

PAPER

Effect of the COVID-19 Pandemic on the Working Practices of Analytical Facilities II



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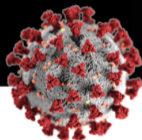
EXECUTIVE SUMMARY

COVID-19 has a substantial impact on the operations of analytical facilities that serve external users.¹ At the end of April 2020, only a third of the surveyed research infrastructures (RIs) reported that they maintained such user access activities; however, several had set up specific COVID-19 services and responded to travel limitations with a strong shift towards remote services. Half a year later, the pandemic is still not over, and the significant mutations of the virus observed recently indicate that COVID-19 is likely to remain endemic for the foreseeable future. RIs, as a consequence, will have to learn how to live with it to some degree, possibly for years to come.

The present questionnaire aims to report on the changes and challenges that analytical facilities faced at the end of October 2020, just before the rise of the second wave, which again severely interrupted their activities. The following observations can be made:

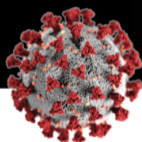
- Most of the RIs have resumed operations, including general support to external users. More than two-thirds report full operations, with almost no change relative to the pre-COVID-19 period with respect to the share of instruments running. Despite the instruments' availability, a large majority of RIs serve fewer external users compared to the pre-pandemic era. This situation will likely translate into slower progress or lower output in ground-breaking research and solutions to societal challenges.
- COVID-19 research is still an important focus of many facilities, with dedicated services offered by more than half of the RIs that have resumed operations.
- The RIs have largely adapted their operations as a consequence of the pandemic. This is reflected in diminished staff presence, largely introduced due to safety

¹ Jana Kolar, Andrew Harrison, & Florian Gliksohn. (2020, May 6th). ERF's Review of Working Practices of Analytical Facilities During the Pandemic. Zenodo. <http://doi.org/10.5281/zenodo.3813493>



- requirements. A significant share of remote access is observed, with samples mailed in, due to the restrictions on users' travel. In the pre-COVID-19 period, remote access was rather limited, typically comprising up to 20% of all access. This has changed remarkably during the pandemic, with almost a third of RIs estimating that more than 60% of their access is currently remote.
- Several measures have been introduced by the facilities to enable remote experiments, from virtual communication tools, remote control of the acquisition systems and remote analysis to resources for data sharing. However, no additional funds have been granted to the facilities to support these activities, which were resourced by reallocating internal funds, and, in one case, EC funding.
 - Several difficulties relating to remote access, as compared to on-site access have been reported. They relate mostly to the increased workload of instrument scientists and reduced training opportunities. The complexity of some experiments also prevents them from being conducted remotely at present.
 - Institutions generally (70%) expect that the increased share of remote access is here to stay, even when COVID-19 no longer significantly constrains operations. There are many reasons for this, from higher experimental throughput, to decreased environmental impact and additional/better services to the users.
 - Regarding safety measures at the facilities, widespread – although remarkably diverse – preventative measures have been adopted since the April survey. Most RIs have worked out how to put in place best-practice protocols and have implemented them. Additionally to mask-wearing, which is now broadly adopted, the measures include, for example, an increased percentage of remote access, the introduction of thermal testing and some form of testing for the virus, e.g. PCR tests.
 - The most common planned development to enhance safety in the future is the introduction of testing for staff and users. However, one-third of all respondents have no plans to enhance safety measures further, and only a third indicated plans to introduce measures that are not yet in force, suggesting a high degree of satisfaction with current measures.
 - The survey underlined the marked change in the extent to which facility staff now travel for work-related business (for example, to perform experiments or attend events, particularly outside their home country) as compared to before the COVID-19 pandemic.

The report demonstrates that the majority of the RIs have introduced changes to operations over the last half a year, which will enhance the extent and quality of their operations under the pandemic conditions while taking many precautions to protect their staff. The most significant change apart from the introduction of various safety protocols is the increase in remote access. However, this development has also revealed more clearly the challenges of



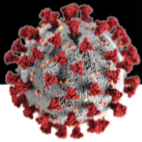
such type of access, be it for the performance of complex experiments or more generally in relation to the extra workload it demands of the RI staff.

There is therefore a big need to improve the effectiveness and efficiency of such access modes. The main bottlenecks need to be assessed, and the development of the solutions systematically prioritised. As far as complex experiments are concerned, there are no short-term solutions to facilitate their performance via remote access; measures should be put in place to get users back as soon as possible. However, in the longer-term tools should also be developed to enhance the capacity of RIs to perform this type of experiment remotely on a more systematic basis. This would have many benefits for users and for the environment. Finally, it is proposed that funders at both national and EU levels support the RIs in this transformation by enabling the development of joint solutions, which will help RIs to serve more users, protect their staff better, increase the quality of services and decrease their environmental footprint.

Considering the extent to which COVID-19 has exerted a negative impact on the efficiency and effectiveness of many RIs, the apparent lack of ambition of many RIs to further improve the safety conditions is surprising. A platform supporting the systematic exchange of information on the topic could highlight potential room for improvements and lead to their implementation. The introduction of testing regimes, whether provided by the RI or the host country, at least until vaccination becomes much more widespread and effective, is a relevant example of a practice that could be more widespread.

INTRODUCTION

In Spring 2020, the Association of European-level Research Infrastructure Facilities (ERF) and CERIC-ERIC conducted a survey of the operations and measures that analytical research infrastructures (RIs) had taken in the wake of the first wave of COVID-19 to try to maintain operations.¹ The report revealed the strong impact of COVID-19 on their operations. Since then, many facilities have reflected on how to provide the most effective and resilient services in a world where COVID-19 will continue to be present and perhaps return in successive waves. With this in mind, a follow-up survey was organised to try to capture, share and benefit from the growing experiences, understandings and plans. As of October 30th 2020, just before the second wave of the pandemic affected most of Europe again, 27 RIs, mainly European synchrotrons, neutron sources and laser research infrastructures, listed in Annex 1, have submitted their replies. The present paper reports on the findings



and also discusses some of the issues and possible future developments of the analytical facilities.

It should be acknowledged that the situation has been very fluid since then, often requiring a continuous re-assessment and updates of the policies and practices by the RIs on a regular basis. We believe, however, that many of our observations reflect significant evolutions that are likely to affect the way RIs operate durably. It is the purpose of this report to analyse them and express, wherever relevant, recommendations for future action to support this transition.

LEVEL OF OPERATIONS AND ACCESS

MOST OF THE RIs ARE FULLY OPERATIONAL

While in April only half of the responding RIs were in operation, most of them had resumed operations by October (Figure 1), albeit with significant changes in the type of user support, when compared to the pre-COVID-19 era.

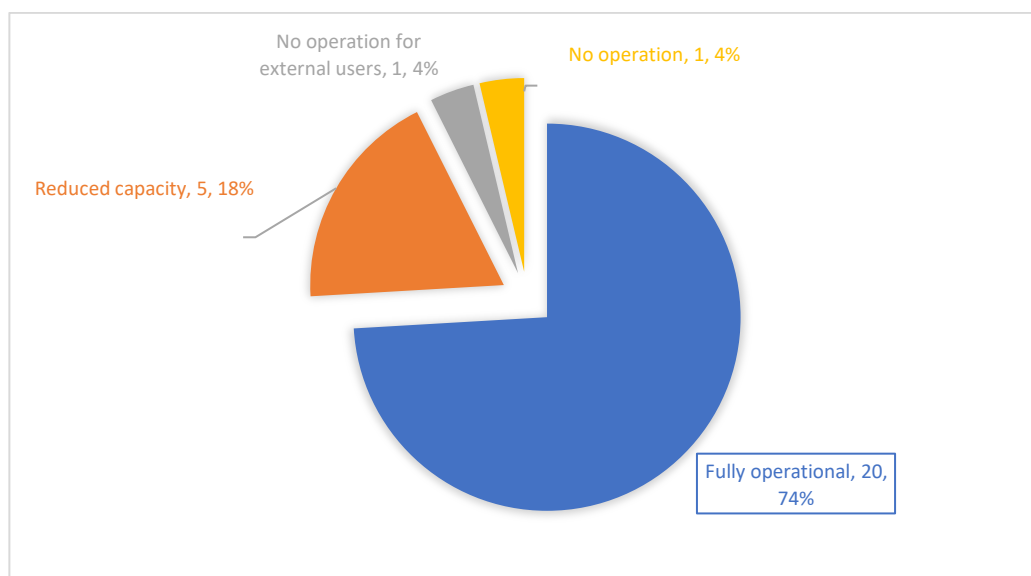
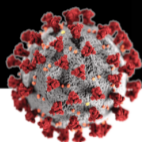


Figure 1: Level of operations reported by the responding facilities (fully operational, with reduced capacity, no support to external users, or no operation) in number and percentage of responding facilities.

GENERAL SUPPORT TO USERS HAS LARGELY RESUMED, WITH MORE THAN HALF OF RIs ALSO RUNNING COVID-19 DEDICATED SERVICES

The pandemic has also had an impact on the types of services offered. At its onset, many of the analytical facilities had set up dedicated services for COVID-19 research. In fact, all



but one of the 10 RIs (out of 28 respondents) that were serving external users in April had dedicated COVID-19 services, while 6 supported external users working also on other topics. **Error! Bookmark not defined.** COVID-19 dedicated services remain a prominent activity also in October 2020, with 64% of the institutions serving users (25) reporting COVID-19 dedicated access for external users. However, by now, a large majority (21 RIs, 84% of RIs serving users) also report supporting research other than COVID-19.

OPERATIONS ARE ADAPTED TO COVID-19 CONDITIONS

When considering only the facilities that have reported full operations (20 RIs), there is almost no change compared to the pre-COVID-19 period with respect to the share of instruments running (Figure 2), while their current average availability is only slightly reduced. However, the impact of the pandemic is strongly reflected in reduced staff presence, largely introduced due to the safety requirements, which usually mandate increased inter-personal distance and lower room occupancy, thus making the support of some types of experiments more challenging.

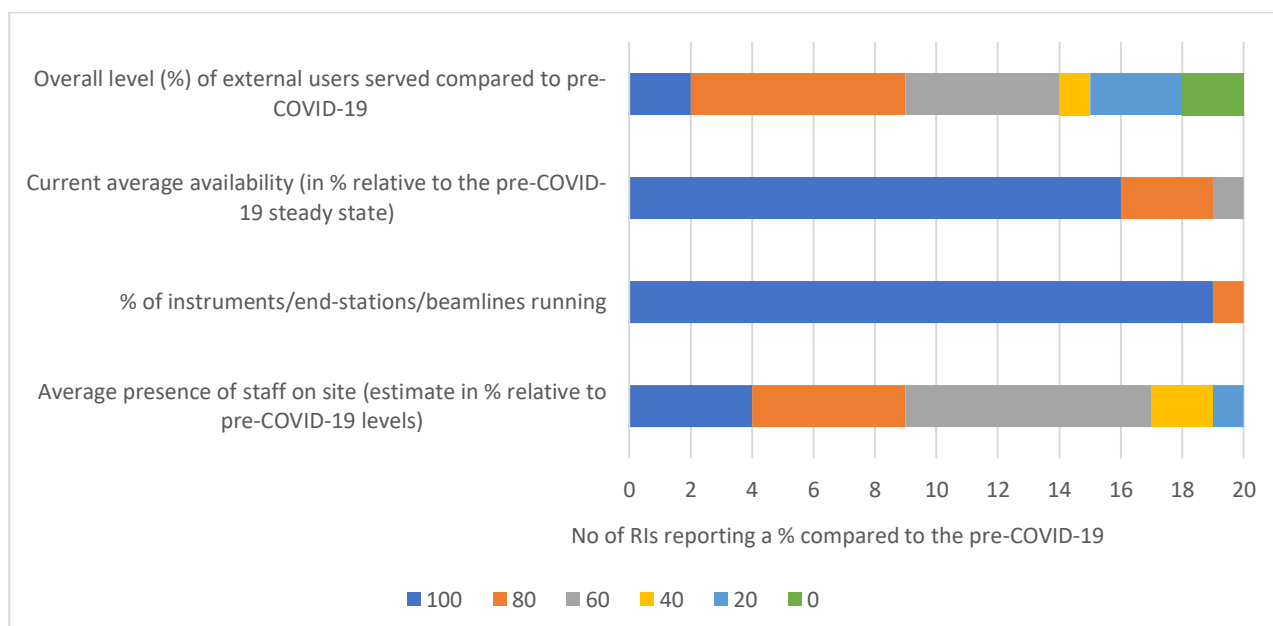
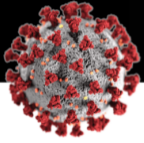


Figure 2: Levels of service, availability, offering and staff presence in October 2020, compared to the pre-COVID-19 period. Colours indicate the average values in percentage (relative to the pre-COVID-19 period) reported by the RIs currently in operation (20 in total).²

² When a range was provided, e.g. 20-40%, the higher number was considered, i.e. 40%. One RI reported 75%, which was rounded to 80%.



CHANGES IN OPERATIONS DUE TO COVID-19

MOST OF THE RIs PROVIDE A MIX OF REMOTE AND ON-SITE ACCESS

The effect of COVID-19 still hugely affects the type of access the facilities provide. Of the facilities serving external users, only one reports on-site user access to the level observed in the pre-COVID-19 period, while three RIs report only remote access through the mailing of the samples. All other RIs report a mix of remote and on-site access.

INABILITY OF USERS TO TRAVEL IS CONSIDERED THE MAIN REASON FOR NOT BEING ABLE TO SERVE USERS ON-SITE

When asked about the reasons for not being able to serve users on-site, the inability of users to travel was reported as the most relevant, while the least relevant was the inability of the facility to serve users (Figure 3).

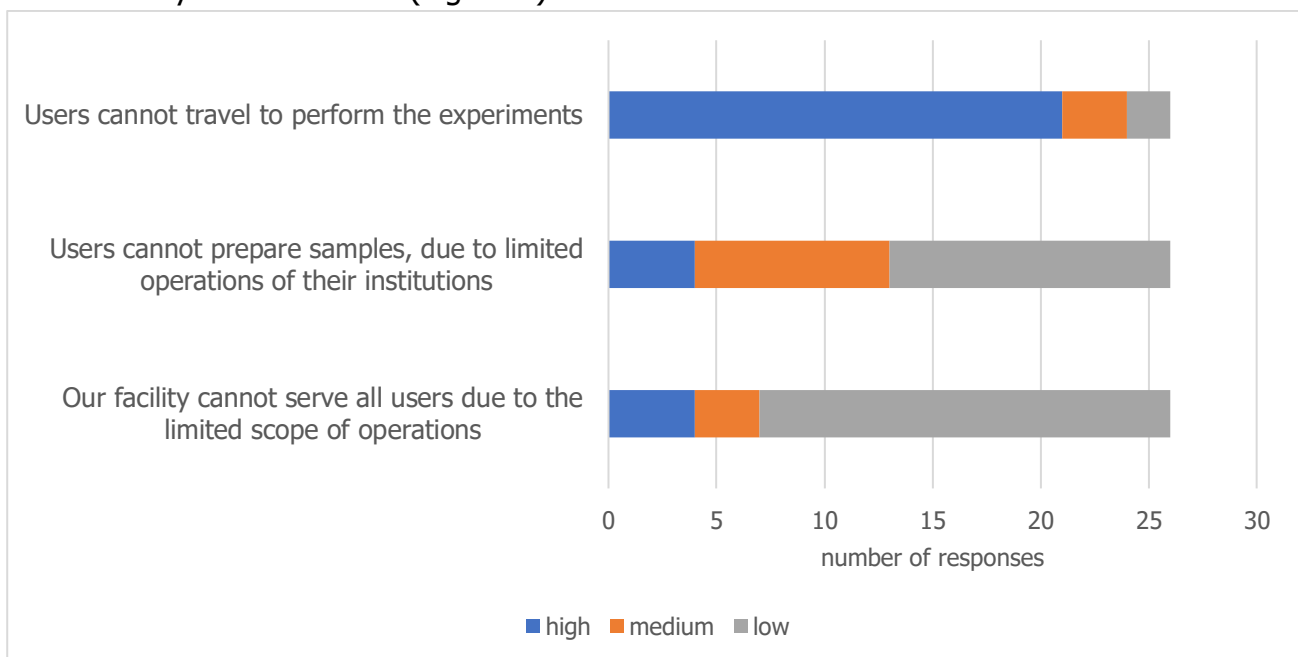
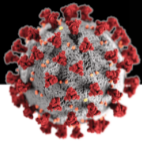


Figure 3. Main reasons for users not being served on-site, according to the relevance of the proposed answer. ('low', 'medium' or 'high')

Among other reasons, the RIs report that users do not meet the facility's safety regulations (1 RI), and the fear of travelling due to risk of exposure to COVID-19 was also mentioned by 1 RI.



SEVERAL MEASURES ARE INTRODUCED TO ASSIST REMOTE ACCESS

To support remote access, facilities have introduced a number of measures, presented in Figure 4. These include tools to enable remote communication, remote control of the data acquisition system and remote analysis in real-time, as well as resources for data sharing.

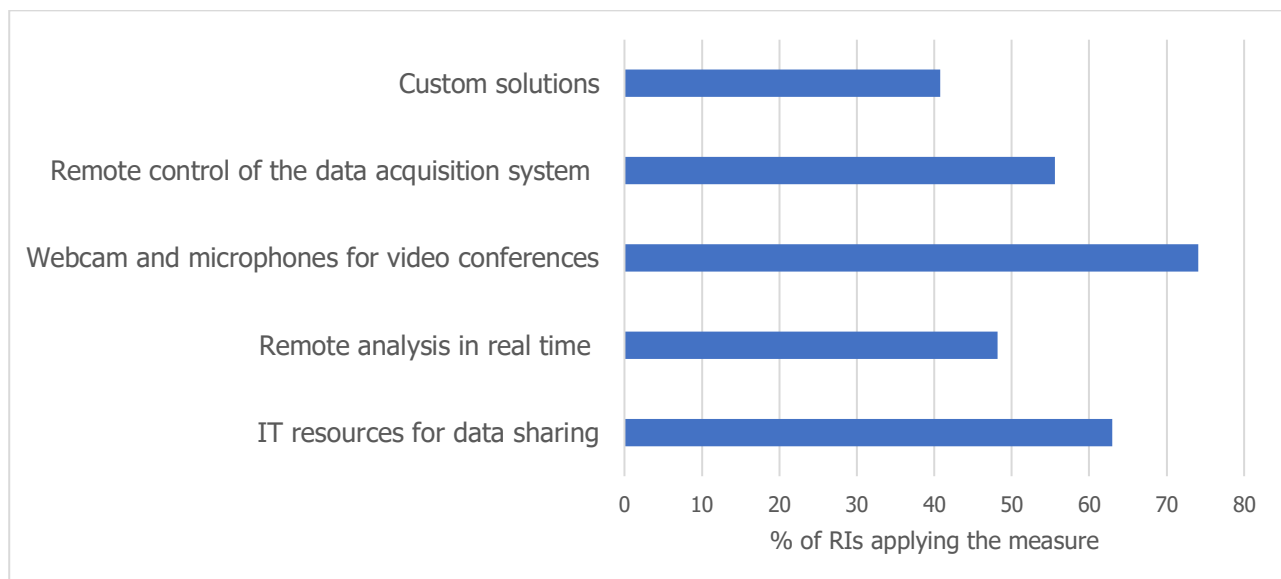


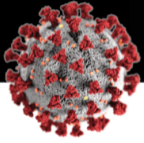
Figure 4: % of RIs replying that they have introduced a particular measure to support remote access.

One RI commented that access for remote data visualisation and analysis is now available on all instruments. Access can be given for instrument control, but at the discretion of the instrument scientists for particular instruments and particular experiments. Among other tools, the use of telepresence robots and wearable cameras were also reported.

This is certainly the field for which the most significant developments have been observed in the last half a year. Due to its relevance to many aspects described in more detail elsewhere in the text, this topic would certainly benefit from a coordinated approach supported by funders.

NO ADDITIONAL EXTERNAL FINANCIAL SUPPORT FOR IMPLEMENTATION OF REMOTE ACCESS IS REPORTED

No facilities report they have received additional funding to facilitate remote access. When they were supported, the institutions reallocated some of their internal funds, with one RI reporting also reallocation of some of some of its EC funding.



REMOTE ACCESS FACES MANY DIFFICULTIES

While facilities are striving to increase the share of remote access, they may face a number of issues, which are presented in Figure 5. When interpreting these findings, caution needs to be exercised as responses depend on the types of experiments and vary between different research infrastructures and with the different instruments of the same facility. One synchrotron commented that for the last three questions, the response is low for some beamlines (e.g. MX) and high for some others (e.g. diffraction for engineering experiments) so 'medium' is an average.

Across the RIs, the main challenges to effective remote access are perceived to be the increased workload for instrument scientists, reduced training opportunities for users and the complexity of experiments.

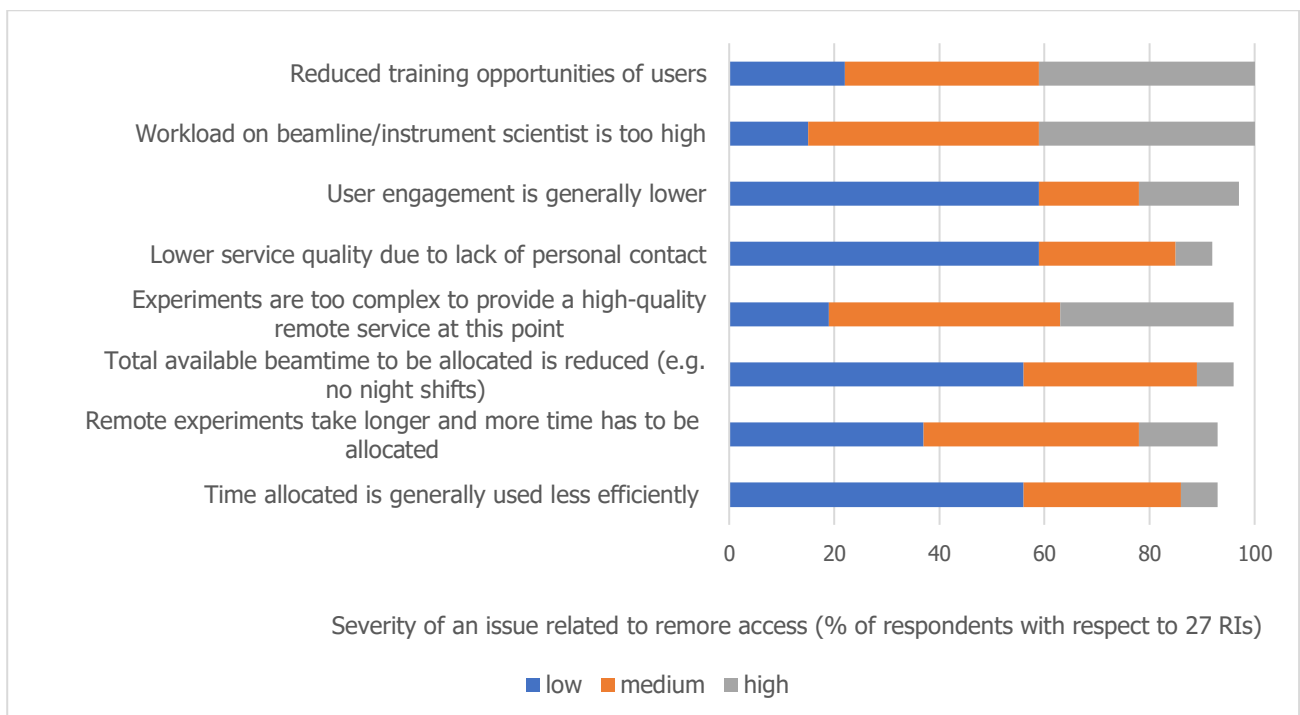
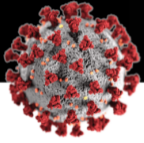


Figure 5: Severity of challenges for the provision of remote access, with their severity expressed by assigning a score of 'low', 'medium' or 'high'. The chart shows the percentage of responses for each level of severity, out of the 27 RIs replying to the survey.³

³ Some of the 27 responding RIs have not replied to the question, which is why the total might be less than 100%.



SHARE OF REMOTE ACCESS IS NOT EXPECTED TO RETURN TO PRE-COVID-19 ERA IN THE MEDIUM TO LONG-TERM

In the pre-COVID-19 period, remote access was rather limited, with more than 90% of respondents stating that it comprised only up to 20% of all access. This has changed remarkably during the pandemic, with 30% of RIs estimating that more than 60% of their access is currently remote. While this share is expected to decrease after the pandemic, most institutions (70%) expect that remote access will not return to the pre-COVID-19 levels in the medium to long term, when the current crisis is expected to be over.

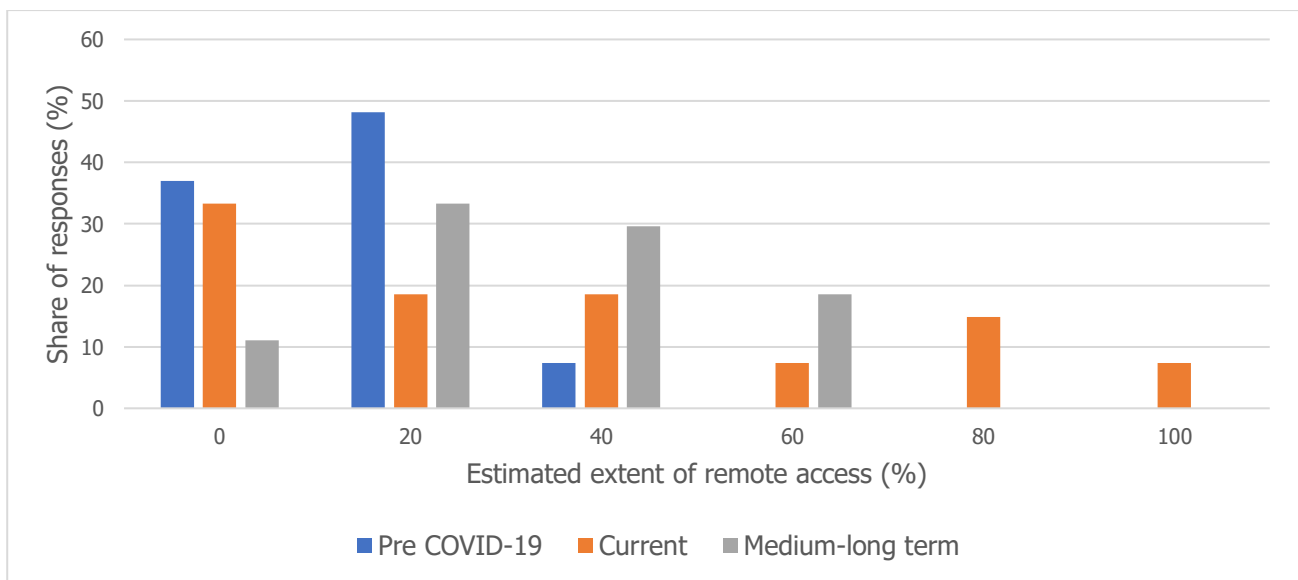


Figure 6: Estimated extent of remote access in the pre-COVID-19 era, during the pandemic, and in the post-COVID-19 period.

THERE ARE MANY REASONS FOR INCREASED REMOTE ACCESS IN THE POST-COVID-19 PERIOD

As is the case with the previous question, the relevance and motivations for an increased use of remote access after the pandemic is over strongly depends on the type of experiments and vary between the facilities as well as within them.

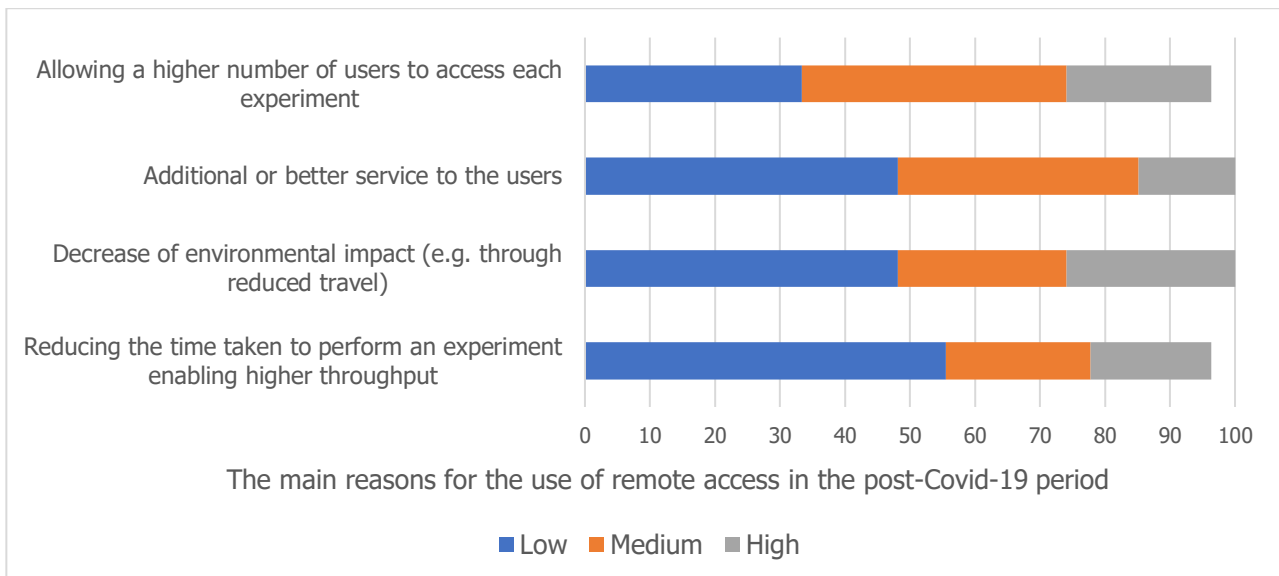
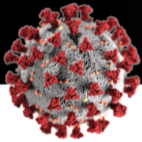


Figure 7: Reasons for the use of remote access in the post-Covid-19 period, with their relevance assessed as 'low', 'medium' or 'high'.

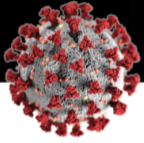
Among other reasons stated for increased remote access by the RIs were decreased travel costs and the time saved due to travelling, lack of funding for transnational access after 2021, and alternative engagement in cases where the travel had to be postponed or cancelled at the last minute or when the travel would be too difficult or too costly.

SAFETY AND WELLBEING

MOST RIs HAVE ENHANCED SAFETY MEASURES IN PLACE

Since the first survey was conducted in April 2020 more is known about transmission pathways, preventative measures (for example mask-wearing), and hospital treatment for COVID-19 and various forms of testing had become much more widely available in many of the countries whose RIs were surveyed - though at the time of the second survey it was not clear when a vaccine might be available. At the time of that survey, infection rates had started to rise again steeply, and more stringent measures were being brought back in at those RIs that had relaxed them over the summer. It should be noted too that some aspects of the measures being taken with regard to safety were influenced by national policy, with some countries requiring certain measures to be in place in the workplace.

Since the first survey, there has been very widespread – but, remarkably, not universal – adoption of preventative measures. In almost all cases, social distancing, and enhanced sanitisation and cleaning measures have been put in place. The most widespread change in safety protocols since the last survey was the introduction of mask-wearing on-site – an action that the previous survey recommended, ahead of common recommendations at the



time. The survey did not reveal the details of mask-wearing policy in each case, but judging by free-text submissions mask-wearing is most commonly specified for multi-occupancy spaces.

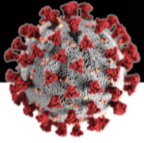
Other new measures introduced by facilities include increased percentage of remote access, particularly for external users; introduction of thermal testing or some form of testing for the virus, e.g. PCR tests; tracing of infected staff to determine who else might have come into contact with them; reducing densities of staff, e.g. by limiting assembly of staff in particular spaces or encouraging staff to work from home.

WIDESPREAD USE OF RAPID TESTING IS THE MOST COMMON PLANNED DEVELOPMENT FOR THE FUTURE

The most common planned development to enhance safety was the introduction of testing for staff and users. It was not clear in all cases whether this was something that the RIs themselves planned to do or whether it was something that they aimed to adopt through external provision, though there are clearly stated examples of the former (e.g. in-house PCR testing for viral RNA). A significant number of RIs also cited increased levels of remote access as an action to enhance safety, and a smaller number mentioned plans to improve air purification and circulation or introduce of masks and/or other PPE.

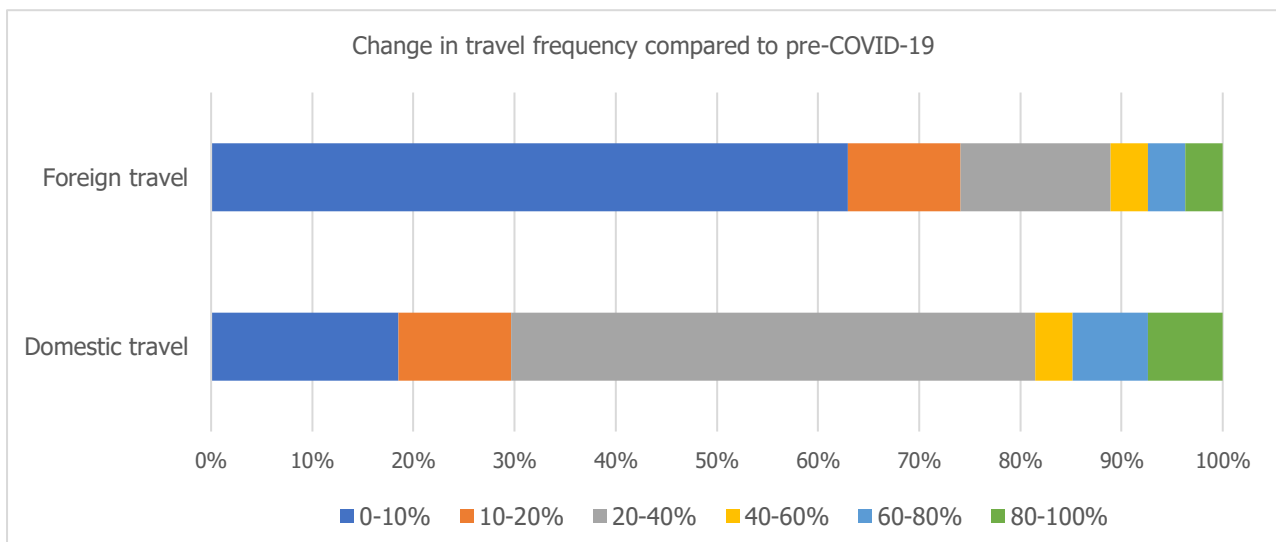
One-third of all respondents had no plans to enhance safety measures further, reporting that they planned not to make further changes, or that they could not work out what might be needed in future, or that they would simply follow national guidelines. Some RIs have reported limited faith in national guidelines, choosing to develop and adopt their own protocols. Mask-wearing is a case in point, with some RIs adopting their use based on the best scientific evidence of the time rather adopting national policies where some Governments have been reluctant to take such action.

Relatively few RIs – about a third in total – gave examples of measures that they would like to be able to introduce that are not yet available. This suggests a lack of concern or thought given to the challenge – or a high degree of satisfaction with current measures – which is curious given the extent to which COVID-19 has impacted negatively on the efficiency and effectiveness of many RIs. Those that did express a wish to enhance measures, most commonly included various forms of testing for users and staff, improving air purification and circulation, more information about health risks posed by users from other countries and more general guidelines about the movement of users and staff in a European context. A higher degree of remote access scored low in this respect – perhaps because it is already planned or adopted.



TRAVEL OF THE STAFF IS HIGHLY DECREASED

The survey underlined the marked change in the extent to which facility staff now travel compared to before the COVID-19 pandemic for work-related business, for example, to perform experiments or attend events. This was particularly marked for travel abroad, where over 60% of staff no longer travelled, and approximately 90% travelled 20% or less compared to before. Domestic travel was less restricted, but still, about 80% of respondents travelled 20% or less for work-related purposes within their own country compared to before. These changes are likely to be even more marked towards the end of 2020 and into 2021 as infection rates rise and new mutations of the virus appear.

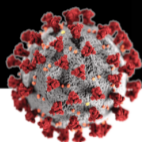


CONCLUSIONS

The survey indicates that over the last half-year, the RIs surveyed have introduced significant changes to their operations enabling them to return to a situation close to full operations, although with modified access modes. The main changes are related to the increased usage of remote access, put in place due to numerous internal developments and improved safety measures.

To enable further development of operations during the COVID-19 period and beyond, the following recommendations should be considered:

- Remote access needs further development in order to improve its effectiveness and efficiency. The main bottlenecks need to be assessed, and the development of the solutions systematically prioritised. Such developments should be planned and implemented as coherently as possible across RIs, sharing best practice and

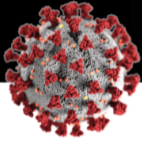


- technological solutions. Optimally, the funders should financially support such joint activities.
- In the case of complex experiments, the short-term solution relies on increased safety measures, since users need to be brought back fully, as soon as possible. In the longer term, tools should also be developed to enhance remote access for these experiments, whenever possible, which would have benefits for users and the environment by reducing travel requirements.
 - Regarding safety, a platform for systematic exchange of information on the topic could highlight potential room for improvements and lead to their implementation. Introduction of testing regimes is likely to make the biggest changes, whether provided by the RI or the host country – at least until vaccination becomes much more widespread.
 - Remote access is more demanding on staff time, so there is a significant need to increase the number of staff serving users if pre-COVID-19 levels of use of instruments are to be maintained.
 - It is proposed that the funders at both national and EU level should support the RIs in the transformation, by the enabling development of joint solutions, which will help the RIs to serve more users, protect their staff, increase the quality of services and decrease their environmental footprint.

ACKNOWLEDGEMENT

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ANNEX 1

Respondents to the questionnaire.

ALBA Synchrotron, Spain

Budapest Neutron Centre, Centre for Energy Research. Hungary

CEA – DRF, IRAMIS, LIDYL, France

Centro de Laseres Pulsados, Spain

Deutsches Elektronen-Synchrotron DESY, Germany

Diamond Light Source, UK

Elettra Sincrotrone Trieste, Italy

European XFEL, Germany

FELIX Laboratory, The Netherlands

Forschungszentrum Juelich GmbH - Juelich Centre for Neutron Science, Germany

Foundation for Research and Technology - Hellas, Ultraviolet Laser Facility, Greece

Heinz Maier-Leibnitz Zentrum – MLZ, Germany

Helmholtz Institute Jena, Germany

Helmholtz Zentrum Berlin fuer Materialien und Energie - BESSY II, Germany

Helmholtz-Zentrum Dresden-Rossendorf, Germany

HiLASE, Czech Republic

INFN – Laboratori Nazionali di Frascati, Italy

Institut Laue Langevin, France

ISA, Aarhus University, Denmark

ISIS Neutron and Muon Source, UK

Laboratoire d'optique appliquée, France

Nuclear Physics Institute of the Czech Academy of Sciences, Czech Republic

Paul Scherrer Institute, Switzerland

Physikalisch-Technische Bundesanstalt, Germany

Prague Asterix Laser System, Czech Republic

SOLARIS National Synchrotron Radiation Centre, Jagiellonian University, Poland

Synchrotron SOLEIL, France