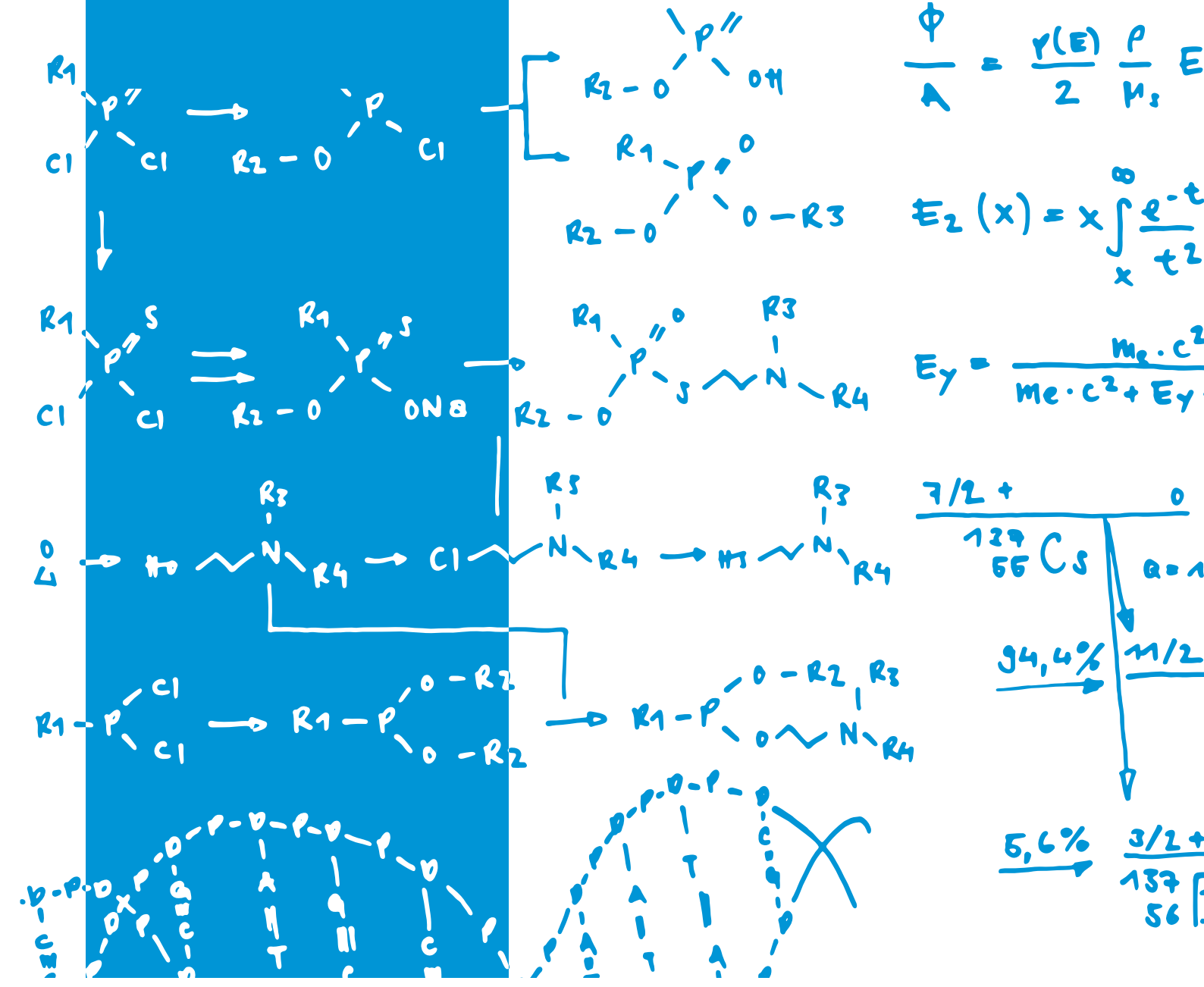
Annual Report 2020

SPIEZ LABORATORY



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This Annual Report is also available in German and French.

Content

27 May 2021

Dear Readers,

Dr. Marc Cadisch
Director, Spiez Laboratory

Corona also dominated the first half 2020 for us. From the start, we were able to take on important tasks in four key areas:

1. Even before the pandemic began to affect Europe and Switzerland, we were able to establish diagnostic capabilities for SARS-CoV-2 in Spiez, making us one of the first laboratories in Switzerland to offer this diagnostic. In particular, during the initial phase of the pandemic, we supported various partners with analytical capacities and made our know-how available to other laboratories so that they could also quickly establish diagnostics for SARS-CoV-2. The NBC Defence Laboratory 1 of the Armed Forces substantially supported us in this task.

2. Our research projects on the pandemic cover a broad spectrum: from quality assurance of sampling material for Covid-19 tests to the investigation of the antiviral effects of substances related to SARS-CoV-2, as well as studies on the health effects of the Covid-19 disease in specific population groups.

3. During the initial phase of the pandemic, there was a shortage of respirator masks (FFP2/3 masks) and hygiene masks. In this regard, we supported the Swiss authorities and the health sector in projects to continue using protective masks with expired use-by dates, and to procure new masks.

4. At the beginning of April 2020, we received a mandate from the Federal Council, in favour of the Federal Office of Public Health (FOPH), to coordinate laboratory capacities for Covid-19 testing in Switzerland. For this purpose, we had to develop and introduce a system for monitoring the laboratory capacity situation. This data served as a basis for further enhancing test capacity at national level.

Areas 1 and 2 are among the core tasks of the Biology Division at Spiez Laboratory. Therefore, it was no surprise to us that we would take on such tasks in a pandemic. We were prepared for it; it is part of our core mission.

On the other hand, in areas 3 and 4 , we rather surprisingly had to take on a key role: With very short notice, our CBRNe Protective Systems Division had to transfer its knowledge in the field of NBC protective masks to a «neighbouring» area and develop off-the-cuff methods for testing FFP and hygiene masks. At the beginning of the pandemic, these non-accredited tests served to provide the health sector and care facilities in Switzerland with a sufficient number of acceptable quality masks. The assignment to the area of nationwide laboratory coordination also came as a surprise to us. Nevertheless, we had to face this challenge, because

technical knowledge in the laboratory field is required to implement such coordination. As a result, we were able to help overcome the shortage of test capacities relatively quickly.

Looking back at 2020, there is one key conclusion from the operational year of Corona: We must be prepared to use our laboratory capacities and expertise in a diverse and flexible manner - even for tasks that are not part of our ordinary portfolio in a normal situation. Our partners in the authorities, the operational organisations, the health sector and the care sector have a right to receive support from Spiez Laboratory. That is what we are here for, we owe that to the Swiss population.

We must be prepared to use our expertise flexibly- even for tasks that are not part of our portfolio in regular circumstances

I would like to thank all partners of Spiez Laboratory for the excellent cooperation during the past year, especially the NBC Defence Laboratory 1 of the Armed Forces as well as all the employees of Spiez Laboratory, who ensured the operational readiness of our laboratory to respond to NBC incidents at all times during this extraordinary period.

Together we were able to gain valuable experience in a difficult operational situation, which we can also draw on in the long term, for example for a timely and transparent exchange of epidemiological and clinical data during a pandemic. A related project is being launched at the same time as these lines go to press: At the end of May 202, Federal Councillors Alain Berset and Viola Amherd signed a cooperation agreement with the World Health Organisation‘s (WHO) Director-General Dr Tedros Adhanom Ghebreyesus within the framework of the WHO BioHub Initiative. With this agreement, Switzerland makes Spiez Laboratory available to the WHO as a repository for SARS-CoV-2 viruses or other pathogens with epidemic or pandemic potential.

01

Spiez Laboratory during the Corona Pandemic

In 2020, the Corona pandemic determined the tasks and everyday operations at Spiez Laboratory: We found ourselves in an operational situation for an extended period of time, in which several challenges had to be overcome: From the very beginning, we took on important tasks in the areas of diagnostics and virological research of the new Corona virus (SARS-CoV-2). In accordance with an assignment from the Federal Council, we supported the Federal Office of Public Health (FOPH) in the coordination of laboratories throughout Switzerland. Finally, we used our many years of experience in the testing of NBC protective materials to support the armed forces and the Public Health Service in the difficult procurement of medical protective material.

Daniel Jordi
César Metzger
Kurt Münger
Matthias Wittwer

A major challenge was to maintain full operational readiness of all specialised units as well as the DDPS Emergency Response Teams (EEVBS). We are under obligation to be able to fulfil our core mandate at all times. Thus, even during the Corona pandemic, we had to be ready to conduct missions involving radioactivity, chemical or biological warfare agents. Bearing this and with other considerations in mind, the management board of Spiez Laboratory recognised early on that an extraordinary situation was looming for its own operations. As early as the end of February 2020, it formed an internal Corona special task force. This task force met several times a week until May 2020 to analyse the situation, to discuss and decide on the current tasks and to regulate the internal protective measures. The internal organisation and operational processes were dynamically adapted to the situation as part of the business continuity management.

We maintained the operational readiness of all divisions and emergency teams during the pandemic

To ensure operational readiness, we adopted and implemented strict protective measures from the very beginning. Access by external persons was severely restricted. Meetings, workshops, etc. were held almost entirely online, and events involving visits to the laboratory were cancelled. In this way, we were always able to maintain our operational readiness despite the difficult conditions during the pandemic.

SARS-CoV-2 Diagnostics

Through the Emerging Viral Diseases-Expert Laboratory Network (EVD-LabNet), laboratories in Europe continuously exchange up-to-date information. At the end of 2019, reports of a novel SARS virus emerging in China appeared in the EVD-LabNet for the first time. In early January 2020, the Charité University Hospital in Berlin received positive controls with the novel virus and was thus able to validate three SARS-CoV-2-specific PCR detection systems. These PCR systems were immediately published by the World Health Organization as a diagnostic tool.

Spiez Laboratory quickly recognised and accepted the new challenge: We were immediately able to obtain the necessary material from the Charité to evaluate the new PCR detection systems for our own laboratory diagnostics as early as mid-January 2020. Shortly afterwards, we received a first batch of samples with infectious SARS-CoV-2 from the Institut Pasteur in Paris. This enabled us to test the PCR systems proposed by the WHO with a patient sample, whereby it turned out that only one of the PCR systems achieved the required detection sensitivity. As a consequence, we immediately developed a second, internal PCR protocol, so that by mid-February two PCR systems were internally validated and ready for use. This enabled us at a very early stage to offer SARS-CoV-2 diagnostics to support the Swiss Public Health system and other partners. With our expertise, we also supported other laboratories in developing the necessary diagnostic systems.

Beginning in March - with an increasing spread of SARS-CoV-2 in the population - the number of clinical samples to be analysed also increased rapidly in Switzerland. Thanks to the PCR detection systems established early on, we were able to bridge analytical bottlenecks. A large proportion of the samples came from members of the armed forces. However, to help other test laboratories, requests from various civilian agencies were also processed; during this critical initial phase, more than 1000 samples were analysed for the Inselspital Bern and the hospitals in Interlaken and Moutier alone. These partners appreciated the unbureaucratic access and the rapid availability of the results.

Support by the NBC Defence Laboratory 1 of the Armed Forces

The increasing volume of samples and a large number of requests for support in the area of research and development required the deployment of all available personnel resources to implement the tasks resulting from the Corona pandemic. In view of its limited personnel resources, the Biology Division

quickly reached its capacity limits and support by external personnel became indispensable. These were quickly deployed due to a political decision: With the declaration of an extraordinary situation by the Federal Council on 16 March 2020, the Swiss Armed Forces could be deployed within the framework of the assistance service mission «CORONA 20».

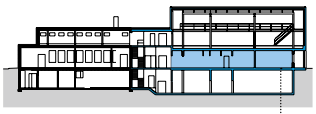
B-specialists of the NBC Defense Laboratory 1 helped with the molecular diagnostics.

With the NBC Defence Laboratory 1, Switzerland has a specialised military unit that can provide personnel and material support to Spiez Laboratory in the event of a large-scale sample workload. The structures and processes for civil-military cooperation in Swiss NBC protection prepared for disasters and emergencies, including in particular the excellent cooperation with our military partner on site, the NBC-EOD Competence Centre of the Armed Forces, have proven their worth in the Corona pandemic. For a longer period, several well-trained B specialists from the NBC Defence Laboratory 1 were deployed to us for molecular diagnostics. Only thanks to this support was it possible to form three independent diagnostic teams that were on duty around the clock, including weekends if necessary. This enabled us to guarantee the continuity of the analysis even during the critical phase when a large number of samples had to be analysed.

Later in the spring of 2020, hospitals and private laboratories in Switzerland established efficient structures and processes for high-throughput diagnostics of SARS-CoV-2, thus largely overcoming the analytical bottleneck in Switzerland. We were therefore able to scale down our analytical capacities at the end of May 2020 and the military personnel were released from service and could return to civilian life.

Because we established our PCR detection systems early, we were able to avoid analytical bottlenecks

Virology research tasks

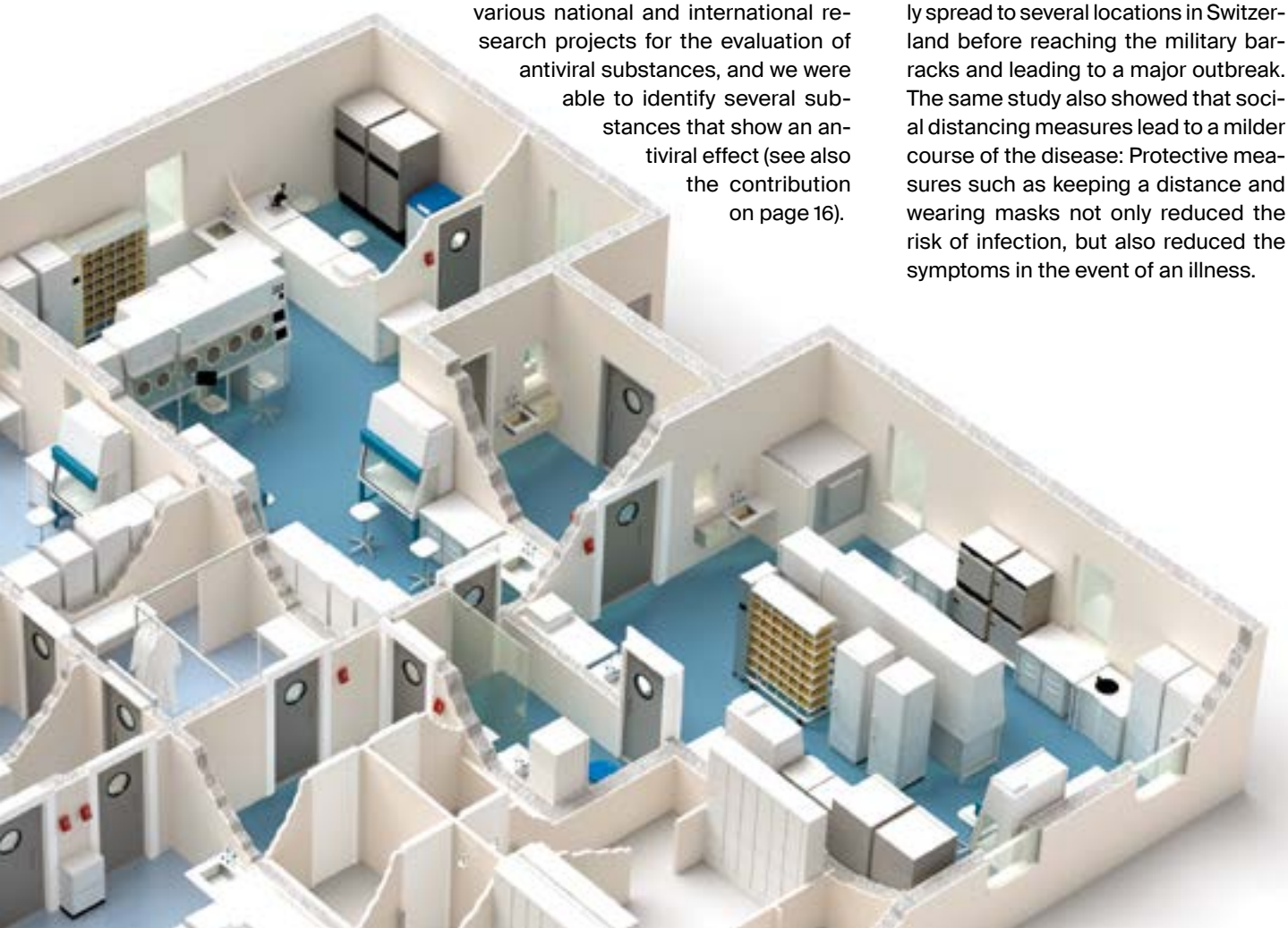


BSL-3 Laboratory in Spiez

In parallel with the diagnostic tasks, we also carried out evaluation work for the necessary test materials during the initial phase of the Corona pandemic. To counteract the initial shortage of swabs for COVID-19 tests, the Armed Forces Pharmacy ordered a large number of corresponding swabs from a new supplier. To this end, we tested whether viral stability was guaranteed with the transport medium they contained. PCR test kits for the detection of COVID-19 were also tested in Spiez to support procurement projects.

As the pandemic progressed, we increasingly took on other tasks besides SARS-CoV-2 diagnostics: Research on antiviral substances came to the fore. We were and continue to be involved in various national and international research projects for the evaluation of antiviral substances, and we were able to identify several substances that show an antiviral effect (see also the contribution on page 16).

Another research focus aims at the employment of genome sequencing methods, which have been established in Spiez Laboratory for some time. Using these techniques, relationships between pathogens can be shown - this is of central importance for understanding the epidemiology of outbreaks. We have applied this methodology, for example, in a large study carried out jointly with the Swiss army involving 550 recruits, in which a SARS-CoV-2 outbreak from mid-March 2020 in a recruit school in Airolo was investigated in detail. Based on the genome sequencing, the spread path of the virus circulating in the barracks could be traced in textbook manner. The virus had been imported into Switzerland from Lombardy in mid-February and subsequently spread to several locations in Switzerland before reaching the military barracks and leading to a major outbreak. The same study also showed that social distancing measures lead to a milder course of the disease: Protective measures such as keeping a distance and wearing masks not only reduced the risk of infection, but also reduced the symptoms in the event of an illness.



Development of the situation overview of the laboratories and support in the allocation of COVID-19 reagents

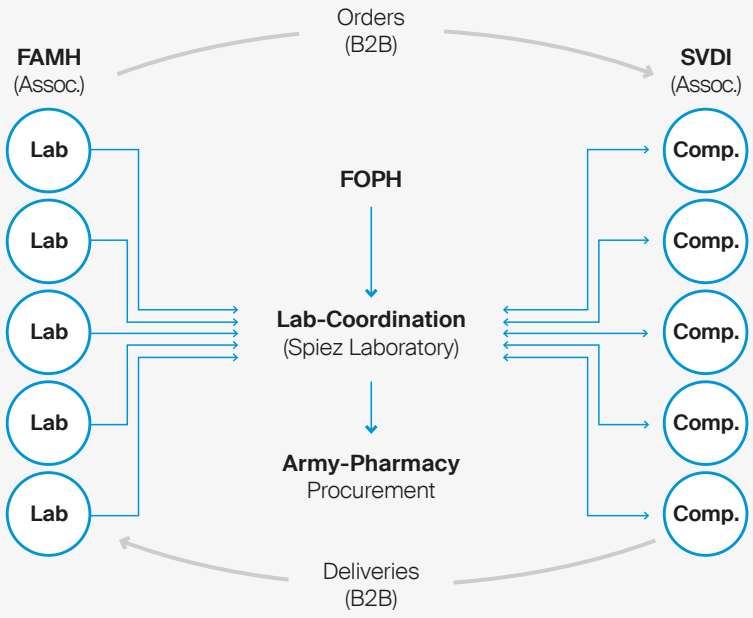
Ensuring sufficient numbers of daily tests requires the accurate and timely distribution of reagents, materials and other resources such as personnel. In a pandemic keeping track of the exact situation at public health organisations is therefore very important. However, at the beginning of the Corona pandemic, it was not even known what laboratory capacities were available in Switzerland for testing for the new SARS-CoV-2. In addition, the laboratories suffered from the worldwide shortage of reagents and materials (in vitro diagnostics) needed for the tests. Due to the mushrooming demand, the supply of the corresponding chemicals on the world market could not be guaranteed. In order to be able to maintain and, if necessary, increase laboratory capacities in Switzerland, it was essential to improve planning and coordination across Switzerland. To support and relieve the Federal Office of Public Health (FOPH) in this difficult situation, we launched a new process for tracking laboratory diagnostic capacities as early as 16 March 2020.

In its decision on the amendment of Ordinance 2 on measures to combat the Corona virus of 3 April 2020, the Federal Council then formalised this mandate. It obliged the laboratories and the suppliers of in vitro diagnostics to regularly report their current stocks to Spiez Laboratory. In addition, it gave Spiez Laboratory the mandate – when necessary and in agreement with the FOPH - to take over the allocation of in vitro dia-

Coordination of Resources

FAMH = The Medical Laboratories of Switzerland

SVDI = Swiss Association of Diagnostics Industries



gnostics for COVID-19 tests to hospitals and laboratories. In order to fulfil this responsibility, we set up a differentiated situation analysis system together with the FOPH and sector representatives from industry and laboratories. As a result, we have been monitoring the situation since the beginning of the pandemic at the approximately 80 Swiss laboratories that offer SARS-CoV-2 diagnostics.

The Federal Council and other decision-makers always had the necessary evidence-base for their decisions

With regard to suppliers, the system monitors around 30 key products for PCR tests as well as all rapid antigen tests validated in Switzerland. The resulting accurate picture of the supply chains and the overall supply situation is of central importance in order to identify possible bottlenecks in a timely manner, and to take the necessary measures together with the affected partners from industry and laboratories as well as the FOPH. For example, in the summer of 2020, when the supply of swabs was severely limited worldwide, industry partners from Switzerland and Liechtenstein were brought together to jointly launch an innovative production of swab collection kits using 3D printing. This significantly improved the supply in both countries.
Due to the increasing number of cases during the two pandemic waves in spring and autumn 2020, the testing facilities in Switzerland were sometimes exceptionally busy. In addition, the testing behaviour of the population changed frequently, reflecting in particular changes in travel behaviour. There were significant peaks before the summer holidays and again in September. In response, many laboratories had to adjust their capacities within a very short time. We were able to support them by providing them with access to reagents and equipment from the federal reserves specifically built up for the crisis. We were also able to coordinate the assistance offered by the federal laboratories - in addition to Spiez Laboratory, these include in particular the Institute of Virology and Immunology (IVI), Swissmedic, the Federal Food Safety and Veterinary Office (FSVO), Agroscope, armasuisse S+T, EMPA, Eawag, METAS, the Paul Scherrer Institute (PSI) and the Swiss Federal Institute for Forest, Snow and Landscape Research WSL - and the more than 250 member companies of the Swiss industry association scienceindustries in support of the COVID-19 laboratories. Towards the end of 2020, when the more dangerous virus variant B.1.1.7 began to spread rapidly in Switzerland, the established situation analysis system made it possible to monitor this development successfully, as the relevant testing capabilities of the laboratories could be quickly recorded and documented. As a result, the Federal Council and other decision-makers always had the necessary evidence-base for their decisions.

When conventional supply options are exhausted, sometimes unconventional solutions have to be found. As part of the National COVID-19 Science Task Force, we developed a novel online platform called Academic Resources for COVID-19 (ARC) together with the École polytechnique fédérale de Lausanne (EPFL) and ETH Zurich. Using this system, which was programmed in record time, requests from laboratories for critical equipment, reagents, consumables as well as personnel can be prioritised and then matched with existing stocks in the laboratories and warehouses of numerous academic research groups. As a result, the parties concerned are quickly connected. The platform was also built in such a way that it can be used not only in the case of a pandemic, but also in other crises for efficiently exchanging resources between many actors.

Mask shortages: Procurement and quality control in a dramatic market situation

With regard to the supply of protective medical material, Switzerland was not sufficiently prepared for the Corona pandemic. In the initial phase, the shortage in this area was probably even more pronounced than in the area of in vitro diagnostics. In particular, there was a shortage of filtering half masks (FFP2 and FFP3 masks) as well as hygiene masks (surgical or medical masks). In retrospect, it seems hardly surprising: markets around the world were experiencing a rapid increase in demand for masks. In addition, existing production and supply chains were partially disrupted. Overall and for some time, there was a confusing, dramatic market situation. In some cases, supplies destined for Switzerland were blocked by other countries.

The deficit was quickly recognised by the responsible authorities: On 20 March 2020, the Federal Council commissioned the Armed Forces Pharmacy with the procurement of important medical goods for the entire Swiss health system. This procurement order also included large quantities of filtering and hygiene masks. The Armed Forces Pharmacy endeavoured to subject the products in question to a quality check before procurement. However, laboratory quality control was a major problem: Switzerland does not have an accredited laboratory for testing masks for medical and nursing use, and the recognised laboratories in Europe were not available for Switzerland during the initial phase of the pandemic. In this situation, Spiez Laboratory stepped in: Drawing on our many years of experience and expertise in testing NBC respirators (military full-face masks, half masks and filter systems), we were able to develop a simplified, non-certified procedure for testing the quality of FFP masks and hygiene masks on an ad hoc basis. On behalf of the Armed Forces Pharmacy and the FOPH, we processed over 100 test orders for masks between March and July 2020. In this way, we were able to make an important contribution to the supply of necessary masks to Switzerland and to the efficient use of public funds: compared to other countries, the failure rate due to quality deficiencies was low in Switzerland.


Coronavirus: Switzerland is in an open dispute with Germany


The manufacture of protective masks in Switzerland is a long time coming

Federal Councillor Viola Amherd visits Spiez Laboratory in April 2020.

Requalification of expired masks and research on the reuse of disposable masks

In addition to supporting the major procurements, we were also involved in other projects to combat the mask shortage: As early as February 2020, we received orders from various federal and cantonal offices as well as from large companies in the retail trade to test the material properties of expired masks. These were mainly stocks from the time of the swine flu pandemic of 2009/2010. Based on our tests, large stocks could be released for further use - which at least temporarily alleviated the major shortage in the health and care sector at that time.

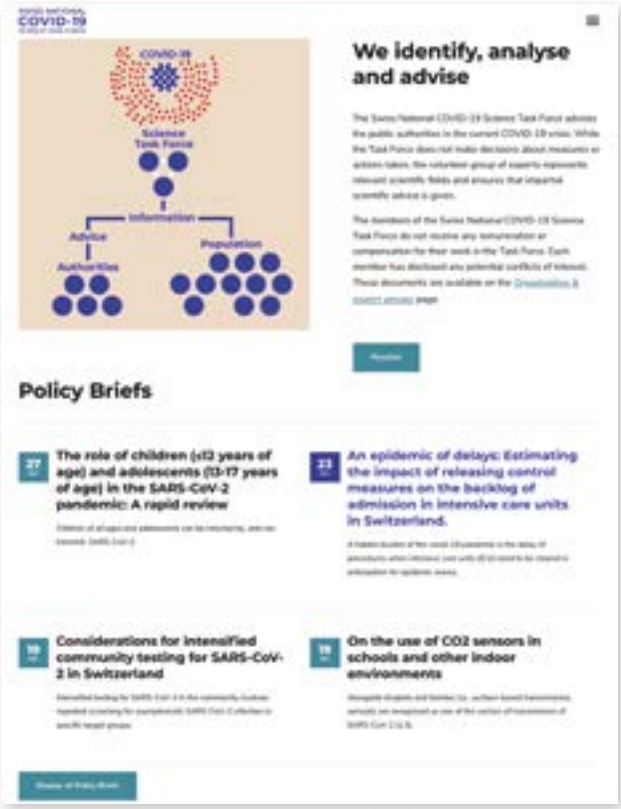
Also, as early as February 2020, the reuse of masks was being considered. In collaboration with the Swiss Society for Sterile Supply (SGSV) and various university hospitals, we investigated the material changes and separation efficiency of masks after they had been sterilised using common sterilisation methods. This showed that each method affected the quality of the disposable masks, albeit with great differences between the individual products and methods. Thus, it was hardly possible to determine a universally valid method for the reuse of masks. It was shown that overall, the reuse of disposable masks is associated with too many uncertainties and risks.

Participation in the Swiss National COVID-19 Science Task Force

At the end of March 2020, the Federal Council established the Swiss National COVID-19 Science Task Force as a scientific advisory body to support the authorities in dealing with the Corona crisis. Spiez Laboratory has been involved from the beginning in two expert groups of the task force: The head of NBC Coordination at Spiez Laboratory, Dr César Metzger, is a member of the "Diagnostics and Testing" expert group to provide scientific advice on issues related to laboratory analyses and testing in general. The head of CBRNe Protective Systems, Daniel Jordi, is a member of the «Infection, Prevention and Control» group, which was heavily involved in tackling the protective mask issue in 2020. In association with scientific partners, we were thus able to contribute our expertise in the best possible way.

In order to equip Switzerland with efficient protective material in the Corona crisis, the CBRNe Protection Systems Division is also significantly involved in the «ReMask» project. Under the leadership of the Empa Swiss Federal Laboratories for Materials Science & Technology and together with a nationwide team from research, healthcare

and industry, new mask types as well as technologies for the reuse of existing protective material are being developed - to cope with the current Corona pandemic, but also with a view to future pandemics.



Conclusion

The Corona pandemic has challenged us greatly. More or less from a standing start, we had to take on demanding and, in some cases, completely new tasks. In the area of SARS-CoV-2 diagnostics, we made a significant contribution to ensuring that the necessary know-how was available in Switzerland in good time. By taking over the coordination of laboratories, we helped to ensure that the laboratories in Switzerland always had sufficient testing capacity. Finally, with the testing of respiratory protection and hygiene masks, we were able to provide well-founded but always pragmatic and solution-oriented support for the extraordinarily difficult procurement tasks. In addition, both in the area of virology and in the area of protective masks, we were, and continue to be, involved in various research projects on COVID-19. Despite the extraordinary workload, we were able to maintain operations in the entire laboratory so that the regular daily tasks in all areas could continue to be carried out.

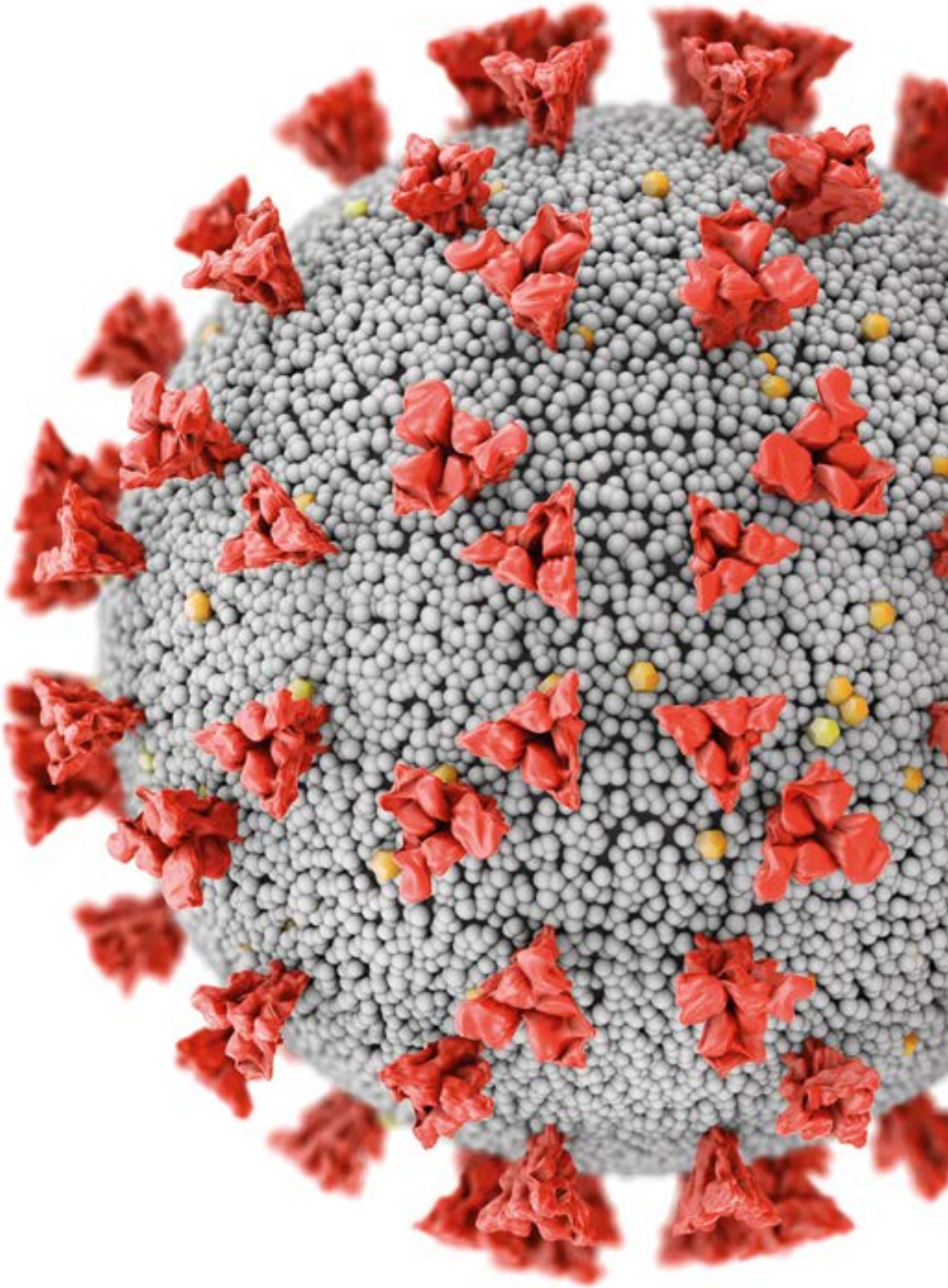
Overall, we were able to make important contributions to the management of the pandemic in Switzerland. In addition, in accordance with our mandate, we were ready at any time to implement other missions as well.

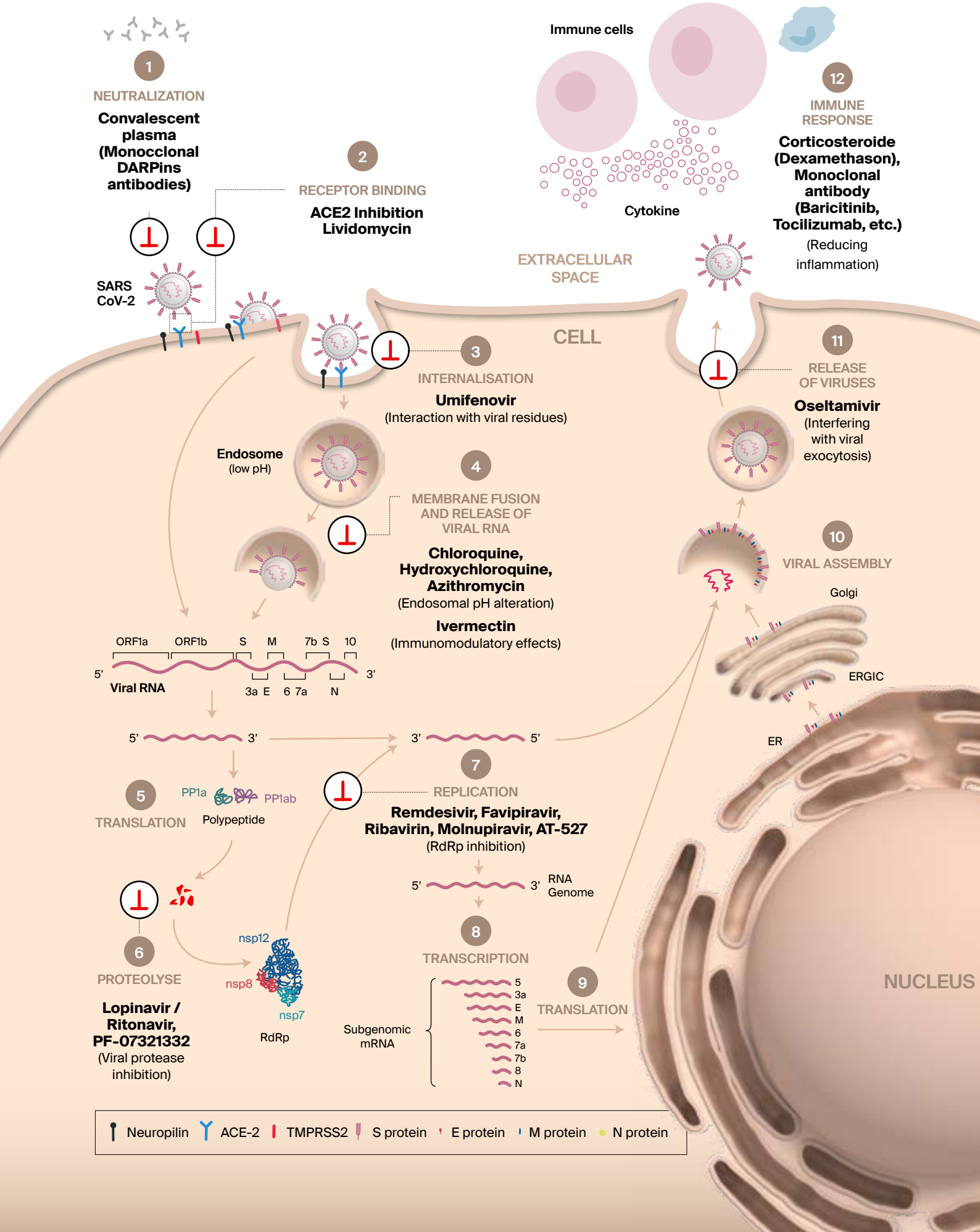
02 Evaluation of antiviral substances against SARS-CoV-2 in cell culture systems

Because SARS-CoV-2 is a virus with increased pathogenicity, therapeutic options can only be tested directly on the virus in a level 3 biosafety laboratory (BSL3). In Spiez we have a biosafety laboratory and the necessary experience in dealing with highly pathogenic viruses. Early on, the Biology Division was involved in a number of projects to develop antiviral strategies: In collaboration with the company Molecular Partners and the University of Lausanne, we are pursuing the development of virus-neutralising DARPins. In collaboration with Epithelix and the Bill and Melinda Gates Foundation, we are testing pre-selected virus inhibitors and evaluate them in various combinations. Furthermore, in national and international research collaborations, we are testing a variety of natural substances and synthetic molecules in cell culture systems for their effect against SARS-CoV-2.

Olivier Engler
Hulda R. Jonsdottir

SARS-CoV-2 has many similarities with other viruses in terms of its infection and replication cycle. Therefore, the efforts of the international research community to find an antiviral therapy against SARS-CoV-2 were primarily based on strategies and substances that had already been developed and approved for other viral diseases or infectious diseases in general. Secondly and thirdly, other collections of approved substances were evaluated, and new substances were specifically developed.




1
NEUTRALIZATION
Convalescent plasma (Monocclonal DARPins antibodies)
2
RECEPTOR BINDING
ACE2 Inhibition
Lividomycin
SARS CoV-2
Immune cells
Cytokine
12
IMMUNE RESPONSE
Corticosteroide (Dexamethason), Monoclonal antibody (Baricitinib, Tocilizumab, etc.)
(Reducing inflammation)
EXTRACELULAR SPACE
CELL
3
INTERNALISATION
Umifenovir
(Interaction with viral residues)
11
RELEASE OF VIRUSES
Oseltamivir
(Interfering with viral exocytosis)
Endosome
(low pH)
4
MEMBRANE FUSION AND RELEASE OF VIRAL RNA
Chloroquine, Hydroxychloroquine, Azithromycin
(Endosomal pH alteration)
Ivermectin
(Immunomodulatory effects)
10
VIRAL ASSEMBLY
Golgi
ERGIC
ER
ORF1a ORF1b S M 7b S 10
5'
3'
Viral RNA
3a E 6 7a N
5' 3'
3' 5'
5
TRANSLATION
PP1a
PP1ab
Polypeptide
7
REPLICATION
Remdesivir, Favipiravir, Ribavirin, Molnupiravir, AT-527
(RdRp inhibition)
5' 3'
RNA Genome
8
TRANSCRIPTION
6
PROTEOLYSE
Lopinavir / Ritonavir, PF-07321332
(Viral protease inhibition)
nsp12
nsp8
nsp7
RdRp
Subgenomic mRNA
5
3a
E
M
6
7a
7b
8
N
9
TRANSLATION
NUCLEUS
Neuropilin
ACE-2
TMPRSS2
S protein
E protein
M protein
N protein

Starting points for a therapy against SARS-CoV-2

A first starting point for therapeutic strategies is to target the stage shortly before infection, when the virus hits the mucous membranes in an aerosol or is released after a replication cycle (1). At this point, neutralising substances can prevent the virus from entering the cell. Antibodies (REGEN-COV* and Bamlanivimab, Etesevimab), but also synthetic neutralising molecules, such as DARPin molecules (Ensovibep*) or soluble ACE-2 receptors, which bind to the spike (S) protein and thus prevent attachment to the cellular receptor, are suitable for neutralising viruses outside the cell (2). A variety of synthetic substances (e.g., Umifanovir*) or substances of natural origin (e.g. Echinacea*) show a virus-neutralising effect or inhibition of virus uptake into the cells in the cell culture system (3).

Once the virus has bound to the receptor, the further steps of viral replication are considered possible points of intervention for antiviral substances, from virus uptake into the cell via cellular vesicles (endosomes), the release of the viral genome from the vesicles into the cytoplasm (e.g., by chloroquine, hydroxychloroquine, azithromycin) (4), synthesis and cutting into the finished viral proteins (proteolytic cleavage; e.g., by lopinavir*/ritonavir*) (6) and via replication of the viral genome (replication; e.g., by nucleotide analogues remdesivir*, faviparivir, ribavirin, molnupiravir * and AT-527) (7) and the assembly of the viruses (10) as well as the shedding (exocytosis; e.g. by oseltamivir) (11).

Another important therapeutic approach is to mitigate the secondary effects of viral infection. In particular, the systemic calming of the immune system by glycocorticoids (e.g., dexamethasone) and interferons (interferon ⍰*) or more specifically by blocking certain cytokines (messenger substances: e.g., anti-IL6 antibody tocilizulimab) are used therapeutically (12).

In collaboration with the Bill and Melinda Gates Foundation and Epithelix®, we have evaluated a selection of these molecules in special cell culture systems (substances marked with *). In collaboration with Molecular Partners, we supported the development of virus-neutralising DARPin molecules and, together with international partners, we investigated synthetic molecules and natural compounds for their virus-inhibiting effect.

We investigate artificial molecules and natural compounds for their virus-inhibiting effect

© Spiez Laboratory

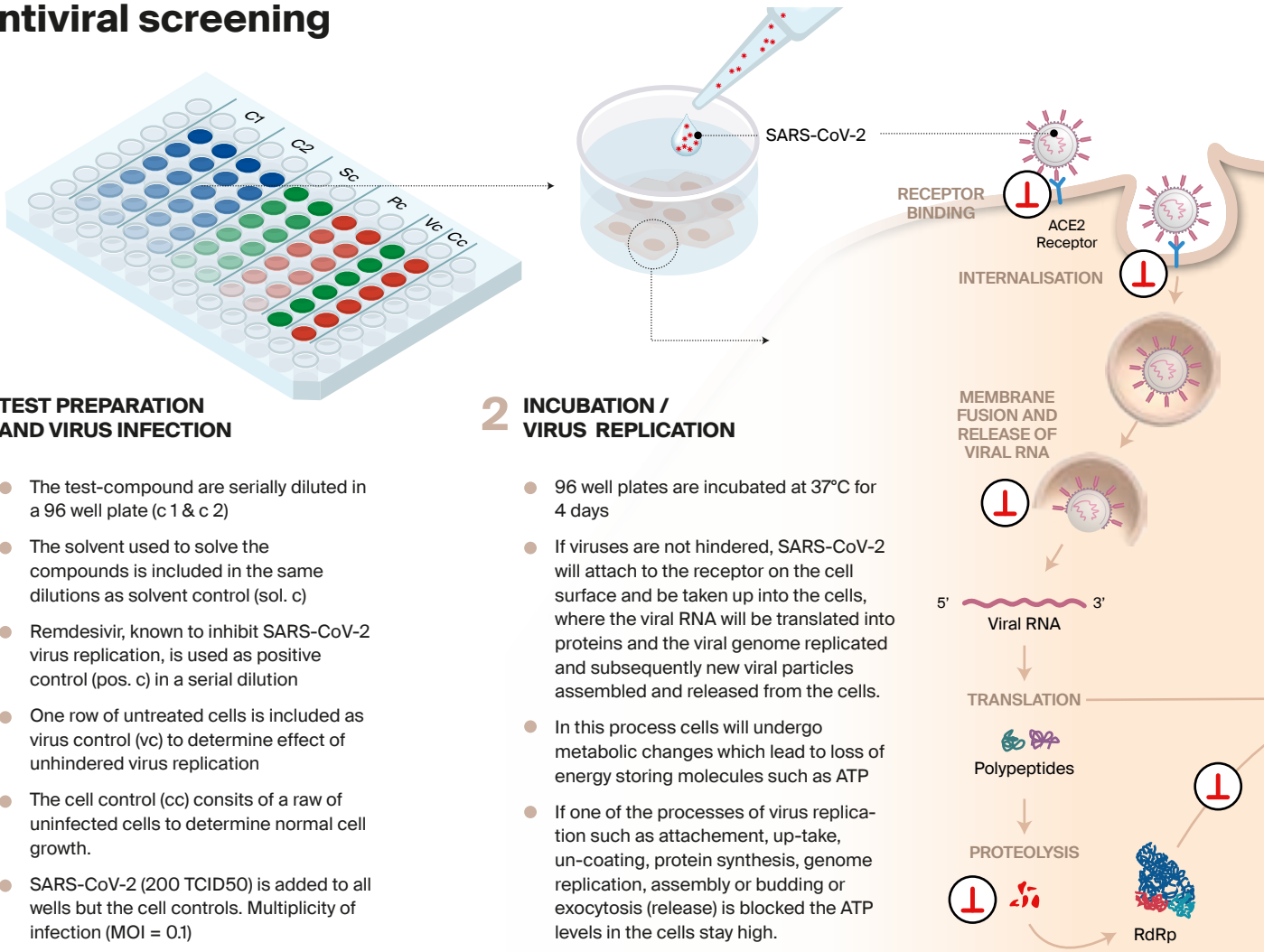
Evaluation of antiviral substances

For the evaluation of antiviral substances as a therapeutic option, we established targeted virus/cell culture test systems. Two important test systems are explained below:

The «Antiviral Screen Assay» using CellTiterGlo® was established for screening potential active substances and for an initial determination of the therapeutic window.

In this assay format, the substances to be tested are added to Vero E6 cells (tumour cell line from monkey kidney) together with SARS-CoV-2 viruses and incubated at 37°C for 4 days. Under the given conditions, the viruses infect the cells and undergo several replication cycles, during which the Vero E6 cells die. The state of the cells can be determined by the content of the energy carrier adenosine triphosphate (ATP) in the cells, whereby the ATP content is measured using the enzymatic luminescence assay CellTiterGlo®. If one of the evaluated substances prevents the entry of the virus into the cell or the replication of the virus, this has an influence

Antiviral screening



1 TEST PREPARATION AND VIRUS INFECTION

- The test-compound are serially diluted in a 96 well plate (c 1 & c 2)
- The solvent used to solve the compounds is included in the same dilutions as solvent control (sol. c)
- Remdesivir, known to inhibit SARS-CoV-2 virus replication, is used as positive control (pos. c) in a serial dilution
- One row of untreated cells is included as virus control (vc) to determine effect of unhindered virus replication
- The cell control (cc) consits of a raw of uninfected cells to determine normal cell growth.
- SARS-CoV-2 (200 TCID50) is added to all wells but the cell controls. Multiplicity of infection (MOI = 0.1)

2 INCUBATION / VIRUS REPLICATION

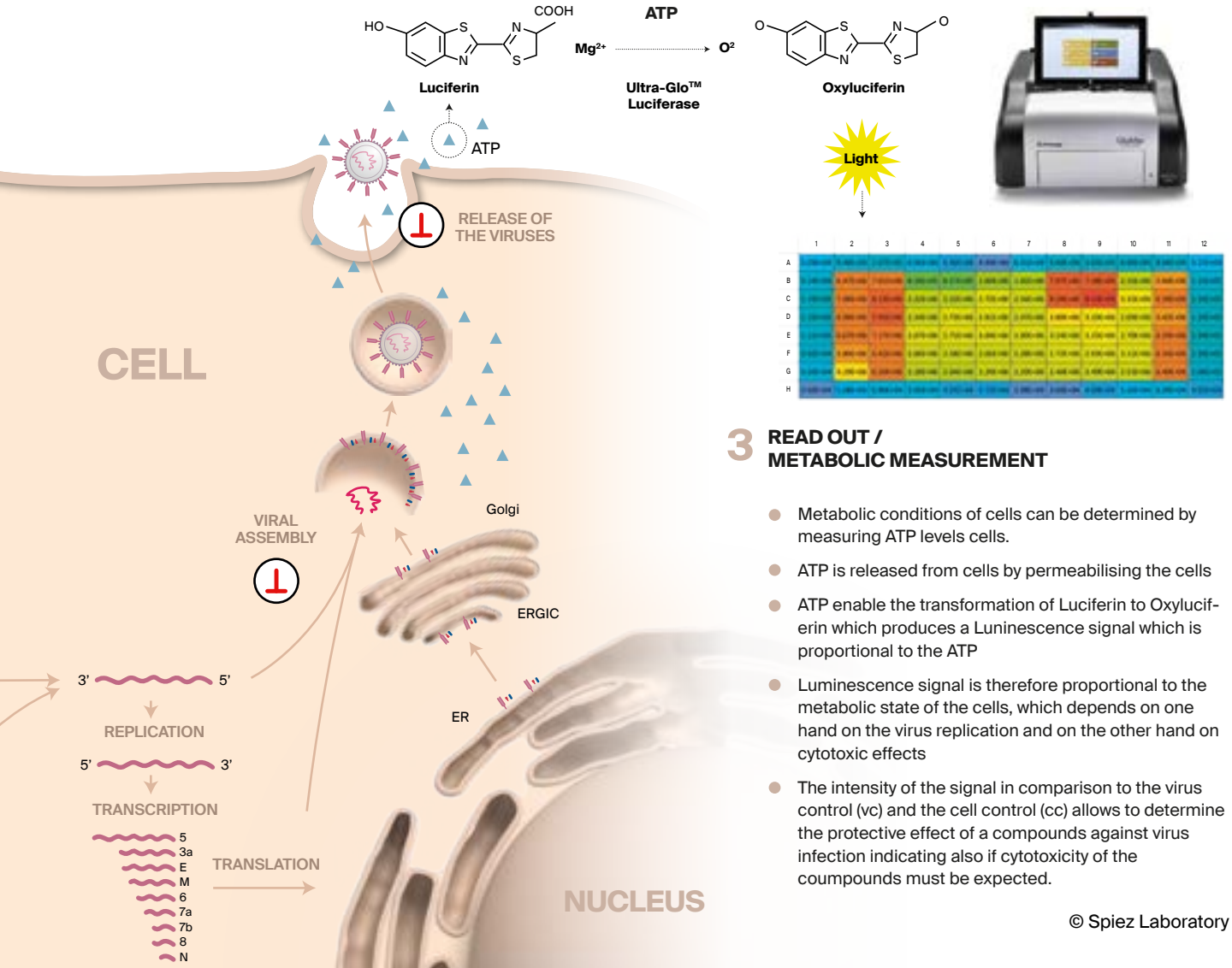
- 96 well plates are incubated at 37°C for 4 days
- If viruses are not hindered, SARS-CoV-2 will attach to the receptor on the cell surface and be taken up into the cells, where the viral RNA will be translated into proteins and the viral genome replicated and subsequently new viral particles assembled and released from the cells.
- In this process cells will undergo metabolic changes which lead to loss of energy storing molecules such as ATP
- If one of the processes of virus replication such as attachement, up-take, un-coating, protein synthesis, genome replication, assembly or budding or exocytosis (release) is blocked the ATP levels in the cells stay high.

on the state of the cells, which in turn can be measured by the CellTiter-Glo® assay showing a stable ATP content. By using a well-defined range of concentrations, the CellTiterGlo® assay can be used to narrow down the antiviral activity and to approximate the IC50 (the concentration that reduces viral activity to 50%). We used this method to assess the neutralising effect of DARPin molecules on infectious viruses.[1] By comparing the IC50, the most efficient DARPin molecules could be selected and specifically developed further (Ref BioRxiv). Similarly, the inhibitory activity (IC50) of neutralising molecules can be determined for different virus concentrations, and the effect against emerging SARS-CoV-2 variants can be continuously evaluated (Ref BioRxiv).[2]

The assay is also suitable for screening collections of synthetic molecules or natural substances for potential antiviral activity against SARS-CoV-2. For use as a screening assay, the number of measured concentrations is reduced to a minimum so that a larger number of substances can be evaluated. In an analogous cell toxicity assay, the toxic effect of the substances (without the virus) on the cells is determined. This makes it possible to determine an approximate therapeutic range for the sub-

(1) Highly potent anti-SARS-CoV-2 multi-DARPin therapeutic candidates

(2) Multi-specific DARPin® therapeutics demonstrate very high potency against mutated SARS-CoV-2 variants in vitro



3 READ OUT / METABOLIC MEASUREMENT

- Metabolic conditions of cells can be determined by measuring ATP levels cells.
- ATP is released from cells by permeabilising the cells
- ATP enable the transformation of Luciferin to Oxyluciferin which produces a Luninescence signal which is proportional to the ATP
- Luminescence signal is therefore proportional to the metabolic state of the cells, which depends on one hand on the virus replication and on the other hand on cytotoxic effects
- The intensity of the signal in comparison to the virus control (vc) and the cell control (cc) allows to determine the protective effect of a compounds against virus infection indicating also if cytotoxicity of the coumpounds must be expected.

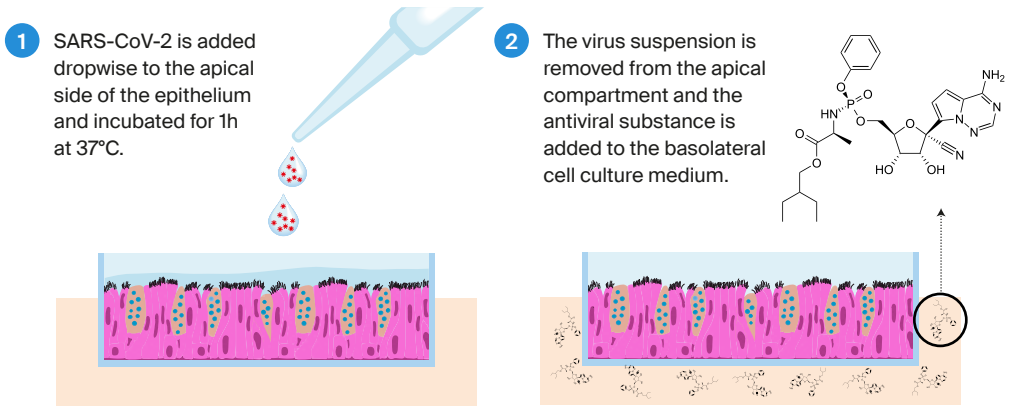
stances – or the effective concentration range in the cell culture system that is non-toxic. Certain clarifications of the mechanism of action of the substances are also possible in this way. For example, by adding the active substance at different times, it can be assessed whether the substance acts more on extracellular viruses or on the surface of the cells, or whether the effect is maintained even after the viruses have been absorbed into the cell.

Evaluation of antiviral substances in reconstituted respiratory epithelia

To replicate respiratory virus infection studies in a true-to-nature environment, infections can be simulated with an in vitro reconstituted human epithelium, the primary entry site of respiratory viruses. Epithelial cultures representing different sections of the human respiratory tract can be replicated in the laboratory. For SARS-CoV-2, we mainly used reconstituted nasal epithelium to mimic the initial site of infection (the portal of entry) of SARS-CoV-2. The reconstituted nasal epithelium is a sensitive cell culture system and thus, this system allows an accurate determination of the toxicity of antiviral substances, in advance of other tests.

After infection with SARS-CoV-2, virus replication can be measured in different areas of the cell culture. Over several days, virus secretion can be followed by real-time RT-PCR and, at the end of the experiment, the remaining viruses within the cell can also be quantified. In addition to quantifying the number of viral genomes, the number of infectious viruses in the cell culture is also determined for selected substances. A major advantage of the reconstituted respiratory epithelium is that the viruses trigger an immune response in these primary cells similar to that in the patient. The production and release of proteins that influence the immune response, e.g., cytokines, can be quantified by standard immunoassays (ELISA) or gene expression analysis (qPCR).

We have investigated the efficacy of the substances with regard to three aspects of the SARS-CoV-2 infection: firstly, the influence on the multiplication of the viruses (replication), secondly, the change in the integrity of the epithelial barrier and thirdly, the influence on the production and release of various cytokines.



Due to the polarity of the respiratory cell culture system, infection can take place as in natural transmission by droplets from the air-facing, upper (apical) side. Therapeutic intervention takes place after one hour from the lower side, simulating administration via the blood. After two and three days, we examine viral replication in the cells and in the secreted supernatant, we determine the integrity of the epithelial barrier and the secretion of cytokines.

When an antiviral substance is effective, we observe a decrease in viral replication and an increase in epithelial barrier integrity. Both the integrity of the epithelial barrier and the reduction in the release of immunomodulatory mediators are important prerequisites to control the disease symptoms and should be a primary goal of effective therapy.

Over the past year, in collaboration with Epithelix Sàrl in Geneva and the Bill and Melinda Gates Foundation (BMGF), we have tested a wide range of compounds and combinations thereof. New drugs take a long time to develop, and in acute situations, repurposing already approved drugs to treat COVID-19 becomes a priority. We have tested around 100 such already approved compounds and combinations for their antiviral activity against SARS-CoV-2. As shown in clinical trials, very few compounds are effective as monotherapy, highlighting the need for treatment with a combination of drugs against COVID-19.

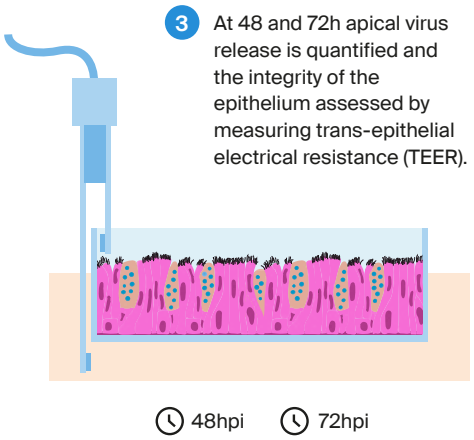
Outlook

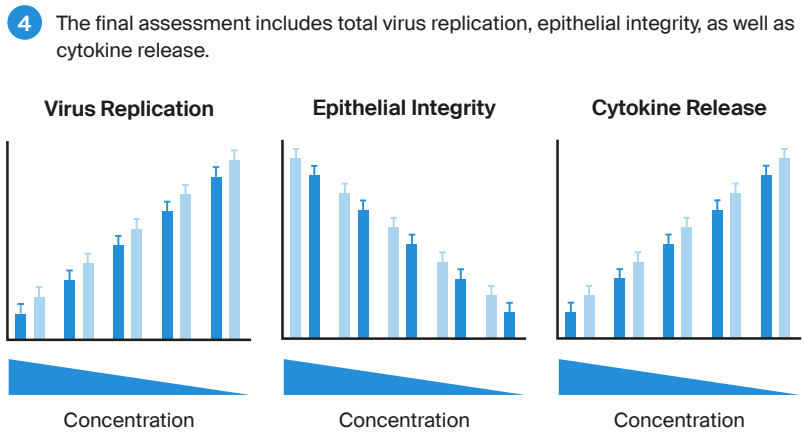
The in vitro test results from virus culture systems form an important basis for decision-making for further studies in animals and humans. Early publications of analytical data on various substances worldwide have shown that the results vary depending on the test system and can also lead to exaggerated expectations.

In times of a pandemic, this can lead to a lot of energy being invested in unnecessary clinical tests due to exaggerated expectations, or even to substances being given prematurely to patients.

Standardisation of in vitro test systems should help to present results in the right light and to be able to compare results between laboratories. Spiez Laboratory is in contact with various institutions to achieve better standardisation of test systems.

In a reconstituted respiratory epithelium the viruses trigger an immune response similar to that in the patient





03

3 Testing laboratory for the determination of radionuclides and elemental analysis

Spiez Laboratory has maintained accredited test laboratories in the field of nuclear chemistry for almost 30 years. Our current test facility STS 0028 with its highly developed measuring capacity and analytical diversity is focused on the determination of radionuclides and their content in any type of sample material. It is also one of the few testing facilities in Switzerland that is also accredited for sampling. We provide our services to both national and international partners. Our designation as an IAEA Collaborating Centre is based to a significant degree on the services provided by the testing laboratory.

Mario Burger

Switzerland was one of the first countries to allow three types of flexibility for testing bodies. While type A accreditation is based on clearly defined test procedures, type B allows for a modification of the prescribed test procedures. Type C is an accreditation based on defined technologies and measurement principles and allows the testing laboratory to include new test methods in the scope of its accreditation without prior assessment by the Swiss Accreditation Service (SAS). The testing laboratory STS 0028 is accredited according to type C. The comprehensive scope of accreditation can be found in the officially published STS directory of the SAS (www.sas.admin.ch).

The first accreditation of a testing laboratory in the field of nuclear chemistry took place as early as 1993. Since then, we have made our expertise available to various national and international partners. In the process, the testing laboratory has continuously enhanced its capabilities. The test methods and the range of tests have been continually adapted and expanded in order to integrate and apply new, future-oriented technologies. For example, in radio analysis and inorganic analysis and mass spectrometric testing methods in particular are now established which have enabled a great increase in efficiency. Twenty years ago, we needed around 4 to 5 weeks to determine ura-

International Missions

1 **1997** **Bosnia and Herzegovina**. Water processing plant (OSCE)

2 **2001** **Bosnia and Herzegovina**. DU-Contamination (UNEP)

3 **2001** **Serbia and Montenegro**. DU-Contamination (UNEP)

4 **1999-2001** **Albania**. Destruction of toxic chemicals (NATO)

2004 **Albani.** Chemical weapons analysis (CISP/FDFA)

5 **1999** **Albania**. Drinking water analysis (SDC)

6 **1999-2000** **Kosovo**. DU-Contamination (UNEP)

7 **1998** **Kosovo**. Drinking water analysis (SHA)

8 **2000** **Romani.** Cyanide contamination (UNEP/OCHA)

9 **2000** **Romania**. Mining waste contamination (UNEP/OCHA)

2017 **Bulgaria**. Regional Workshop on Sampling Procedures for Water and Sediment

10 **2009** **Gaza**. Environmental assessment (UNEP)

11 **2000** **Palestine**. Drinking water analysis (UNEP)

12 **2006-2007** **Lebano.** DU-Munitions usage (UNEP)

2020 **Lebanon**. Provision of assistance in radiation-related matters following the explosion in Beirut Port

13 **1999** **Jordan.** Training of Iraqi inspectors (UNMOVIC)

2004 **Jordan**. Training of Iraqi inspectors in DU Assessment (UNEP)

2018 **Jordan.** Regional Training on Assessment of Water Resources Based on Environmental Isotopes and other Related Techniques (IAEA)

14 **2013** **Syria**. Monitoring CW-Destruction (UNEP)

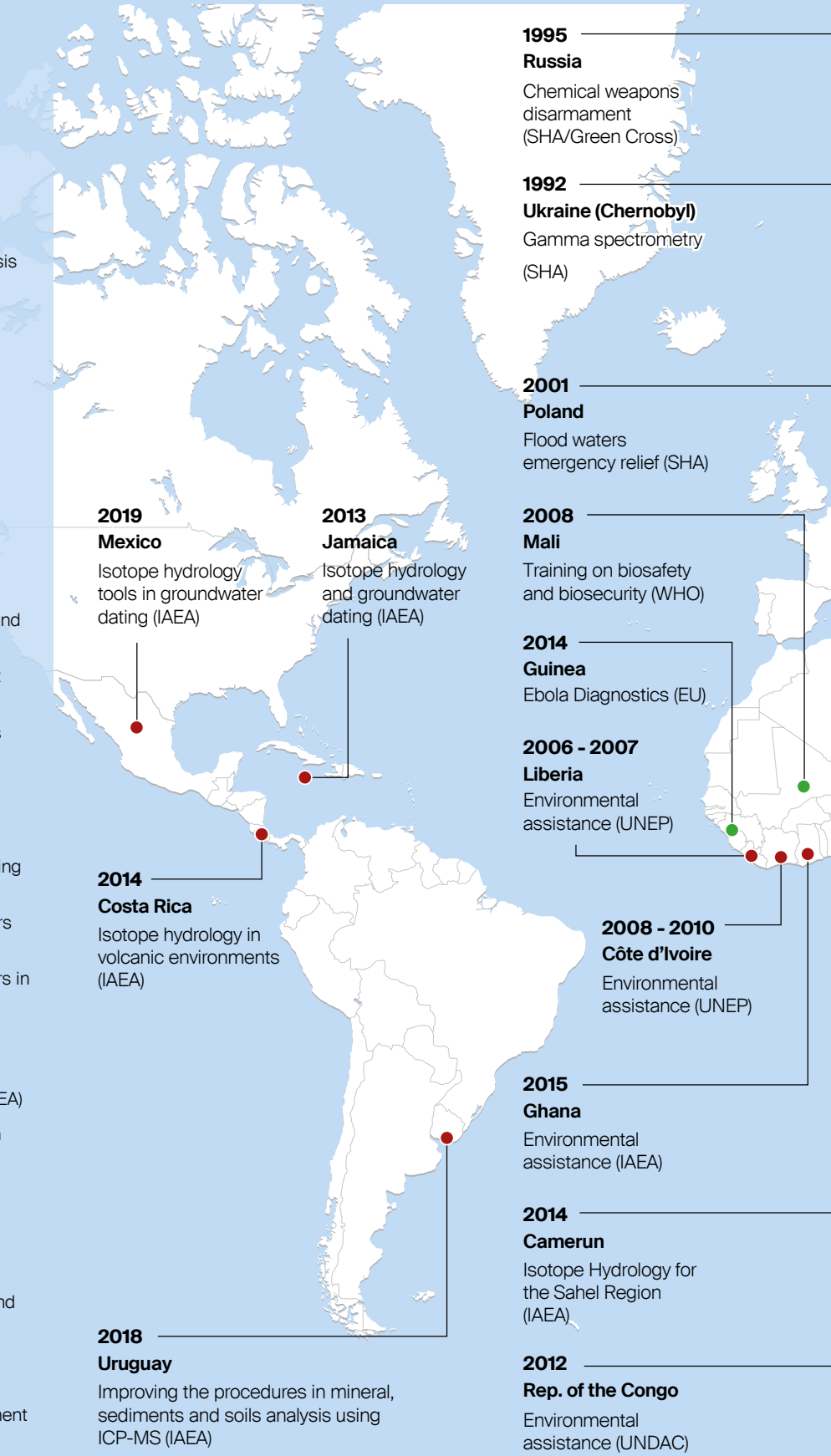
15 **1991-1999** **Iraq**. Use of bio-weapons and disarmament (UNSCOM)

16 **1984** **Iraq**. Use of chemical weapons (UN)

1991-1999 **Iraq**. Use of chemical weapons and disarmament (UNSCOM)

17 **2003-2006** **Iraq**. DU-Contamination (UNEP)

18 **2018** **Iraq**. Contaminated Site Assessment and Training Workshops



1995
Russia
Chemical weapons disarmament (SHA/Green Cross)

1992
Ukraine (Chernobyl)
Gamma spectrometry (SHA)

2001
Poland
Flood waters emergency relief (SHA)

2019
Mexico
Isotope hydrology tools in groundwater dating (IAEA)

2013
Jamaica
Isotope hydrology and groundwater dating (IAEA)

2008
Mali
Training on biosafety and biosecurity (WHO)

2014
Guinea
Ebola Diagnostics (EU)

2006 - 2007
Liberia
Environmental assistance (UNEP)

2014
Costa Rica
Isotope hydrology in volcanic environments (IAEA)

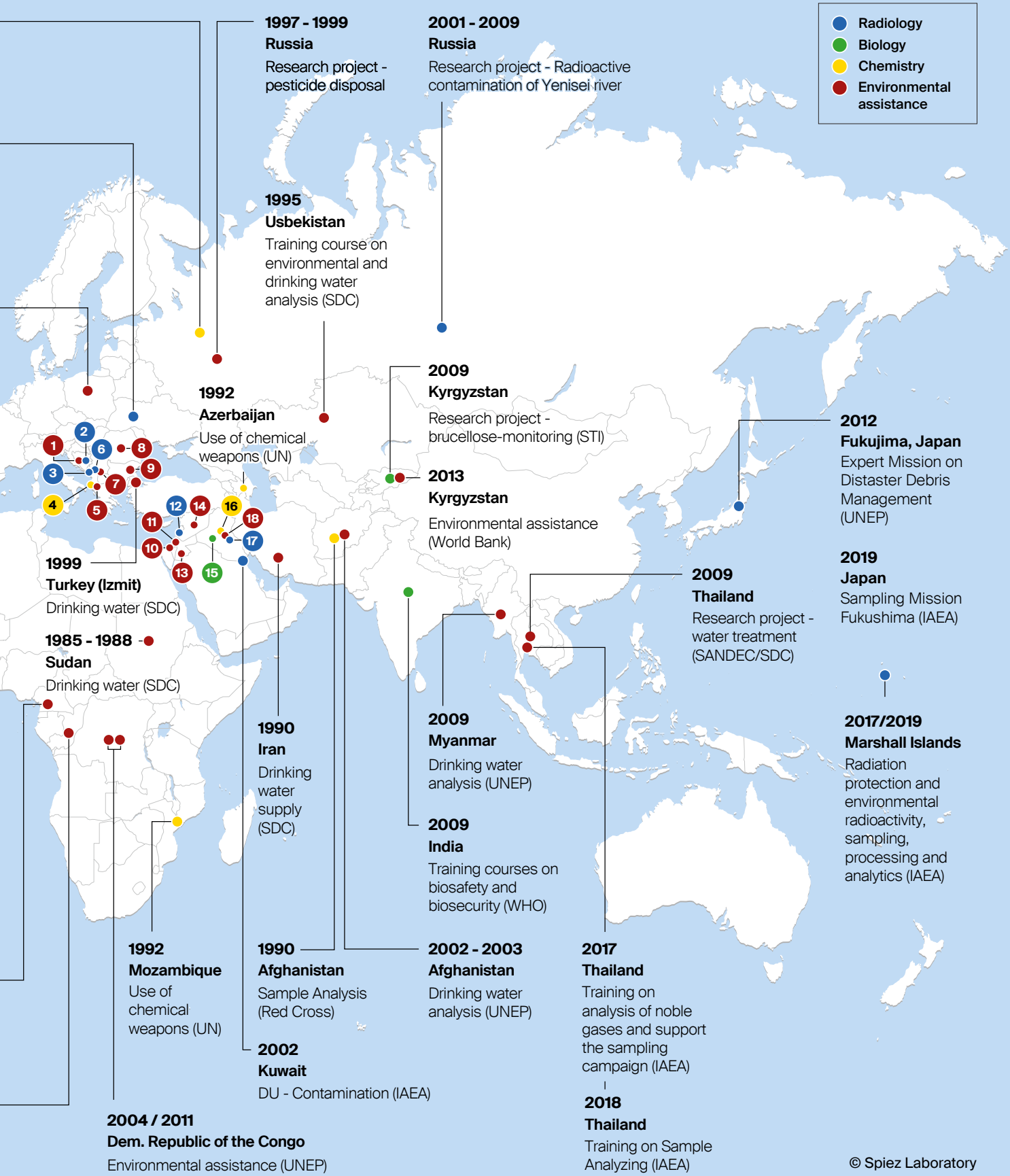
2008 - 2010
Côte d'Ivoire
Environmental assistance (UNEP)

2015
Ghana
Environmental assistance (IAEA)

2014
Camerun
Isotope Hydrology for the Sahel Region (IAEA)

2018
Uruguay
Improving the procedures in mineral, sediments and soils analysis using ICP-MS (IAEA)

2012
Rep. of the Congo
Environmental assistance (UNDAC)



STS 0028 is one of the few testing bodies in Switzerland that is also accredited for sampling

nium in 10 mineral waters using classical radiochemical separation methods and depositing the uranium from the pure eluate onto a steel plate for alpha spectrometry. Today, the same analyses can be done in less than 2 hours.
An important milestone was the merger of two testing laboratories which were active until 2016: STS 028: Testing laboratory for the determination of radionuclide contents, and STS 101: Testing laboratory for the determination of major and trace elements as well as selected air pollutants, to form the currently active testing laboratory STS 0028: Testing laboratory for the determination of radionuclides and element analysis. This amalgamation was carried out for reasons of efficiency and in view of the technologies applied.

STS 0028 is one of the few testing bodies in Switzerland that is also accredited for sampling. These requirements have become increasingly stringent in recent years - which is professionally correct and important. Correct sampling is essential so that accurate, meaningful and statistically viable statements can be made when dealing with environmental issues, remediation etc. The ability to take samples correctly is critical also to the testing laboratory's ability to deal with a radiological event. Today, results from food and feedstuff samples can be compiled and made available to the relevant authorities within hours - rather than days or weeks. The same applies to cases of environmental contamination by heavy metals or other substances. The authorities can react quickly and review or expand measures already taken.

These enhancements, however, do not come free of charge: The standard as well as the accreditation authority places comprehensive requirements on the measurement equipment and on the organisation of the testing laboratory. Today, STS 0028 works on the basis of 113 specific regulations and 34 superordinate regulations and guidelines within the quality management system of Spiez Laboratory. The technologies are all based on highly specialised electronic, computer-based high-end equipment. The integration of new analysis technologies is usually associated with great efforts for the testing laboratory. The division also regularly provides technical experts to the SAS, and is represented in the Chemistry Sector Committee of the SAS.

For years, we have also been providing the services of the testing laboratory STS 0028 internationally. The designation of Spiez Laboratory as an IAEA Collaborating Centre is based largely on the services of the testing laboratory. We regularly work on complex IAEA projects that require the precise work of STS 0028. In recent years, we have been involved in international missions, analyses and capacity building in Fukushima, on the Marshall Islands (to deal with the consequences of past nuclear tests by the USA), in the Gulf of Mexico and in Lebanon.

In addition, we are very active in the IAEA laboratory network (ALMERA) and in technical cooperation projects. Central to this is the promotion of the competences of the participating laboratories, not least with regard to accredited laboratory activities. The laboratories participating in the network are given access to standardised test procedures for the determination of specific radioisotopes (e.g., according to ISO/EN 17025). Together with another IAEA Collaborating Centre, we are involved in the development of such test methods. Based on these achievements, Spiez Laboratory was re-designated as a Collaborating Centre by the IAEA in 2021 for a second period until 2025.

In addition to the IAEA, the United Nations Environment Programme (UNEP) is an important international partner. For example, we were able to provide evidence-based information on the problem of depleted uranium ammuni-

tion for regions in the Balkans, but also in Iraq, Kuwait and Lebanon. To this end, we have carried out comprehensive assessments in each case: from the correctly performed sampling to the standard-compliant analysis in radiochemistry and inorganic chemistry to the publication of the results. Based on these assessments, several countries have redefined the guidelines for the handling of this type of ammunition by their armed forces. Furthermore, we have used the analytical competence of STS 0028 in more than 20 international UNEP missions on environmental pollution with heavy metals and other substances, especially in the area of drinking water quality. Overall, we were able to make an important contribution to clarifying the hazards and improving the living conditions in the affected regions.

Spiez Laboratory and its STS 0028 also perform a wide range of tasks for various partners in Switzerland. Within our own Department of Defence, Civil Protection and Sport (DDPS), we cooperate closely on environmental issues with the Competence Centre Soil Protection of armasuisse and with environmental assessments for the General Secretariat DDPS. We regularly collect samples and carry out analyses in the context of projects for the conversion or decommissioning of military training areas. Furthermore, we carry out monitoring tasks and impact assessments with regard to military firing ranges and installations; we also support the armed forces in assessing the impact of new types of ammunition on the environment.

In the STS 0028 testing laboratory, focus is on the determination of radionuclides and their content in any type of sample material. The highest radioanalytical challenge lies in nuclear forensics, which we as a nationally designated laboratory have established for such analyses. Here, ultra-low-level radioanalysis - mostly based on mass spectrometry - is used following complex separation procedures. The aim is to be able to determine the history of a specific nuclear material (e.g., uranium) from its origin (determination of the mining site) to its reprocessing history on the basis of isotope ratios. By far the three most important institutes of the sampling and measurement organisation (MO) in the case of increased radioactivity in Switzerland are the Paul Scherrer Institute (PSI), the Institut Radiophysique Appliquée (IRA) in Lausanne, and Spiez Laboratory with its testing laboratory STS0028. Without a question, the highest measurement capacity and analysis diversity amongst them resides in Spiez, especially since, in the event of an incident, the military laboratory unit (NBC Defence Laboratory 1) can be called upon to render assistance. The approximately 60 N-specialists of NBC Defence Laboratory 1 are trained by the Nuclear Chemistry Division in the necessary routine analysis based on accredited test procedures. The members of the armed forces can be deployed for this purpose in Spiez Laboratory as well as in a military facility that is always in operation. In this way, Switzerland has accredited test results at its disposal in every phase of an incident.

For all analytical methods, one central principle has always applied in the Nuclear Chemistry Division and generally at Spiez Laboratory: the key to trust, transparency and comparability lies in professional competence, coupled with accreditation that is continuously lived. In this spirit, the management of the testing laboratory STS 0028 has acquired a high level of competence over the years. We will carry on developing the testing facility STS 0028 also in coming years so that we can continue to offer our services to our national and international partners at the highest level.

The highest radioanalytical challenge lies in nuclear forensics, which we as a nationally designated laboratory have established for such analyses

04 CWC: New tasks for Spiez Laboratory

As a result of the use of nerve agents of the Novichok-class, these substances were included in the so-called Schedule 1 of the Chemical Weapons Convention. This schedule contains chemicals that can be developed, produced, stockpiled or used as chemical weapons. This extension of Schedule 1 has consequences for the OPCW, the States Parties and their institutions affected by it. Thus, Spiez Laboratory has to cope with a whole range of new tasks and challenges. Several research and development projects have been launched to this end.

Christophe Curty
Beat Schmidt

On 4 March 2018, the former Russian double agent Sergei Skripal and his daughter Yulia were found unconscious on a park bench in Salisbury, UK. Both suffered from severe poisoning. Investigation results of the British authorities strengthened the suspicion that they were victims of a targeted attack. According to the investigations of a British laboratory, the Skripals as well as a police officer who was in Sergei Skripal's house during the investigation had come into contact with a nerve agent of the so-called Novichok-class. Two other people in nearby Amesbury came into contact with the same substance, which was contained in a perfume sprayer. One of these individuals from Amesbury died in hospital a few days later. The Skripals, the police officer and the other person from Amesbury survived the poisoning.

The Organisation for the Prohibition of Chemical Weapons (OPCW) later confirmed the results of the British laboratory: the Skripals, the police officer and the two accidental victims had been poisoned with a Novichok-class nerve agent.

The chemicals belonging to the Novichok-class are said to have been developed between the early 1970s and the 1990s in the then Soviet Union within the framework of the so-called Foliant Programme at the Moscow GosNIIOKhT Institute (State Research Ins-


1 العربية
2 中文
3 English
4 Français
5 Русский
6 Español
OPCW

titute for Organic Chemistry and Technology).[1] Vil Mirzayanov, according to his own statements a former employee of the Soviet chemical weapons programme, had revealed the existence of these substances and their high toxicity in his 2008 book.[2]

The Chemical Weapons Convention (CWC) is a legally binding treaty under international law that establishes a comprehensive ban on chemical weapons for its 193 States Parties. The development, production, stockpiling and use of chemical weapons are prohibited. The CWC contains a list of toxic chemicals in its Annex on Chemicals. Of particular importance is Schedule 1, which contains chemicals that can be developed, produced, stockpiled or used as chemical weapons. The chemicals of the Novichok-class did not appear on this list until recently, as they were never officially declared by the Soviet Union and later by Russia. Until the Skripal attack, there was also very little openly accessible information on the novel nerve agents. Neither was there a public debate on the subject: the concern about proliferation and that the nerve agent could be spread and used as a terror weapon was too great.

After the Skripal attack, however, this restraint was no longer possible. Even if the chemicals of the Novichok-class were not listed in Schedule 1 of the CWC, the OPCW nevertheless describes the deliberate poisoning of a person with a nerve agent as the use of a chemical weapon. In its conclusion, the OPCW therefore unequivocally classified the incident as a violation of the CWC. Since then, several countries

The OPCW describes the deliberate poisoning of a person with a nerve agent as the use of a chemical weapon

have accused the Russian secret services of having carried out this attack (using the nerve agent originally developed in the Soviet Union, according to Mirzayanov). Moscow rejects these accusations to this day.

In October 2018, Canada, the Netherlands and the USA submitted a request to extend Schedule 1 of the CWC: two families of Novichok chemicals were to be added to this list. Russia responded with its own proposal: it wanted to add three more families of chemical warfare agents (one Novichok family and two others) to the banned list in addition to the two proposed families. These included families of chemical warfare agents that had been developed in the USA. According to the OPCW, one of the chemical warfare agent families proposed by Russia did not meet the guidelines for inclusion in Schedule 1. After lengthy negotiations, delegates agreed by consensus on 27 November 2019 at the annual Conference of States Parties of the CWC to accept both proposals in principle. As a result, four new families of millions of chemicals were added to Schedule 1 of the CWC. This decision marks the first significant change to this Schedule 1 since the entry into force of the Convention in 1997.

This political decision has implications for the OPCW and for States Parties. In a letter dated December 2019, the OPCW informed all States Parties that the amendments to Schedule 1 of the CWC must be implemented nationally by 7 June 2020. Switzerland took the necessary steps in due time and included a revised CWC text in the official collection of laws and amended the Chemicals Control Ordinance accordingly. In addition, the affected industrial companies were informed about the

Switzerland included a revised CWC text in the official collection of laws and amended the Chemicals Control Ordinance accordingly

Glovebox in the chemical safety laboratory

(1) Jonathan B. Tucker, The Future of Chemical Weapons, The New Atlantis, No. 26 (Fall 2009/Winter 2010), pages 3-29.

(2) Vil S. Mirzayanov, State Secrets: An Insider's Chronicle of the Russian Chemical Weapons Program, Outskirts Press; 22.12.2008. Vgl. auch Fedorov, Lev and Vil Mirzayanov, Poisoned Politics, Moskovskiye Novosti weekly (newspaper), No. 39 (1992) page 22.

Sufficiently sensitive detectors must be developed to reliably detect the newly scheduled chemicals

adjustments. Spiez Laboratory already implemented the new declaration requirements and integrated them into Switzerland's annual declaration of spring 2020. This prompted the OPCW to have the Schedule 1 facility at Spiez Laboratory, which is declared to the OPCW, inspected by an international team of inspectors as early as December 2020 - with faultless results.

The extension of CWC Schedule 1 also has far-reaching consequences at the technical level for the OPCW, the States Parties and their institutions affected by it. As a result, Spiez Laboratory, too, has had to cope with a whole range of new tasks and challenges: Knowledge about the chemicals newly listed as chemical warfare agents must be comprehensively built up and expanded. In 2020, several research and development projects were already launched to this end. Spiez Laboratory must be able to produce the new Schedule 1 chemicals and related compounds for research, testing and training purposes. It is obvious that the methods for producing and purifying these chemicals are not generally known, and Spiez Laboratory must develop them itself. This is done within the scope of activities permitted under the CWC and under OPCW control, with the quantities produced being correspondingly small.

As a designated laboratory of the OPCW, Spiez Laboratory must also be able to analyse suspect samples for the new Schedule 1 chemicals. The chemicals mentioned must be isolated as completely as possible from all types of solid, liquid and gaseous environmental and material samples as well as from biomedical samples, and subsequently detected and identified. This involves not only the detection of a chemical agent in its pure form intended for use, but also of the precursor chemicals used in its manufacture as well as degradation products which, in contrast to the intact chemical warfare agent, are still detectable after some time following a chemical weapon use.

Problems also arise in the area of detection and detoxification: due to their low volatility, sufficiently sensitive detectors must be developed to reliably detect the newly scheduled chemicals. Spiez Laboratory is therefore analysing whether and how sensitively the chemicals are detected by the detection devices currently used by the army and by other emergency services. A comparable task also arises with regard to decontamination: For the protection of members of the armed forces and other organisations that take part in a possible deployment, it is essential that Switzerland has decontamination agents and methods in hand that render the new Schedule 1 chemicals harmless. This knowledge must be developed by Spiez Laboratory and then made available to the partners. Likewise, Spiez Laboratory must be able to safely carry out the testing of other NBC protection systems for their performance in relation to the new chemicals. Among other things, this involves personal protective equipment such as gloves, protective suits or masks.

All this fundamental work in the areas of synthesis and analysis of new Schedule 1 chemicals and related compounds, and of testing of detection devices, decontamination agents and protective equipment is of great importance for security in Switzerland. In addition to the protection of members of the armed forces, this also concerns the protection of emergency response personnel and the entire population - for example in the event of terrorist attacks.

With the first-time adaptation of Schedule 1 chemicals in the Annex on Chemicals of the CWC, the community of

states has demonstrated that it remains capable of acting in the face of new challenges through common political will. However, the chemical weapons issue unfortunately remains on the international agenda: the well-known Russian opposition politician Alexei Navalny was hospitalised in Omsk on 20 August 2020 after his condition deteriorated dramatically during a domestic flight over Siberia and the plane had to make an emergency landing. On 22 August, he was flown to the Charité Hospital in Berlin for treatment. The examination of blood samples in designated laboratories of the OPCW revealed beyond doubt that Alexei Nawalny had been exposed to a Novichok-class nerve agent - the Skripal attack a good two years earlier was no longer an isolated case.

The challenge to the international community remains: The use of chemical weapons violates international law and is prohibited to all actors at all times and under all circumstances. As in the case of the Skripal attack, Switzerland, in line with other states, has condemned the renewed use of chemical weapons in the Nawalny case in the strongest possible terms and called on Russia to conduct a swift and comprehensive investigation with the independent involvement of the OPCW.

However, the case of Nawalny also shows the technical and scientific challenges that arise with the new Novichok-class agents: The exact chemical structure of the substance used has not yet been disclosed; according to the OPCW, however, it is not a chemical belonging to the new Schedule 1 families. It remains to be seen whether the CWC Schedule will have to be adjusted again. The next official meetings of the OPCW are likely to be strongly influenced by the debate surrounding the necessary measures after the Nawalny case. The entire CWC community of states, including Switzerland and thus also Spiez Laboratory, will not run out of tasks to implement and further develop the CWC that soon.

The use of chemical weapons violates international law and is prohibited to all actors at all times and under all circumstances

05

Hydration systems for the armed forces and emergency personnel

Spiez Laboratory has developed, tested and optimised a safe and reliable method for testing hydration systems for resistance to chemical warfare agents. This lays the foundations for tackling the procurement of an important element of the army's modular clothing and equipment system.

Christian Gloor
Peter Siegenthaler

The dangers for soldiers and other emergency personnel are becoming more and more diverse. As a consequence, the requirements for the necessary protective material are also constantly changing. CBRN[1] substan-

Testing hydration systems under full chemical protection

ces pose a particular challenge, as they can have a great effect in very small quantities. There has been significant progress in the development of CBRN protective equipment in recent years. In combination with the changed needs of the forces, this has resulted in new procurement programmes, also for the Swiss Armed Forces: Specifically, the projects Modular Clothing and Equipment System (MBAS) and the renewal of individual CBRN protective equipment are part of this effort.

Within this framework, among other things, a hydration system is to be introduced that will allow soldiers to carry larger quantities of liquid on their backs, for example, and to drink during deployments whilst wearing their protective masks. However, commercially available hydration systems for recreational use are not suitable for use in a contaminated area, as they do not provide protection against chemical warfare agents. Any gap in the overall protection concept has potentially fatal consequences, because contact with even the smallest amounts of chemical warfare agents can have serious consequences for soldiers, including death. Moreover, when ingested with food or drink, toxic substances usually cause particularly severe damage. Specially manufactured CBRN-safe hydration systems are therefore necessary for exposed emergency personnel.

Considerations for the development of the test

The testing of CBRN protective materials is one of our core tasks. Through regular participation in the NATO Physical Protection Panel, we also have access to the NATO standard on requirements and testing of CBRN-proof hydration systems, which is currently under development (AEP[2] 4810: On-The-Move CBRN Proof Hydration System). With a view to procuring such a hydration system, we developed a method in 2020 for testing the resistance of hydration

(1) CBRN = Chemical, biological, radiological and nuclear

(2) Allied Engineering Publication

NATO standards usually involve an essential and a desirable value for the test parameters, which can differ greatly from one another

systems to chemical warfare agents on behalf of armasuisse.

The development of a new method for testing CBRN protective equipment requires precise planning of the experimental design. In the present case, there was little guidance in this respect as only a few comparable methods have been developed so far. Thus, we had to develop our own new test methodology based on the draft AEP-4810. In doing so - taking into account the high standards for the safety of people and the environment - the type and scope of the material testing must be designed close to reality so that the results will be meaningful for uses under operational conditions. Such a test requires the experience of several divisions at Spiez Laboratory: The Chemical Safety Laboratory provides essential fundamentals. The experience in carrying out the test procedures for chemical resistance comes from the Materials Testing Branch, and the necessary skills for analysing the drinking water samples come from the Analytical Chemistry Branch.

NATO standards usually involve an essential and a desirable value for the test parameters, which can differ greatly from one another. Therefore, the question initially arose of the test parameters to be used, such as the surface load of the chemical warfare agent to be applied to the hydration system. Following other CBRN tests already established for Switzerland, a surface loading of 10 g/m2 was specified, which corresponds to the value for testing materials with regard to permeation according to TOP[3]. While Yperit (HD) is indisputably considered the standard for the testing of blister agents, the question arose as to whether the test using a nerve agent should be carried out with Soman (GD) or Sarin (GB). Sarin has been used by a foreign institute in the testing of two hydration systems. However, since Sarin has a much higher volatility than Soman, most of the test substance evaporates over the duration of the test (24 hours). This leads to a decrease in the surface load and thus to a less stringent test. For the test at Spiez Laboratory, therefore, Soman was selected as the nerve agent representative.

Preliminary tests for the analysis of drinking water

AEP-4810 describes the requirements for the maximum concentrations of warfare agents that may enter the drinking water (or any other drinking liquid) through the hydration system. Since these are naturally very low, highly sensitive analytical methods are needed that require as little processing of the water as possible in order to minimise possible losses of analyte. In addition, the methods must be sensitive enough to detect the substances even below the NATO limits.

Measurements of diluted reference standards by the Analytical Chemistry Branch showed that the intact warfare agents (HD and GD) at the measured concentrations hydrolyse completely within one hour to the degradation products TDG[4] (for HD) and PIMPA[5] (for GD), respectively, and can thus be detected via these degradation products. Furthermore, liquid chromatography-tandem mass spectroscopy (LC-MS/MS) has been shown to be extremely sensitive and capable of detecting the selected chemical warfare agents as well as their degradation products with high specificity and well below the detection limits required by AEP-4810.

After determining the test parameters and the analysis method, and after developing the test, it was necessary to

(3) Test Operations Procedures (USA)

(4) Thiodiglycol

(5) Pinacolyl methylphosphonate

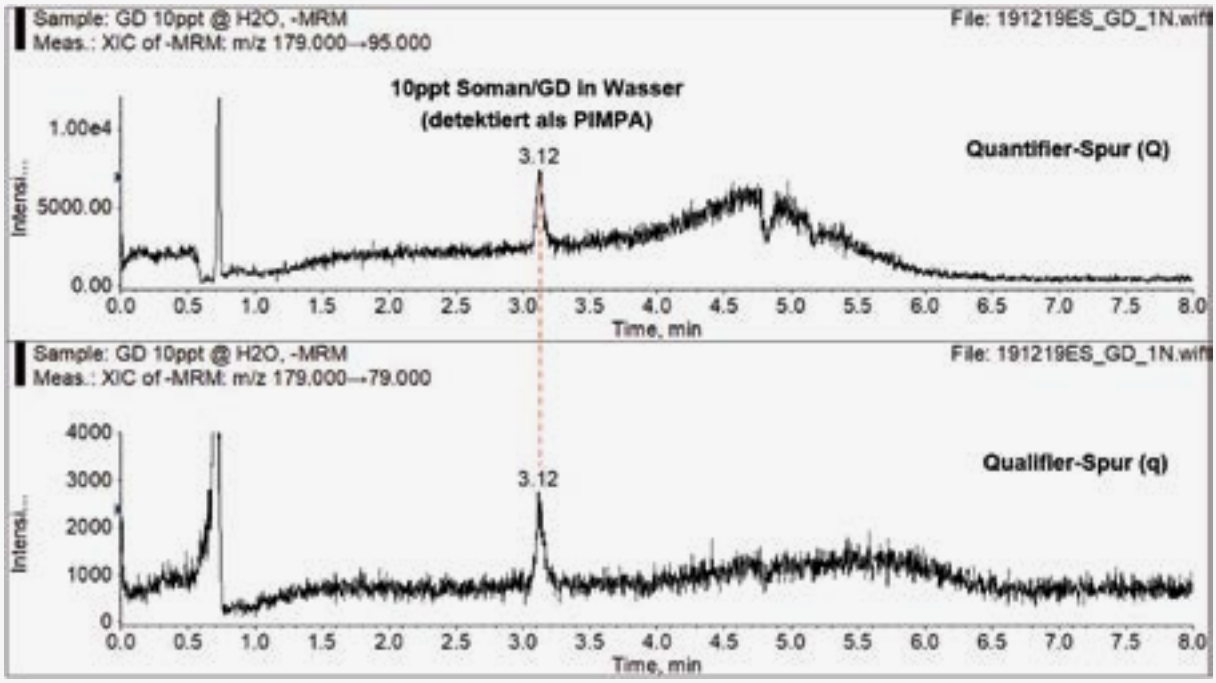


Figure 1: LC-MS/MS sample chromatogram of Soman. Detection signal for 10 ppt (corresponds to 10 ng/L) Soman in water.

validate the test methodology. For this purpose, three hydration systems with a capacity of 2 litres were completely filled with water. HD or GD drops were applied to the front side of each drinking bladder including the drinking tube in accordance with a predetermined contamination scheme, so that a surface density of 10 g/m2 was achieved. This corresponds to applying an amount of chemical warfare agent of approx. 1 g per drinking bladder. The third hydration system served as a blank sample. After application of the agent, the drinking systems were stored in a fume cupboard and the drinking bladders were emptied via the drinking hose after 24 hours.

The first 40 mL, which roughly corresponds to the contents of the drinking tube, were collected separately so that a statement could also be made about the resistance of the drinking tube. Subsequently, the samples from the drinking tube and the remaining bladder contents were analysed for the presence of the test substances, and their concentrations were determined by measuring reference solutions. The analyses showed that higher concentrations of the test substances were present in the water from the drinking tube than in the water from the respective drinking bladders.

Findings of the trial test

The trial test showed that the previously developed procedure for testing the chemical resistance performs well in principle. The trial test also identified points for optimisation that should be adapted for subsequent test orders. For example, it emerged that when using bulging drinking bladders, soman flows off over the curved surface due to its low viscosity and collects in the weld

seam. Consequently, a lower filling level of the drinking bladder is necessary to reduce the run-off of the chemical warfare agent.

Furthermore, it was found that the outlet valve harbours a potential risk of contamination when emptying the contents. This is especially true when testing with Soman, as Soman vapours can accumulate at the outlet valve. Therefore, the emptying step through the drinking tube is one of the most critical steps in the manipulation of the hydration system, as the analysis will detect even the smallest traces of potential agent carryover.

The test allows products that are being considered for procurement to be tested not only for their material properties, but also for their integral resistance to blister and nerve agents. Furthermore, by developing such tests, we can expand and secure our specialist expertise - as a basis for rendering further advice to the emergency forces concerned.

Figure 2: Hydration system loaded with HD. It consists of a drinking bladder, a drinking tube and a mask adapter (not shown here). All components are being tested.

06 Publications

Nuclear Chemistry Division

J. A. Corcho Alvarado, H. Sahli, S. Röllin, C. von Gunten, R. Gosteli, J. Ossola, M. Staufer

Validation of a radiochemical method for the determination of 55Fe and 63Ni in water and steel samples from decommissioning activities

Journal of Radioanalytical and Nuclear Chemistry (2020) 326:455–463.

https://doi.org/10.1007/s10967-020-07297-0

Lino Valcarcel Rojas, José Araújo dos Santos Júnior, José A. Corcho Alvarado, Marvic Ortueta Milan, Stefan Röllin, Romilton Santos Amaral, Zahily Herrero Fernández, Josineide Marques do Nascimento Santos

Natural uranium isotopes and 226Ra in surface and groundwater from a basin of a semiarid region in Brazil

Journal of Radioanalytical and Nuclear Chemistry (2020) 326, 1081–1089.

https://doi.org/10.1007/s10967-020-07393-1

Kiattipong Kamdee, José A. Corcho Alvarado, O. Occarach, Vanachawan Hunyek, A. Wongsit, C. Saengkorakot, P. Chanruang, C. Polee, S. Khaweerat, Ioannis Matiatos, Takuya Matsumoto

Application of isotope techniques to study groundwater resources in the unconsolidated aquifers along the Ping River (Thailand)

Isotopes in Environmental and Health Studies.

https://doi.org/10.1080/10256016.2020.1739672

Jasquelin Peña, Marietta Straub, Virginie Flury, Eymerick Loup, José Corcho, Philipp Steinmann, François Bochud, Pascal Froidevaux

Origin and stability of uranium accumulation-layers in an Alpine histosol

Science of the Total Environment 727 (2020) 138368.

https://doi.org/10.1016/j.scitotenv.2020.138368

Misael Díaz Asencio, Maickel Armenteros, José A. Corcho Alvarado, Ana Carolina Ruiz Fernández, Joan Albert Sanchez Cabeza, Adrian Martínez Suárez, Stefan Röllin, Vladislav Carnero-Bravo

Coastal accretion and sea-level rise in the Cuban Archipelago obtained from sedimentary records

The Holocene. 2020;30(9):1233-1242.

https://doi.org/10.1177%2F0959683620919981

Lino Valcarcel Rojas, José Araujo Santos Junior, José A. Corcho Alvarado, Romilton Santos Amaral, Stefan Röllin, Marvic Ortueta Milan, Zahily Herrero Fernández, Kennedy Francis, Marianna Cavalcanti, Josineide N. M. Santos

Quality and management status of the drinking water supplies in a semiarid region of Northeastern Brazil

J Environ Sci Health A Tox Hazard Subst Environ Eng. 2020;55(10):1247-1256.

https://doi.org/10.1080/10934529.2020.1782668

Misael Díaz Asencio, Joan Albert Sanchez Cabeza, Ana Carolina Ruiz Fernández, José A. Corcho Alvarado, Libia Hascibe Pérez Bernal

Calibration and use of well-type germanium detectors for low-level gamma-ray spectrometry of sediments using a semi-empirical method

Journal of Environmental Radioactivity, Volume 225, December 2020, 106385.

https://doi.org/10.1016/j.jenvrad.2020.106385

José Corcho, Hans Sahli

Validierung der Methode zur Bestimmung von Fe-55 und Ni-63 in Wasser und Stahl

LN 2020-01 CORJ

Regula Gosteli

Vergleich zweier Probenvorbereitungs-Verfahren für Umweltproben für das BAG URA-Programm

LN 2020-01 GOSR

Regula Gosteli

Optimierung der Extraktion und Probenaufarbeitung von Boden-, Milch- und Grasproben für die Strontium-Analytik (L 028 076)

LN 2020-02 GOSR

Fabian Hauenstein

Flugerfahrungen mit dem NuEM Drones-G

LN 2020-01 HFA

Fabian Hauenstein

Drohnenflug Vergleichsmessung ARM20

LN 2020-02 HFA

Adam Kimak

Determination of carbon enhancement effect on a broad scale of elements (NUC-20-303)

LN 2020-01 ADK

Adam Kimak

Neodymium targeted Lanthanide separation using ion chromatography (NUC-20-404)

LN 2020-02 ADK

Adam Kimak

Chemical Forensic – pilot study to investigate the potential of metal analysis in organic solvents

LN 2020-03 ADK

Nina Mosimann

Bestimmung der Positionierunsicherheit bei Ganzkörpermessungen

LN 2020-01 SNIN

Nina Mosimann

Ursachensuche für die tendenzielle Unterschätzung der Aktivität in den Invivo-Ringversuchen 2015-19

LN 2020-02 SNIN

Jasmin Ossola

Validierung der Bestimmung der Standard Kationen mittels ICP-OES in Wasserproben

LN 2020-01 OSJA

Jasmin Ossola

Bestimmung der Verfahrensnachweisgrenze verschiedener Methoden in der AA

LN 2020-02 OSJA

Stefan Röllin, Hans Sahli, Lars Gnägi, José A Corcho Alvarado

Determination of Plutonium and Uranium Radionuclides in Glacier Ice Samples by MC-ICP-MS

CHIMIA International Journal for Chemistry, Volume 74, Number 12, December 2020, pp. 989-994(6).

https://doi.org/10.2533/chimia.2020.989

V. Putyrskaya, E. Klemt, S. Röllin, José A. Corcho Alvarado, H. Sahli

Dating of recent sediments from Lago Maggiore and Lago di Lugano (Switzerland/Italy) using 137Cs and 210Pb

Journal of Environmental Radioactivity 212 (2020) 106135.

https://doi.org/10.1016/j.jenvrad.2019.106135

Guillaume Jouvet, Stefan Röllin, Hans Sahli, José A. Corcho Alvarado, Lars Gnägi, Loris Compagno, Dominik Sidler, Margit Schwikowski, Andreas Bauder, Martin Funk

Dating the ice of Gauligletscher, Switzerland, based on surface radionuclide contamination and ice flow modeling

The Cryosphere.

https://doi.org/10.5194/tc-2020-142

Stefan Röllin

Validierung der Messung von Plutoniumisotopen in Boden- und Sedimentproben mit einem Sektorfeld ICP-MS (Element XR, Element 2)

LN 2020-01 ROF

Stefan Röllin

Validierung der Messung von Uranisotopen und Th-232 in Bodenproben mit einem Sektorfeld ICP-MS (Element XR, Element 2)

LN 2020-02 ROF

Hans Sahli

Validierung der Aufkonzentrierung von Cs-Isotopen aus Wasserproben zur Messung mittels Gamma-Spektrometrie

LN 2020-01 SAAH

Hans Sahli

Neugestaltung der Vorschriftenwelt im Bereich ICP-MS der Gruppe Radiochemie

LN 2020-02 SAHH

Hans Sahli

Validierung der Messung von Uran-Isotopen in Wasserproben mit ICP-MS

LN 2020-03 SAHH

Hans Sahli

Validierung der Messung von Plutonium-Isotopen in Wasserproben mit ICP-MS

LN 2020-04 SAHH

Marc Stauffer

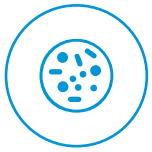
Ringversuchsergebnisse 2019 der Prüfstelle STS 0028

LN 2020-01 STM

Cedric von Gunten

Testing of BlueAct›s Granulated Material for the expert group «Water, Sanitation and Hygiene» WASH of the Swiss Humanitarian Aid Unit SHA

LS 2020-11



Biology Division

Joyce Odeke Akello, Stephen L. Leib, Olivier Engler, Christian Beuret

Evaluation of Viral RNA Recovery Methods in Vectors by Metagenomic Sequencing

Viruses 2020, 12(5), 562.

https://doi.org/10.3390/v12050562

Christian Beuret, Sandra Paniga, Sarah Ryter, Olivier Engler

Verifizierung des qualitativen Multiplex-Nukleinsäure-Assay für den Nachweis von Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) mittels BioFire® FilmArray® Respiratory Panel 2.1

LN 2020-02 BCR/PS/RYSA/ENO

Maximilian Brackmann, Christian Müller

Evaluationsbericht zur Beschaffung eines LC-IMS-MS/MS Systems

LN 2020-01 BM

Jennifer Mayor, Giulia Torriani, Sylvia Rothenberger, Olivier Engler

T-cell immunoglobulin and mucin (TIM) contributes to the infection of human airway epithelial cells by pseudotype viruses containing Hantaan virus glycoproteins

Virology. 2020 Apr; 543:54-62.

https://doi.org/10.1016/j.virol.2020.02.002

Johanna Signer, Hulda R. Jonsdottir, Werner C. Albrich, Marc Strasser, Roland Züst, Sarah Ryter, Rahel Ackermann-Gäumann, Nicole Lenz, Denise Siegrist, Andreas Suter, Roland Schoop, Olivier Engler

In vitro virucidal activity of Echinaforce®, an Echinacea purpurea preparation, against coronaviruses, including common cold coronavirus 229E and SARS-CoV-2

Virol J. 2020 Sep 9;17(1):136.

https://doi.org/10.1186/s12985-020-01401-2

Author Correction: Virol J. 2020 Nov 9;17(1):172.

https://doi.org/10.1186/s12985-020-01439-2

Daniel Brigger, Michael P. Horn, Luke F. Pennington, Abigail E. Powell, Denise Siegrist, Benjamin Weber, Olivier Engler, Vanja Piezzi, Lauro Damonti, Patricia Iseli, Christoph Hauser, Tanja K. Froehlich, Peter M. Villiger, Martin F. Bachmann, Stephen L. Leib, Pascal Bittel, Martin Fiedler, Carlo R. Largiadèr, Jonas Marschall, Hanspeter Stalder, Peter S. Kim, Theodore S. Jardetzky, Alexander Eggel, Michael Nagler

Accuracy of serological testing for SARS-CoV-2 antibodies: First results of a large mixed-method evaluation study

Allergy. 2021 Mar;76(3):853-865.

https://doi.org/10.1111/all.14608

Daniel Kümin, Monika Gsell Albert, Benjamin Weber, and Kathrin Summermatter

The Hitchhiker's Guide to Hydrogen Peroxide Fumigation, Part 1: Introduction to Hydrogen Peroxide Fumigation

Applied Biosafety, Vol. 25, No. 4.

https://doi.org/10.1177/1535676020921007

Daniel Kümin, Monika Gsell Albert, Benjamin Weber, Kathrin Summermatter

The Hitchhiker's Guide to Hydrogen. Peroxide Fumigation, Part 2: Verifying and Validating Hydrogen Peroxide Fumigation Cycles

Applied Biosafety, Vol. 26, No. 1.

https://doi.org/10.1089/apb.21.921099

Michel Bielecki, Roland Züst, Denise Siegrist, Daniele Meyerhofer, Giovanni Andrea Gerardo Crameri, Zeno Stanga, Andreas Stettbacher, Thomas Werner Buehrer, Jeremy Werner Deuel

Social Distancing Alters the Clinical Course of COVID-19 in Young Adults: A Comparative Cohort Study

Clin Infect Dis. 2021 Feb 16;72(4):598-603.

https://doi.org/10.1093/cid/ciaa889

Giovanni Andrea Gerardo Crameri, Michel Bielecki, Roland Züst, Thomas Werner Buehrer, Zeno Stanga, and Jeremy Werner Deuel

Reduced maximal aerobic capacity after COVID-19 in young adult recruits, Switzerland, May 2020

Euro Surveill. 2020 Sep 10; 25(36): 2001542.

https://dx.doi.org/10.2807%2F1560-7917.ES.2020.25.36.2001542

Chemistry Division

Thomas Clare, Peter Siegenthaler, Andreas Schorer

Validierung des Gerstel TD 3.5+ / Agilent 7890B/5977B TD-GC-MSD/dFPD Systems (TD3-MSD7) im Modus für Thermodesorption

LN 2020-04 CLA

Jean-Claude Dutoit

Formation des suppléants pour la préparation d›échantillons

LN 2020-03 DUT

Fausto Guidetti

Überprüfung von C-Nachweisgeräten – 2019

LN 2020-01 GIF

Fausto Guidetti

Messkampagne mit den Geräten GDA-P und GDA-FR der Firma Airsense

LN 2020-02 GIF

Fausto Guidetti

Messkampagne mit den Geräten RAID-M 100, RAID-XP, DE-tector und MM2 der Firma Bruker

LN 2020-03 GIF

Fausto Guidetti

Messkampagne mit dem Gerät GTD-S der Firma Oritest

LN 2020-04 GIF

Fausto Guidetti

Überprüfung von Detindiv-Sensoren

LN 2020-05 GIF

Fausto Guidetti

Überprüfung von C-Nachweisgeräten – 2020

LN 2020-06 GIF

Urs Meier

Marktübersicht für den möglichen Ersatz des bestehenden LC-SPE Systems der Gruppe Organische Analytik

LN 2020-01 MRU

Urs Meier

Untersuchung der Herstellung von Diisopropyl-Methylphosphonat, Thiodiglykol und Sarin durch Bestimmung der 2H/1H-Isotopenverhältnisse mittels Site-Specific Natural Isotope Fractionation – Nuclear Magnetic Resonance Spectroscopy (SNIF-NMR)

LN 2020-02 MRU

Benjamin Menzi

Herstellung und Anwendung von Alkylphosphonsäure-dibromide

LN 2020-01 MEN

Martin Schär, Marco Elmiger, Peter Siegenthaler

Validierung des LC-MS/MS Systems Agilent 1290 Infinity II / Sciex QTrap6500+

LN 2020-05 SCM

Martin Schär, Andreas Schorer, Peter Siegenthaler

Bestimmung der Addukte von Nervengiften an Butyrylcholinesterase in Blutplasma mit LC-MS/MS und LC-HRMS

LN 2020-06 SCM

Andreas Schorer, Silvan Glauser, Peter Siegenthaler

Bestimmung der Yperit-Metabolite Thiodiglykol (TDG) und Thiodiglykolsulfoxid (TDGO) in Urin mittels GC-MS/MS

LN 2020-03 ANDRS

Andreas Schorer, Martin Schär, Peter Siegenthaler

Fluoridreaktivierung von Nervengiften in Blutplasma und Bestimmung mittels GC-MS/MS

LN 2020-07 ANDRS

M. Kuitunen, J. C. Altamirano, P. Siegenthaler, T. H. Taure, V. M. A. Häkkinen, P. Vanninen

Derivatization and rapid GC-MS screening of chlorides relevant to the Chemical Weapons Convention in organic liquid samples.

Analytical Methods, 2020, 12, 2527-2535.

https://doi.org/10.1039/D0AY00263A

CBRNe Protection Systems Division

Beat Aebi

Chemische Gefährdung durch ausgewählte Lithium-Akkus

LS 2020-01

Beat Aebi

Mangel an Schutz- und Hygienemasken in der Covid-19 Krise. Wiederverwendung und Desinfektion von Einwegmasken: Zusammenfassung der Literatursuche

LN 2020-01 AEB

Reto Augsburger

Ausarbeitung einer Methode zur Messung der Kampfstoffbeständigkeit (Sarin)

LS 2020-08

Isabelle Feller

Hitzestress in ABC-Schutzkleidung: Die Entwicklung eines Messkonzeptes

LN 2020-01 FELI

Thomas Friedrich

Werkstoffprüfungen während SARS-CoV-2-Pandemie. Vorgehen und Erkenntnisse bei Schutzmasken-Prüfungen

LS 2020-06

Jean Schmitt, Lewis S. Jones, Elise A. Aeby, Christian Gloor, Berthold Moser, Jing Wang

Protection Level and Reusability of a Modified Full-Face Snorkel Mask as Alternative Personal Protective Equipment for Healthcare Workers during the COVID-19 Pandemic

Chem. Res. Toxicol. 2021, 34, 1, 110–118.

https://doi.org/10.1021/acs.chemrestox.0c00371

Christian Gloor, Peter Siegenthaler

CBRN Trinksysteme. Etablierung einer Prüfung auf chemische Beständigkeit von Trinksystemen

LS 2020-14

Christian Gloor, Reto Augsburger

Atemschutzmaske FM 53 von AVON. Prüfung einer Atemschutzmaske mit verschiedenen Luftzufuhr-Konfigurationen

LS 2020-13

Christian Gloor

Dichtigkeitsprüfungen von Schutzmasken Vergleichsmessungen zwischen PortaCount® und Helium-Prüfkammer

LN 2020-01 GLOC

Christian Gloor

Prüfungen zur Bestimmung der nach innen gerichteten Gesamtleckage von Atemschutzmasken. Ein praktischer Vergleich von Bewegungsabläufen verschiedener Normen und Standards

LN 2020-02 GLOC

Christian Gloor

Ad-hoc Methodik zur qualitativen Bestimmung der Filterleistung von Einweg-Atemschutzmasken mit einem Prüfkopf unter simulierter Atmung

LN 2020-03 GLOC

Christian Gloor

Zusammenarbeit mit dem ABC Abwehr Labor 1. Erfahrungen des Fachbereichs CBRNe-Schutzsysteme während des Assistenzdienstes Covid-19

LN 2020-04 GLOC

Christian Gloor

Steigende Nachfrage nach Beatmungsgeräten während der Covid-19 Pandemie. Dichtigkeitsprüfungen in Zusammenarbeit mit der Firma Hamilton Medical AG

LN 2020-05 GLOC

Markus Gurtner

Ersatzbeschaffung Gaschromatograf zu Sorptionsprüfapparatur (SOPRAN)

LN 2020-01 GM

A.F. Widmer, G. Richner

Proposal for a EN 149 acceptable reprocessing method for FFP2 respirators in times of severe shortage

Antimicrob Resist Infect Control 9, 88 (2020).

https://doi.org/10.1186/s13756-020-00744-3

Gilles Richner

Schutzanzug: Einfluss des Konfektionssitzes auf die Schutzleistung von ABC-Schutzanzügen

LN 2020-01 GRIC

Gilles Richner, Christian Gloor

Mangel an Schutz- und Hygienemasken. Wiederverwendung von Einwegmasken durch Sterilisation oder Dekontamination

LN 2020-02 GRIC/GLOC

Gilles Richner, Luca Huwyler

Mangel an Schutz- und Hygienemasken. Alternative Masken- und Filtermaterialien

LN 2020-01 HUW/GRIC

Christoph Wirz, Thomas Friedrich, Reto Augsburger

Charakterisierung von Vliesstrukturen aus der Atemschutzmaske FFP2 von Paul Boyé mittels REM, PW-2020-0050

LS 2020-03

Christoph Wirz, Thomas Friedrich, Reto Augsburger

Charakterisierung von Vliesstrukturen aus der Atemschutzmasken FFP2 von 3M (AURA 1862+) von Uni Spital Basel mittels REM, PW-2020-0043

LS 2020-02

Christoph Wirz, Thomas Friedrich, Reto Augsburger

Charakterisierung von Vliesstrukturen aus drei verschiedenen Masken mittels Raster Elektronen Mikroskop (REM), PW-2020-0037

LN 2020-01 WIC

Andres Wittwer

Anwendbarkeit der Prüfmethoden des Labor Spiez zur Partikelabscheideleistung von ABC-Schutzmasken und -filtern auch für die Prüfung von Filterhalbmasken und Hygienemasken

LN 2020-02 WITA

André Zahnd

Grundlagen Prüfverfahren STS 0055 - Druckstossprüfungen Numerische Simulation von Luftstössen in den beiden Stosswellenrohren der Prüfstelle STS 0055 mit dem CFD-Programm Apollo Blastsimulator

LS 2020-07

André Zahnd

Modellierung und Simulation der im SHIELD-Test generierten Druckwelle

LS 2020-12

NBC Arms Control Unit

Christoph Wirz

CTBTO Level 5 Radionukliddetektion vom 23. Juni 2020

LN 2020-04 WIC

07 Accredited laboratories

Participation in External Quality Assurance (EQA) Exercises October 2019 - September 2020

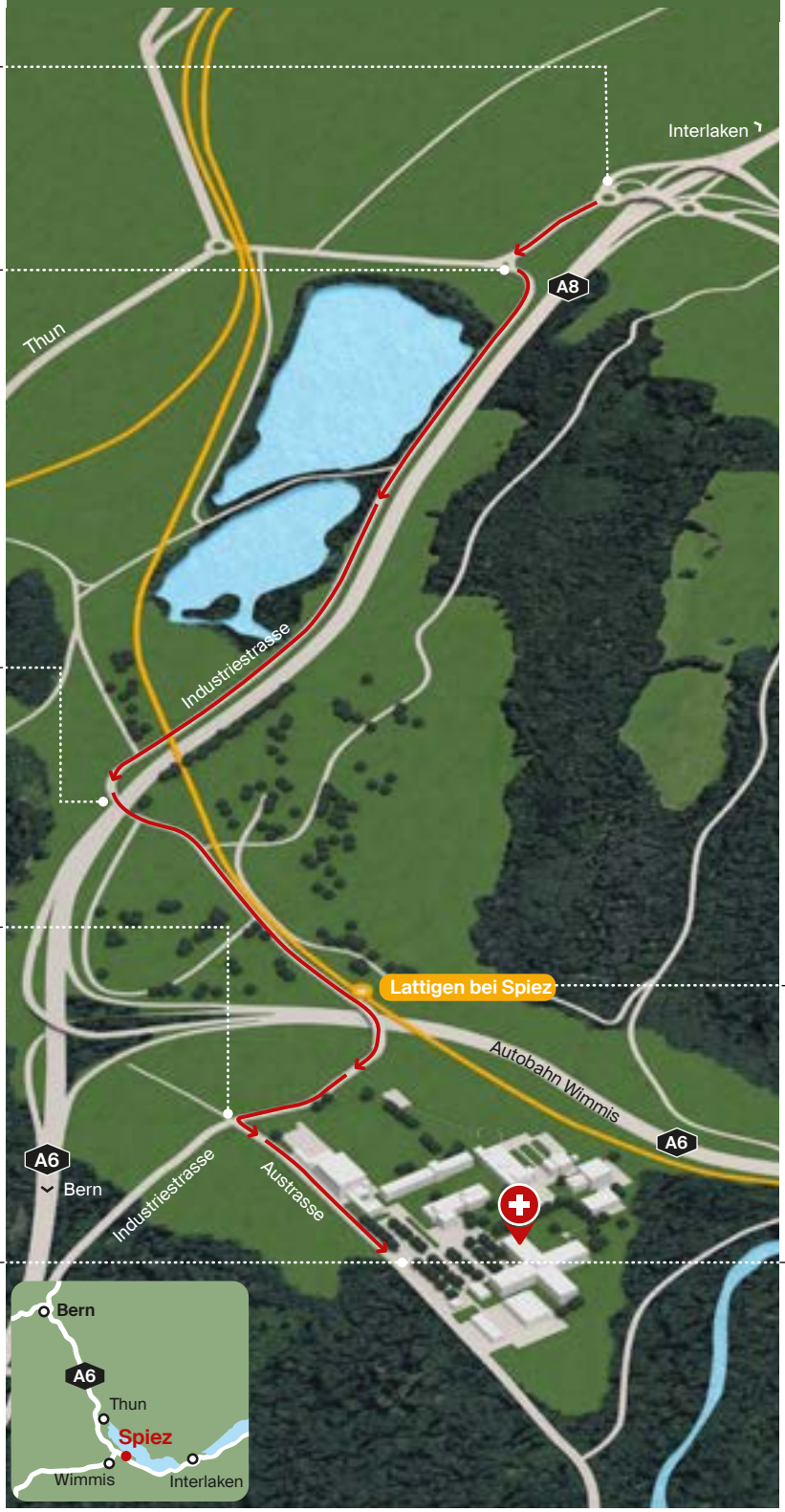
Test Centre	Number	Type and Partner
STS 0019	0	Due to successfully completed OPCW off-site analysis orders and the correct analysis of the control samples supplied, Spiez Laboratory was exempted by the OPCW from participation in the OPCW Proficiency Tests in 2020 and has been able to secure OPCW designation for a further year.
STS 0022	1	Comparative measurements on HEPA filters 180 m3/h according to EN 1822 and standard-like in-house procedures
STS 0028	7	– International Soil Exchange ISE – University of Wageningen – Potable water – Ielab – PT ALMERA – IAEA (International Atomic Energy Agency) – PT Seawater RML – IAEA – PT IRA/BAG – In-vivo EQA exercise – Federal Office for Radiation Protection D – PT TRIC - IAEA
STS 0036	7	EQA Exercise series organised by the Institute of Plastics Lüdenscheid:
		– Thermal analysis DSC, melting temperature and melting enthalpy
		– Thermal analysis DSC, glass transition temperature elastomers
		– Thermal analysis DSC, glass transition temperature thermoplastics
		– Thermal analysis DSC, filler content
		– Tensile properties, thermoplastics
		– Tensile properties, elastomers
		– Compression set
STS 0054	1	SH1 SHARP WP7: B.anthracis, Brucella spp., Burkholderia, Francisella spp., Yersinia.
	1	UNSGM EQAE UN3: Anthrax forensics
	1	INSTAND EQA exercise: PCR for B. anthracis, F. tularensis, C. burnetti, Brucella spp. and Borrelia (11.11.2019)
	1	INSTAND EQA exercise: PCR for B. anthracis, F. tularensis, C. burnetti, Brucella spp. and Borrelia (05.06.2019)
	1	RefBio EQAW1 Tox Rizin
	1	INSTAND EQA exercise FSMEV, serology
	1	QCMD EQA exercise: MERS-Corona virus, PCR (not accredited)
	1	WHO SARS-CoV-2, PCR
	3	FEPTU EQA exercise E. coli and enterococci
STS 0055	1	Informal round robin exercise with STS 0179 and STS 0667

How to get to SPIEZ LABORATORY

BY CAR

1. Leave the motorway via the ‘Spiez’ exit and continue in the direction of Spiez.
2. After approx. 100 m turn left in front to the fuel station and follow the ‘ABC-Zentrum’ signpost using the road that lies parallel to the motorway.
3. Use the tunnel to cross under the motorway.
4. Turn left and follow the ‘ABC-Zentrum’ signpost.
5. The entrance to Spiez Laboratory is on your left after approx. 200 m.

   Register at the reception of Spiez Laboratory, on the right after passing through the main entrance gate.



BY TRAIN

1. Purchase a ticket to ‘Lattigen bei Spiez’. Please note that there are direct train connections from Bern.
2. In Spiez you change trains (if necessary) and take the regional train in the direction of Zweisimmen until you reach ‘Lattigen bei Spiez’ (first stop after Spiez).

CAUTION
In the train be sure to press the ‘Halten/Aussteigen’ button.

3. Turn to the left when leaving the train stop ‘Lattigen bei Spiez’ and follow the yellow signpost ‘ABC Zentrum’ (approx. 10 minutes on foot).
4. The entrance to Spiez Laboratory is on your left after approx. 200 m.

   Register at the reception of Spiez Laboratory, on the right after passing through the main entrance gate.

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Office for Civil Protection FOCP
SPIEZ LABORATORY