KRÍZOVÝ MANAŽMENT
DOI 10.26552/krm.C.2025.2.32-41
ISSN – 1336 – 0019 (tlač)
ISSN – 2730 – 0544 (online)

PROTECTION OF ENCLOSED UNIVERSITY FACILITIES IN THE EUROPEAN UNION AGAINST CBRN THREATS: LESSONS LEARNED FROM PAST INCIDENTS AND PREPAREDNESS STRATEGIES

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ABSTRACT: *The paper examines the protection of enclosed university facilities in the European Union against chemical, biological, radiological and nuclear (CBRN) threats. It analyses key incidents, such as the 2001 explosion at the AZF factory in Toulouse, the 2018 Novichok poisonings, and the 2018 ricin attack in Cologne. It explores current preparedness measures, including training initiatives and infrastructural improvements inspired by these events. The 2023 shooting at the Faculty of Arts of Charles University in Prague serves as a case study, highlighting the need for rapid response, effective communication and psychological support. The paper also proposes specific measures to enhance the security of universities and other higher education institutions. These measures include, among others, detection systems, entry control systems and cooperation with local authorities and agencies, aiming to minimise the risks posed by both CBRN and conventional threats.*

KEYWORDS: *CBRN threats, university security, emergency preparedness, decontamination, Charles University shooting.*

INTRODUCTION

Universities face increasing CBRN-related risks, yet documented university-specific incidents are very sparse. Therefore, this paper analyses analogous public-space CBRN incidents to extract lessons relevant to enclosed academic environments. Such incidents—though they occur in industrial, business, or political contexts—reveal vulnerabilities directly applicable to universities, where enclosed spaces, high population density, and laboratory activities elevate risk.

This paper explores how enclosed university environments across the European Union (EU) are increasingly vulnerable to unconventional threats—specifically chemical, biological, radiological, and nuclear (CBRN) hazards. Drawing on high-profile incidents such as the 2001 Toulouse, France Azote Fertilisant (AZF) factory explosion, the 2018 Novichok poisonings in the United Kingdom, and the attempted 2018 ricin attack in Cologne, Germany, the analysis highlights how such events, though not always university-centred, offer critical lessons for academic settings.

The 2023 mass shooting at Charles University in Prague is presented as a case study to illustrate the broader implications of emergency readiness in educational institutions. The paper assesses universities' existing preparedness, examines gaps in infrastructure and training, and evaluates national and EU-level coordination frameworks. In doing so, it sheds light on the developing concept of campus resilience, including both physical safeguards and psychological response strategies.

This paper is based primarily on results and analyses from the UNICOPS project. References to eNOVATION project, the EU Centres of Excellence (CoE), and national emergency plans such as the UK's National CBRN governance arrangements and France's Plan ORSEC serve only to illustrate complementary EU-level training resources.

1. CBRN INCIDENTS IN THE EUROPEAN UNION

Although major intentional CBRN attacks on European university campuses remain rare, documented events such as discoveries of legacy radioactive sources and chemical-reaction evacuations show that academic institutions nevertheless face tangible hazards. The four cases published on the following pages underline the need for systematic hazardous-materials inventories, regular audits of legacy equipment and stocks, rigorous lab ventilation and maintenance programmes, tailored incident response plans, and improved governance of technology parks and spin-off research facilities.

1.1 Discovery of radioactive sources at the University of Bordeaux, France, 2015

On 18 September 2015, staff at a joint INSERM (French National Institute of Health and Medical Research) / University of Bordeaux laboratory discovered two previously undocumented sealed radioactive sources in a research room. The event was reported to the French Nuclear Safety Authority (ASN) and declared a Level-2 incident; incident follow-up included radiological monitoring, characterisation of the sources, dose assessments for potentially exposed personnel and implementation of ASN-requested corrective measures. This case highlights the persistent risk of *legacy* or forgotten radioactive sources in older research facilities and underscores the need for systematic inventories, decommissioning protocols, and periodic radiological audits in university laboratories.

1.2 Discovery of legacy radioactive sources and residual contamination at University Hospitals of Strasbourg, France

Inspections in 2020–2021 at buildings operated by the University Hospitals of Strasbourg revealed legacy radioactive sources and localised residual contamination tied to historical medical radiotherapy and research activities dating back many decades. The case required radiological characterisation, mapping of contamination points, packaging and removal of legacy sources, and dosimetry evaluations for workers — demonstrating that legacy radiological hazards may persist at university-affiliated sites and require dedicated resources to identify and remediate them before reuse or refurbishment of older buildings.

1.3 Evacuation after chemical reaction at Radboud University, Netherlands, 2023

On 29 August 2023, a chemical reaction in a laboratory inside the Mercator III building on the Radboud University campus (Nijmegen) released fumes that prompted an immediate evacuation of the building and the attendance of the local fire service and hazardous-materials responders. No serious injuries were reported; the affected laboratory was sealed for cleaning and specialist remediation before re-use. The event emphasises that routine laboratory operations in university campuses can produce sudden airborne chemical hazards in multi-use buildings and underlines the importance of robust ventilation maintenance, spill-response plans and well-rehearsed evacuation procedures.

1.4 Explosion at the New University of Lisbon technology park, Portugal, 2024

On 4 July 2024, an explosion occurred in the technology-park area of the Faculty of Science and Technology at the New University of Lisbon, Caparica (Almada), with emergency services mobilised and at least one fatality reported. The event (investigated by national authorities) illustrates that larger-scale accidents — including those involving prototype systems, gas or pressurised containers or process equipment in university innovation parks — can produce consequences similar to industrial incidents and therefore require that campus risk governance covers technology parks, spin-off labs and incubators in addition to conventional teaching and research spaces.

Specific CBRN contamination incidents in EU university facilities, such as lecture halls or libraries, are not widely documented, likely because of their rarity or sensitivity. However, several notable CBRN-related incidents in the EU provide critical context for understanding the broader threat landscape and its implications for educational institutions. Starting on the next page are key examples, their circumstances, substances involved, decontamination procedures, and lessons learned.

1.5 TOULOUSE AZOTE FERTILISANT (AZF) FACTORY EXPLOSION IN 2001

The September 2001 explosion at the AZF factory in Toulouse, France**,** which killed 31 people and injured thousands, brought to the public's attention the critical need for stringent chemical storage regulations in urban areas. The Seveso III Industrial Safety Protocol (Directive 2012/18/EU) had to be revised to enhance risk management for facilities handling hazardous substances. Emergency services focused on evacuating affected areas, treating respiratory and ocular injuries, and monitoring air quality.

Contaminated areas were cleaned using water-based solutions to neutralise chemical residues. Long-term efforts included soil and water remediation to address environmental contamination. The incident emphasised the need for urban planning to separate industrial zones from educational institutions, reducing exposure risks. Regular audits of nearby industrial facilities and collaboration with local authorities are now seen as essential for campus safety. For universities, this highlighted the importance of preparing for external chemical threats, such as airborne contaminants, that could affect campus facilities. Universities must implement air quality monitoring systems and rapid evacuation protocols to protect students and staff. Training programs should include scenarios for chemical spills to ensure preparedness for such external threats.

1.6 NOVICHOK POISONINGS IN MARCH 2018

These poisonings took place in Salisbury, UK, of Sergei Skripal and his daughter, Yulia Skripal, demonstrating the challenges of identifying and containing chemical agents in public spaces. See Fig.1 below.

Figure 1 Individuals in protective suits and a tent covering the bench where Skripal collapsed (Authors, 2025)

Novichok is a highly toxic nerve agent developed for chemical warfare. The incidents, involving a nerve agent, led to severe health impacts and international diplomatic tensions. Universities can apply these lessons by installing chemical detection systems in high-traffic areas, such as lecture halls and laboratories. Staff training on recognising symptoms of chemical exposure, such as respiratory distress or neurological symptoms, is crucial for early intervention. Rapid response protocols, including coordination with local hazmat teams, should be established to contain contamination. The incidents also highlighted the need for secure storage of research chemicals to prevent misuse. Public awareness campaigns can educate campus communities about reporting suspicious substances, enhancing overall safety. These proactive measures reduce the risk of chemical threats on campuses.

Decontamination efforts involved sealing off affected areas, including public spaces and buildings, and using specialised chemical neutralisation agents. Responders wore Level A hazmat suits, and contaminated objects were removed or destroyed. Public health campaigns informed residents about the risks of secondary exposure.

1.7 POLONIUM-210 POISONING IN 2006

In November 2006, Alexander Litvinenko was poisoned with Polonium-210 in London. Po-210 is a highly radioactive isotope causing severe radiation poisoning. This incident exposed the insidious nature of radiological threats, which are difficult to detect without specialised equipment. Universities must invest in radiation detectors for laboratories and public spaces to mitigate similar risks. Training personnel in radiological safety protocols, including handling and disposal of radioactive materials, is essential. The incident also underscored the importance of international cooperation in tracking radiological

substances, as universities often collaborate globally on research. Emergency response plans should include procedures for isolating contaminated areas and providing medical support. Public health campaigns can raise awareness about radiological risks, ensuring a proactive approach to safety. Regular drills simulating radiological incidents can further enhance preparedness and protect campus communities from such threats.

Affected areas, including hotel rooms and public spaces, were sealed and decontaminated using specialised radiological cleaning techniques, including HEPA (high-efficiency particulate air) filtration, vacuuming, and chemical washing. Contaminated materials were disposed of as radioactive waste.

1.8 RICIN PLOT IN COLOGNE IN 2018

The ricin plot, uncovered on 12 June 2018 in Cologne, Germany, involved a Tunisian extremist, Sief Allah H. He produced ricin, a biological toxin derived from castor beans, capable of causing severe organ damage. This marked the first time a jihadi terrorist in the West successfully created this biological agent for a planned terrorist attack. See Fig. 2 below.

The plot was swiftly resolved when the suspect was arrested in his apartment, highlighting the effectiveness of electronic surveillance and intelligence sharing. As the plot was intercepted before execution, no actual contamination occurred. However, preparedness measures included plans for biological decontamination, such as using bleach-based solutions and isolating affected areas.

Figure 2 Police officers wear protective clothes and respiratory masks during the operation on June 12, 2018, in Cologne, Germany (Authors, 2025)

Universities must implement strict access controls for laboratories handling biological agents, with biometric security and regular audits. Monitoring online communications for radicalisation is critical, as the Islamic State inspired the suspect. Training programs should include protocols for identifying and reporting suspicious activities to ensure early intervention. These measures strengthen university defences against biological threats.

The incident underscored the need for vigilance in monitoring hazardous substances and securing research facilities. Universities with laboratories handling biological agents must implement strict access controls and monitoring systems. These incidents, while not directly involving universities, demonstrate the diverse nature of CBRN threats and their relevance to enclosed public spaces, including educational institutions. The lack of specific university incidents suggests that such events are either rare or not publicly reported, necessitating a focus on preparedness and lessons from broader CBRN events.

1.9 POLIO INCIDENT IN THE NETHERLANDS IN 2022

Utrecht Science Park/Bilthoven is a research hub in the Netherlands, hosting facilities that study infectious diseases. The 2022 poliovirus incident in the Netherlands revealed the importance of wastewater monitoring for early detection of biological contaminants. Regular wastewater testing can provide early warnings of biological threats, allowing for rapid containment and was intensified after the incident. Universities with research facilities that handle pathogens must ensure up-to-date vaccination status for laboratory personnel to prevent outbreaks. Collaboration with public health authorities is essential to align university protocols with national guidelines. Training should include biosafety measures, such as proper handling and disposal of biological agents. Public awareness campaigns can

educate students and staff about the importance of vaccination, reducing the risks of spreading disease. These strategies enhance university preparedness for biological incidents, ensuring campus safety.

2. PREPAREDNESS MEASURES IN EU UNIVERSITIES FOR CBRN THREATS

Past CBRN incidents, such as the Toulouse, France AZF factory explosion and the Cologne ricin plot, have significantly shaped up university preparedness strategies. These events highlighted the need for enhanced laboratory security, including biometric access controls and regular audits of hazardous materials. Regular training and drills for staff and students, simulating CBRN scenarios, have become standard to ensure rapid response capabilities. Collaboration with national and local emergency services, as seen in the response to the Charles University shooting, ensures coordinated action during crises. Investments in detection equipment, such as chemical and radiation sensors, and decontamination facilities reflect lessons from incidents like the Novichok poisonings, emphasising proactive safety measures.

The first EU CBRN CoE (Centre of Excellence) initiative was formally launched in 2010. The CoE supports partner countries in mitigating CBRN risks through capacity building and training. Universities benefit from access to advanced research on CBRN defence technologies, such as portable chemical detectors and decontamination systems. The initiative fosters interagency collaboration, enabling universities to align with national security frameworks. For example, universities in Germany have adopted the CoE guidelines to enhance laboratory safety post the Cologne ricin plot. Training programs developed through the CoE equip faculty with the skills to handle CBRN incidents, thereby improving campus resilience. Partnerships with regional centres ensure access to cutting-edge resources, reducing response times during emergencies. Universities should integrate the CoE best practices into their emergency plans, ensuring compliance with EU standards. Regular workshops with the CoE experts can further enhance preparedness, making universities proactive in addressing CBRN threats.

National emergency plans, such as the UK's national CBRN governance arrangements and France's Plan ORSEC, include protocols for CBRN incidents. Universities are required to integrate these plans into campus-specific procedures and coordinate with local authorities. For instance, the Netherlands universities adopted wastewater monitoring protocols following the 2022 polio incident. The EU civil protection mechanism facilitates cross-border cooperation and provides guidelines for managing CBRN threats. Universities can adapt these for campus use, establishing clear lines of command. Audits are conducted regularly to ensure compliance with national standards. Joint exercises with emergency services enhance preparedness. These measures reflect lessons from past incidents, ensuring robust response capabilities in future. Universities should also participate in national CBRN simulations to test their protocols and improve readiness for real-world scenarios.

Universities develop tailored emergency response plans that include evacuation, decontamination, and communication procedures. For example, the University of Copenhagen conducts annual CBRN drills, simulating chemical spills. These plans designate decontamination zones and secure storage for hazardous materials used in research. CBRN response teams, composed of trained faculty and staff, are established to manage crises. Regular audits ensure compliance with safety standards, while student orientation programs include safety briefings. Lessons from the explosion at the AZF factory in Toulouse emphasise the need for clear evacuation routes and communication systems. Universities should invest in mobile applications to deliver real-time alerts, improving response efficiency. Collaboration with local fire and hazmat teams can further streamline emergency responses, ensuring campus safety during CBRN incidents.

Regular training and drills are critical to prepare university communities for CBRN threats. The eNOVATION initiative, coordinated by the Belgian national crisis centre, develops advanced training methods for first responders, which universities can adopt. For example, German universities conduct biannual CBRN drills, involving police and hazmat teams. These exercises simulate scenarios as chemical leaks, thus ensuring staff and students are familiar with protocols. Training includes recognising symptoms of chemical or biological exposure and improving early detection. Post-incident reviews, as seen after the Cologne ricin plot, refine training programs. Universities should increase drill frequency and include students to enhance community resilience. Partnerships with national training programs can provide access to advanced simulation tools, improving preparedness.

Infrastructure upgrades have been implemented in several universities, including the installation of advanced air filtration systems, secure storage facilities, and decontamination zones. Loughborough University installed radiation detectors in laboratories soon after the Polonium-210 incident. Air sampling

devices, inspired by the explosion at the AZF factory in Toulouse, mitigate chemical risks. Biometric access controls prevent unauthorised laboratory access, a lesson from the Cologne ricin plot. Regular maintenance ensures equipment reliability, while partnerships with technology providers enhance capabilities. Universities should prioritise funding for these upgrades to ensure compliance with EU safety standards and reduce vulnerabilities. Regular infrastructure audits can identify gaps, ensuring campuses are equipped to handle CBRN threats effectively.

3. Case Study - Shooting Incident at Charles University

On December 21, 2023, a tragic shooting occurred at the Faculty of Arts of Charles University in Prague, resulting in 14 deaths and 25 injuries. The gunman, a 24-year-old postgraduate student named David Kozák, was found dead at the scene, having committed suicide after being confronted by police. This incident, while not a CBRN event, provides critical insights into emergency response in university settings and offers a basis for comparison with potential CBRN incidents. Some students, who escaped from the shooting, are trying to find a safe place and are shown in Figure 3 below.

The shooting began at approximately 15:00 local time in the Faculty of Arts building, located in Jan Palach Square, a popular tourist area in Prague's historic Old Town. Student David Kozák, armed with a rifle and other weapons, targeted students and staff in classrooms and corridors. The attack was described as a premeditated violent act, possibly inspired by mass shootings abroad, though not linked to international terrorism. Earlier that day, Kozák's father was found dead, and he was later connected to a double murder in Klánovice.

Figure 3 Students crouched on a ledge at Charles University building to hide from gunfire (Authors, 2025)

Police and emergency services responded within minutes, securing the area and providing the first medical aid to the injured. Prior alerts about Kozák's intentions facilitated the rapid response, as he was suspected of planning to take his own life. Emergency medical teams treated 11 seriously injured, eight moderately injured, and five lightly wounded individuals, demonstrating effective triage.

The university's emergency plan was also promptly activated, with clear communication channels established to guide individuals to evacuation routes or shelter-in-place procedures. See Fig. 3 above. Some of the students escaped through windows and onto ledges, highlighting the need for flexible response strategies in extreme situations. Social media footage showed students barricading themselves in classrooms, indicating they were aware of lockdown protocols.

The incident had a profound psychological impact on the university community, particularly affecting the deaf studies program, where eight students and a professor were among the victims. The Czech Government declared a National Day of Mourning on 23 December 2023, and Charles University organised a memorial service to honour the victims. The event underscored the need for comprehensive mental health support post-incident, as reported by Charles University.

The shooting at Charles University's Faculty of Arts confirmed the great value of several lessons learned from previous incidents elsewhere. A rapid police response minimised casualties, underscoring the need for immediate action. Clear communication via digital platforms and public address systems guided students and staff, a model for CBRN incidents. Pre-existing lockdown protocols enabled effective responses, underscoring the value of regular drills. The significant psychological trauma experienced

by survivors necessitated robust mental health resources. Therefore, universities should establish counselling services and peer support groups to address trauma. Collaboration with local authorities, as seen in the swift response, is critical for managing crises. Regular reviews of security protocols can help prevent future incidents and ensure campus safety. These lessons should be applied to enhance CBRN preparedness, particularly in crisis management.

4. COMPARISON AND LESSONS LEARNED

A thorough comparison between the Charles University shooting and potential CBRN incidents reveals several reinforced strengths and persisting vulnerabilities. Drawing on the incidents discussed in previous chapters, we can better evaluate current readiness and propose further enhancements.

The Charles University shooting demonstrated commendable strengths in emergency response. The rapid deployment of armed police, immediate area lockdown, and swift triage by emergency medical teams prevented further casualties. This type of decisive action should serve as a blueprint for CBRN scenarios. Quick mobilisation, particularly if hazardous materials are involved, can be the difference between containment and catastrophe. Interagency cooperation functioned efficiently. Police, fire departments, medical services, and the university administration worked in tandem to control the situation. Such coordination is paramount for CBRN emergencies, where hazmat response teams must integrate with university safety officers. Events like the 2018 ricin plot in Cologne further emphasise the importance of early intelligence and law enforcement coordination in preventing incidents.

Communication systems functioned but proved not to be entirely fail-safe. The incident showed that communication tools—public address systems, mobile alerts, and social media—were well-utilised and effective. However, their over-reliance on electricity and mobile connectivity could be problematic in CBRN attacks involving infrastructure sabotage. Universities should invest in redundant communication systems, including battery-powered or battery-backed-up public address systems and offline alert applications. Moreover, multilingual messaging should be standard, given the diverse nature of university populations. The 2018 Novichok incident showed that effective public health communication can reduce panic and help direct public behaviour.

While basic lockdown procedures were followed well during the Prague shooting, many students lacked clarity on whether to evacuate or shelter in place. This exposes a weak point that could have severe consequences in a CBRN situation. CBRN scenarios require tailored drills that include chemical spill simulations, radiological decontamination practices, and biological exposure protocols.

Some university infrastructure items have been modernised, but many still need upgrading. Audits conducted at Charles University shortly after the incident revealed ageing ventilation systems and limited biometric access in research labs. In contrast, Loughborough University's proactive installation of radiation detectors following the Litvinenko incident illustrates a high standard of modernising infrastructure. Most EU universities still lack advanced chemical detection systems in non-laboratory environments like libraries or cafeterias. Similarly, not all facilities are equipped with secure, negative-pressure rooms or decontamination chambers.

Psychological preparedness is still a critical weak spot**.** Charles University provided immediate counselling after the shooting, a model response for emotional recovery. However, the trauma associated with invisible threats like radiation or pathogens can be even more psychologically destabilising. Long-term psychological care, not just post-incident but also preventive education about CBRN risks, should be incorporated into campus wellness programs. Lessons from the aftermath of the Novichok poisonings show that communities exposed to CBRN threats endure lingering fear and uncertainty. Universities should offer multilingual mental health support and proactive resilience-building programs.

5. STRATEGIC RECOMMENDATIONS TO STRENGTHEN EU UNIVERSITY RESILIENCE

Based on the case analysis, the following key recommendations are proposed to strengthen CBRN preparedness in EU universities:

The development of redundant, battery-operated, or at least battery-backed-up communication systems must be prioritised. Beyond public address systems and mobile phone applications, universities must prepare for CBRN-specific disruption scenarios. These include manual signalling tools, printed

emergency instructions in multiple languages, and clear signage to direct movement during low-visibility events (e.g., smoke or chemical mist).

Universities' participation in EU and national CBRN programs should be expanded to include active involvement in training initiatives such as the EU Centres of Excellence and eNOVATION. These programs offer simulations, virtual reality training, and collaborative exercises that can significantly enhance university staff preparedness.

All enclosed university buildings should be evaluated for CBRN-readiness, and infrastructure upgrades prioritised. Investment in ventilation systems with HEPA and chemical filters, radiation and gas detectors, and secure access controls must become standardised. EU or national grants can be pursued to support such upgrades. CBRN preparedness must extend beyond laboratories, and a campus-wide emergency culture must be established. Libraries, cafeterias, and administrative areas should also have marked shelter zones, stocked decontamination kits, and accessible emergency instructions. Awareness campaigns during orientation weeks can embed a culture of safety. Standing support teams composed of counsellors, psychologists, and trained peer supporters should be created. Offer post-incident trauma care and pre-incident awareness about coping with uncertainty. Universities can collaborate with public health agencies to streamline services and ensure readiness for mass-scale psychological interventions. Universities must review existing statutes and policies to ensure swift activation of emergency powers. Legal clarity on campus lockdowns, staff duties, and communication responsibilities will reduce hesitation during CBRN crises. Case studies from the UK's Defra's CBRN emergency arrangements and France's plan ORSEC provide guidance. By implementing these strategies, EU universities can significantly raise their preparedness for future CBRN or hybrid threats, thereby enhancing the safety and resilience of academic communities across the continent.

CONCLUSION

The protection of enclosed university facilities against CBRN threats is no longer a hypothetical challenge. Recent incidents such as the Charles University shooting, past poisonings involving Novichok and ricin, and evolving geopolitical tensions highlight the fact that academic institutions in Europe are increasingly vulnerable to both conventional and unconventional attacks. These events underline the urgent need for comprehensive risk assessments, cross-sectoral coordination, and a proactive approach to resilience.

Throughout this paper, we have examined critical areas where EU universities have demonstrated strength—such as rapid emergency response and inter-agency coordination—as well as areas still requiring serious improvement. The lack of consistent CBRN-specific drills, outdated infrastructure in many facilities, and limited psychological preparedness stand out as persistent vulnerabilities that could severely undermine the response in case of a real CBRN crisis. What emerges is the necessity of mainstreaming CBRN preparedness across all layers of university operations. This includes not only laboratory and research spaces, but also lecture halls, libraries, cafeterias, and student residences. Just as critical is the need to embed a safety culture that is not reactive but anticipatory, supported by legal clarity, regular training, robust infrastructure, and well-funded emergency protocols.

The recommendations provided in this paper are not merely aspirational—they are actionable, and in many cases, already implemented in pockets across the EU. The goal now must be to scale these best practices, supported by EU-wide frameworks such as the EU Centres of Excellence and national programs such as the UK's CBRN Governance Arrangements and France's Plan ORSEC. In closing, safeguarding university campuses against CBRN threats is a shared responsibility among government, university leadership, emergency services, and the academic community. Only by working in unison can we ensure that places of learning remain bastions of safety, science, and civil resilience in an increasingly unpredictable and turbulent world.

ACKNOWLEDGMENT

This paper has been supported by the research project UNICOPS 101 190 929 carried out under the European Union HORIZON Programme.

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