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Commentary

Lifted Up from Lockdown

Emilia C. Arturo^{1,*} and Erica Ollmann Saphire^{1,*}¹La Jolla Institute for Immunology, La Jolla, CA, USA*Correspondence: earturo@lji.org (E.C.A.), erica@lji.org (E.O.S.)<https://doi.org/10.1016/j.cell.2020.09.027>

The pandemic has impacted every scientist differently. Many negative impacts are frequently discussed. Here we highlight unexpected positives that we have found and hope will persist: improved access to experts; deeper and broader human engagement among colleagues, collaborators, and competitors; and significant democratization of research.

One Lab from Many

Since early March, it has felt like we are attending a worldwide lab meeting for the largest shared research project ever conducted. Our perspectives are those of a professor directing a global collaboration for SARS-CoV-2 therapeutics and a postdoctoral fellow in her laboratory who is focused on illumination of viral targets by cryoelectron microscopy (cryo-EM). Meetings of the Coronavirus Immunotherapy Consortium (CoVIC) mean that the alarm rings for one of the authors (Saphire) at 5:15 a.m. and the coffee pot perks to commence the twice weekly 5:30 a.m. phone conferences on standards and models needed for SARS-CoV-2 research. The timing is punishing to those on both sides of the Pacific, but scientists and stakeholders at all time zones are present and commenting on novel data. Our experience now and with Ebola is that a pandemic brings out the worst in some people but the best in many others. The best is particularly evident in these international troubleshooting sessions when ideas and materials are offered freely and eagerly, more agnostic to competitive and physical boundaries than at other times. We report and receive weekly updates and input from colleagues whom we would typically see just once or twice in other years, and would see only in more formal settings. The greater frequency of interaction with our national and international colleagues amplifies the greater urgency and greater shared purpose. Equally overworked experts around the world frequently share an hour of rare stolen Saturday mornings, or stay late on Friday nights to catch up and advise on questions of the CoVIC, wishing each other well and offering

needed reagents. Up to 20 other meetings per week by Zoom, Teams, Webex, BlueJeans, FaceTime, and a few other formats have made the width of the country and the breadth of the oceans dissolve.

The extent and speed of our united efforts on COVID-19 and SARS-CoV-2 projects worldwide have been breathtaking. Data, analyses, and predictions from thousands of labs, representing many different disciplines in all parts of the world, are pouring into our consciousness daily from preprint servers, social media, podcasts, and discussion boards. One of the authors (Saphire) hasn't had a workday less than 12 hours since February, with her spouse picking up all of the slack at home. The other (Arturo) is juggling childcare along with experiments to be done in the lab. All bench biologists are navigating biological experiments that rarely adhere to set schedules being further complicated by the sometimes odd working hours used to achieve sufficient physical distancing in a busy and crowded lab. This new routine is exhausting, and we can't yet afford to slow down. Immunity for the masses, delivered safely by biomedical advances, is needed before most of the world can emerge from our houses and continue safely with human endeavors. It is the worst of times, the most pressing, and the most urgent, but it's also the most illuminating and vitalizing to the fields of virology and immunology. We knew them to be essential, but now the questions of whether we will have immune memory and antibody activity are on everyone's minds.

Changes in space and connection are felt within our own lab as well. We used to be on top of each other, elbow to

elbow. Now, we are distanced in time and space, with many writing, reading, and processing data at home amid distractions that are different from those of the laboratory. We use video conferencing to coordinate with one another to make more efficient use of our respective time in the lab to keep joint projects flowing smoothly. One might expect that the physical distance and lack of "face time" among colleagues would lead to a mental distance as well, but we have found the opposite. One-on-one meetings via video conference with the PI or with lab mates are more focused, more natural, and more personal. Since we haven't seen each other in a while, this time is more special and enjoyable. It's not just another thing to tick off in the day, before sidestepping each other in crowded corridors while juggling flasks and to-do lists. Lab meetings are by Zoom with the 30 of us Brady-bunch style in a photo grid. When the speaker begins, we see the data better on our own screens than we did in the typical lab meeting conference room.

New and Improved Access to Experts

When shelter-in-place directives were first issued, many of us had to end our lab work and transition almost entirely to work from home. While at home, many structural biologists used the opportunity to get up to speed with new technology developments. Cryo-EM technologies, for example, are in constant development, putting users under perpetual pressure to adapt to changes in the algorithms, image processing, and the software required to obtain better structural information. Many of us are



self-taught in key aspects, but self-teaching can be cautious and slow, which may not be options during a pandemic. To learn better and faster, we need continued access to experts that in-person workshops, now canceled, had previously provided.

We are pleased to have found that the lockdown of the pandemic did not make us more isolated from experts, but instead gave us *greater* access to them. The cryo-EM centers supported by the National Institutes of Health Common Fund have recently made lecture material from workshops freely available online and also provided small-group “roundtable” discussions and one-on-one “office hours.” In this program, EM scientists from both the National Center for CryoEM Access & Training (NCCAT, New York) and the Pacific Northwest CryoEM Center (PNCC, Portland) have been available by Zoom to discuss individuals’ datasets. This provision for highly personalized coaching in data analysis and processing is different from an experience at a workshop with sometimes quite large classes, and the need to travel from home to attend them. Outside lockdown, these scientists are usually overrun with demands for their time and are overseeing a fully booked facility. The availability of office hours during the pandemic were a boon.

In other examples, the COVID-19 Open Structures Platform and the Coronavirus Structural Task Force are collaborative projects driven by structural biologists volunteering time and resources to the structural biology of COVID-19. These volunteers audit and refine the rapidly growing collections of protein structures and offer expert advice and collaboration for more rapid completion of data analysis and model building of COVID-19-related proteins. One participant produces and publishes online videos using Twitch where anyone can watch the inspection, refinement, and rebuilding of previously deposited or predicted structures related to this virus. These presentations provide a previously uncommon opportunity to see how experts build and refine models as they do it.

Democratization of Research

Access to a variety of professional group meetings is now immensely easier to pur-

sue in spite of, or because of, the pandemic’s limitations on travel and congregating. For example, the California-based Cryo-EM Center at the Stanford Linear Accelerator Center (SLAC) recently held their 3-day cryo-EM workshop via Zoom with over 300 participants at the lectures and 60 students enrolled to engage in the practical course using cloud-based resources to perform computations in real time with the speaker. The speaker and moderators fielded over 150 questions per lecture, with each question and answer maintained in text and available via transcript later on for future reference. Pre-pandemic, a quiet newcomer might not muster up the courage or be so lucky to catch the attention of the speaker to ask a question, let alone two, in a room where at least half the participants each also had a question. This new format allowed questions to flow to the chat box during the presentation where a moderator arranged and relayed them in a rational way at various points during the workshop. If one didn’t catch the answer, one could expect to find the answer, in a searchable format, along with the recording soon after the organizers would post it alongside the speaker’s slides. No conferences pre-pandemic that we know of had ever featured a comprehensive record of all questions and answers that were discussed after a lecture. We have also participated in several other meetings initially planned as in-person events but then turned virtual, including the Spotlight Sessions of the American Society for Biochemistry and Molecular Biology (ASBMB) and the Collaborative Computational Project for Electron Microscopy (CCP-EM) Spring Symposium. Questions were answered by the speakers either live or in text after their presentation. Again, the in-text answers were particularly useful relative to the shorter Q&A sessions that typically follow in-person conference sessions.

In the lab, our schedules have changed in many ways. We no longer overlap physically as extensively as we once did; several of us have shifted our lab time to start at 6 a.m., while others begin their day in the lab at 6 p.m. Others with family obligations that further complicate their schedules are welcome and able to work on a flexible schedule

throughout all or any days of the week. The flexibility in number of hours devoted to lab work per day or on any given week has often been a positive aspect of academic science, but it is now a critical feature of our current lives. Despite the period of adjustment to the new schedule, productivity seems positively affected by allowing more personal choice in how and when work is done in the laboratory. Our staggered hours have also pushed us to communicate more often, more precisely, and sometimes more personally with colleagues, which has led to a deeper appreciation for one another and greater efficiency. We have also found that the necessity of video conferences (whether it’s among lab colleagues or with collaborators around the world) has blurred work-life boundaries and humanized us all: life for anyone, no matter their pedigree, job title, career stage, or age, can be messy, artsy, full of children and other distractions, and accented by blank walls or eccentric backdrops.

The need to physically travel to attend workshops and conferences had previously limited participation for some scientists. Labs without travel funding can now more freely attend workshops and conferences. Those with disabilities that limit physical travel can also now attend and interact with speakers and colleagues around the world. One author (Arturo) was able to participate in the aforementioned ASBMB, CCP-EM, and SLAC meetings, plus two dissertation defenses on topics related to her work, one in the UK, one on a remote California campus, while supervising at-home learning for her sixth- and fourth-grade children. Overall, hands raised online are now more equal—you don’t have to have a big name, a loud voice, or significant funds or time for travel to join the conversation. Whereas before we would only see an industry expert at a conference in a hotel ballroom, now we know what board games their family plays (we have those games too).

We venture to predict that this format for workshops and conferences is here to stay. For years, climate activists had been advocating for conference organizers to broadcast live sessions in parallel with or instead of in-person meetings in order to reduce fossil fuel use associated

with travel, while advocates for people with disabilities had been clamoring for telecast live meetings to make the meetings more widely accessible. Parents of children who had also previously struggled with the overlap of typical lab working hours with school-related activities are exploring more flexible schedules. These trials in virtual conference meetings and staggered work hours will help us sort out how to make these accommodations and allowances for one another a permanent feature of scientific workflow.

Conclusions

Scientists the world over have indeed been impressively productive, creative, collaborative, and resilient under the circumstances, and we highlight only a few examples here. However, it's important to acknowledge how exhausted we have

become, what little promise there is of upcoming respite, and how much more vulnerable we are to a variety of societal ailments as a result of this seemingly endless research project. When the first conferences and in-person meetings were canceled beginning in early March, many of us felt a momentary relief as we watched our travel calendars clear up. For some of us now, our schedules are becoming even more crunched. But perhaps we're getting better at all of this, more efficient and more appreciative of one another and of our own abilities to adapt and make something permanently good out of a difficult situation. We reflect on these positive aspects—greater access to experts and a greater and newer sense of camaraderie—in hopes that these features of the scientific workflow can be further developed even when a

raging pandemic is no longer driving them.

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WEB RESOURCES

Coronavirus Immunotherapy Consortium, <https://covic.lji.org/>
Viral Hemorrhagic Fever Consortium, <https://vhfc.org/>
COVID-19 Open Structures, https://www-structmed.cimr.cam.ac.uk/COVID19_Open_Structures.html
Coronavirus Structural Task Force, https://github.com/thorn-lab/coronavirus_structural_task_force