



**GLOBAL**  
PUBLIC HEALTH  
WEEK 4 - 8 April 2022

Public Health  
Matters: Building  
the New Future

**MEDNARODNI DNEVI  
SANITARNEGA INŽENIRSTVA 2022**

**INTERNATIONAL DAYS  
OF PUBLIC AND ENVIRONMENTAL  
HEALTH PROFESSION 2022**

**Zbornik povzetkov**  
Book of Abstracts

Ljubljana, 2022

## **MEDNARODNI DNEVI SANITARNEGA INŽENIRSTVA 2022**

INTERNATIONAL DAYS OF PUBLIC AND ENVIRONMENTAL HEALTH PROFESSION 2022

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# UVODNIK

**Aleš Krulec in Sara Tajnikar**

Zbornica sanitarnih inženirjev Slovenije

Inštitut za sanitarno inženirstvo

Spoštovane kolegice in kolegi,

pred vami je Zbornik povzetkov Mednarodnih dnevov sanitarnega inženirstva 2022, ki so potekali 7. in 8. aprila 2022, v Ljubljani. Letošnji, že tradicionalni, Mednarodni dnevi sanitarnega inženirstva so potekali v okviru iniciative Svetovnega združenja zvez za javno zdravje (WFPHA): Global Public Health Week 2022, pod temo »Public Health Matters: Building the New Future«. Pri iniciativi smo sodelovale institucije, združenja in drugi pomembni akterji na področju javnega zdravja z vsega sveta, z namenom, da predstavimo primere najboljših praks in zapolnimo vrzeli, ki so bistvene za preprečevanje širjenja bolezni ter promocijo zdravja in dobrega počutja vseh nas.

Osnovni namen strokovnega dogodka, organiziranega s strani Inštituta za sanitarno inženirstvo in Svetovnega združenja zvez za javno zdravje (WFPHA), je bil v povezovanju udeležencev in promociji stroke sanitarnega inženirstva. Krepitev in promocija stroke je v prihodnost usmerjen proces, ki zahteva veliko znanja, iznadljivosti, predvsem pa samoiniciativnosti sanitarnega inženirja v delovnem okolju.

Dogodek je v dveh dneh gostil več kot 120 udeležencev. V uvodnem dnevu, v četrtek, 7. aprila 2022, je potekal starteški forum »Krepitev povezanosti poklicnih / strokovnih združenj in njihovih članov na področju javnega zdravja«, v okviru katerega se je zbrala ožja strokovna skupina vabljenih predstavnikov reprezentativnih strokovnih združenj in institucij.

Med njimi predstavniki Zbornice sanitarnih inženirjev Slovenije, predstavnici Inštituta za sanitarno inženirstvo, predstavnik Mednarodnega združenja za okoljsko zdravje (IFEH), predstavniki Zdravstvene fakultete Univerze v Ljubljani, predstavniki Zbornice sanitarnih inženirjev iz Hrvaške, predstavnica Katedre za sanitarno inženirstvo na Medicinski fakulteti Univerze v Reki in predstavnik sekcije sanitarnega inženirstva pri Sindikatu zdravstva in socialnega varstva Slovenije. Namen strateškega foruma je bilo povezovanje sanitarnih inženirjev v zdravstvu in socialnem varstvu ter strateško načrtovanja in usmeritve razvoja sanitarnega inženirstva v Republiki Sloveniji, kot tudi v širši mednarodni skupnosti. Oblikovali smo skupna stališča in kratkoročne ter dolgoročne ukrepe za krepitev in promocijo sanitarnega inženirstva, in sicer:

- i) podpora sekciji sanitarnih inženirjev Sinidkata zdravstva in socialnega varstva RS, s ciljem izboljšanja položaja vseh zaposlenih sanitarnih inženirjev v zdravstvu in socialnem varstvu v RS;
- ii) informiranje splošne in strokovne javnosti glede pomembnih strokovnih tem s področja sanitarnega inženirstva. Vsled tega spodbujanje sanitarnih inženirjev k aktivnemu publiciranju splošnih strokovnih člankov v slovenskem jeziku in v slovenskih strokovnih revijah, s ciljem razvijanja stroke sanitarnega inženirstva iz njegovih temeljev v zdravstvu;
- iii) usmerjeno mednarodno povezovanje z Medicinsko fakulteto Univerze v Reki, s ciljem okrepitve raziskovanja na področju bolnišniških okužb in higiene v zdravstvu;
- iv) promocija uspešnih sanitarnih inženirjev na nacionalni in mednarodni ravni, kot pomembnih akterjev v vlogi javnozdravstvenih strokovnjakov, ko gre za preprečevanje prihodnjih pandemij oz. drugih tveganj za zdravje.

Naslednji dan, v petek, 8. aprila 2022, so sledila strokovna predavanja v znamenju pandemije COVID-19. Predavanja so potekala on-line. Predstavljene so bile vsebine s poudarkom na vlogi sanitarnega inženirja pri preprečevanju prihodnjih pandemij. Pridružili so se nam predavatelji iz različnih sfer, in sicer iz Nacionalnega inštituta za javno zdravje, Zdravstvenega inšpektorata RS, Urada RS za kemikalije, Zdravstvene fakultete Univerze v Ljubljani in Mediciske fakultete Univerze v Ljubljani. Povzetki predavanj so predstavljeni v nadaljevanju tega zbornika.

Ob tej priložnosti se zahvaljujemo vsem udeležencem in predavateljem za izkazan interes po izmenjavi idej, znanja in dobrih praks. Veseli nas, da vam lahko predstavimo Zbornik povzetkov Mednarodnih dnevov sanitarnega inženirstva 2022, ki je rezultat izjemnega prizadevanja predavateljev, avtorjev povzetkov – sanitarnih inženirjev. Publikacija je namenjena vsem, ki se ukvarjate s področjem javnega zdravja in z njim povezanih strokovnih področij.

Udeležence letošnjih dnevov sanitarnega inženirstva, kakor tudi vse ostale bralce tega zbornika, ki se našega dogodka niste udeležili, vabimo na naslednje Mednarodne dneve sanitarnega inženirstva 2023.

Želimo vam prijetno branje.

Aleš Krulec, urednik

*Krulec*

Sara Tajnikar, urednica

*Tajnikar*

# EDITORIAL

**Aleš Krulec and Sara Tajnikar**

Chamber of Sanitary Engineers of Slovenia  
Institute of Public and Environmental Health

Dear Colleagues,

It is our pleasure to present you the Abstract book of International Days of Public and Environmental Health Profession 2022. This year the International Days of Public and Environmental Health Profession were organized as part of the initiative of the World Federation of Public Health Associations, called Global Public Health Week with the theme »Public Health Matters: Building the New Future«. The initiative involved institutions, associations, and other main public health actors worldwide to present examples of best practices and fill gaps essential in preventing the spread of disease and promoting the health and well-being of each of us. The International Days of Public and Environmental Health Profession 2022 took place in Ljubljana on the 7th and 8th of April 2022.

The main purpose of the professional event was to connect participants and promote the profession of sanitary engineering. Strengthening and promotion is a future-oriented process that requires a lot of knowledge, excellence, and, above all, self-initiative of sanitary engineers in the work environment.

The event was organized by the Institute of Public and Environmental Health (*Inštitut za sanitarno inženirstvo*) and the World Association of Public Health - WFPHA.



It hosted more than 120 participants in two days. On April 7, 2022, the strategic forum called »Strengthening Public Health Associations and Communities« brought together a small group of invited representatives of representative professional associations and institutions: the representatives of the Chamber of Sanitary Engineers of Slovenia, representatives of the Institute of Public and Environmental Health, a representative of the International Environmental Health Association - IFEH, representatives of the Faculty of the Health Sciences University of Ljubljana, representatives of the Chamber of Sanitary Engineers of Croatia, the representative of the Department of Sanitary Engineering of the Medical Faculty University of Rijeka, and a representative of the section of sanitary engineering of the Trade Union of Health and Social Security of Slovenia.

The main goal of the strategic forum was to connect sanitary engineers in health and social care as well as design the strategic plan and direction of the development of sanitary engineering in the Republic of Slovenia, as well as in the wider international community. We have developed common standpoints, also short-term and long-term measures, to strengthen and promote sanitary engineering, namely:

- i) to support the section of sanitary engineers of the Syndicate of Health and Social Welfare of the Republic of Slovenia, to improve the position of all employed sanitary engineers in health and social care in the Republic of Slovenia;
- ii) to inform the general and professional public about important professional topics in the field of sanitary engineering. Consequently, encouraging sanitary engineers to actively publish general professional articles in the Slovene language and Slovene professional journals, to develop the profession of sanitary engineering from its foundations in health care;
- iii) targeted international networking with the Medical Faculty of the University of Rijeka, intending to strengthen research in the field of nosocomial infections and health hygiene;
- iv) promotion of successful sanitary engineers at the national and international level, as important actors in the role of public health experts when it comes to preventing future pandemics or other health risks.

On April 8, 2022, expert lectures on the COVID-19 pandemic followed. The lectures were held online. Contents were presented with an emphasis on the role of the sanitary engineer in preventing future pandemics. We were joined by lecturers from various fields, namely from the National Institute of Public Health, and the Health Inspectorate of the Republic of Slovenia. Office of the Republic of Slovenia for Chemicals, Faculty of Health of the University of Ljubljana, and Faculty of Medicine of the University of Ljubljana. Summaries of the lectures are presented later in this abstract book.

We would like to take this opportunity to thank all participants and lecturers for their interest in exchanging ideas, knowledge, and good practices. We are pleased to present the Book of abstracts of the International Days of Public and Environmental Health Profession 2022, which is the result of the extraordinary efforts of lecturers, and authors of abstracts – sanitary engineers (public and environmental health professionals). The publication is intended for all those who deal with the field of public health and related professional fields.

Participants of this year's International Days of Public and Environmental Health Profession, as well as all other readers of this publication who did not attend our event, are kindly invited to the next International Days of Public and Environmental Health Profession 2023.

We wish you a pleasant reading.

Aleš Krulec, editor

*Krulec*

Sara Tajnikar, editor

*Tajnikar*

# VLOGA SANITARNEGA INŽENIRJA V EPIDEMIOLOŠKI SLUŽBI MED EPIDEMIJO COVID-19 V SLOVENIJI

**An Galičič, mag. san. inž.**

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**Ključne besede:**

sanitarno  
inženirstvo, covid-19,  
epidemiološka  
služba, Slovenija

## **Povzetek**

Sanitarni inženir je zaradi svojih širokih znanj lahko profiliran na številna strokovna področja, za katera so značilne interakcije med zdravjem in okoljem. Eno izmed teh področij je tudi epidemiologija nalezljivih bolezni. Pri obvladovanju epidemije covid-19 je bil sanitarni inženir pomemben del epidemiološke službe Nacionalnega inštituta za javno zdravje (NIJZ) na nacionalni (Center za nalezljive bolezni) in regijski ravni (delovne skupine za nalezljive bolezni na območnih enotah NIJZ). Pripravljen je bil pregled nalog, vezanih na covid-19, ki so jih opravljali sanitarni inženirji na nacionalni in regijski ravni epidemiološke službe na NIJZ. Naloge so razdeljene v področja epidemiologije nalezljivih bolezni. Spremljanje covid-19: spremljanje potrjenih in prijavljenih primerov okužb, priprava statističnih analiz, avtomatiziranih in/ali interaktivnih poročil, spremljanje izbruhov v vzgojno-izobraževalnih zavodih ter okužb v domovih starejših občanov (DSO), spremljanje različic SARS-CoV-2 posebnega pomena in različic, ki jih podrobneje spremljamo in sodelovanje pri epidemiološkem spremljanju resne akutne okužbe dihal (SARI) v bolnišnicah za akutno oskrbo. Pripravljenosti in odzivanja covid-19: priprava nacionalnih priporočil za preventivno ravnanje, strokovnih navodil, navodil za posamezne sektorje (npr. vzgoja in izobraževanje) in algoritmov epidemiološke službe, vzpostavitev klicnih centrov za epidemiološko poizvedovanje in zahtevnejših podpornih sistemov epidemiološkega poizvedovanja, priprava strokovnih izhodišč za posamezne ukrepe, odzivanje na velike izbruhe na nacionalni ravni, sodelovanje v mobilni enoti za testiranje na covid-19 v sklopu predsedovanja Slovenije Svetu EU.

**Sanitarni inženirji so bili pri obvladovanju epidemije covid-19 pomemben člen epidemiološke službe NIJZ na nacionalni in regionalni ravni.**

Cepljenje proti covid-19 in neželenih učinkov po cepljenju: delo v ambulantni za cepljenje proti covid-19, spremljanje neželenih učinkov po cepljenju proti covid-19, administrativno-tehnična podpora pri Posvetovalni skupini cepljenje in pri pripravi strategije cepljenja proti covid-19, upravljanje Elektronskega registra cepljenih oseb in neželenih učinkov po cepljenju in zagotavljanje podatkov nadzornim in inšpekcijskim organom glede sumov na kršitve pogojev PCT in ponarejenih DCP. Epidemiološko poizvedovanje za covid-19, ki se je izvajal na regijski ravni: epidemiološko anketiranje oseb s potrjeno okužbo s SARS-CoV-2, epidemiološko poizvedovanje visokorizičnih kontaktov (VRK) oseb s potrjeno okužbo s SARS-CoV-2 ter napotovanje v karanteno in epidemiološko poizvedovanje ob izbruhih (npr. DSO, VIZ, podjetja) in izbruhih na množičnih dogodkih (npr. maturantski izleti) in njihovo spremljanje. Na nacionalni ravni tudi obravnava VRK nastalih v VIZ in napotovanje v karanteno. Sanitarni inženirji, ne glede na področje dela, so odgovarjali na vprašanja prebivalcev, strokovne javnosti, novinarjev, državnih inštitucij, nudili strokovno podporo klicnemu centru NIJZ, predavali in predstavljali navodila različnim javnostim, se udeleževali strokovnih srečanj na nacionalni in mednarodni ravni, intenzivno medsektorsko in medresorsko sodelovali, pripravljali sporočila za na spletno stran ter publicirali strokovne in znanstvene vsebine. Sanitarni inženirji so bili pri obvladovanju epidemije covid-19 pomemben člen epidemiološke službe NIJZ na nacionalni in regionalni ravni. Vključeni so tudi v priprave za naslednje hladnejše obdobje leta oz. morebiten pojav nove nevarnejše različice virusa, v sklopu česar sodelujejo v novo vzpostavljenem operativnem centru NIJZ za krizno upravljanje, vzpostavitvi epidemiološkega spremljanja SARS-CoV-2 v odpadnih vodah ter nadgradnji sistema spremljanja s sekvenc SARS-CoV-2 in spremljanja okužb v DSO.

# ROLE OF SANITARY ENGINEERS IN EPIDEMIOLOGICAL SERVICE DURING COVID- 19 EPIDEMIC IN SLOVENIA

**An Galičič, mag. san. inž.**

National Institute of Public Health,  
Communicable Diseases Centre

**Keywords:**

sanitary engineering,  
covid-19,  
epidemiological  
service, Slovenia

**Abstract**

Due to his extensive knowledge, a sanitary engineer can be profiled in many professional fields, which are characterized by interactions between health and environment. One of these professional fields is also the epidemiology of communicable diseases. In the control of covid-19 epidemic sanitary engineer played an important part of the epidemiological service of the National Institute of Public Health (NIJZ) at the national (Communicable Diseases Centre) and regional level (working groups on communicable diseases at NIJZ regional units). An overview of the tasks related to covid-19, which were performed by sanitary engineers at the national and regional level of the epidemiological service at the NIJZ, was prepared. The tasks are divided into fields of epidemiology of communicable diseases. Covid-19 surveillance: surveillance of confirmed and reported cases of infections, preparation of statistical analyzes, automated and/or interactive reports, monitoring of outbreaks in educational institutions and infections in long-term health care facilities (LTCH), surveillance of SARS-CoV-2 variants of concern and variants of interest and participation in the epidemiological surveillance of severe acute respiratory infections (SARI) in intensive care units. Preparedness and response covid-19: preparation of national recommendations for preventive behavior, expert instructions, instructions for individual sectors (eg. education) and algorithms of the epidemiological service, establishment of call centers for contact tracing and more demanding support systems for contact tracing, preparation of expertise for individual measures, response to major outbreaks at the national level, participation in the mobile unit for

**Sanitary engineer was an important member of the NIJZ epidemiological service at the national and regional level in the control of the covid-19 epidemic.**

testing on covid-19 within the Slovenian Presidency of the Council of the EU. Vaccination against covid-19 and adverse events following immunization: work in the ambulant of covid-19 vaccination, surveillance of adverse events following immunization, administrative and technical support to the National Immunization Technical Advisory Group and preparation of a strategy for vaccination against covid-19, the management of the Electronic register of vaccinated persons and adverse events following immunization and the provision of data to supervisory and inspection authorities on suspected breaches of PCT and falsification of DCP conditions. Contact tracing for covid-19 conducted at the regional level: epidemiological survey of persons with confirmed SARS-CoV-2 infection, contact tracing of high-risk contacts of persons with confirmed SARS-CoV-2 infection and referral to quarantine, contact tracing in the outbreaks (eg. LTCF, school settings, companies) and outbreaks at mass gatherings (eg. graduation trips) and their surveillance. At the national level, it also deals with VRK which were created in school settings and quarantine referrals. Sanitary engineers, regardless of their field of work, answered questions from residents, professionals, journalists, state institutions, provided professional support to the NIJZ call center, lectured and presented instructions to various publics, attended professional meetings at national and international level, intensive cross-sectoral and interministerial cooperation, preparing messages for the website and publishing professional and scientific papers. Sanitary engineer was an important member of the NIJZ epidemiological service at the national and regional level in the control of the covid-19 epidemic. Sanitary engineer is also involved in the preparations for the next colder period of the year or the possible emergence of a new, more dangerous variant of the virus. As part of this, we are participating in the newly established NIJZ Emergency Operations Center, establishing epidemiological surveillance of SARS-CoV-2 in wastewater and upgrading the surveillance system with SARS-CoV-2 sequences and surveillance of infections in LTCF and special social institutions.

# THE ROLE AND ACTIVITIES OF THE HEALTH INSPECTORATE OF THE REPUBLIC OF SLOVENIA (HIRS) DURING AND AFTER COVID-19 EPIDEMIC

Zora Levačič, dr. med.

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Zdravstveni inšpektorat Republike Slovenije

## Ključne besede

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tveganja

## Povzetek

Izhodišče za pripravo prispevka je predstavitev Zdravstvenega inšpektorata RS (ZIRS) in razlik v delovanju v času pred razglašeno epidemijo virusa nalezljive bolezni COVID-19 in po epidemiji. Z namenom varovanja javnega zdravja je bil kot posledica epidemiološke situacije v tem obdobju obseg izrečenih ukrepov bistveno večji kot kadarkoli prej. V članku so predstavljeni izzivi in napor, s katerimi se je inšpektorat soočal. V času, ko je bila epidemija razglašena prvič, je bil ZIRS edini inšpekcijski organ, pristojen za nadzor nad izvajanjem ukrepov po Zakonu o nalezljivih boleznih. Ker število inšpektorjev ni zadoščalo za obseg nadzora, so bili s sprejemom interventne zakonodaje za nadzor pooblaščen tudi drugi organi. Prioriteta ZIRS v zadnjih dveh letih je bil nadzor nad več kot 200 novimi oziroma tedensko spremenjenimi predpisi, izdanimi na podlagi Zakona o nalezljivih boleznih. Vladi RS je ZIRS v vlogi operativnega koordinatorja redno poročal o opravljenih nadzorih vseh 24 inšpektoratov v Sloveniji. Koordinacija izvajanja nadzora nad predpisi je bila vzpostavljena tudi v okviru Inšpekcijskega sveta. Skupno je bilo v dveh letih opravljenih skoraj 130.300 inšpekcijskih pregledov, od tega pregledov v povezavi z epidemijo skoraj 120.000. V letu 2021 se spremeni struktura ukrepov; močno prevladujejo prekrškovne sankcije, v preteklosti je bilo izrečenih več upravnih ukrepov. Skupen znesek izrečenih glob v obdobju epidemije je bil 2.895.000 EUR, od tega v povezavi s COVID-nadzori 2.202.000 EUR.

**Zaradi preventivne funkcije inšpektorata pri obveščanju javnosti je bilo ključno redno sodelovanje na tedenskih novinarskih konferencah Vlade RS, kjer se je obravnavala izključno tematika v povezavi z nalezljivo boleznijo COVID-19.**

Zaradi preventivne funkcije inšpektorata pri obveščanju javnosti je bilo ključno redno sodelovanje na tedenskih novinarskih konferencah Vlade RS, kjer se je obravnavala izključno tematika v povezavi z nalezljivo boleznijo COVID-19. Preko medijev je bila javnost redno obveščena in apeliralo se je na spoštovanje predpisov. Pripravljale so se izjave za javnost; tudi skupne izjave s Policijo. Prejeto je bilo povečano število prijav in novinarskih vprašanj, kot tudi vprašanj posameznikov, podjetij in institucij, na kar se je bil organ dolžan ažurno odzivati. Po epidemiji se je v skladu z oceno tveganja ponovno pričelo z opravljanjem rednih inšpekcijskih nadzorov tudi na drugih področjih; primarno na področju pacientovih pravic; pitne vode ter objektov in naprav za javno preskrbo s pitno vodo, splošne varnosti proizvodov, varnosti živil za posebne skupine in zdravstvene namene (dojenčki, majhni otroci, bolniki); omejevanje porabe alkohola ter omejevanje uporabe tobačnih in povezanih izdelkov



# VLOGA IN DELOVANJE ZDRAVSTVENEGA INŠPEKTORATA RS MED IN PO EPIDEMIJI COVID-19

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## **Abstract**

### **Keywords:**

epidemic, Health  
Inspectorate, COVID-  
19, inspection, risk  
assessment

The main reason for preparing this article is the presentation of the Health Inspectorate of the Republic of Slovenia (HIRS) and the differences in performance of the inspectorate in the period before the declared epidemic of the infectious disease virus COVID-19, as well as after the epidemic. In order to protect public health, as a result of the epidemiological situation during this period, the scope of the measures imposed was significantly higher than ever before. The paper introduces the challenges and efforts faced by the inspectorate. At the time the epidemic was first declared, HIRS was the only inspectorate responsible for supervising the implementation of measures under the Infectious Diseases Act. As the number of inspectors was far from sufficient for the required scope of inspections, other supervisory organs bodies were also authorized to adopt control legislation. During the last two years the priority of HIRS was the inspection of more than 200 new or weekly amended regulations issued on the basis of the Infectious Diseases Act. As an operational coordinator, HIRS regularly reported to the Government of the Republic of Slovenia on the inspections performed by all 24 inspectorates in Slovenia. The coordination of regulatory oversight was also established within the Inspection Council. In total, almost 130.300 inspections were performed in two years, almost 120.000 of which were related solely to the epidemic. . In 2021, the structure of measures changed; misdemeanor sanctions were strongly prevalent, whereas mainly administrative measures have been imposed in the past.

**Due to the preventive function of the inspectorate in informing the public, regular participation at weekly press conferences of the Government of the Republic of Slovenia in connection with the infectious disease COVID-19 was crucial.**

The total amount of fines imposed during the epidemic was EUR 2.895.000, of which the sum of EUR 2.202.000 was COVID-related. Due to the preventive function of the inspectorate in informing the public, regular participation at weekly press conferences of the Government of the Republic of Slovenia in connection with the infectious disease COVID-19 was crucial. The public was regularly informed through the media. Appeals for compliance with regulations were made, press statements were prepared as well as several joint statements with the Police. A strongly increased number of reports (mostly anonymous) and questions from journalists were received, as well as questions from individuals, companies and institutions, to which the inspectorate was obliged by law to respond promptly. Following the epidemic, in line with the risk assessment, regular inspections resumed in other areas; primarily in the field of patients' rights; drinking water and facilities for the public supply of drinking water, general product safety, food safety for special groups and health purposes (infants, young children, patients); limiting alcohol consumption and restricting the use of tobacco and related products.

# VPELJAVA POPULACIJSKIH PRISTOPOV NA PODROČJU JAVNEGA ZDRAVJA

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**Ključne besede:**

javno zdravje,  
preventiva,  
populacijski pristop

## **Povzetek**

Uvod in namen: Javno zdravje je kombinacija znanj, veščin in prepričanj, ki je usmerjena v ohranjanje in krepitev zdravja vseh prebivalcev s pomočjo skupnih oziroma družbenih aktivnosti, zaradi česar je javno zdravje multidisciplinarna stroka, ki jo opravljajo strokovnjaki različnih strok. V prispevku smo se osredotočili na dva preventivna pristopa in sicer populacijski pristop in pristop k posameznikom z visokim tveganjem. Metode: V prvem delu je bila predstavljena raziskava, ki so jo izvedli na Nacionalnem inštitutu za javno zdravje (NIJZ) in sicer »Raziskava o vplivu pandemije na življenje (SI-PANDA)«. Namen raziskave je bil pridobiti vpogled v boljše poznavanje in razumevanje vedenja ljudi v času med in po epidemiji COVID-19 v Sloveniji. Podrobnejša metodologija je dostopna na spletni strani NIJZ (<https://www.nijz.si/sl/raziskava-o-vplivu-pandemije-na-zivljenje-si-panda-20202021>). V drugem delu smo predstavili vlogo prehranskih in okoljskih dejavnikov pri tveganju za nastanek prezgodnje menopavze. Podrobnejša metodologija je predstavljena v preglednem znanstvenem članku Vičiča s sodelavci. Rezultati: Izsledki panelne spletne raziskave o vplivu pandemije na življenje (SI-PANDA) po opazovanih valovih so predstavljeni na spletni strani NIJZ (<https://www.nijz.si/sl/raziskava-o-vplivu-pandemije-na-zivljenje-si-panda-20202021>).

**V novejših epidemioloških raziskavah ugotavljajo obratno povezanost med prezgodnjo menopavzo in koncentracijo vitamina D, kalcija, cinka, selena in bakra.**

Prezgodnja menopavza je arbitrarno opredeljena kot izguba aktivnosti ovarijev pred 40. letom starosti. Prezgodnja menopavza prizadene okoli 1 % žensk med 30. in 39. letom oziroma 0,1 % žensk v starosti od 15 do 29 let. V novejših epidemioloških raziskavah ugotavljajo obratno povezanost med prezgodnjo menopavzo in koncentracijo vitamina D, kalcija, cinka, selena in bakra. Podrobnejši rezultati so predstavljeni v preglednem znanstvenem članku Vičiča s sodelavci. Zaključki: V prispevku smo opredelili pomen pridobivanja z dokazi podprtih ocen povezanosti med opazovanimi pojavi na populacijski ravni za oblikovanje in vpeljavo javnozdravstvenih ukrepov.

# PUBLIC HEALTH ACTIONS AND APPROACHES: A CASE STUDY

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## Keywords

public health,  
prevention,  
population approach

## Abstract

Introduction and aim: Public health is a combination of knowledge and skills aimed at maintaining and improving the health at population level through collective or societal action, which makes public health a multidisciplinary discipline, carried out by professionals from different disciplines. In this paper, we focus on two prevention approaches: the population approach and the approach to high-risk individuals.

Methods: In the first part, the survey "Survey on the impact of the COVID-19 pandemic on life (SI\_PANDA)" from National Institute of Public health was presented. The aim of the survey was to gain insight into better knowledge and understanding of human behavior during and after the COVID-19 pandemic in Slovenia. A more detailed methodology is available on the NIJZ website (<https://www.nijz.si/sl/raziskava-o-vplivu-pandemije-na-zivljenje-si-panda-20202021>). In the second part of the survey, we presented the role of dietary and environmental determinants as a risk factor for premature menopause. A more detailed methodology is in a scientific review article by Vičič and colleagues.

Results: The results of an online panel survey on the impact of the COVID-19 pandemic on life (SI-PANDA) after the observed waves are presented on the NIJZ website (<https://www.nijz.si/sl/raziskava-o-vplivu-pandemije-na-zivljenje-si-panda-20202021>).

**Most recent epidemiological studies have found that premature menopause and concentration of vitamin D, calcium, zinc, selenium and copper are inversely associated.**

Premature menopause is arbitrarily defined as the loss of ovarian activity before the age of 40. Premature menopause affects about 1% of women between the ages of 30 and 39, and 0.1% of women between the ages of 15 and 29. Most recent epidemiological studies have found that premature menopause and concentration of vitamin D, calcium, zinc, selenium and copper are inversely associated. More detailed results are presented in a scientific review article by Vičič and colleagues. Conclusions: In this paper, we defined the importance of obtaining evidence-based estimates of the relationship between the observed phenomena at the population level for the formulation and implementation of public health measures

# POMEN SPODBUJEVALCEV ŽELENEGA HIGIENSKEGA VEDENJA IN NJIHOVA APLIKACIJA V PRAKSI

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## **Ključne besede:**

spodbujevalci, higiena,  
varnost živil, okužbe,  
povezane z zdravstvom

## **Povzetek**

Sistemi in zakonodaja na področju higiensko občutljivih delovnih procesov so dobro razviti, vendar se tako na področju bolezni, povzročenih s hrano in okužb, povezanih z zdravstvom še vedno dogaja veliko higienskih nepravilnosti in neskladnosti. Človeški faktor, na organizacijski in izvedbeni ravni je vzrok nedopustnih odstopanj v delovnih procesih, ki se izrazijo v kritičnih razmerah. Pri tem je treba izpostaviti temeljne ovire, ki se kažejo na področju izobraževanja, usposabljanja in komunikacije. Področje uporabe orodij za spodbujanje zelenega higienskega vedenja v obratih za proizvodnjo in promet z živilom še ni tako raziskano, kot je uporaba teh orodij na ostalih področjih, njihova vpeljava je še v začetni fazi. Potrebne so dodatne raziskave, ki bi potrdile učinkovitost orodij spodbujanja v proizvodni živil. Spodbujanje (ang. Nudge) sta opredelila Thaler & Sustein (2008) kot vplivanje na človeško vedenje brez prepovedovanja katerekoli možnosti izbire in brez finančne spodbude. V skladu s to definicijo je spodbujanje lahko katerikoli dejavnik, ki vpliva na človeško vedenje. V raziskavah, ki obravnavajo spreminjanje higienskega vedenja, so uporabljena različna orodja spodbujanja (plakati, vonj po citrusih, utripajoče luči, itd.). Njihova prednost je v enostavnosti njihove uporabe in učinkovitosti pri spreminjanju vedenja oseb, ki omenjene spodbujevalce opazijo. Pri spodbujevalcih se uporabljajo že uveljavljeni psihološki pristopi. Ko se odločamo, katero vrsto spodbujevalca bomo uporabili, upoštevamo principe poenostavljanja informacij, spremembe fizičnega okolja, spremembe osnovne izbire, uporabimo pa tudi socialne norme.

**Sanitarni inženirji imamo pomembno vlogo tako na področju živilstva in zdravstva pri vzpostavitvi, obvladovanju, nadzoru in verifikaciji higienskih procesov.**

Pri aplikaciji spodbujevalcev v različne delovne procese smo ugotovili znatna izboljšanja higienskega stanja. Na primer v kuhinji doma za starejše občane je slika vbojnega termometra na delovnih mestih slaščičarja in kuharja bistveno izboljšala upoštevanje kritičnih kontrolnih točk in nadzor nad njimi. Prav tako je vonj po citrusih in napis, da vonj pozitivno vpliva na higieno rok, bistveno izboljšal izvedbo umivanja rok zaposlenih v vseh kritičnih fazah priprave živil. Izbrano orodje spodbujanja zelenega higienskega vedenja je doseglo svoj namen. Zaposleni v domu starejših občanov, ki so bili izpostavljeni sliki moških oči nad dozirniki razkužil, so bolj vestno skrbeli za umivanje in razkuževanje rok. Zaposleni na organizacijski ravni so ključni akterji pri izvajanju dela po določenih higienskih pravilih, spreminjanju ustaljenih navad in vpeljevanju inovativnega pristopa, ki se učinkovito in hitro odziva na spremembe v delovnem okolju. Na zdravstvenem področju se spodbujevalci že uspešno uporabljajo, na področju živilstva je vpeljeva orodij za spodbujanje zelenega vedenja šele v začetni fazi. V znanstveni literaturi zasledimo pobude o smiselnosti vpeljave spodbujevalcev zelenega vedenja oziroma v vpeljavi novih pristopov vedenjske motivacije zaposlenih pri delu z živili. Sanitarni inženirji imamo pomembno vlogo tako na področju živilstva in zdravstva pri vzpostavitvi, obvladovanju, nadzoru in verifikaciji higienskih procesov. Pomembno je, da so vsa tveganja najprej prepoznana in nato obvladovana, med drugim tudi človeški faktor, ki pa ga podrobneje raziskujejo družboslovne znanosti.



# THE IMPORTANCE OF NUDGING TOOLS FOR DESIRED HYGIENE BEHAVIOUR AND THEIR APPLICATION IN PRACTICE

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**Keywords:** nudging tools, hygiene, food safety, health-related infections

## **Abstract**

Systems and legislation regarding hygiene work processes are well developed, but there are still many hygiene non-compliances in both foodborne diseases and health-related infections. The human factor, at both organisational and implementation level, is the cause of unacceptable deviations in work processes, which manifest themselves in critical situations. In this context, it is important to highlight the fundamental obstacles that are manifested in the areas of education, training and communication. The use of nudging tools to promote the desired hygiene behaviour in different hygiene processes is still at an early stage of investigation and implementation. Further research is needed to confirm the effectiveness of this tools in food establishments. Nudging is defined by Thaler & Sustein (2008) as influencing human behaviour without prohibiting any choice and without financial incentive. According to this definition, nudging can be any factor that influences human behaviour. Research on hygiene behaviour change has used a variety of incentive tools (posters, citrus scent, flashing lights, etc.). Their advantage lies in their ease of use and their effectiveness in changing the behaviour of the persons who notice these incentives. Stimulants use well-established psychological approaches. When deciding which type of stimulant to use, we take into account the principles of information simplification, changes in the physical environment, changes in the underlying choice, and the use of social norms. We have found significant improvements in hygiene when applying stimulants to different work processes.

**Sanitary engineers have an important role in both the food and health sectors regarding management, control and verification of hygiene processes.**

For example, in the retirement home kitchen, the image of a thermometer in the pastry and kitchen workplace significantly improved the adherence to and control of critical control points. Similarly, the citrus smell and the sign that the smell has a positive effect on hand hygiene significantly improved the performance of hand washing of employees at all critical stages of food preparation. The tool chosen to promote the desired hygiene behaviour has achieved its purpose. Employees in the retirement home, who were exposed to the image of men's eyes over the disinfectant dispensers were more diligent about washing and disinfecting their hands. Employees at the organisational level are key players in implementing work according to defined hygiene rules, changing established habits and introducing an innovative approach that responds effectively and quickly to changes in the work environment. In the health sector, nudging tools are already being used successfully, while in the food establishments the introduction of nudging tools is still at an early stage. The scientific literature suggests that incentives for desired hygiene behaviour should be introduced or that new approaches to behavioural motivation of food handlers should be introduced. Sanitary engineers have an important role in both the food and health sectors regarding management, control and verification of hygiene processes. It is important that all risks are first identified and then managed, including the human factor, which is being studied in more detail in the social sciences.

# IZOBRAŽEVANJE IN USPOSABLJANJE NA ŠIRŠEM PODROČJU HIGIENE – IZZIVI IN PRILOŽNOSTI

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## **Ključne besede:**

higiena, javno zdravje,  
okoljsko zdravje,  
izobraževanje,  
usposabljanje

## **Povzetek**

V širok nabor ukrepov, ki jih poznamo na področju sanitarnega inženirstva med drugim sodi tudi izobraževanje in/ali usposabljanje zaposlenih, ki se pri svojem delu vključujejo v higiensko občutljive delovne procese. Na omenjenem področju se vse več pozornosti namenja vedênju zaposlenih. Izobraževanja in/ali usposabljanja, ki jih pogosto v okviru svojega rednega dela izvajajo tudi sanitarni(e) inženirji(ke), pa so ena najpogostejših aktivnost spreminjanja vedênja in navad. Predvsem tistih, ki negativno vplivajo bodisi na zdravje posameznika bodisi na zdravje sočloveka. Poleg tega v ospredje vse bolj prihaja tudi kultura delovne organizacije. Kulturo katere koli delovne organizacije oblikuje najslabše vedenje, ki ga je vodja pripravljen tolerirati. To kaže na pomen odgovornih oseb, v vlogi katerih se pogosto znajdejo tudi sanitarni inženirji in inženirke. Vsako izobraževanje ali usposabljanje je treba ustrezno načrtovati (ugotoviti potrebe, oblikovati načrt in določiti cilje ter po sami izvedbi evalvirati učinek). Kadar je cilj izobraževanja oz. usposabljanja spremeniti neko vedênje je najprej nujno treba razumeti razloge za obstoječe stanje. V okviru ugotavljanja potreb je zato ključno prepoznati kaj zaposleni (ne)razumejo, narobe razumejo ali morda mislijo, da razumejo ter kdo od zaposlenih bo ravnal pravilno in kdo ne. Ljudje imajo namreč zelo pogosto odpor do spreminjanja vedênja. Slednje med drugim izhaja tudi iz pomanjkanje zaupanja v sistem katerega del so in močno zaupanje v lastno sposobnost preprečevanja neželenih posledic. Je pa pri spreminjanju navad nato, ko poznamo razloge za obstoječe stanje, pomemben še en vidik. In sicer je posamezniku ali skupini treba ponuditi alternativo oz. mu poleg prepovedi neželenega prikazati tudi želeno vedênje.

**»Delo na področju sanitarnega inženirstva je kot borba z velikani. Ne odnehaš, ko si utrujen. Odnehaš, ko so velikani utrujeni«. To pa vsekakor velja tudi za področje izobraževanja oz. usposabljanja drugih.**

Pandemija COVID-19 in z njo povezani ukrepi so vplivali tudi na izvedbo izobraževanj in usposabljanj. Kljub temu, da so digitalne platforme omogočile številne aktivnosti, ki jih poučevanje v živo ne more in so (vsaj na prvi pogled) postale lažje dostopne, ker omogočajo vključevanje večje skupine oseb kar iz domačega naslonjača, pa podatki različnih analiz zadnjih dveh let kažejo, da se je izključno spletno poučevanje izkazalo za slabo prakso. Izkazalo pa se je tudi, da lahko kombinacija spletnega poučevanja, uporabe digitalnih orodij in tradicionalni pristop v živo prinese številne prednosti za vse vpletene (učitelje in udeležence) v kolikor je aktivnost ustrezno načrtovana. Upoštevajoč dejstvo, da imajo ljudje zelo pogosto odpor do spreminjanja vedênja to marsikoga vodi v dvom glede učinkovitosti ali celo smiselnosti izobraževanja oz. usposabljanja drugih. V primeru, da smo pri spremembi navad ciljne skupine uspešni in tako preprečimo negativne vplive na zdravje, pa to lahko celo vodi v t. i. paradoks preventive. To pomeni da uspešno izvedena aktivnost postane žrtev lastnega uspeha. Zato je delo na področju preventivne ter še posebej izobraževanja ali usposabljanja drugih možno opisati z mislijo, ki jo je kolega Rok Fink delil z občinstvom leta 2018: »Delo na področju sanitarnega inženirstva je kot borba z velikani. Ne odnehaš, ko si utrujen. Odnehaš, ko so velikani utrujeni«. To pa vsekakor velja tudi za področje izobraževanja oz. usposabljanja drugih.

# HYGIENE EDUCATION AND TRAINING - CHALLENGES AND OPPORTUNITIES

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**Ključne besede:**

hygiene, public health,  
environmental health,  
education, training

## **Abstract**

Among the many measures we are familiar with in the field of public and environmental health is also the education and/or training of employees involved in hygienically sensitive work processes. In this area, there has been a recent focus on employee behavior. Education and/or training, often provided by public and environmental health professionals as part of their regular work, is the most common behavioral and habit modification activity. Especially those that negatively affect either the health of the individual or the health of fellow human beings. Therefore, the culture of the work organization is becoming increasingly important. The culture of any work organization is shaped by the worst behavior that the supervisor is willing to tolerate. This demonstrates the importance of the people in charge, whose role often includes public and environmental health professionals. Any education or training must be well planned (identifying needs, planning and setting goals, and evaluating impact after implementation). If the goal of education or training is to change a behavior, it is first necessary to understand the reasons for it. As part of the needs assessment, it is therefore critical to determine what employees (do not) understand, misunderstand, or think they understand, and which of the employees will act correctly and which will not. People are very often reluctant to change their behavior. The latter is due, among other things, to a lack of trust in the system of which they are a part and strong confidence in their own ability to prevent undesirable consequences. However, there is another important aspect to changing habits after knowing the reasons for the existing situation.

**"Working in the field of public and environmental health is like fighting the giants. You do not give up when you are tired. You give up when the giants are tired." And that's certainly true in the field of educating and training.**

Namely, in addition to prohibiting the undesirable, the individual or group must also be offered an alternative to show them the desirable behavior. The COVID-19 pandemic interventions have also impacted education and training. Although digital platforms have enabled many activities that are not possible in live classes and have become more accessible (at least at first glance) because they allow the involvement of larger groups of people from home, data from various analyses over the past two years show that online-only teaching has proven to be poor practice. However, it has also shown that the combination of online teaching, the use of digital tools, and the traditional live approach can provide many benefits to all stakeholders (teachers and participants) if the activity is properly planned. Because people very often resist behavioral change, many doubt the effectiveness or even the usefulness of education or training. If we manage to change the behavior or habits of the target group and thus prevent negative effects on health, this can even lead to the "paradox of prevention", when an activity becomes a victim of its own success. Therefore, working in the field of prevention and especially educating and/or training of others can be described with the thought that my colleague Rok Fink shared with the audience in 2018: "Working in the field of public and environmental health is like fighting the giants. You do not give up when you are tired. You give up when the giants are tired." And that's certainly true in the field of educating and training.

# POTREBA PO RAZKUŽEVANJU SOB V NASTANITVENI DEJAVNOSTI V LUČI EPIDEMIJE COVID

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## **Ključne besede:**

SARS-CoV-2,  
razkuževanje, zdravje,  
okolje, dileme

## **Povzetek**

Decembra 2019 so na Kitajskem poročali o izbruhu akutnega respiratornega sindroma, povzročitelj katerega je virus SARS-CoV-2. V začetku marca 2020 zaznamo prvi potrjeni primer tudi v Sloveniji, 11. marca WHO razglasi pandemijo, 12. marca je razglašena epidemija na območju Slovenije. Razglasitvi epidemije sledi sprejem številnih ukrepov za obvladovanje širjenja virusa. Tudi na področju nastanitvene dejavnosti so uvedene številne omejitve. Ob prvotnih ukrepih omejitve gibanja je nastanitvena dejavnost zaprta, kasneje se s sproščanjem ukrepov odpirajo tudi nastanitvene kapacitete. Za dejavnost turizma je NIJZ v času epidemije izdal higienska priporočila za preprečevanje širjenja okužbe s SARS-CoV-2 in podrobnejša priporočila za čiščenje in razkuževanje prostorov. Oba dokumenta pred oddajo sobe gostu predvidevata obvezno razkuževanje prostorov. Obvezno upoštevanje priporočil NIJZ je opredeljeno tudi v veljavnem odloku vlade RS. Zaradi odnosa gostov do mikrobiološke varnosti ter zaradi usmeritev in zahtev uradnih institucij so nosilci nastanitvene dejavnosti močno spremenili protokole priprave sob za gosta in v proces priprave vključili tudi razkuževanje prostorov. Metode: Izveden je bil pregled objavljenih del v bazah PubMed in ScienceDirect. Dodatno so bile pregledane smernice in strokovna priporočila, ki obravnavajo razkuževanje nastanitvenih enot v času epidemije covid-19. Na podlagi zbranih podatkov smo razvili hipoteze o vplivu široke rabe razkužil na zdravje in okolje. Rezultati: Številne (predvsem in vitro) raziskave potrjujejo prisotnost virusne RNA na različnih površinah, a v nobenem primeru na teh površinah niso potrdili viabilnega virusa.

**Splošna raba razkužil v vsakdanjem življenju je v okolju izven zdravstvenih zavodov pretiran ukrep, ki ne zasleduje ciljev, zaradi katerih je bil uveden.**

Zato se poraja resno vprašanje o smiselnosti splošnega razkuževanja bivalnega okolja. Neselektivna raba razkužil vpliva na celotno mikrobioto in ne le na ciljani virus. Posledica prekomerne neselektivne rabe razkužil je tudi pojav odpornosti mikroorganizmov na razkužila, lahko tudi na antibiotike. Ob dokazih, da se odpornost bakterij lahko razvije proti številnim pogosto uporabljenim razkužilom v kliničnih in industrijskih okoljih, bi njihova prekomerna uporaba v splošni populaciji (kot posledica uporabe v trenutni epidemiji) lahko dodatno obremenila svetovno javno zdravje. Dodatno intenzivna raba razkužil povzroča suho in iritirano kožo, razvoj atopijskega dermatitisa, posledično pa lahko tudi okužbo poškodovane kože, izgubo stalne bakterijske populacije na rokah in s tem pojav prostora za razrast oportunistov, tudi patogenih. Raziskave kažejo, da se na površinah materialov, ki so pogosto izpostavljeni razkužilom, pojavijo mehanske poškodbe, zaradi katerih je v nadaljevanju razkuževanje in čiščenje poškodovanega materiala težje in manj učinkovito. Raba razkužil za nosilce dejavnosti predstavlja tudi znatno finančno breme, za gosta pa nemalokrat predstavlja t.i. občutek lažne varnosti, zaradi katerega posameznik ni več dovolj pozoren na osnovne preventivne ukrepe in ne prevzema več odgovornosti za svoje zdravje, pač pa čaka, da bodo to zanj storili drugi. Posledično so se številne hotelske verige opremile s sodobnimi tehnološkimi rešitvami za zagotavljanje čiščenja in dezinfekcije prostorov, s katerimi vplivajo na dožemanje varnosti in zmanjšanje ravni strahu pri gostu. Rezultati raziskav kažejo na številne negativne posledice prekomerne uporabe razkužil. Splošna raba razkužil v vsakdanjem življenju je v okolju izven zdravstvenih zavodov pretiran ukrep, ki ne zasleduje ciljev, zaradi katerih je bil uveden. Čas je, da začnemo pripravljati izhodno strategijo iz te pretirane previdnosti in prenehamo s široko rabo razkužil v vsakdanjem življenju.



# Room's disinfection in accommodation sector and hotel industries due to the covid epidemic

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## **Abstract**

### **Key words:**

SARS-CoV-2, disinfection, health, environment, dilemmas

Background: In December 2019, an outbreak of acute respiratory syndrome caused by SARS-CoV-2 virus was reported in China. In early March 2020, the first confirmed case was detected in Slovenia, and on March 11, WHO declared a pandemic, and on March 12, an epidemic was declared in Slovenia. As a result, a variety of different preventive measures were taken to contain the spread of the virus. Restrictions were also introduced in hotels and other accommodation facilities. During the epidemic, the Slovenian National Institute of Public Health (NIJZ) issued hygiene recommendations to prevent the spread of SARS-CoV-2 infection and more detailed recommendations for cleaning and disinfecting premises. Both documents suggest mandatory disinfection of premises. Mandatory compliance with NIJZ recommendations is also specified in the Decree of the Government of the Republic of Slovenia. Due to the requirements and guidelines of official institutions, as well as the expectations of guests regarding microbiological safety, management in accommodation facilities has significantly changed protocols for room preparation, including intensive disinfection of premises. Methods: A review of scientific papers published in PubMed and ScienceDirect was performed. In addition, guidelines and expert recommendations for disinfecting housing units during the Covid-19 epidemic were reviewed. Based on the data collected, hypotheses were made regarding the health and environmental impact of the widespread use of disinfectants.

**The widespread and generally nonselective use of disinfectants in living environment is an excessive approach in non-healthcare facilities that does not pursue the goals for which disinfection was introduced.**

Results: Numerous studies (especially in vitro) confirm the presence of viral RNA on various surfaces, but no confirmation of viable virus on these surfaces has been published in scientific literature. Therefore, there is a serious question about the usefulness of general disinfection of the living environment. Furthermore, non-selective use of disinfectants affects the entire microbiota in the environment, not only the targeted virus. Excessive and nonselective use of disinfectants also leads to the emergence of antimicrobial resistance to disinfectants, possibly including also antibiotic resistance. Because bacterial resistance can develop to many commonly used disinfectants in clinical and industrial settings, their overuse in the general population (due to their increased use in the current epidemic) could pose an additional burden to global public health. Intensive use of disinfectants can also cause dry and irritated skin and lead to the development of atopic dermatitis. Intensive use of disinfectants can also cause mechanical damage to materials, making future disinfection and cleaning more difficult and less effective. The use of disinfectants also places a significant financial burden on business operators. Disinfected rooms, on the other hand, could also make guests feel too safe and consequently they would not take all precautions to prevent the spread of SARS-CoV-2 infection seriously. Considering all this, many hotel operators have equipped their premises with modern technical solutions for cleaning and disinfection to reduce guests' anxiety. Therefore, disinfection became another marketing strategy to attract future guests. Conclusions: The results of our study show several negative consequences of the excessive use of disinfectants. The widespread and generally nonselective use of disinfectants in living environment is an excessive approach in non-healthcare facilities that does not pursue the goals for which disinfection was introduced. It is time to prepare an exit strategy from this overly precautionary approach and end the widespread use of disinfectants in everyday life.

# POTENCIAL UPORABE HLADNE PLAZME V OBVLADOVANJU BIOFILMOV

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**Ključne besede:**

bakterijski biofilmi;  
hladna plazma,  
eradikacija.

## **Povzetek**

Bakterijski biofilmi predstavljajo enega izmed največjih groženj javnemu zdravju, saj bakterije postajajo vse bolj odporne na konvencionalne protibakterijske snovi. Znanost sicer ponuja pristope, ki omogočajo eradikacijo biofilmov s površin, vendar ti načini običajno vključujejo spojine na osnovi klora, benzotiazolov in kvartarnih amonijevih spojin, ki pa imajo negativen vpliv na zdravje in okolje. V zadnjih letih se vse bolj razvijajo pristopi, ki so učinkoviti in imajo hkrati najmanjši možen vpliv na okolje. Hladna plazma s temperaturo pod 40 °C nastane s postopkom ionizacije plina in pri tem tvori reaktivne kisikove in dušikove spojine, ki imajo protimikroben učinek. Namen raziskave je bil analizirati potencial uporabe hladne plazme za obvladovanje biofilmov *E. coli*, *S. aureus* in *P. aeruginosa* na površini polietilen tereftalata. Za ta namen je bila izdelala posebna naprava za plazemski curek z drsnim oblokom. Zrele biofilme *E. coli*, *S. aureus* in *P. aeruginosa* smo izpostavljali različnim režimom hladne plazme. Po izpostavljenosti plazmi so bili biofilmi odstranjeni s površine s sonikacijo in inokulirani na selektivna gojišča. Ugotovili smo, da čas izpostavljenosti in razdalja med plazemskim curkom pomembno vpliva na učinkovitost eradikacije biofilma. Daljši čas izpostavljenosti in krajša razdalja pomeni večjo učinkovitost. Rezultati raziskave so dokazali, da lahko že pri izpostavljenosti 60 s dosežemo redukcijo log CFU ~7.

**Hladna plazma s temperaturo pod 40 °C nastane s postopkom ionizacije plina in pri tem tvori reaktivne kisikove in dušikove spojine, ki imajo protimikroben učinek.**

Hkrati smo ugotovili, da so Gram negativne bakterije E. coli in P. aeruginosa bistveno bolj občutljive na plazmo, kot Gram pozitivne bakterije S. aureus. Prednosti uporabe plazme za obvladovanje biofilmov so nizki stroški, varna uporaba, majhni vplivi na okolje, velika učinkovitost in dejstvo, da plazma ne povzroča odpornosti bakterij. Številne aplikacije uporabe hladne plazme v živilski industriji za podaljševanje roka obstojnosti živil, čistih površin v zdravstveni dejavnosti ter postopkov dezinfekcije zraka kažejo na to, da je pristop učinkovit in da bo v prihodnosti igral pomembno vlogo pri obvladovanju globalne protimikrobne krize.

# POTENTIAL OF COLD PLASMA FOR BIOFILM CONTROL

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**Key words:**

bacterial biofilms, cold plasma, eradication.

## Abstract

Bacterial biofilms pose one of the greatest threats to public health as bacteria become increasingly resistant to conventional antibacterial agents. While science offers approaches to eradicate biofilms, these methods typically involve chlorine-containing compounds, benzothiazoles, and quaternary ammonium compounds that have negative health and environmental impacts. In recent years, approaches have been developed that are effective and have a minimal environmental impact. Cold plasma with a temperature below 40°C is produced by the process of gas ionisation and forms reactive oxygen and nitrogen compounds that have antimicrobial activity. This study aimed to analyse the potential of cold plasma to control biofilms of *E. coli*, *S. aureus* and *P. aeruginosa* on polyethylene terephthalate. For this purpose, a special plasma jet device with a gliding arc was fabricated. Mature biofilms of *E. coli*, *S. aureus* and *P. aeruginosa* were exposed to different cold plasma regimes. After plasma exposure, biofilms were removed from the surface by sonication and inoculated into selective media. We found that the exposure time and the distance between plasma exposures significantly affected the efficiency of biofilm eradication. Longer exposure times and shorter distances resulted in higher efficiency. The results of the study showed that a reduction in log CFU  $\sim 7$  at 60 s can be achieved. We also found that Gram-negative bacteria *E. coli* and *P. aeruginosa* were significantly more sensitive to plasma than Gram-positive bacteria *S. aureus*.

**Cold plasma with a temperature below 40°C is produced by the process of gas ionisation and forms reactive oxygen and nitrogen compounds that have antimicrobial activity.**

The advantages of using plasma for biofilm control are low cost, safe application, low environmental impact, high efficiency, and the fact that plasma does not cause bacterial resistance. Numerous applications of the use of cold plasma in the food industry, clean surfaces in healthcare, and air disinfection show that the approach is effective and will play an important role in addressing the global antimicrobial crisis in the future.

# DOSTOPNOST NA TRGU IN UPORABA BIOCIDNIH PROIZVODOV ZA DEZINFEKCIJO

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## Povzetek

### Ključne besede:

razkužila, dovoljenje za dostopnost na trgu in uporabo, Urad RS za kemikalije, register biocidnih proizvodov

Zakon o nalezljivih boleznih dezinfekcijo oz. razkuževanje pojasni kot odstranitev in uničevanje bolezenskih klic s predmetov, snovi in okolja. Dezinfekcija je lahko mehanska, fizikalna in kemična. Za kemično dezinfekcijo se uporabljajo razkužila, ki jih uvrščamo med biocidne proizvode. Uredba o biocidnih proizvodih (Uredba (EU) št. 528/2012) ureja uporabo biocidnih proizvodov in njihovo dajanje na trg, ki se uporabljajo za zaščito ljudi, živali, materialov ali izdelkov pred škodljivimi organizmi, kot so škodljivci ali bakterije, virusi itd., z delovanjem aktivnih snovi, ki jih vsebuje biocidni proizvod. Za vse biocidne proizvode je treba pridobiti dovoljenje, preden se jih da na trg in v uporabo. Tudi aktivne snovi, ki jih biocidni proizvod vsebuje, morajo biti predhodno odobrene. Vendar obstajajo v zvezi s tem načelom nekatere izjeme: aktivne snovi, ki so še v postopku pregleda, ter biocidni proizvodi, ki te snovi vsebujejo, so lahko na trgu dostopni (v skladu z nacionalnimi predpisi) med postopkom sprejemanja končnega sklepa o odobritvi. Na trgu so dovoljeni tudi biocidni proizvodi izdani na podlagi izrednega dovoljenja in začasnega dovoljenja za proizvode z novimi aktivnimi snovmi, ki so še v postopku ocenjevanja. Izredna dovoljenja se lahko izdajo v primeru nevarnosti za javno zdravje, zdravje živali ali okolje, ki je ni mogoče obvladati z drugimi sredstvi ter kadar je sredstvo bistveno za zaščito kulturne dediščine in ni na voljo ustreznih nadomestnih možnosti.

**Na podlagi ocene tveganja se določijo pogoji za varno uporabo razkužila. Vsako odobreno razkužilo se vpiše v register biocidnih proizvodov. Register biocidnih proizvodov na trgu RS je seznam biocidnih proizvodov, za katere je bilo izdano dovoljenje.**

Podjetja morajo za razkužila, ki jih želijo tržiti, najprej pridobiti dovoljenje. Zato morajo vložiti vlogo za razkužilo, ki ga pristojni organ oceni; v Sloveniji je pristojni organ Urad RS za kemikalije. Pristojni organ oceni tveganje razkužila za varnost in zdravje ljudi, živali ali za okolje. Pri tem določi nevarnost, oceni razmerje med odmerkom (koncentracijo) in odzivom (učinkom), oceni izpostavljenost ter oceni tveganje. Na podlagi ocene tveganja se določijo pogoji za varno uporabo razkužila. Vsako odobreno razkužilo se vpiše v register biocidnih proizvodov. Register biocidnih proizvodov na trgu RS je seznam biocidnih proizvodov, za katere je bilo izdano dovoljenje. Urad RS za kemikalije pa enkrat mesečno na portalu OPSI objavi izvleček iz registra, ki vsebuje trgovsko ime, vrsto proizvoda (področje uporabe), aktivne snovi, veljavnost dovoljenja in imetnika dovoljenja. Vsako odobreno razkužilo mora biti pred dajanjem na trg in njegovo uporabo opremljeno z etiketo in z varnostnim listom v slovenskem jeziku. Sestava in vsebina etikete ter varnostnega lista je natančno predpisana in je končnemu uporabniku v pomoč pri pravilni uporabi razkužila. Uporaba odobrenega razkužila je pravilna samo v skladu z navodili navedenimi na etiketi in je ključna za učinkovito dezinfekcijo.



# MAKING AVAILABLE ON THE MARKET AND USE OF BIOCIDAL PRODUCTS FOR DISINFECTION

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**Key words:**

disinfectants, making available on the market and use, Chemicals Office of the Republic of Slovenia, register of biocidal products

**Abstract:**

Communicable Diseases Act disinfection explains as removing and destroying disease germs from objects, substances, and the environment. Disinfection is mechanical, physical, and chemical procedure. Disinfectants classified as biocidal products are used for chemical disinfection. The Biocidal Products Regulation (Regulation (EU) 528/2012) concerns the placing on the market and use of biocidal products to protect humans, animals, materials, and products against harmful organisms e.g., pests or bacteria, viruses etc., by the action of the active substances contained in the biocidal product. For all biocidal products is required an authorisation before they are placed on the market and the active substances contained in that biocidal product must be previously approved. There are, however, certain exceptions to this principle. For example, biocidal products containing active substances in the Review Programme can be made available on the market and used (subjected to national laws) pending the final decision on the approval of the active substance. Products containing new active substances that are still under assessment may also be allowed on the market where a provisional authorisation is granted. Biocidal products issued based on an exceptional authorization and a provisional authorization for products with new active substances that are still under assessment may also be allowed on the market. Derogation from the requirements permits should be issued in case of danger to public health, animal health or the environment which cannot be managed by other means and where the product is essential for the protection of cultural heritage and that no appropriate alternatives are available.

**Based on the risk assessment the conditions for the safe use of the disinfectant are determined. Each approved disinfectant shall be entered into the register of biocidal products. The Register of Biocidal Products on the Market of the Republic of Slovenia is a list of biocidal products for which a permit has been issued.**

Companies first obtain a permit for the disinfectants they want to market. They therefore apply for a disinfectant assessment by the competent authority; in Slovenia the competent authority is Chemicals Office of the Republic of Slovenia. The competent authority shall assess the risk of the disinfectant to the safety and health of humans, animals, or the environment, identifies the hazard, assess the dosage (concentration) and response (effect) relationship, and assess the exposure and risk. Based on the risk assessment the conditions for the safe use of the disinfectant are determined. Each approved disinfectant shall be entered into the register of biocidal products. The Register of Biocidal Products on the Market of the Republic of Slovenia is a list of biocidal products for which a permit has been issued. Once a month Chemicals Office of the Republic of Slovenia publishes an extract from the register on the OPSI portal which contains the trade name, product type (field of use), active substances, validity of the permit and the permit holder. Prior to placing on market in Slovenia and its use each approved disinfectant must be provided with label and safety data sheet in Slovenian language. The form and content of the label and safety data sheet are precisely prescribed, and it helps the end user to use it properly. The use of an approved disinfectant is correct only in accordance with the instructions published on the provided label and is crucial for effective disinfection.

# SPREMEMBE V KOLIČINAH IN SESTAVI ODPADKOV IZ ZDRAVSTVENE DEJAVNOSTI V ČASU PANDEMIJE

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## **Povzetek**

### **Ključne besede:**

odpadki iz zdravstvene dejavnosti, pandemija, Covid-19

Izhodišča: Zaradi količin, različnih lastnosti in vrst ter potencialnih tveganj ob neustreznem ravnanju z njimi, pomenijo odpadki iz zdravstvene dejavnosti tveganje za okolje in zdravje ljudi. Pandemija Covid-19 je ponovno močno izpostavila problematiko odpadkov, ki nastajajo v zdravstveni dejavnosti in pomen ustreznega ravnanja z njimi z vidika tveganja za prenos nalezljivih bolezni. Zaradi omenjenega tveganja pa je po drugi strani zavrla uvajanje sprememb v sisteme ravnanja z odpadki v zdravstvenem sektorju. Uvajanje konceptov trajnosti in krožnega gospodarstva v sisteme ravnanja z odpadki je ponovno obrnila v uporabo velikih količin izdelkov za enkratno uporabo ter sežigom kot najprimernejšo obliko tehnološke obdelave odpadkov iz zdravstvene dejavnosti. Že pred pandemijo je po ocenah prispeval zdravstveni sektor kar 4,4 % celotnih globalnih emisij CO<sub>2</sub>. 71% emisij izvira iz oskrbovalne verige zdravstvenega sektorja (proizvodnja, transport in poraba zdravil, kemikalij, hrane, medicinske opreme, instrumentov, materiala za enkratno uporabo itd). Metode: Pregled stanja na področju odpadkov iz zdravstvene dejavnosti smo pripravili na osnovi podatkov pridobljenih iz virov, dostopnih v podatkovnih bazah ScienceDirect in Google Scholar ter podatkov Statističnega urada Republike Slovenije. Na osnovi pridobljenih podatkov smo pripravili oceno sprememb v količinah in sestavi odpadkov iz zdravstvene dejavnosti v času pandemije Covid-19. Rezultati: Rezultati raziskave, ki jo je izvedla Svetovna zdravstvena organizacija so pokazali, da so v obdobju dveh let pandemije nastale velike količine ton dodatnih odpadkov, predvsem plastike, kar je povzročilo preobremenjenost sistemov za ravnanje z odpadki iz zdravstvene dejavnosti.

**Po podatkih Statističnega urada Republike Slovenije so se tudi v Sloveniji v letu 2020 količine odpadkov iz zdravstvene dejavnosti povečale za 4,7 %. Glede na leto 2019 se je za 30 % povečal delež nevarnih odpadkov med odpadki iz zdravstvene dejavnosti.**

Na primer, zgolj pri osebni varovalni opremi so ugotovili, da je bilo v 20 mesecih, med marcem 2020 in novembrom 2021, v zdravstvene ustanove dobavljenih 87.000 ton dodatne osebne varovalne opreme, od česar naj bi je kar 45 % porabili po nepotrebnem in je torej povzročila nepotreben porast količine odpadkov. Organizacija Healthcare Without Harm opozarja na dodaten porast količin odpadkov iz zdravstvene dejavnosti, ker so podjetja za reciklažo, zaradi strahu pred prenosom okužbe, zavračala zbiranje in obdelavo odpadkov iz zdravstvenih zavodov. Prav tako so velike količine odpadne plastike nastale ob uporabi HAq testnih setov (2.600 ton dodatnih odpadkov). 8 milijard doz cepiva pa naj bi prispevalo še k dodatnih 144.000 ton odpadkov (viale, igle, septo-boxi). Rezultati raziskave, ki jo je opravili pod okriljem organizacije United Nations Environmental Programme pa so pokazali tudi izrazit porast odpadkov, ki nastanejo v bolnišnica ob zdravstveni obravnavi bolnikov. Pred pandemijo sta nastala v povprečju 2 kilograma odpadkov na posteljo na dan, v času pandemije pa so se te količine povečale za 3,4 kilograma na dan, torej na 5,4 kilogramov. Po podatkih Statističnega urada Republike Slovenije so se tudi v Sloveniji v letu 2020 količine odpadkov iz zdravstvene dejavnosti povečale za 4,7 %. Glede na leto 2019 se je za 30 % povečal delež nevarnih odpadkov med odpadki iz zdravstvene dejavnosti. Zaključki: Rezultati raziskav izvedenih v obdobju pandemije, kažejo tako na utemeljen, kot tudi neutemeljen porast količin odpadkov iz zdravstvene dejavnosti v tem obdobju, predvsem pa na povratek k uporabi izdelkov za enkratno uporabo. Morda lahko povratek za 20 let v preteklost in vreče popolnoma „pre“mešanih odpadkov, ki jih nato v velikem deležu neutemeljeno obravnavamo kot infektivne, omogočijo izhodišče za postavitve učinkovitejšega sistema ravnanja z odpadki iz zdravstvene dejavnosti v prihodnje?

# Changes in the quantities and composition of healthcare waste during the pandemic

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**Key words:**

healthcare waste,  
pandemic, Covid-19

## **Abstract**

Background: Due to quantities, different characteristics and species, and potential risks as a consequence of inadequate management, healthcare waste poses a risk to the environment and human health. The Covid-19 pandemic has once again strongly highlighted the problem of waste arising from health activities and the importance of proper management of waste in terms of the risk of transmission of infectious diseases. On the other hand, it has stopped the introduction of changes to waste management systems in the health sector. The introduction of sustainability and the circular economy concepts into waste management systems has once again turned into the use of large quantities of single-use products and incineration as the most appropriate form of technological treatment of healthcare waste. Even before the pandemic, the health sector estimated as the source of 4.4% of total global CO<sub>2</sub> emissions. 71% of emissions come from the supply chain of the health sector (production, transport and consumption of medicines, chemicals, food, medical equipment, instruments, disposable materials, etc.). Methods: The healthcare waste overview was prepared based on data obtained from sources available in ScienceDirect and Google Scholar databases and data from the Statistical Office of the Republic of Slovenia. Based on the data obtained, an assessment of changes in the quantities and composition of healthcare waste during the Covid-19 pandemic was prepared.

**According to data from the Statistical Office of the Republic of Slovenia, in 2020 the amount of waste from health activities increased by 4.7 %. Compared to 2019 the share of hazardous waste among waste from health activities increased by 30 %.**

Results: The results of a study carried out by the World Health Organization showed that large quantities of tons of additional waste, mainly plastics, occurred over a period of two years of pandemics, leading to overloading of healthcare waste management systems. For example, in the case of personal protective equipment alone, they found out that in the 20 months, between March 2020 and November 2021, 87,000 tons of additional personal protective equipment were delivered to healthcare facilities, of which as much as 45% were spent unnecessarily and thus led to an unnecessary increase in the amount of waste. At the same time, organization Healthcare Without Harm points to a further increase in the amounts of healthcare waste, as recycling companies have refused to collect and process waste from health facilities for fear of spreading the infection. Also, large quantities of waste plastic were generated using HA<sub>g</sub> test sets (2,600 tons of additional waste). 8 billion doses of the vaccine are expected to contribute an additional 144,000 tons of waste (vials, needles, septo-boxes). The United Nations Environmental Programs survey showed a marked increase in healthcare waste in hospitals. Before the pandemic, in hospitals was produced an average of 2 kilograms of waste per bed per day, and during the pandemic, these amounts increased by 3.4 kilograms per day, i.e. to 5.4 kilograms. According to data from the Statistical Office of the Republic of Slovenia, in 2020 the amount of waste from health activities increased by 4.7 %. Compared to 2019 the share of hazardous waste among waste from health activities increased by 30 %. Conclusions: The results of the surveys carried out during the pandemic period point out both, justified and unjustified increase in the amount of healthcare waste, and in particular the return to the use of single-use products. Perhaps a return of 20 years to the past and bags of completely mixed waste, which is then treated as infective in a large proportion, can provide a starting point for the design of a more efficient health waste management system in the future?

# NAD+ in COVID-19

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## **Ključne besede:**

SARS-CoV-2,  
NAD+,  
imunski odziv,  
prekurzorji

## **Povzetek**

Izhodišča: Molekula nikotinamid adenin dinukleotid-a (NAD+) je pomembna za tvorbo ATP, saj sodeluje kot redoks koencim pri prenosu elektronov med oksidacijsko-redukcijskimi reakcijami v mitohondrijih. Poleg tega NAD+ sodeluje v več kot 500 encimskih reakcijah in je vključen v številne signalne poti, kot so na primer DNK popravljalni mehanizmi, apoptoza, imunski odzivi na virusne okužbe, genomska signalizacija, endokrina signalizacija, proces staranja, proliferacija, vnetja, obramba pred patogenimi organizmi, delovanje mitohondrijev, homeostaza lipidov in glukoze ter drugo. Poleg tega je NAD+ vključen v regulacijo imunskega odziva pri virusnih okužbah in ima obetaven terapevtski potencial za zdravljenje koronavirusne bolezni (COVID-19). Metode: Izveden je bil pregled objavljenih del v bazah PubMed in ScienceDirect. Rezultati: V celicah človeškega telesa se koncentracija NAD+ s starostjo zmanjšuje. Več kot 80 % hospitaliziranih bolnikov s COVID-19 je starejših od 65 let in ti bolniki imajo večje tveganje za smrt, kot mlajša populacija obolelih. Dokazi kažejo, da nižje ravni NAD+ v pljučnem in žilnem endoteliju prispevajo k slabim izidom COVID-19. Na metabolizem NAD+ vplivajo isti dejavniki tveganja, kot za slabši potek COVID-19: starost, sladkorna bolezen, debelost in hipertenzija. Tudi sama okužba s SARS-CoV-2 povzroči upad znotraj celičnega NAD+. Tako prirojeni imunski sistem kot virus se borita za razpoložljivost celičnega NAD+. Obnovitev ravni NAD+ bi lahko zmanjšala resnost imunskega odziva telesa na okužbo in izboljšala stanje hospitaliziranih bolnikov s COVID-19.

**Dokazi kažejo, da nižje ravni NAD+ v pljučnem in žilnem endoteliju prispevajo k slabim izidom COVID-19.**

Zaključki: Intervencije, ki zvišajo znotraj celične ravni NAD+ z dodatkom NAD+ prekurzorjev spodbujajo protivirusno obrambo in zavirajo nenadzorovano vnetje. NAD+ se pri sesalcih sintetizira iz prekurzorjev triptofana, nikotinske kisline (piridin-3karboksilna kislina), nikotinamida (amid nikotinske kisline), nikotinamid mononukleotida (NMN) in nikotinamid ribozida (NR). Farmakološka obnova NAD+ je trenutno v fazi intenzivnih preiskav. Pristopi vključujejo nadomestne terapije NAD+ s prekurzorji, kot so prej omenjeni NR, NMN in NA, ali z zaviranjem delovanja poli-ADP-riboze polimeraze (PARP) in zaviralcev CD 38, ki porabljajo NAD+. Za razumevanje mehanizmov imunskega odziva pri SARS-CoV-2 so potrebne nadaljnje študije. Prihodnje klinične raziskave je potrebno usmeriti v iskanje ustreznega in učinkovitega odmerka prekurzorjev NAD+.



# NAD<sup>+</sup> and COVID-19

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**Key words:**

SARS-CoV-2,  
NAD<sup>+</sup>,  
immune response,  
precursors

## Abstract

Introduction: The nicotinamide adenine dinucleotide molecule (NAD<sup>+</sup>) is important as a redox coenzyme in electron transfer during oxidation-reduction reactions to generate ATP and as a cofactor for NAD<sup>+</sup>-dependent enzymes. In addition, NAD<sup>+</sup> is required for more than 500 enzymatic reactions and is involved in numerous signaling pathways, including DNA repair, apoptosis, immune responses to viral infections, genomic signaling, endocrine signaling, senescence, proliferation, inflammation, pathogen defense, mitochondrial function, lipid and glucose homeostasis. In addition, NAD<sup>+</sup> is an emerging regulator of immune responses in viral infections and may be a promising therapeutic target for coronavirus disease (COVID-19). Methods: A review of published works in PubMed and ScienceDirect databases was performed. Results: Levels of NAD naturally decrease with age. More than 80% of hospitalized COVID-19 patients are over 65 years of age and have a significantly higher risk of death. Evidence suggests that lower NAD<sup>+</sup> levels in the lung and vascular endothelium contribute to poor COVID-19 outcomes. Nicotinamide adenine dinucleotide metabolism (NAD) is disrupted by COVID-19 risk factors such as age, diabetes, obesity, and hypertension, and SARS-CoV-2 infection itself can cause disruptions in the NAD pathway. Both the innate immune system and the virus fight for cellular NAD<sup>+</sup> availability. Restoring NAD<sup>+</sup> levels could reduce the severity of the body's immune response to infection to improve the condition of COVID-19 patients. Conclusions: Interventions that increase NAD<sup>+</sup> levels through NAD<sup>+</sup> supplementation could promote antiviral defense and suppress uncontrolled inflammation.

**Evidence suggests that lower NAD<sup>+</sup> levels in the lung and vascular endothelium contribute to poor COVID-19 outcomes.**

NAD<sup>+</sup> is synthesized in mammals from precursors: Tryptophan, nicotinic acid (pyridine-3-carboxylic acid), nicotinamide (nicotinic acid amide), nicotinamide mononucleotide (NMN), and nicotinamide riboside (NR). Several NAD<sup>+</sup>-enhancing compounds and molecules targeting NAD<sup>+</sup>-producing or -consuming enzymes are in clinical development as potential anti-inflammatory or antiviral drugs. Pharmacological restoration of NAD<sup>+</sup> is currently under intense investigation. Approaches include i) NAD<sup>+</sup> replacement therapies with NAD<sup>+</sup> precursors such as NR, NMN and NA or disruption of NAD<sup>+</sup> utilization through the use of poly-ADP-ribose polymerase (PARP) and CD 38 -inhibitors. Future studies are needed to understand the mechanisms of immune response in SARS-CoV-2. Future clinical studies should be conducted to determine the proper effective dose of NAD<sup>+</sup> boosters and duration of treatment needed to prevent aging and treat certain diseases.

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