

Reorganization of the working process in Ljubljana Maternity Hospital during SARS-CoV-2 pandemic

Reorganizacija dela v Porodnišnici Ljubljana v času izrednih razmer zaradi pandemije virusa SARS-CoV-2

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Abstract

In December 2019, a new strain of coronavirus SARS-CoV-2 that causes COVID-19 appeared in Wuhan, China. The signs and symptoms of COVID-19 include cough, dyspnea, fever and muscle aches, as well as loss of taste and smell. Experience from the outbreaks of other human coronaviruses (Severe Acute Respiratory Syndrome Coronavirus - SARS-CoV and Middle East Respiratory Syndrome Coronavirus - MERS-CoV) places pregnant women and their fetuses at high risk for severe form of the disease, but surprisingly according to the current knowledge pregnant women are not at risk for severe COVID-19. In March 2020 a global pandemic was declared, and strict measures had to be undertaken in order to limit the spread of the virus. As a result, all aspects of life have changed dramatically. The working process in hospitals had to be strongly adapted to the existing situation. After the announcement of the SARS-CoV-2 pandemic, Ljubljana Maternity Hospital developed clinical guidelines for the treatment of pregnant and laboring women during the pandemic. Due to the nature of the work, the scope of activities could not be significantly reduced, so we had to prepare for the admission of potentially or confirmed SARS-CoV-2-positive pregnant women in an extremely short time. The maternity ward was divided into three zones: the white zone for healthy pregnant women, the grey zone for pregnant women with suspected but not yet confirmed SARS-CoV-2 infection, and the red zone, where we treated SARS-CoV-2 positive pregnant women. Until the end of May 2020, two SARS-CoV-2 positive women and 3 women who had had SARS-CoV-2 during pregnancy, but were already negative, gave birth. None of them had severe symptoms of COVID-19, and no intensive therapy was required.

Izvleček

Decembra 2019 se je v Wuhanu na Kitajskem pojavil novi sev koronavirusa SARS-CoV-2, ki povzroča bolezen covid-19. Ta se kaže s simptomi in znaki prizadetosti zgornjih dihal: s kašljem, dispnejo, povišano telesno temperaturo, prisotne pa so lahko bolečine v mišicah, prebavne težave, izguba vonja in okusa. Znanje, pridobljeno na podlagi izbruhov ostalih človeških koronavirusov (*angl.* Severe Acute Respiratory Syndrome Coronavirus - SARS-CoV in Middle East Respiratory Syndrome Coronavirus - MERS-CoV), uvršča nosečnice in njihove plodove v ranljivo skupino, vendar pa trenutno velja, da nosečnice niso bolj ogrožene za težak potek bolezni covid-19. Po razglasitvi pandemije so sledili ostri ukrepi, katerih cilj je bil omejiti širjenje virusa. Zato se je življenje na vseh področjih korenito spremenilo. Tudi delovanje bolnišnic se je moralo prilagoditi na obstoječe razmere. V Porodnišnici Ljubljana smo se po razglasitvi pandemije covid-19 zavedali, da bo treba za optimalno oskrbo vseh nosečnic oblikovati smernice oz. kliničnih poti za vse zaposlene. Zaradi narave dela obsega dejavnosti ni bilo mogoče bistveno zmanjšati, zato smo se

na sprejem morebitno ali potrjeno okuženih nosečnic morali pripraviti v izjemno kratkem času. Porodnišnico smo razdelili na tri območja po zgledu urgentnega bloka Univerzitetnega kliničnega centra Ljubljana: belo območje za zdrave nosečnice, sivo območje za nosečnice, pri katerih smo sumili na okužbo s SARS-CoV-2, vendar ta še ni bila potrjena, in rdeče območje, kjer smo obravnavali dokazano pozitivne nosečnice. Do konca maja 2020 sta v Ljubljanski porodnišnici rodili dve porodnici z dokazano okužbo z virusom SARS-CoV-2 in tri porodnice po preboleli okužbi z virusom SARS-CoV-2. Nobena od njih ni imela hujših simptomov bolezni covid-19, zato tudi intenzivno zdravljenje ni bilo potrebno.

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1 Introduction

This article was written during the first wave of the SARS-CoV-2 pandemic. It presents the adjustments that were implemented in the period between March and May 2020 and does not fully reflect the current conditions at the Ljubljana Maternity Hospital. The clinical pathway is constantly changing according to the conditions and national and international recommendations.

In December 2019 a new strain of coronavirus appeared in China. The viruses from this group cause diseases of the upper respiratory tract, as well as the severe acute respiratory syndrome, which gives the virus its name Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV). SARS-CoV-2 is transmitted from person to person via droplets, which requires a close contact with an infected person, it can also be transmitted indirectly through infested surfaces or objects (1). The virus is highly contagious. One infected person on average infects 2.5 healthy people. It causes the COVID-19 disease, symptoms of which include fever, cough, muscle pain, dyspnea, headache, loss of smell and taste, diarrhea (2). In just a few months, the SARS-CoV-2 virus has spread across the globe, and the

World Health Organization declared the global pandemic on March 11th 2020 (3). By the end of May 2020, more than 5.5 million people have become infected, with approximately 350,000 of those who had fallen ill, have also died (4).

The experience obtained from the outbreaks of other human coronaviruses (Severe Acute Respiratory Syndrome Coronavirus, SARS-CoV in Middle East Respiratory Syndrome Coronavirus, MERS-CoV), puts pregnant women and their fetuses in a high-risk group, as other outbreaks had been connected with a high rate of maternal mortality (25% for SARS-CoV-1, 35% for MERS-CoV), neonatal mortality (27% for MERS-CoV), miscarriage in the first trimester and intrauterine growth restriction in the second and third trimester of pregnancy (5,6). However, based on the experience from the past epidemics of human coronaviruses, we cannot reliably predict the course of infection with SARS-CoV-2 in pregnant women and neonates. Currently, it is believed that pregnant women are no more endangered for a severe course of the disease and the symptoms in pregnant women do not differ from those in the general population. Approximately

5% have severe symptoms that require intensive care (1).

Vertical transmission of SARS-CoV-2 from the pregnant woman to the fetus is probable; however, it has yet to be proven. There were two published case studies in which IgM antibodies against the SARS-CoV-2 were discovered in the neonate's serum. Because IgM antibodies are not passed through the placenta, it is likely that they were created as a response to the infection of the fetus with SARS-CoV-2 in the womb (7,8). So far SARS-CoV-2 has not been found in the placenta, vaginal discharge, mother's milk, placenta, umbilical blood, and in the nasopharyngeal space of a newborn (1). According to the current data, it appears that SARS-CoV-2 is not teratogenic and does not affect the rate of early miscarriages or premature births (8,9). All the data is based on a small sample of examined women in retrospective analyses. The pandemic is ongoing and we expect that this information will change in the future.

After the pandemic had been declared, strict measures were implemented with the objective of limiting the spread of the virus, which thoroughly changed our lives. The activity of the hospitals had to adapt significantly to the existing conditions. Hospitals had to provide high-quality care for those who needed it, while also protecting both the healthcare workers and other patients from potential infection with the novel coronavirus. Limiting the spread among healthcare workers was crucial, as a higher number of infected among those employed at hospitals could lead to severe limitations in providing healthcare.

Maternity hospitals could not limit the scope of their work. Compared to the previous months, the number of births was not significantly reduced due to the pandemic. Safe working conditions required a reorganization of work across all levels of perinatal care.

After SARS-CoV-2 pandemic was declared, we in Ljubljana Maternity

Hospital were also aware that in order to ensure optimal care for all pregnant women, we had to prepare guidelines and clinical pathways for employees. The objective of the clinical pathway is a detailed definition of organization of the working process for healthcare workers who participate in the treatment of pregnant women. Writing clinical pathways in an emergency situation is difficult, as it is important to first define the criteria for entry, the course of treatment and any and all derogations that may occur during the treatment in spite of the uncertainties related to the pandemic. The clinical pathway must be designed according to the organization of work, which is specific to each maternity hospital and each working environment.

Pregnant women have to be treated as a vulnerable group if infected with SARS-CoV-2, therefore the goal of the healthcare personnel must be to set diagnosis on time and quickly, monitoring the condition of the pregnant woman and the fetus, and an optimal organization of labor, postnatal period, and the protection of healthy pregnant women and the healthcare staff from the spread of the virus within the maternity hospital.

2 Adjustments at the Ljubljana Maternity Hospital

At Ljubljana Maternity Hospital, one of two tertiary centers in the country, we deal with healthy pregnant women and we also treat high risk pregnancies. Approximately 5,500 women give birth at the Ljubljana Maternity Hospital every year, the ward for pathological pregnancy has the capacity for 15–20 pregnant women, and every day up to 100 pregnant women are examined at the hospital. Nearly all extremely premature children are born here, and also the majority of all premature children from entire Slovenia. 17 obstetricians, specially trained for handling the most complicated pregnancies and deliveries, 9 neonatologists, 45 midwives,

and 4 anesthesiologists, who are focused on anesthesia in obstetrics are employed at Ljubljana Maternity Hospital. Due to the nature of work, it was not possible to significantly reduce the scope of activities, so we had to prepare for admitting potentially infected pregnant women and those with confirmed infection in a very short time. Work conditions changed for all employees; physicians, midwives, nurses, anesthesiologists, pediatricians, technicians, administrators, security guards. When adopting and customizing the measures, we adhered to the recommendations of the National Institute for Public Health (NIPH), the World Health Organization (WHO), the Service for managing and preventing hospital infections of the Ljubljana University Medical Centre, and foreign associations of gynecologists and obstetricians.

2.1 Employees at the Maternity Hospital

When arriving to work, all employees had to measure their body temperature, and list their medical condition into a special form. When working with patients, we wore surgical masks, gloves, protective coats and glasses. We took care of hand hygiene even more than usually.

Doctors were divided into two groups; one worked for a week and the other stayed at home, waiting to jump in in case an infection occurred among staff.

In the delivery room, colleagues from the Department of Human Reproduction also assisted, as they were not performing their full scope of work during the pandemic.

2.2 Areas of work

The Maternity Hospital was divided into three zones similar to the Emergency Department of the Ljubljana University Medical Centre: white zone for healthy pregnant women, grey zone for pregnant women with suspected infection with

the SARS-CoV-2 virus that has not been confirmed, and the red zone, where we treated the pregnant women who were proven positive. We defined the conditions for entry, the organization of the space, the equipment used by the staff when working with a pregnant woman and the course of work for the midwife, the obstetrician, and the technician for each of the zones. These are described in detail in the document Clinical pathway for treating pregnant woman mother with COVID-19 (Klinična pot obravnave nosečnice/otročnice z okužbo covid-19).

2.3 Entering the Maternity Hospital

We organized the so-called pre-triage at the entrance of the maternity hospital, where a resident and a nurse or a midwife, with the assistance of a security guard, asked a pregnant woman about her health condition before she was allowed to enter the building. If there was no suspicion of her being infected with SARS-CoV-2 virus, we informed the pregnant woman of the importance of regularly disinfecting her hands, she received a protective mask and was allowed to attend the examination. Her treatment followed established procedures, while adhering to the general recommendations of avoiding social contacts. We made sure that in the waiting rooms there was appropriate safety distance between patients (> 1.5 m). The partners were not permitted to attend the examination and had to wait outside the maternity hospital.

2.4 Planned admittance to the Maternity Hospital

All pregnant women who were referred for admission (for labor induction, planned cesarean section, planned admission to the department) were referred for the swab of the nasopharyngeal space a day before planned admission. They were treated according to the test results,

and if symptoms occurred during hospitalization, we performed another swab, according to the clinical indications.

2.5 Suspected infection

If a pregnant woman manifested symptoms and signs that are characteristic for a disease of the upper respiratory tract at the arrival to the hospital, we assessed whether she has an acute obstetric condition that requires immediate treatment or the obstetric examination is non-urgent. In the latter case, we referred the patient to her general physician for the treatment of the respiratory disease, and only after admitted her to the maternity hospital. If the pregnant woman needed an immediate examination, we referred her to the separate entrance from Zaloška cesta, which was off limits for patients without respiratory tract infection symptoms and employees of the maternity hospital. She had to wear a surgical mask, and the staff that was in contact with her was dressed in an appropriate protective personal equipment (PPE). In a specially refitted, so-called isolating examination room, a physician and a midwife treated the pregnant woman according to accepted clinical practice. The examination room is equipped with standard amenities, such as CTG, ultrasound etc. If the pregnant woman needed to be admitted to the maternity clinic, we also took a swab of her nasopharyngeal space to test for the SARS-CoV-2 virus.

If the pregnant woman needed to be admitted to a hospital because of the start of labor, we admitted her into a special part of the delivery ward, in a room that was located in the grey area. Pregnant women who needed to be admitted to the Department for pathological pregnancy waited in the grey area, which was organized in front of the isolation triage, or were admitted to the Department for pathological pregnancy's grey zone. If the SARS-CoV-2 test was negative, we kept

the patient in isolation and later moved her to the white zone and treated her according to the established clinical practice. If the result was positive, confirming the presence of the SARS-CoV-2 virus, we moved the patient to the red zone of the delivery ward or the red zone of the department for intensive perinatal medicine depending on the reason for her admission (contractions, rupture of membranes, hemorrhaging, suspicious/pathologic CTG).

For transferring potentially infected pregnant women, we used a separate elevator and appropriate protective equipment.

2.6 Confirmed infection

Asymptomatic pregnant women, who tested positive for SARS-CoV-2, and needed a routine examination, were treated at the Outpatient clinic for pathological pregnancy for COVID-19. The premises of the Outpatient clinic for pathological pregnancy were temporarily rearranged, and the regime of examinations was adjusted. The outpatient clinic for COVID-19 patients operates every Friday after noon. The regular examination of an infected pregnant woman is undertaken by two teams (physician, nurse), so that the work is performed safely and effectively. Pregnant women were examined in the suitable PPE. In order to access the outpatient clinic, we used the entrance from Zaloška cesta, as it does not cross pathways with the pathways of healthy pregnant women. Work equipment at the outpatient clinic (computer, ultrasound device, examination table) was protected appropriately. We conducted comprehensive examinations, including ultrasound, and drew blood and urine samples for laboratory tests. In April and May, we conducted 1 to 4 exams of pregnant women who were positive for the SARS-CoV-2 virus, but showed no symptoms per week.

2.7 Delivery ward

The delivery ward was divided into three separate working areas. A part of the delivery ward (**the COVID-19 area**) was dedicated to treating patients with a suspected infection with the SARS-CoV-2 virus (grey zone) or a confirmed infection with the novel coronavirus (red zone). After an infected laboring woman was admitted, this part of the delivery ward was completely separated from the rest of the delivery ward, as we erected additional barrier walls and doors that could be closed and locked if needed. There are three delivery rooms in the COVID-19 zone – one is rearranged and equipped as an operating theater, the second one is for vaginal delivery, and in the third one we treat pregnant women who have a suspected, but not yet confirmed infection. This is the grey zone, which can change into a red zone, if the swab results come back positive. We also provide clear markings for this separation. Rooms are equipped with essential equipment needed for safe labor.

During labor, one of the midwives was with the woman in labor the whole time. She was dressed in personal protective equipment and communicated with the obstetrician and other midwives in the delivery ward using a predesignated phone. During labor, we minimized the number of people present in the delivery room. The biggest challenge was working in PPE, as it is physically more demanding. One of the biggest issues was with the protective eyewear steaming up, which we successfully resolved in collaboration with the Department for Infectious Diseases, as they lent us a positive pressure protective suit, and later we also obtained two of our own. The procedures during labor did not differ from standard labor practice. In order to limit the spread of the virus with aerosol, we did not provide analgesia with nitrous oxide and remifentanyl; however, we did ease the pain during labor with pethidine and epidural

analgesia (Figure 1).

For research purposes, we took a sample of blood from the woman in labor and umbilical blood for serology for the SARS-CoV-2 virus. We took a swab from the vagina and a piece of the placenta, as we wanted to verify whether the virus is found in these tissues.

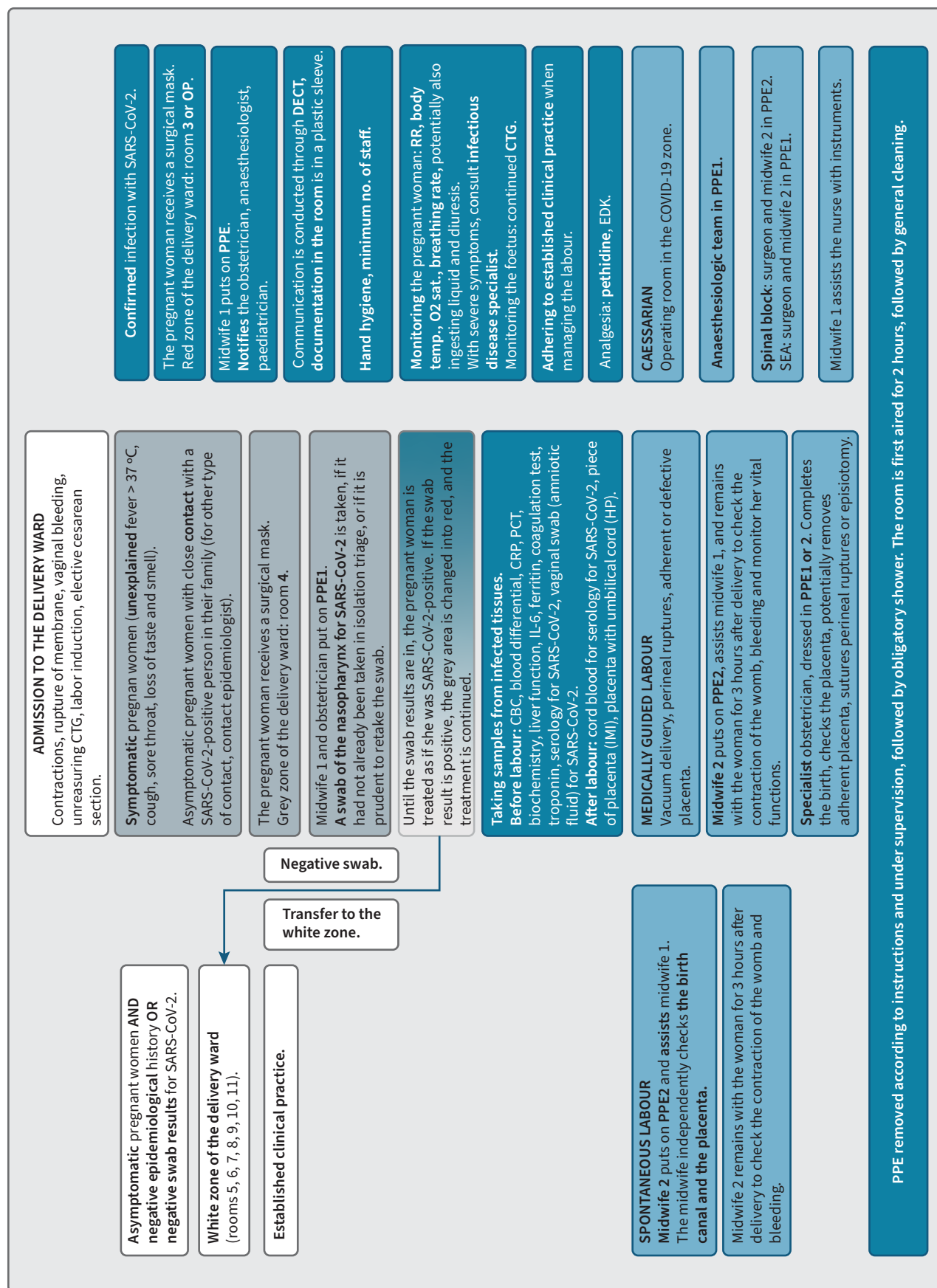
To limit the spread of infection, the presence of the companion during labor and delivery was not permitted, which caused additional stress to most women in labor, as well as an additional burden for the medical staff who had to pay extra attention to the woman in labor.

2.8 Postpartum care

After the delivery, the mother and the newborn were moved into the red zone on the ward. International guidelines recommend the newborn is fed with breast milk. In some countries, e.g., the US and China, the newborn is separated from the mother, who pumps her milk, and the medical staff then feed the baby with the breast milk (10,11). In the UK, the breastfeeding is recommended while adhering to strict hygienic measures, which is also what we did at the Ljubljana Maternity Hospital (1). When using a protective mask and adhering to the rules for hand hygiene, the risk for transmitting the virus from the mother to the newborn is very low, and certainly does not outweigh the benefits of breastfeeding and rooming-in. We released both the mother and the child into home care as soon as it was safe for both of them.

3 Discussion

The COVID-19 pandemic in the first half of 2020 brought enormous changes to all aspects of life. Institutions such as maternity hospitals, which could not reduce the scope of their work, had to adapt to the new circumstances practically overnight. All employees of the Maternity Hospital were included in the work

Figure 1: Treatment of women in labour during the SARS-CoV-2 pandemic.

reorganization. Even during emergency conditions, the standard of perinatal care had to be kept at the highest level, making the procedure of adaptation even more difficult. At the Ljubljana Maternity Hospital, we adhered to the expert recommendations on COVID-19, and in cooperation with Service for managing and preventing hospital infections of the Ljubljana University Medical Centre created the clinical pathway for treating pregnant women during the COVID-19 epidemic. Ljubljana Maternity Hospital was divided into three work zones: red for infected pregnant women, white for healthy ones, and grey zone, where we treated those with suspected, but unconfirmed infection. We faced problems because of the lack of space, as the design of the maternity hospital does not support the need for the separation of the pathways for infected and non-infected patients. Along with the organization of work zones, we needed to ensure appropriate personal protective equipment for all employees and a sufficient supply of surgical masks for employees and patients in a very short time. The spaces at the maternity ward, which is not adapted to treat both the infected and the healthy patients, had to be separated by work areas and equipped appropriately. We limited entry to the hospital, limited the number of pregnant women who had appointments for examinations, increased the time intervals between examinations, so that in the waiting rooms there were as few people as possible. We prohibited fathers from being present at birth. Emergency conditions presented an additional stress factor for pregnant women, so they needed additional support of the medical personnel. These new conditions were also psychologically and physically demanding for medical professionals.

Even though adapting to the new reality was at first demanding both for healthcare workers and for pregnant women and those giving birth, we believe that at the Ljubljana Maternity Hospital

we managed to organize ourselves quickly and effectively. Some may believe that the measures we adopted were excessive, as we treated only a few infected pregnant women, and because of that, the treatment of healthy patients was hindered. The presence of a birth partner was not permitted during labor or examinations, and the movement in the maternity hospital was limited, while the number of examinations, especially at the primary level, was reduced. During the first wave of the epidemic, we did not have any uncontrolled infections or virus transmissions between the patients, even though we treated healthy ones, those infected and those with symptoms. Therefore, we assess that our adaptation was successful.

4 Conclusion

At the Ljubljana Maternity Hospital, we treated a few patients, who were infected with the SARS-CoV-2. By the end of May 2020, two women with a proven infection and three who had gotten over the infection with the SARS-CoV-2 gave birth. None of them had any severe symptoms of the COVID-19. Intensive care treatment was not necessary. There were no labor complications with any of them. The all gave vaginal births. The mothers and the newborns are in home care and feel well. The newborns are breastfed.

According to the latest data, the number of people, who recovered from COVID-19, is between 2 and 4 % of the population, which means that there is a high probability of the second wave of the pandemic (12). At the Ljubljana Maternity Hospital, we successfully adapted the level of our professional work to the changed needs during the epidemic. We introduced an adjusted regime of treating infected pregnant women, mothers and newborns. Based on the result, we assess that we are prepared for a potential new wave of infection with the clinical pathway and work protocols. Successfully combating the new wave of COVID-19

will largely also depend on the availability of protective masks and other personal protection equipment, since we as healthcare workers have to first and foremost protect ourselves in order to be able to care for others.

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