

# ROLE OF SANITARY ENGINEERS IN PREVENTION OF COVID-19 PANDEMIC

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**Abstract:** Among the most emphasized consequences of pandemic COVID-19 influence is a negative trend of economic development and lock down of many production companies.

One of areas where sanitary engineers can be engaged is drinking water safety and safety of wastewater. The new situation requires the change of actual teaching content during the teaching process of sanitary engineers, with the purpose of their training for inclusion in activities on prevention of virus spreading and controlling subjects in charge of people health protection, food safety and protection of living environment.

It is very important that higher school institution authorities become familiar with knowledge gaps, potential implications on food, water and environment safety, research direction and other issues related to virus control, among which is also SARS–COV-2.

The aim of this work is to encourage wider discussion on promotion of the actual study programs on higher institutions in Bosnia and Herzegovina and neighbouring countries as well as development of content proposals, which can lead to knowledge promotion, and competence of graduated students.

During the recent discussion, we came to conclusion that it is necessary to develop studies, which have multidisciplinary approach, including the area of public health system, quality, food safety, environment protection and administrative law.

Apart from that, students should obtain the necessary knowledge level in area of organization, management and economy, and with the purpose of enabling continuous production and income creation. We should also develop student research capabilities.

**Key words:** sanitary engineering, Covid-19, food safety.

**JEL classification:** I2, Q020.

## INTRODUCTION

Appearance of Covid-19 infection in China at the beginning of 2020 lead to pandemic, which was a big concern for the public health in the whole world for the World Health Association (WHO) (Wen et al., 2020.). The current research has proved the virus has many different forms, different incubation period and can affect people's health in many different ways. Virus Covid-19 is resistant to external factors, easily penetrates into human body and can be lethal. Medical intervention is required for recovery of infected patient (Shen et al., 2020.). For this reason, it is very important to stop further virus spreading in public places (Morse et al., 2020.). Application of adequate measures for virus prevention in places where larger number of people are present is only possible with the full understanding of transmission mechanism and virus sustainability.

As there are not space limits for its spreading, pandemic Covid-19, caused by coronavirus SARS-CoV-2, affects all areas of human life. Covid-19 has big influence on global economy and for this reason; companies in the whole world go through difficult times. Some branches of economy require prioritized measures and help in order to survive.

Regardless to declared emergency situation because of Covid-19 pandemic, people still must function. They need material things, including food. In regards to this, agriculture, food processing industry, distribution and food trade have become prioritized economy branches (Genkin et al., 2020.). There is a big concern in the world that pandemic will lead to long lasting crisis in area of food processing industry (Fei et al., 2020.). Functioning of companies in the above-mentioned sector is crucial for unobstructed food supply for citizens. There are huge negative consequences of Covid-19 in tourism and gastronomy (Hao et al., 2020; Kaushal et al., 2020). Baek et al. (2020) claim that the highest negative effect of pandemic suffered production of oil and natural gas, restaurants and hotels, while production of food and drinks was not affected it such an extent.

Covid-19 has significant impacts on stability in financial sector (Baek, 2020; Heyden, 2020; Liu et al., 2020; Zaremba et al., 2020; Zhang et al., 2020.).

American association of food industry assumes that health system, chain of food supply, food safety, employment services, media and services for acting in emergencies, should get together and offer help for endangered economy sectors (Mayurnikova et al., 2020). In February 2020 Russian service, in charge of consumer protection, developed recommendations with measures for prevention of corona virus infection in food and drink establishments, food storages and educational institutions. (Dolgov and Savinov, 2020); (Mayurnikova et al., 2020.). Companies and institutions developed additional measures for Covid-19 prevention. Mayurnikova et al. (2020). have proposed the practical measures for prevention of pandemic in gastronomy.

Pandemic Covid-19 continually affects changes of education system (Bond et al., 2020.), including higher education too. The new situation influenced the change of environment (place) and the way of performing lessons. Students and teachers are looking for other types of teaching process, while state institutions check on the current systems and processes (Self, 2020.). Changes under pressure in emergency are stressfully for all participants.

Consequences of Covid-19 pandemic are present in all areas of society, including economy, health system and education. It is evident that we need adequate competent people to fight against it. Health – sanitary experts and sanitary engineers have their special place in it, both during preventive activities and in the process of elimination. Their education requires special attention and requires from the higher institutions content that will enable promotion of knowledge and competencies for graduated students. We should encourage promotion of the current study programs at higher education institutions in Republic of Srpska, Bosnia & Herzegovina and surrounding countries through the wide discussions and show that qualitative engineer education can be achieved during big disasters, as Covid -19 pandemic is.

## **MATERIALS AND METHODS**

Methodology procedures in work are based on the previous research in this area and it is available in scientific publications, studies and the other relevant sources published on this topic. During the development of this work, different sources are used: scientific publications, (works published in leading world journals), official regulations, instructions and recommendations of international organizations (WHO) and national authorities, expert bodies and agencies, company's documentation. The following methods, as some of famous and approved research methods from scientific research part for the needs of this work, are used: method of theoretical analysis, method of descriptive analysis of research in collecting, processing and data comparison.

## RESULTS AND DISCUSSION

### TEACHING DURING PANDEMIC

In the beginning of 2020, education system in most of the countries was threatened by Covid-19 pandemic. In such circumstances, the higher education was exposed to new challenge: it was necessary to maintain teaching process without physical presence of students in classrooms and laboratories, without gatherings of bigger groups of students, with strict compliance of hygienic measures (wearing masks and disinfection of hands) (Self, 2020.). The higher school institutions (higher school institutions) had no sufficient amount of time or none at all to plan and develop new procedures for teaching process. Regardless of this, teachers and students had innovative approach. Teachers used flexibility in just adopted regulations and support of modern technology equipment to offer their students interesting content (Iveland et al., 2020.).

For students of health sciences, the special problem is incapability of organizing practical lessons in health institutions, institutions and factories. State authorities in conjunction with recommendations of World Health Organization, developed instructions for conduct and work in educational institutions, including higher school institutions. Such drastical changes in planning, organization and realization of teaching process have not been seen before. The solution to maintaining teaching process was found in so called „on-line teaching“, which has been known and realized with some study programs that not require work in laboratories and practical lessons, which is a dominant type of teaching at both of faculties of health sciences and medical faculties of natural-technical science. The new approach requires change in attitude of students and teachers. It requires from a teacher to convey their creativity from classroom-laboratory to online teaching.

Measures taken under urgent procedures and applied during summer semester of academic 2019/20 are necessary to be carefully analysed and adapt to teaching process in 2020/21. New academic year will still be challenging. The Ministry for technology development, higher education and computer science of Republic of Srpska (Ministarstvo, 2020a.) has given the new recommendation for teaching. In accordance with classic model, with proposed alternative to have on-line lessons, in case if health–epidemiology situation should be requiring it. For the beginning of teaching in academic 2020/21 year, The Ministry for technology development, higher education and computer science of Republic of Srpska (Ministarstvo, 2020b.) has given the new recommendation. There has been given option of using different environment during teaching process (known as hybrid model, where is allowed that certain number of students is attending lessons in classroom while the others on-line). It is difficult to estimate if it is going to come to termination of teaching process and when and for how many times. Regardless of it, higher education institutions should come up with backup plans and foresee innovative and flexible system of transition from one to another way of teaching process. In order to show insight and guidelines on how to maintain high quality of education during Covid-19 pandemic, Academy of science, engineering and medicine of the USA (Self, 2020.) expressed its attitude in regards to it in their book „Teaching K-12 Science and Engineering During a Crisis“. Some of directives are very acceptable in case of academic education of health-sanitary engineers and authors cited suggestion given in this book for many times.

In the new situation, it is not acceptable to omit the bigger units and content specific for vocational profile. Moreover, it is necessary that process have emphasis of scientific approach, by which vision of quality education of health-sanitary engineers must not change. The professional community and lay people can easily understand and critically analyse every procedure of sanitary experts during pandemic. Higher education institutions should accept that as axiom and put additional effort during education of engineers.

At School for Applied Medical Sciences in Prijedor, the beginning of teaching process in summer semester in academic 2019/20 was classical and did not differ much from teaching in other academic years. However, in the beginning of March in Republic of Srpska emergency situation was in power because of Covid-19 pandemic, which reflected on the further continuation of teaching process. Since that moment, the teaching was organized on-line. Some other problems emerged as inexperience of some teachers and lack of computer equipment. The problems were addressed as the teaching went along and after 2-3 weeks, theory teaching was maintained without any bigger issues. Practical lessons (the work in laboratories) were done in the end of semester, and on the basis of certain instruction of The Ministry for technology development, higher education and computer science of Republic of Srpska (Ministarstvo, 2020a.) The other types of practical lessons (work in hospitals, health institutions and factories) were realized by extreme creativity and efforts of teachers and students and by using modern technology.

The acquired experience should be used for organizing teaching in new school year, which is the aim of this work.

### **ANALYSIS OF TEACHING CONTENT**

Covid-19 pandemic, apart from teaching process, also endangered functioning of economy system in the whole world and Republic of Srpska and Bosnia and Herzegovina were not exemption. Moreover, pandemic has pointed out importance of hygiene, sanitation and disinfection in all areas of human activity and life in general. In the other words, it was additionally emphasized importance of experts in that area (sanitary engineers and experts from associated areas). As there was rise in pandemic so the proportionally there was the higher demand for sanitary professionals in area of public health system, food security in the whole chain of supply, life environment and work environment etc. The emphasis should be on the knowledge of sanitary engineers in public services for disinfection, health institutions, state institutions, educational institutions, production companies etc. Sanitary engineers have important role in development of sanitary protection plans and in system of control and supervision in conducting sanitary measures as a whole.

If we look at scope of work done by sanitary engineers, as before in “normal times“, and now during Covid-19 pandemic and in the future, it is clear that they have to possess the high level of knowledge in different areas. The questions, which arise, are related with the way of their education and their ability to respond to different demands during emergencies, like pandemic.

### **OVERVIEW OF EXISTING HIGHER SCHOOL INSTITUTIONS**

In Table 1. there is an overview of higher school institutions in Bosnia and Herzegovina which educate staff of above mentioned profile. As we can see, there are different levels (180 ECTS, 240 ECTS and 300 ECTS) and types of education (academic and vocational). Further, on, we can see that number of higher school institutions is relatively high and we assume that number of graduates can satisfy the needs either in «normal times» or during emergencies or pandemic.

Analysis, which is dealing with the amount of knowledge that students acquire during education, demand deeper and profound analysis. During overview, we can notice that most of higher school institutions study program content of sanitary engineering (or similar titles and acquired academic/vocational titles after graduation) cover four key areas: public health, protection of life environment, food safety, regulations and administrative law. Out of all mentioned areas, the students have at their disposal more subjects that are updated during vertical education.

**Table 1.** Overview of higher school institutions in Bosnia and Herzegovina, which educate sanitary engineers

Higher school institutions		240 ECTS	180 ECTS
BOSNIA AND HERZEGOVINA			
PUBLIC INSTITUTIONS		PRIVATE INSTITUTIONS	
1	School of applied medical sciences Prijedor	+	+
2	University of Banja Luka, Faculty of medicine	+	
3	University of Sarajevo, Faculty of health studies	+	
4	University Bihać, Faculty of health studies	+	
5	University of Tuzla, Medical faculty, Department of health studies		
6	School of applied medical sciences Doboj		+
7	University of Mostar, Faculty of health studies		+
8	Pan-European university Apeiron <b>Banja Luka</b> , Faculty of health sciences	+	+
9	University of Vitez, Faculty of health studies	+	+
10	European University Brčko Faculty of health sciences	+	+

### TEACHING CONTENT CHANGES

Although curriculum and syllabus ensure sufficient amount of knowledge during classical teaching in a classroom/laboratory, it is necessary to analyse their quality during teaching process in emergency circumstances (on-line teaching). We must keep in mind that emergency situation (so Covid-19 pandemic) demands from sanitary engineers additional knowledge and skills. Knowledge: new knowledge in microbiology, especially in virusology, familiarization with the Corona virus, nature, behaviour, ways of transmission, consequences for people. New knowledge in area of personal and collective protection, measures for prevention of Corona virus transmission and spreading disease. New skills in area of decontamination (washing and disinfection, equipment and measures), handling of personal and collective protection means. New knowledge and skills through methods for defining presence of Corona virus in human body and equipment (PCR and ELISA tests).

The need for quick inclusion in business, from newly graduated students, requires the certain level of experience. High school institutions should analyse certain subjects from teaching content and change it in accordance with the needs. What are these subjects? What are the contents? Do the high school institutions have infrastructure needed for realization of the new content? Are the teachers trained to perform theoretical and practical teaching with new content? Do students experience additional burden with new classes, new content or it is necessary just to omit and replace the certain content? These are just some of questions, which superiors at high school institutions should analyse during promotion of teaching of study program of sanitary engineering and similar programs.

In order to have efficient teaching in emergency situation, during the change of teaching plans and programs, we should adhere to certain principles which refer to quality of education and demands of education. We should also pay attention to demands of achieving high level of students knowledge, interdisciplinary and multidisciplinary approach to knowledge from different areas of sanitary engineering. The knowledge from basic sanitary-health disciplines should be combined with engineer practice and other social standards and state standards. It would be good if teachers, during their classes, could use their sci-

entific approach in solving problems (for example, planning of researches and analysis of obtained data). In the end, one of principles can refer to possibility of adapting to changeable surrounding (place where teaching takes place).

The large number of applications for online teaching support is available. Many applications offer support to research approach, including discussion between teacher and students and within the students in the group. By choosing the application for support of teaching process, we should stick to teaching process objectives and choose application that can offer the best support to students. Quality education should be in focus in each moment (Branch and Dousay, 2015.). Some tools can animate students to thinking and communicating during learning, (Moulding and associates, 2019.). There is a large number of softwares for support of teaching. Teachers should take care that new requests for teaching software could cause student disaffection. It is desirable to include video presentations in teaching contents. Many students do not have access to computers or internet, which aggravates communication with teacher and fellow colleagues. High school institutions and teachers should plan how to enable students to have access to teaching resources. World experience shows that it is useful to offer teaching material out of existing net of high school institutions (World Bank, 2020.). In similar situations, the using of mobile telephones enables access to teaching content. More information about resources, which serve for support in online teaching, can be seen on sites of appropriate agencies (SETDA, 2020).

No matter how hard were the efforts of the authorities, state organs, high school institutions, teachers and students, during the teaching process in conditions in Covid-19 pandemic, there can be various issues. Quite often, teachers need to reduce the amount of teaching materials which they present to students, while they still include all teaching materials anticipated for the given course. Sometimes teachers need to change teaching materials in accordance with technology limitations and student needs. The changes can be made in each lesson, using resources, which are used for teaching, or resources from work environment. (Self, 2020.). Many teachers change their teaching materials on their own. Although the mentioned changes are happening very fast, it is important to ensure that materials still keep focus on good principles of teaching process. If it is necessary, from the above-mentioned reasons, to change volume or sequence of teaching materials, it is very important that students do not get in trouble during learning and taking exams. In order to use the most efficiently the teaching process, teachers can obtain a certain level of help with careful analysis and answers to the following questions (Self, 2020.):

- How to organize lessons in order to be focused on the principal needs of students?
- How can students achieve more learning aims simultaneously?
- In which way can be ensured coordination within a group or more groups of students?
- How can students participate in disciplines that are more academic at the same time, and can they?
- Can accommodation of students in dormitories or other community types of accommodation be helpful in solving the problems?

Development of teaching materials is a very complicated process and it involves teams of experts for development of syllabus and curriculum and teachers of given subjects. The change of teaching contents at high school institutions, in case of emergency situations, is quite often done by subject teachers, and changes are approved by experts for teaching content and authorities of high school institutions (for example, Senate). Management of high school institutions and Senate give guidelines for change of content. The size and type of changes, as having been said, depend on resources, which are at disposal to teachers and students (Self, 2020.). It is necessary to accept the real condition in internet access opportunities for all the students and ensure that all students have equal access to teaching. The listed changes should provide sup-

port to students with disabilities. The changes should follow development of computer and communication infrastructure, training of teachers and technical support staff for development and presentation of new content. There is a pending research on this topic which is conducted by EdTrust and Digital Promise (2020).

The difference between the usual forms is that every academic part is taught independently from other disciplines, in emergency, using possible content overlapping in two or more disciplines (teaching subjects), it is desirable to ensure the high level of coordination of teaching between subjects. Discrete content, which is useful only in one area of work, should be changed with focus on knowledge widely applicable. During the change of teaching content, it is desirable to use the precognition, which students have. If the changes of teaching content are done in an unprofessional way, the lack of time can leave numerous voids in students' knowledge. In order to ensure students' knowledge, high school institutions and teachers should ensure coordination of content volume and sequence in the total teaching content that student need to get in emergency situation during Covid-19 pandemic.

## CONCLUSION

Consequences of Covid-19 pandemic are present in all areas of society, including economy, health system and education. In our effort to eliminate disease consequences expert staff –sanitary engineers are included. In Bosnia and Herzegovina and Republic of Srpska there is a larger number of high school institutions that educate professionals of this profile. In order to enable graduated students to respond to needs of society and economy in emergency, they are required to acquire additional specific knowledge and it has to be included in their teaching process.

Pandemic Covid-19 affects the work of high school institutions and way of performing teaching. Taking into account difficulties in classical system of teaching process, high school institutions resorted to online teaching. Apart from the way of performing the teaching, the new situation requires the certain changes in volume and content of teaching subjects. Higher school institutions should abide by accepted principles and keep the high level of teaching quality. With careful and good balanced changes of curriculum and syllabus, higher school institutions is to respond to requirements of times they are working in, the student will get high level of knowledge and skills, and society and economy will get necessary professional experts.

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