

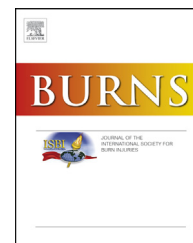


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Burns in pandemic times – The Graz way towards COVID-19 and back



Sebastian P. Nischwitz^{a,b,*}, Daniel Popp^a, Isabelle Sawetz^a,
Christian Smolle^a, Alexandru-Cristian Tuca^a, Hanna Luze^{a,b},
Lars-Peter Kamolz^{a,b}

^a Division of Plastic, Aesthetic and Reconstructive Surgery, Department of Surgery, Medical University of Graz, Graz, Austria

^b COREMED – Cooperative Centre for Regenerative Medicine, JOANNEUM RESEARCH Forschungsgesellschaft mbH, Graz, Austria

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ABSTRACT

The first half of the year 2020 has been shaped by quarantines and lock-downs all over the world. The novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has caused a pandemic, that slowed down not only social interactions and economy, but also medical and health care. Governments and hospitals were forced to create *ad hoc* emergency plans maintaining the balance between an adequate participation in collective response of shutting-down to avoid a further spreading of the virus, while preserving the ongoing acute care and simultaneously being able to react to an imminent overextension with a collapse of capacities. The University Hospital Graz is one of the largest hospitals in Austria. As transregional trauma and burn centre it provides care for people from all over Austria and faced special challenges. We present the strategy of the University Hospital Graz in dealing with the COVID-19 pandemic and the way back to (new) normality. The strategy includes infrastructural, patient-centred and staff-centred measures. The continuously low numbers of new infections in Austria allowed a loosening of the lock-down measures already. Particular attention has to be paid to attentive screening of patients and triaging of surgeries during the re-boot. The re-boot needs to be slow and steady to reduce the risk of an infectiological relapse. Once this pandemic is defeated, a careful re-evaluation of the different internationally applied strategies should be performed to be prepared for the future. © 2020 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

1. Introduction

The first months of the year 2020 have been shaped by the COVID-19 pandemic worldwide, a pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). An

infection with this new type of coronavirus can lead to severe respiratory symptoms and ultimately death [1]. The first case and the presumed origin was in December 2019 in Wuhan, the capital of the Hubei province in China [2]. While the World Health Organization (WHO) declared the outbreak to be a Public Health Emergency of International Concern in January

* Corresponding author at: Division of Plastic, Aesthetic and Reconstructive Surgery, Department of Surgery, Medical University Graz, Auenbruggerplatz 29/4, 8036 Graz, Austria.

E-mail address: sebastian.nischwitz@joanneum.at (S.P. Nischwitz).

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already, it was classified a pandemic on March 11th 2020 [3]. Up to that date, 118,000 infected cases and 4291 deaths were registered [4]. The situation could be controlled with extreme lockdowns in China [5]. On March 13th, two days after the declaration of the pandemic, Europe was considered the active centre of the viral spreading. Besides the abominable medical and humanitarian consequences, this pandemic is accompanied by severe economic and social disruptions whose extent is not foreseeable yet, as most of Europe is still in a lock-down since mid March. With every country's management being different, most experts agree that non-medical measures like social-distancing are effective preventative means to reduce the spreading rate [6,7].

In Austria the first two patients were reported on February 25th [8]. Bordering the massively hit Italy [9], copious precautions and provisions have been made to be capable to handle the pandemic after its spread to Austria. A federal law concerning measures for the prevention of a spreading of COVID-19 was adopted by the National Assembly of Austria on March 15th 2020 [10]. This law enabled the implementation of measures like the restriction of tourism and travelling (March 10th), the cancellation of public events and introduction of social distancing (March 10th), closing of schools and universities (March 11th), the early cessation of the skiing season (March 12th), proclamation of a nationwide quarantine and curfew (March 15th). People in compulsory military/community service could not terminate their service, and the ones having recently concluded their service were asked to re-enlist. Starting April, the use of mouth-nose-masks was made obligatory in supermarkets and public transport. Furthermore, a federal crisis management fund, containing 4 billion €, was established to cushion the expected economic aftermath of the pandemic. These measures were deemed necessary to prevent the spreading of SARS-CoV-2 and to avoid/delay the feared overload of the Austrian hospital's intensive care capacity.

One of the largest hospitals within Austria is located in Graz, the capital of Styria. As institution of maximum medical care, the University Hospital Graz is not only a medical university hospital but also a transregional trauma and burn centre. As such, it is one of the primary destination for patients from all over Austria with its close to nine million inhabitants. This leads to several thousand people frequenting the area daily, which poses an excessive risk of transmitting contagious diseases, like COVID-19, which has an estimated reproduction index of 2.24–3.58 [11]. 15,786 people have been positively tested in all of Austria to date and currently there are 262 infected people in Styria (May 10th) [8].

A specialty that is inordinately sensitive when it comes to infectious diseases is burn medicine. The complication proneness of long-staying, extensively burnt patients calls for specific caution, which is why particular measures should be taken.

Once a pandemic peaks, it is not only necessary to have measures for a down-regulation, but also for a steady way back to a "new normal" to diminish the social and economic consequences, and to get back to (a new) *status quo*.

The purpose of this paper is to present the strategy of Styria, specifically the burn unit of the University Hospital Graz, in the battle against COVID-19, its way back to normality, and compare it to other internationally applied strategies. First,

we will present the measures taken during the shut-down. After these measures could accomplish the prevention of a further spreading, a re-boot comprising measures for safe way back to normal, initiated by the federal government, is possible. These re-booting measures will be presented afterwards.

2. Shut-down

The SARS-CoV-2 is transmitted by respiratory droplets and close contact between humans, and can lead to dangerous and life-threatening conditions [12]. Because of the way of transmission, it is necessary to establish a physical separation of COVID-19 positive and negative areas to hinder an uncontrolled dissemination of virus and disease as part of the shut-down.

The burn unit, which is part of the Division of Plastic, Aesthetic and Reconstructive Surgery at the University Hospital Graz is located in the Department of Surgery. Within this department, a whole area has been designated to the treatment of COVID-19 positive (COVID+) patients. Specific rooms and wards have been temporarily relocated to create a coherent area comprising a surgical wing with 3 operating rooms, a COVID+–ICU, a COVID+–IMCU, a COVID+ monitoring ward and a COVID+ regular ward. Furthermore, an additional ward and ICU for COVID-19 suspect (COVID+/-) patients were established, where patients that showed symptoms, but have not been tested positive yet or patients having had contact with positive patients were admitted. A floor plan depicting the infrastructural proximity of the above mentioned areas is shown in Fig. 1. Access to all COVID+ or suspect areas was granted only to personnel assigned to the immediate patient care and controlled by a double door system. All areas were equally equipped as non-COVID areas, including an operating room for burns.

Every entrance to the hospital's premises was security-controlled to guarantee no non-imperative access. Sufficient personal protective equipment was provided by the hospital's management and distributed upon request, including gowns, FFP3-masks, safety goggles and gloves. In further consequence an obligation to wear protective masks (scarf, surgical mask, or more) was established on the whole hospitals' premises and contact with patients was kept with FFP-3-masks and gloves (COVID-negative). A safety distance of 2m was to be kept between people at all times throughout the premises. Additionally, triage areas, in which body temperature was taken, surgical masks were distributed, and mandatory hand disinfection was asserted, have been erected in front of every doorway, which every non-staff person had to pass before entering the building. No routine testing for SARS-CoV-2, and no routine chest x-ray or CT was performed. If the incoming patient was suspected COVID+, he/she was only let in if medically necessary. The primary assessment including a throat swab PCR-test and a chest X-ray (CT only with special indication) was performed in an isolated room and the patient was transferred to the COVID+/- ward, if stationary care was necessary. If surgery was required, they were treated as COVID + in terms of personal protective equipment until proven differently by two negative PCR-tests. The surgery itself, as

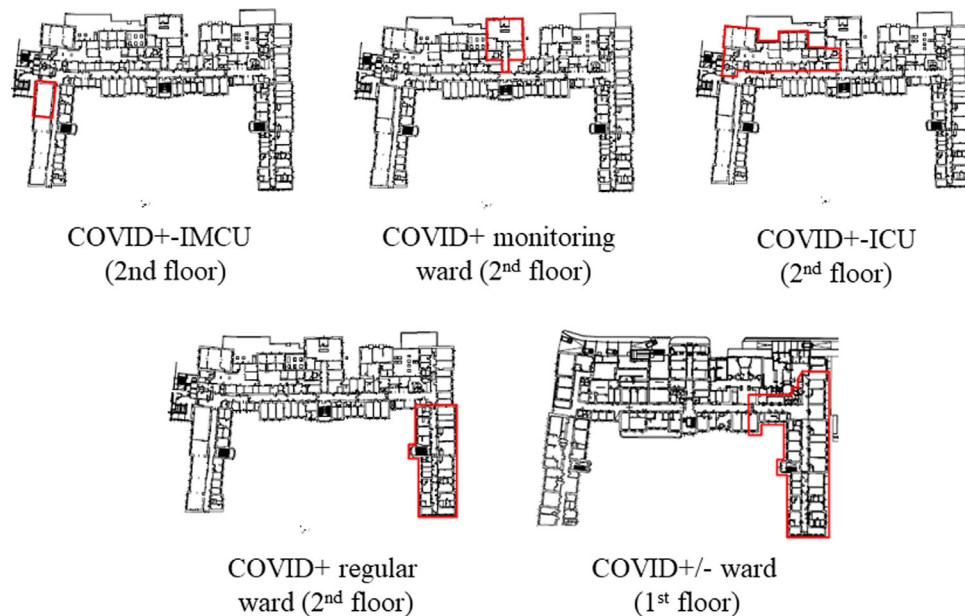


Fig. 1 – Floor plan of the established COVID-areas at the Department of Surgery of the University Hospital Graz.

well as a possible ICU stay, took place in the COVID+ area. However, suspected positive patients have never been in contact with proven positive patients. The same applied for non-responsive patients. Patients developing symptoms compatible with a SARS-CoV-2 infection during stationary care were immediately isolated on the respective ward and a throat swab PCR-test was performed. If the test yielded a positive result, the patient was transferred to the COVID+-ward. A transfer to the non-COVID area was possible after two negative SARS-CoV-2 tests (PCR) and no necessary quarantine due to contact with positive/possibly positive patients. During a patient's stay at the University Hospital Graz, visitors were only allowed in special cases and patients were not allowed to leave the ward. Exceptions were made for paediatric patients who had one healthy accompanying person allowed, as well as for patients in palliative care.

This workflow implied for an extensively burnt patient that he/she got transferred from the emergency trauma room to the COVID+ surgical wing and afterwards the ICU for COVID+/- (suspected positive), where he/she stayed in isolation until a SARS-CoV-2 test came back negative twice. Until then, they were treated as COVID+ in terms of personal protective equipment. Afterwards, a transfer to the regular burn ICU was possible, where regular burn care was administered with routine precautions. Suspected positive patients have been strictly separated from proven positive (and negative) patients.

COVID+ as well as regular wards' patients capacities were reduced to have only one patient per room or as few as possible while the safety distance of 2m (being in place for the whole premises including outpatient clinics) could be kept. Patients were released as soon as medically acceptable and all follow-up visits including physiotherapeutic rehabilitation were outsourced to registered doctor's offices and ambulatory institutions/therapists whenever possible. Most ambulatory outpatient's visits as well as all elective surgical procedures were cancelled/postponed to limit the number of patients on the premises. All research activity involving direct contact to

patients was suspended until further notice, as long as medically acceptable.

To avoid a gradual failure of care by a knockout of the whole team, a protective quarantine at home was imposed on about half of the medical staff of the Division of Plastic, Aesthetic and Reconstructive Surgery for two weeks. The other half could sustain the reduced daily work, starting March 11th – once the pandemic hit Styria. Internal routine meetings were adapted and held only by the minimally necessary staff members for as short as possible. The team at home was instructed to be at disposal in case of waves of patients hitting the hospital, and were not allowed to travel or leave the house more than necessary. Recurring updates were sent via e-mail and other electronic media, so that people did not lose the connection to the events happening in the hospital and did not feel left out.

An additional measure taken by the Austrian Medical Chamber was the suspension of the specialties. Every professionally licensed doctor could hence be active in whatever specialty required (provided the professional expertise). This step was taken to ensure a better cooperation in between different specialties for the treatment of patients.

The above mentioned measures concerning infrastructure, patients and staff were necessary to uphold the medical care, not only for COVID+-patients, but also for every other patient requiring medical attention. The measures taken by the government and these *in-hospital* measures could be sustained long enough to reach effectivity, which was shown by a steady low number of new infections in Austria. Initiated by the government, a systematic re-boot could be started in the beginning of May.

3. Re-boot

3.1. Triaging

Once a pandemic reaches its peak, not only federal regulations and restrictions are loosened, it is also necessary to think about

a way back to normality, or what will be the new normality, in a hospital setting. Initiated by the federal government, measures can be taken to slowly and steadily re-boot the system. This is required to guarantee a safe transmission to establish the level of (elective) medical care needed without overwhelming the capacities by avoiding an overhasty re-boot and thus causing new pandemic waves.

It is of utmost importance to have a good triaging system to differentiate between urgent and elective cases, considering specific needs and identifying groups at risk. Therefore, the triage areas with body-temperature screening remained in place. A checklist was created to ask every entering patient about (1) direct contact with a (suspected) COVID+ person, (2) presence of increased body temperature and the intake of fever-lowering medication, (3) presence of shivering or chills, (4) sudden sore throat, (5) sudden occurrence of coughing, (6) shortness of breath, (7) loss of gustatory sense, (8) loss of olfactory sense, and (9) sudden muscle pain. If they did not show any sign of a possible active SARS-CoV-2 infection, negated all of the above mentioned questions, they were let in. Patients that could not negate all of the above or showed any symptoms were hence suspected to be COVID+. These as well as patients from risk areas like e.g. retirement homes were tested with a throat swab PCR-test and treated as COVID+ until proven negative.

3.2. Surgical triaging

Naturally, during the lock-down, only emergency cases had been operated on. Once we could start the re-boot, it was possible to resume urgent cases that had been postponed during the lock-down first. After the urgent cases, if capacities and epidemiologic data allow it, elective cases can follow next. For the moment, still elective or (in case of Plastic Surgery) cosmetic surgeries are suspended on patients at risk according to the classification of the CDC [13]. Cosmetic surgeries will be postponed for as long as necessary.

Not only the number of surgeries, but also the number of outpatient consultations and routine check-ups is on the rise again. We are however still outsourcing non-necessary follow-up consultations to doctor's offices whenever possible.

It is necessary to keep the number of patients in the hospital as low as possible, since the risk of a viral transmission is significantly higher in a hospital setting. It should be considered to organize procedures that can be performed under local anaesthesia in an outpatient setting. Herewith, the time of contact and the number of patients in the hospital can significantly be reduced.

3.3. Outpatients

In case of ambulatory settings (consultations and ambulant procedures), patient will be scheduled with enough slack time in between their appointments to avoid crowds in the waiting areas. If the infrastructure allows it, the waiting areas will be expanded and the number of accompanying people will also remain limited to allow the adherence of the still necessary safety distance of 2m. Whenever possible, consultations will be outsourced to registered doctors in private practice.

In surgical settings, the number of people in the operating room as well as the number of people in direct contact will be limited to the ones involved in direct patient care. The duration of surgeries and hospital stays will be kept at the possible minimum. Procedures that can be performed under local anaesthesia will be performed ambulatory, if possible.

3.4. Stationary care

Stationary treatment will be mostly reserved for patients requiring general anaesthesia (emergencies > urgent cases > elective cases (> cosmetic cases)). When a stationary treatment is required, the number of patients in a room will be limited to when it is possible to keep a safety distance of 2m in between the patients. All patients should be informed that the risk of contagion with COVID-19 remains to be existent – this should be included on a written informed-consent form. Visitors are still reserved for exceptional cases (see above) to have no uncontrolled glut of non-necessary people on the premises.

3.5. New normal

When re-booting the system, it is necessary to keep a very close eye on the current number of infected people and new infections. The reproduction index in Austria has been below 1 for several weeks which has been a crucial factor in the decision to re-boot [8]. The whole re-boot should take place over several weeks. The surgical capacities are to be increased slowly by about 10% per week, if the numbers of infected people remain steady. The *new normal* will reserve 50% of the capacities for emergencies. An additional 25% is kept for urgent cases, following 15% for elective cases and 10% for cosmetic cases, once epidemiologic data allows it.

Intensive care capacities, which have been reserved exclusively for COVID+ patients, are also being restructured again to reduce the exclusive COVID+ capacity and increase the *regular* capacity again in a slow and steady manner. The designated COVID+ area is shrunk, yet kept to be able to react to a rising number of COVID+ patients. A certain share of ICU capacity should be kept in any case for a possible relapse.

Mouth and nose masks are to be worn by staff and patients throughout the premises and a safety distance of about 2m between people is to be kept at all times possible. Enough personal protective equipment is still readily available with especially FFP2/-3 masks for settings of higher risk or unavoidable close contact.

While the staff quarantine at home is not effective anymore, they are also encouraged not to socialize and reduce contact as much as possible.

4. Discussion

To date, 9 patients required in-patient treatment at the burn unit of the Department of Surgery of the LKH Graz since the beginning of the pandemic. Fortunately, there has not been a single burn-patient that was tested positive for SARS-CoV-2, and only one suspected positive, who ultimately tested negative. When taking a look at the overall numbers in

Austria, it appears that we are located at the tail end of the epidemic surge with currently 34 new confirmed infections on May 9th, whereas the maximum was reached on March 26th with 972 confirmed cases on that day. Recently, no significant new infections have been observed in Styria and the total number of hospitalized COVID+ patients continuously declined [8], hence a re-boot initiated by the government at the beginning of May was justified [14].

In a recently published report by Barrett et al. several international authors have shared their centre's strategy and approach to this worldwide crisis [15]. The authors have divided the centres in ones at the tail end, in the middle and at the start of their surge. Shanghai and Chongqing were the ones reportedly at the end of their surge as well. Whereas Shanghai's largest hospital was directed not to treat any patients with fevers at all, and hence no infected patient has been treated at this hospital, this would not have been a possibility in Graz due to the lack of alternative treatment locations. The burn workforce management during the pandemic was quite similar, since in Shanghai the on call schedule was adapted accordingly, so that there would be always enough physicians in reserve. Similar strategies were applied in Chongqing, where strategies concerning surgery (no elective cases), separate patient cohorting and staff protection resembled to the one used in Graz, as well [15,16]. In both cities a chest CT scan was performed more frequently (Shanghai: all patients, even asymptomatic; Chongqing: suspect and patients of unknown status), whereas in Graz a chest X-ray was performed for suspect or positive patients, but no imaging was used for asymptomatic patients. This is still effective during the re-boot. If in doubt, a patient was and still is treated as COVID-19 positive until counterevidence by two negative PCR tests.

Other European centres like Barcelona (Vall d'Hebron Hospital Campus) or Birmingham (University Hospitals Birmingham) followed similar strategies as well with minimum hospital staff and designated COVID+ areas. However, due to the amount of patients and the restructuring, burn units have lost capacity, yet not having reached their maximum patient capacity and still being able to fully operate. In Graz we did not reach full capacity either. In Barcelona, there have been also some COVID-cases within the staff, fortunately in our facility there has not been a single positively tested staff member (Department of Surgery).

Of special interest is the strategy of Singapore General Hospital, where no extensive changes were needed up to the publication of said report [15]. However, as we in Europe are experiencing this exceptional situation for the first time for the most part, Singapore has some experience with pandemic situations, hence they have had the possibility of preparing themselves and are able to react on short notice if necessary. In Tokyo no drastic impact on the services has been reported either, with apparently no specific strategy changing planned.

It is important to be prepared for when a crisis hits. In a hospital setting, that pertains for the routine patient course including admission, treatment, surgery, transfer, rehabilitation and discharge of a patient, the infrastructural organization and allocation of supplies and equipment, and the staff – medical as well as non-medical. It is of utmost importance to coordinate with public authorities,

other surrounding hospitals and medical professionals in their offices. Ground level employees should be given the autonomy of decision-making within the scope of the hospital's general direction of march to relieve superiors involved in crisis management and to efficiently use resources [17]. Not only measures for a shut-down, but also a controlled re-boot of the systems has to be considered and planned, equally.

To date, no centre has presented their strategy for the transition back to (new) normal.

As the numbers of new infections in Austria have stayed steadily low in the last weeks [8], a step-by-step plan back to (the new) normal has been created. As every country or region is positioned differently on the pandemic's timeline [15], local considerations have to be taken into account before the decision to pursue the long way back to normality.

With rules and laws imposed for the prevention of the spreading of the disease being partially loosened and lifted by the federal government, uncertainties about what is when allowed and under which circumstances, remain. In a hospital setting, clear and distinctive measures are necessary for a re-boot. Increased alertness for possibly infected/contagious persons is still of utmost importance. Patients should be continued to be screened and direct contact should still be reduced to a minimum. Patients should be triaged and the urgent cases earlier postponed should be resumed at first. In case of burn care, patients with contract scars should also be triaged as urgent, since they show significant functional restrictions. Elective and cosmetic cases in Plastic Surgery should follow, when capacities and epidemiologic data allow it. The appointment of an interdisciplinary committee consisting of surgeons, anaesthesiologists, infectiologists and nurses should be considered to decide on the priority of the procedures at hand.

Furthermore, a clear distinction between patients requiring stationary care and patients that can be operated on in an ambulatory setting is needed to reduce the number of patients in the hospital. The need for general anaesthesia or possible local anaesthesia can help to differentiate. Safety distances should be kept and personal protective equipment needs to be available in sufficient amounts. The use of mouth-nose-masks for patient and staff should be encouraged at all times.

With hospitals remaining to have a higher risk of transmission possibility, people should be encouraged to self-isolate for a few days after inpatient stays. If possible, telemedicine and outsourcing of outpatient consultations should be kept up.

Eventually, surgical capacities should be increased gradually (e.g. 10% per week) and intensive care capacity for COVID-19 patients should be kept available in sufficient amount with the ability of capacity increase within a few days. Therefore, the official numbers of new infections provided by the ministry of health (in Austria [8]) should be checked daily to be able to steer early enough and not be surprised by a sudden new wave of infected people.

The here presented plan is one possible strategy being suitable for Austria and the University Hospital Graz. Depending on local resources and progress in the pandemic's course, every country's way back to normality should follow specific considerations and precautions.

The COVID-19 pandemic has changed the world and rendered first experiences with health crisis management in large parts of Europe. The way back out of the pandemic will be long and hard, but possibly this quarantine can serve as a moment of stopping and reflecting, bethinking actual priorities and values in individual circumstances [18]. In times like these, the value of a capable and reliable leadership becomes evident, since not only physical/organizational hurdles, but also emotional challenges are to be overcome.

5. Conclusion

As reported by Siyuan Ma et al. as well as Ning Li et al., numerous arrangements are required to be adequately prepared for a pandemic situation like this. Because of the novelty of this situation for a great part of the world and the low experience with this virus, no ultimately *right* strategy can be recommended. Whether a hospital or a department stays up and running or shuts down to protect patients and staff is always a question on the infrastructural possibilities and the organization of the health system. We, at the Plastic Surgery Division of the LKH Graz are in the lucky position to be able to have a completely separated area, designated to treat infectious people, including operating wing, ICU, IMCU and regular wards. Furthermore, the pandemic has not hit our department with devastating consequences (yet), leaving the opportunity to draw on unlimited resources and being able to properly organize and initiate emergency plans. Reports from other hospitals and/or countries that were hit devastatingly have given us the opportunity to prepare and expect the worst. Given continuously low numbers of newly infected people, we were able to loosen the lock-down already and start to re-boot, as initiated by the federal government. This requires the same care as the lock-down itself, with a special emphasis on continued screening and effective triaging of formerly postponed or cancelled consultations and surgeries. To date, fortunately we were able to handle the situation with a minimum of damage. Once this pandemic is over, we should critically re-evaluate our strategies in international and interdisciplinary exchange. Hopefully, we can all learn from this situation, share our experiences and be prepared for the future.

Declarations of interest

None.

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