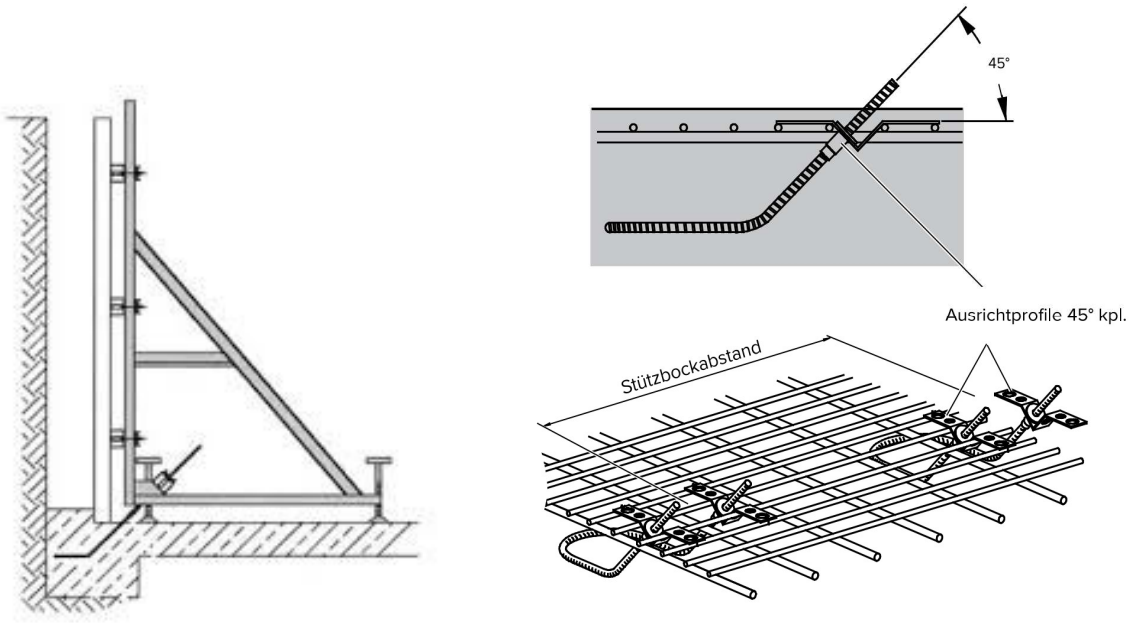
*Splitting of bilateral formwork*

The elements connecting modern framed formwork, the so-called quick clips, are designed to connect the boards and ensure the flatness of the formwork. These are robust strong staples, but it is a misconception that they are also suitable for absorbing the pressure of concrete, since the load capacity of these terminals is no more than 8.00 kN. The concrete pressure transmitted through the steel frame must be absorbed by the jumper screw stems, i.e. threaded reinforcing steels, which can reach 90kN/m2. If these screw stems are not threaded at all board joints, the concrete pressure would have to be absorbed by the terminals, for which they are not dimensioned. In such cases, above a certain concrete height, the staples break, break and the formwork opens. In addition to the fact that the reinforced concrete structure under construction will be destroyed, the concrete spilling under high pressure will sweep away the occupants. If it is on a hanging rack several stories high, the concrete will push everything down into the depths.

*Unilateral formwork damage*

Typical design of one-sided wall formwork, when there is already an existing structure on one side of the reinforced concrete wall structure, such as a gap wall or pile wall. In this case, only one side of the wall to be built is formworked. In the case of bilateral formwork, the concrete pressure is absorbed by threaded ribbed reinforcing steel between the opposing formwork boards, but this method cannot be used in the case of unilateral formwork. In such cases, the formwork must be supported by heavy-duty support bollards, which can absorb concrete pressure through anchors cemented into the base plate. A common source of accidents is when anchors with threaded ribs to be pre-cemented are connected to the

reinforcement of the base plate to the wrong height before it is concreted. If it is concreted to the upper mesh, the 80-100 kN forces will cause the upper belt of the base plate to burst and the formwork will break apart together with the robust bollards. Another typical source of error is when anchors not to be placed in the base plate are used, but only try to absorb concrete pressure with conventional inclined supports. In such cases, due to the vertical component of the rod force formed from the pressure of the concrete, the formwork rises and concrete spills out at the bottom with high pressure. The most common injury in this case is the fracture of the leg of workers *(Figure 7).*




*7. Figure : Supporting one-sided formwork, anchoring the bollards (Source: Thyssen Hünnebeck GmbH.)*

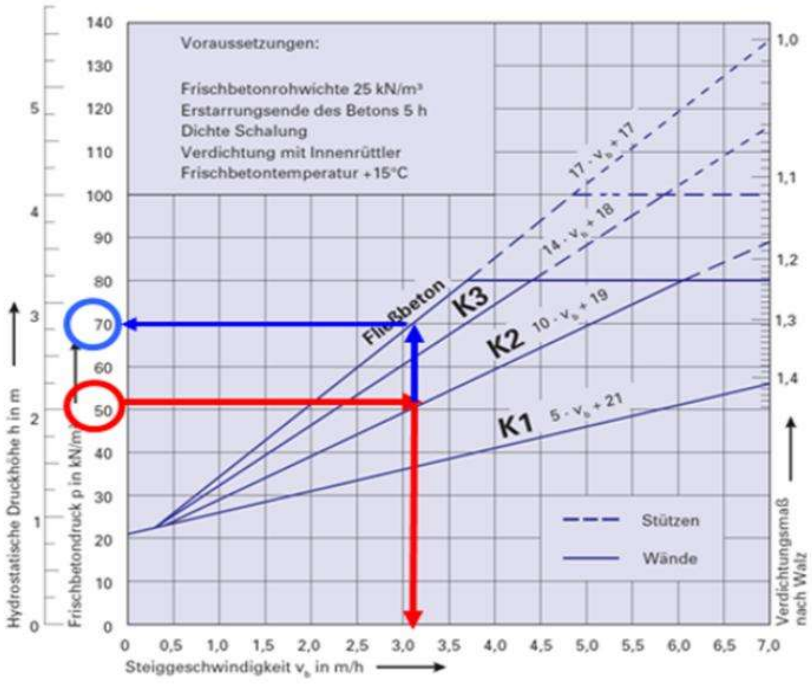
**Consideration of static tests**

In the case of slab formwork, as a rule, accidents do not occur due to a sudden increase in the planned concrete pressure. When concreting the slab, due to the spreading of flowing concrete, the formwork cannot really be overloaded, even in the case of an inattentive pump operator or a faulty concrete pump. This means that for an average slab 20-25 cm thick, this sudden sheet thickness can be up to one and a half times higher than the draft. Taking into account the average density of concrete of 2300 kg/m3, this additional load means an extra load of up to 450-500 kg/m$^2$ formwork on the formwork. This does not pose too much risk considering safety factors.

In contrast, for wall formwork, unplanned concrete pressure poses a serious danger. The load capacity of an average, modern framed wall formwork is 60 kN/m$^2$. In the case of vibrated concrete, taking into account the pressure of hydrostatic concrete, this means that two to two and a half meters high

formwork can be concreted safely without restrictions on the concreting speed. In the case of the construction of reinforced concrete walls higher than this, the limit on the concreting speed must be applied. This is illustrated in Figure *8*.

The danger of unplanned sudden increase in concrete pressure is exponential in pillar formwork. Similarly to framed formwork, pillar formwork has an average load capacity of 60 kN/m$^2$. However, unlike reinforced concrete walls, the capacity of pillar formwork is relatively small. For example, a pillar with a floor area of 30x30 cm and a height of 3 meters has a capacity of 0.27 m$^3$. This means that in the case of concrete pump technology, using an average pump with a capacity of 150 m$^3$/h, the half-cubic meter pillar fills up in 6.5 seconds with 2 strokes. Thus, it is very easy to exceed the concreting speed, which can mean the collapse of the formwork.




Függőleges ordináta: betonnyomás értékek kN/m2-ben
hidrosztatikus nyomásmagasság m-ben
Vízszintes ordináta:betonozási szint emelkedés m/órában
K2 konzisztencia – kissé képlékeny
Fliesbeton – folyós konzisztencia

Alapadatok: Frissbeton sűrűsége: 25 kN/m3
Megszilárdulás vége: 5 óra
Frissbeton hőmérséklete: + 15Co
Tömörítés belső vibrátorral

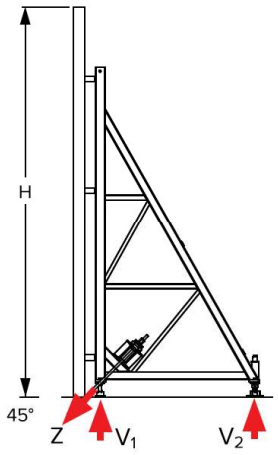
*8. Figure: Evolution of concrete pressure as a function of hydrostatic pressure height*

*(Source: Thyssen Hünnebeck GmbH.)*

With one-sided formwork, the problem is similar, very soon it is possible to exceed the permissible concreting speed. In this case, the bearing capacity of the anchors of the bollards must be adapted to the bearing capacity of the formwork. The table also shows the characteristic formwork loads in the left column (40, 50, 60 kN/m2) and the corresponding anchor forces depending on the allocation of the bollards *(Figure 9).*

**Stützbock 500**
Verankerungsaustritt unter 45°

| **Beton-druck kN/m²** | Betonier-höhe H (m) | Reaktionskräfte | | | Max. Stütz-bock-abstand in m |
|---|---|---|---|---|---|
| | | Z (kN/m) | $V_1$ (kN/m) | $V_2$ (kN/m) | |
| **40** | 3,50 | 153 | 34 | 74 | 2,16 |
| | 4,00 | 181 | 24 | 104 | 1,80 |
| | 4,50 | 209 | 8 | 140 | 1,55 |
| | 5,00 | 238 | -8 | 181 | 0,97 |
| **50** | 3,50 | 177 | 45 | 80 | 1,88 |
| | 4,00 | 212 | 34 | 115 | 1,55 |
| | 4,50 | 247 | 17 | 158 | 1,31 |
| | 5,00 | 282 | -2 | 207 | 0,97 |
| **60** | 3,50 | 195 | 54 | 85 | 1,72 |
| | 4,00 | 238 | 45 | 123 | 1,39 |
| | 4,50 | 280 | 27 | 170 | 1,16 |
| | 5,00 | 322 | 2 | 226 | 0,97 |




*9. Figure : Unilateral formwork anchor forces as a function of concrete pressure*

*(Source: Thyssen Hünnebeck GmbH.)*

**Summary**

Based on the above, it can be said that the majority of formwork accidents are due to human error, which could be prevented. The biggest problem when assembling formwork is the lack of foremanship and the professional control of the final result. Accidents also occurred earlier, in the 60s and 70s, but at that time they were mostly caused by weak lifting mechanisms and lack of occupational safety. Despite today's

modern building technology, the lack of expertise causes most accidents. While earlier formwork was carried out by carpentry brigades with skilled foremen, today Lego-like battery systems are carried out by trained workers, often with incomplete technical knowledge. They cannot assess the risk of an accident because they are not aware of the pressure and weight of concrete, they do not know the load bearing capacity and static load capacity of formwork structures. With greater technical discipline, accidents could be avoided.

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