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The Importance of Biobanking for Response to Pandemics Caused by Emerging Viruses: The European Virus Archive As an Observatory of the Global Response to the Zika Virus and COVID-19 Crisis

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When a new virus emerges and causes a significant epidemic, the emergency response relies on diagnostics, surveillance, testing, and proposal of treatments if they exist, and also in the longer term, redirection of research efforts toward understanding the newly discovered pathogen. To serve these goals, viral biobanks play a crucial role. The European Virus Archive (EVA) is a network of biobanks from research laboratories worldwide that has combined into a common set of practices and mutually beneficial objectives to give scientists the tools that they need to study viruses in general, and also to respond to a pandemic caused by emerging viruses. Taking the most recent outbreaks of the Zika virus and SARS-CoV-2 as examples, by looking at who orders what and when to the EVA, we illustrate how the global science community at large, public health, fundamental research and private companies, reorganize their activity toward diagnosing, understanding, and fighting the new pathogen.

Keywords: viruses, biobanking, preparedness

Introduction

Containing the spread of viruses can be a challenge, depending on their host, infectivity, and mode of transmission, as was observed during the pandemic of Zika and more recently COVID-19. Preparedness and prompt response to emergence are two strong pillars for the control of epidemics. For both of these pillars, biobanks are key resources, as their role is to archive a large variety of viruses along with associated knowledge, techniques, and tools.

In 2008, the European Virus Archive (EVA) biobank was created with that aim in mind. EVA is a nonprofit research infrastructure dedicated to the conservation, production, and distribution of virus isolates, and the corresponding viral-derived products.[1] EVA was funded by the European Commission through three successive programs: EVA, EVAg (''EVA goes global''), and EVA-GLOBAL (2020–2024). EVA has grown from 8 European Union partners in 2008, to 37 laboratories (27 European and 10 non-European) and 9 associated partners for EVA-GLOBAL.

EVA's missions are to collect viruses, to multiply them through cell cultures, and to authenticate and characterize these viruses before making them available to scientists worldwide. In parallel, EVA develops and produces derived products related to these viruses such as antigens, plasmids, *in vitro* transcripts, detection assays, recombinant proteins, and tools for diagnostics and research activities. EVA's aim is to facilitate access to not only viruses and related derived products, but also services for science, medicine, industry, and public health.

EVA operates through a virtual infrastructure based on a website and a web-based catalog. To ensure optimal quality, a set of best practice quality guidelines have been defined and adopted by the partners of the consortium to guarantee the supply of authenticated and quality-controlled resources to users and harmonized service levels across the consortium. It has been an active actor during all the most recent epidemics caused by viruses and affecting humans and animals, including those of Schmallenberg virus, MERS-CoV, Ebola virus, Zika virus (ZIKV), or SARS-CoV-2 virus. The EVA has been recognized and acknowledged for this work by international institutions such as the World Health Organization (WHO). Most recently, plant viruses have been added to EVA.

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The EVA biobank is regularly curated by a panel of experts. This panel evaluates the weaknesses of the collection based on the coverage of the viral sphere, epidemiological trends, and recommendations from international organizations. Viruses and derived products are then produced and made available to the collection, contributing to better anticipation of viral emergence and preparing the biobank for future needs. The organization serves as a network, grouping their biobanks in a virtual catalog, which is an advantage because it means that future end-users will receive the strain or associated products directly from the experts who created them. This ensures quality and saves times for the requesting scientist who will be able to get technical support if needed.

In the case of a new virus, such as SARS-CoV-2, it is likely that diagnostic tools will not be available; accordingly, they will need to be developed as rapidly as possible to enable laboratory documentation of suspected cases. Characteristics of good and reliable diagnostics include ease in sampling of patients, good specificity and sensitivity, and if possible, an inexpensive methodology.[2,3] Molecular diagnostics allows the search of the virus or genetic components of the virus in clinical samples, therefore focusing on patients who may need medical support or can potentially be infectious and spread the disease, as opposed to the search of traces of the exposure of the host to the infection, as in serodiagnosis.

To be able to detect the presence of the virus in a patient's sample, a common technique used is the polymerase chain reaction (PCR). This technique is widely used in diagnostic laboratories around the globe, thus making it the preferred technique developed for diagnostics of an emerging virus when technically possible. To create new diagnostics, there is a need to know the genetic sequence of the pathogen, to determine primers and probes that will be used to amplify the targeted portion of the viral genome.

However, there is also the need for a positive control, and for genetic material from other clinically, phylogenetically, or epidemiologically related viruses, to check that the newly developed test is actually specific and sensitive enough for the emerging virus. Once the test is developed, positive controls are also used to validate routine experimental procedures. Accurate diagnostics allows public health authorities to monitor in real time the evolution of an epidemic, and to take adequate counter measures. There is therefore a need to archive and to render available to the scientific community viral strains to ensure that strains from recent years and different geographical origins are detected by diagnostic methods, to study the geographical[4] and time spread of viruses, to study virus adaptation to the environment and hosts,[5] and to perform phylogenetic studies, to name a few.

To illustrate how the EVA biobank plays a role in the preparedness and response activities toward emerging viruses, we have selected two recent epidemic events that have affected human populations worldwide: ZIKV, a flavivirus transmitted by Aedes mosquitoes, and the most recent pandemic of respiratory infection COVID-19 caused by the SARS-CoV-2.

ZIKV was first isolated in 1947 from an infected sentinel rhesus macaque in the Zika forest in Uganda. The ZIKV belongs to the flavivirus genus and that is predominantly transmitted by infected female Aedes mosquitoes. After its emergence in French Polynesia in 2013–2014,[6] ZIKV spread to South America and Central America in 2015.[7] This was the first time ZIKV was diagnosed outside of the Old World. It was first detected in Brazil in May 2015[8] and later on spread to 87 countries, with a total number of cases approaching 1,000,000 in 18 months.

Until its emergence in South America, it was believed to cause a mild dengue-like syndrome, with a sudden onset of fever, myalgia, and occasionally arthralgia, resolving by itself in a few days. Later, it was discovered that the range of pathologies was broader, and that the transmission mode could be not only through mosquitoes but also vertical transmission from pregnant mothers to their fetus, and horizontal through sexual transmission and blood transfusions. These data on the epidemics triggered the WHO to announce a Public Health Emergency of International Concern (PHEIC) on the 1st of February 2016.

More recently, a new coronavirus later named SARS-CoV-2 for its close genetic similarity with SARS-CoV emerged in China in December 2019 and caused a pandemic with nearly 12 million confirmed cases and at least more than 1 million fatalities as of October 2020.[9]

In both cases, in a matter of days after the sequence of the virus was known, members of the EVA network developed diagnostic guidelines with primers and probes described as well as diagnostic positive controls.[10,11] These materials were rapidly distributed worldwide, which contributed to the development and implementation of molecular assays at both the regional and national scale to allow the detection of the first cases, subsequently facilitating the monitoring of the epidemic in countries that used them.[12]

Functioning as a network of biobanks has led to the issuance of a virtual biobank catalog. Another important and maybe unexpected outcome of that is the fact that with having the access to our collections traceable via an online portal, and the fact that during the first 3 months of the pandemic no commercial diagnostic products were available yet on the market, we were in a position to retrospectively analyze the early stages of global response to a viral emergence.

We did that from two perspectives: the side of public health with, for example, hospitals or local diagnostic reference laboratories putting in place the diagnostic capacities; and also from the Research and Development (R&D) perspective, with orders from research teams both from the public and private sector. These R&D entities further developed pre-existing programs on the causative emerging virus, or, more frequently, reorientated their research programs toward the new pathogen, thus responding to funding opportunities.

Analyzing the activity of the biobank can provide a picture of the behavior of the scientific community in terms of response to an emerging virus.

Materials and Methods

Collection of data

Calculations, statistics, and conclusions for the ZIKV data were performed based on the activity of the EVA biobank from June 2015 to March 2018. This represented a total of 1353 enquiries for EVA products through the web-based portal.

Calculations, statistics, and conclusions for the SARS-CoV2 virus data were performed based on the activity of the

EVA biobank for the period of January 2020 until the end of March 2020. This represented a total of 1215 enquiries for EVA products through the web-based portal.

For each demand for a product from our catalog, some of the associated information was used for this analysis. Each accession was characterized with the following information: date of access, category of product, name of the product, category of the activity of the end-user (self-allocated, i.e., public health, private entity, public research organization), geographical location, and key words for the intended use of the biological resource. An IRB aproval/clinical trial registration number is not applicable for our work.

We included the United Kingdom in the EU countries we analyzed.

Publication data analysis

ZIKV and COVID-19 PHEIC. We selected all the orders made through the EVA catalog related to ZIKV products between the 1st of June 2015 until the 31st of December 2016, and all the orders made through the EVA catalog in 2020 until the 31st of May, related to SARS-CoV-2 products. In the online description of the intended use of the resource, end-users have the possibility to tick different boxes. We removed from the analysis the orders where the intended use was declared as a routine diagnostic setup only, on the basis that this type of work would most probably not be the subject of publications. We kept for the analysis all the orders where an additional intended use was added on top of a routine diagnostic setup, and the ones with project descriptions other than routine diagnostic setup. We therefore analyzed data on 228 inquiries for ZIKV orders, and 192 inquiries for SARS-CoV-2 orders.

Results

ZIKV PHEIC

At the outset of the Zika outbreak (May 2015), two ZIKV-related products were already available in the catalog, following the recommendations of the Collection Executive Board: one virus strain isolated from a patient returning from French Polynesia (H/PF/2013),[13] and the reference African ZIKV strain isolated in the 1970s (MR766).

During the first trimester of 2016, at the peak of international concern, EVA partners rapidly added eight new ZIKV-related products, including six virus strains, a molecular detection system, and a panel of inactivated products for External Quality Assessment of Reverse-Transcriptase-PCR diagnosis.

More than 300 EVA Zika products were distributed worldwide between November 2015 and March 2016, with a peak in February 2016, corresponding to the PHEIC declaration from the WHO (Fig. 1). Most products requested were viral strains at 70%, followed by diagnostic reagents (20%) and other virus-related material (10%) such as extracted and purified viral RNA. Interestingly, the two virus strains that were in the catalog at the onset of the alert (Zika H/PF/2013 and Zika MR766) were the most ordered, representing 52% and 21% of the virus orders, respectively.

Figure 2 represents the profile of end-users requesting Zika products per month. Orders from the public sector, such as hospitals or diagnostic laboratories (7% of our orders), and academic research laboratories (55%) peaked during the month of February, concomitant to the PHEIC declaration. Orders from the private sector (38%) started to increase immediately after the WHO announcement as well.

More than 300 ZIKV products were distributed by EVA to 66 countries worldwide (Fig. 3). A large percentage of orders (30%) came from the United States. Almost no products were distributed in South America, or in Africa.

COVID-19 PHEIC

The COVID-19 pandemic started with the identification of a cluster of pneumonia cases in the Hubei region of China in December 2019, later attributed to a novel coronavirus named SARS-CoV-2 for its close similarity with SARS-CoV that previously caused an outbreak in 2003. On January 10, the first sequence was made publicly available on Virological.org. Four days later, EVA partners from Charité in Berlin, Germany, designed three Reverse-Transcriptase quantitative PCR assays targeting the E gene, the nucleoprotein (N), and the

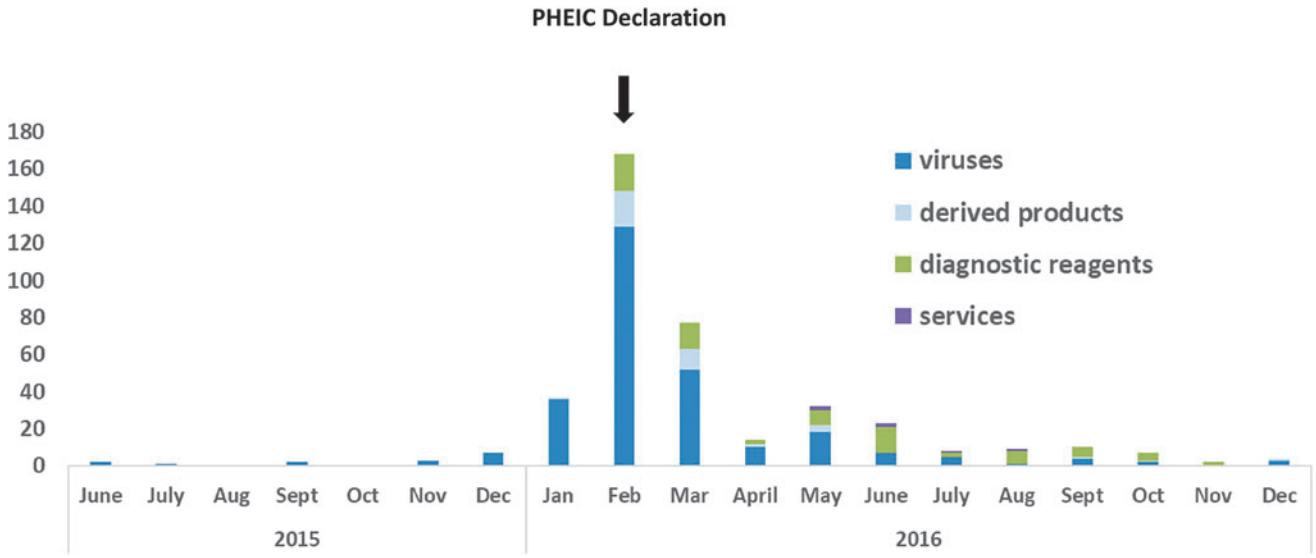

FIG. 1. EVA orders of ZIKV-related products per month, worldwide. EVA, European Virus Archive; ZIKV, Zika virus.

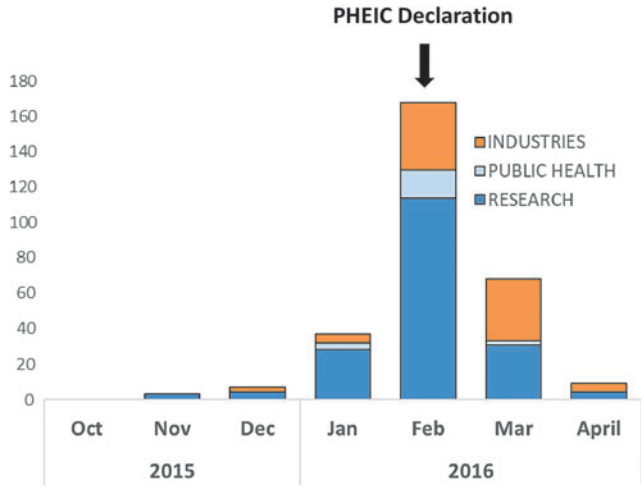

FIG. 2. EVA category of end-users of ZIKV-related products per month, worldwide.

RdRp regions of the genome. They also produced *in vitro* RNA transcripts (IVT RNA) to be used as positive controls for the molecular assays, and advocated to use the E gene assay as a screening test and RdRp as a confirmation test. The sequences of the primers and probe were made publicly available together with a protocol[9] and were included in the WHO-recommended assays for SARS-CoV-2 diagnostics.[11]

The IVT RNA, total SARS-CoV-2 RNA, and a strain isolated in Berlin were placed in the EVA catalog by Charité Berlin (Fig. 4) on the 14th of January 2020 and the distribution of positive controls through the EVA website started. Soon after, the mobilized EVA network added related products (Fig. 4): coronavirus RNA specificity panel (Erasmus Medical School, Rotterdam, Netherlands), the first viral strains isolated from patients in Europe (Charité, Berlin, Germany; Institut Pasteur, Paris, France; Spallanzani Institute, Roma, Italy), and hands-on diagnostic training (Charité, Berlin, Germany).

An alternative solution to stabilize positive control RNAs to allow shipment at ambient temperature was developed by Unité des Virus Emergents (Marseille, France), and in addition to this, a further product was added to the catalog, consisting of a bundle of primers, probes, and positive control for RT-PCR, all sent at ambient temperature. There were large numbers of orders for this specific product, resulting in the sending of nearly 110,000 PCR tests in 23 countries over a period of 17 weeks.

The number of SARS-CoV-2-related materials ordered on the EVA portal for diagnostic purposes by public organizations was tightly surveyed from the beginning of the alert. There was a marked difference in the timing of the online ordering of diagnostic reagents between EU countries (Fig. 5). Before autochthonous strings of transmission in the EU territory, that is, until week 5, 20 of the 27 member states had already ordered products for preparedness activities. When the PHEIC was declared (week 5), 25 EU countries had ordered COVID-19-related diagnostic products. This observation, stemming from the EVA orders, is in concordance with the survey done by the European-funded project EVD-LabNet. EVD-LabNet's missions are to support patient diagnostics, surveillance, and outbreak response by provision of diagnostic tools, among other things. They performed a survey regarding laboratories' capacities in Europe at week 5,[14] and showed that 24 of 30 EU/EAA countries had already implemented molecular tests.

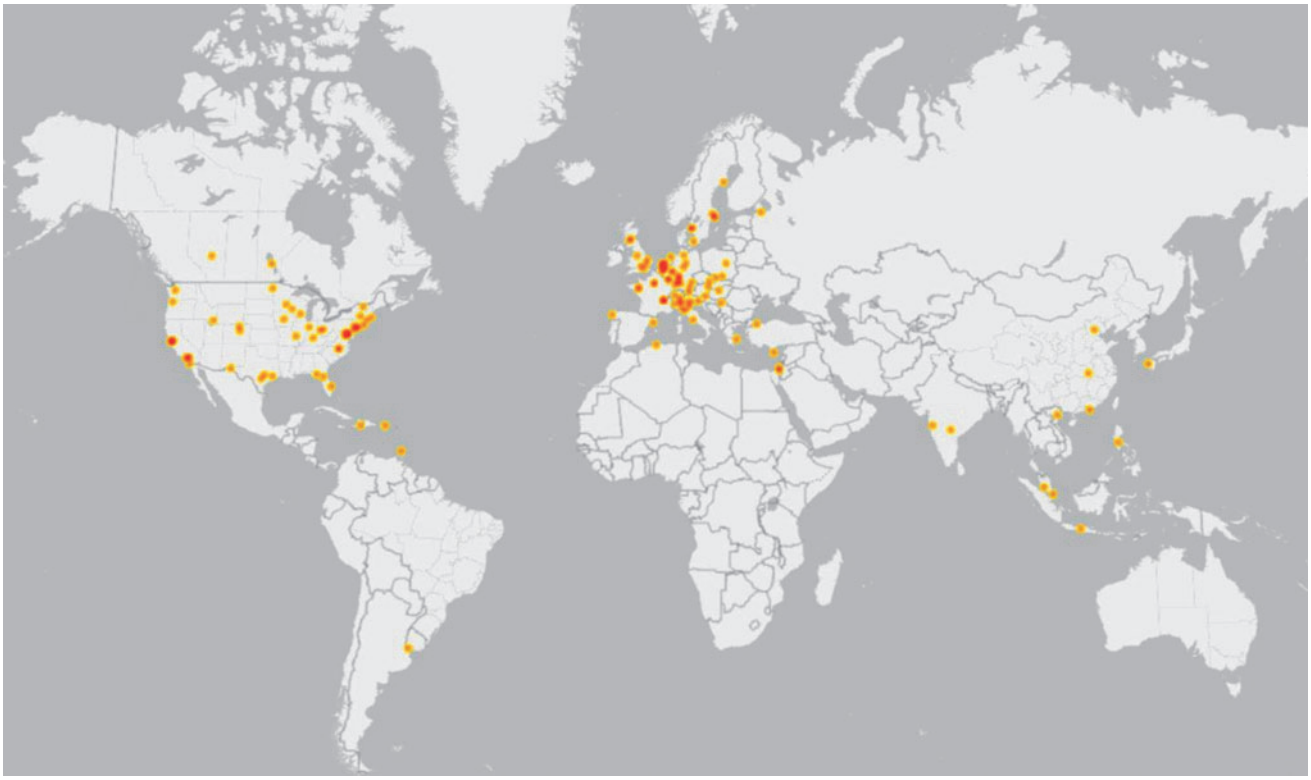

FIG. 3. Geographic distribution of EVA Zika product end-users.

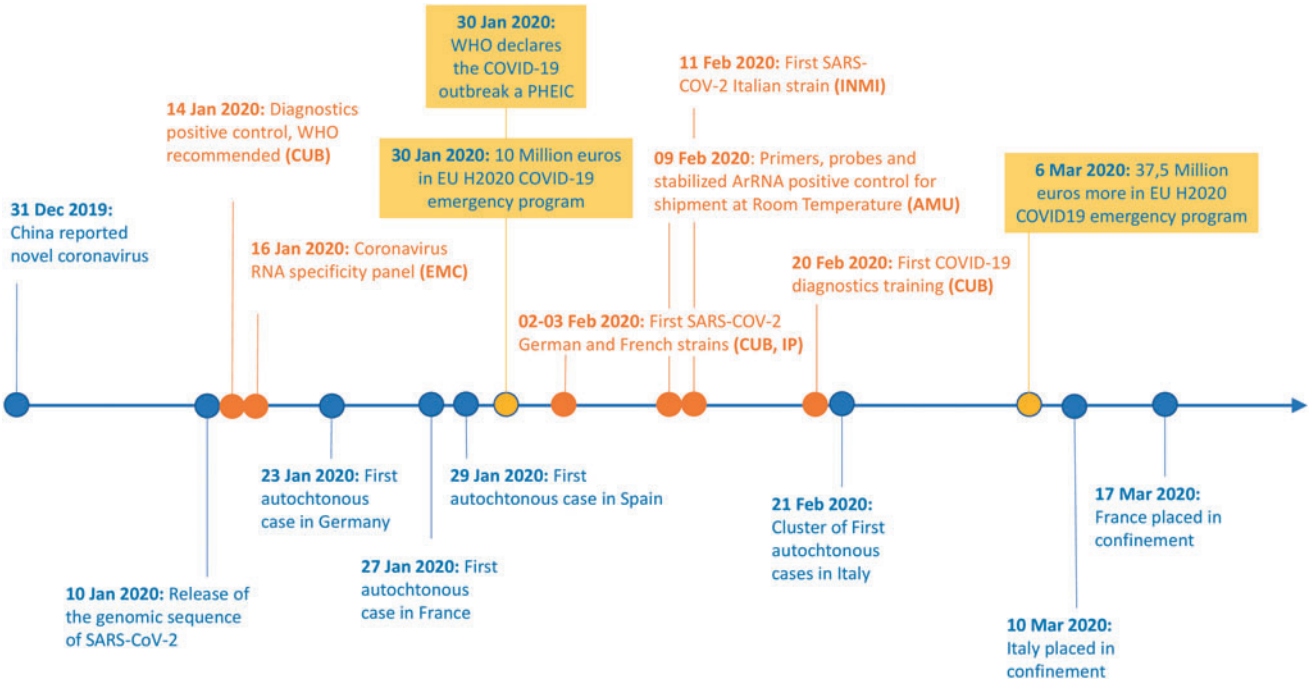

FIG. 4. Time line of the COVID-19 public health crisis. In *blue* is depicted the epidemiology of the pandemic. In *orange* is represented the addition of COVID-19-related products to the EVA online catalog. The acronym of the EVA partner is indicated in *bold*. CUB, Charité Berlin, Germany; IP, Institut Pasteur Paris, France; EMC, Erasmus Medical School, Rotterdam, Netherlands; INMI, Spallanzani Institute, Roma, Italy; AMU, Aix-marseille-University, Marseille, France. In *yellow* are represented the institutional official announcements.

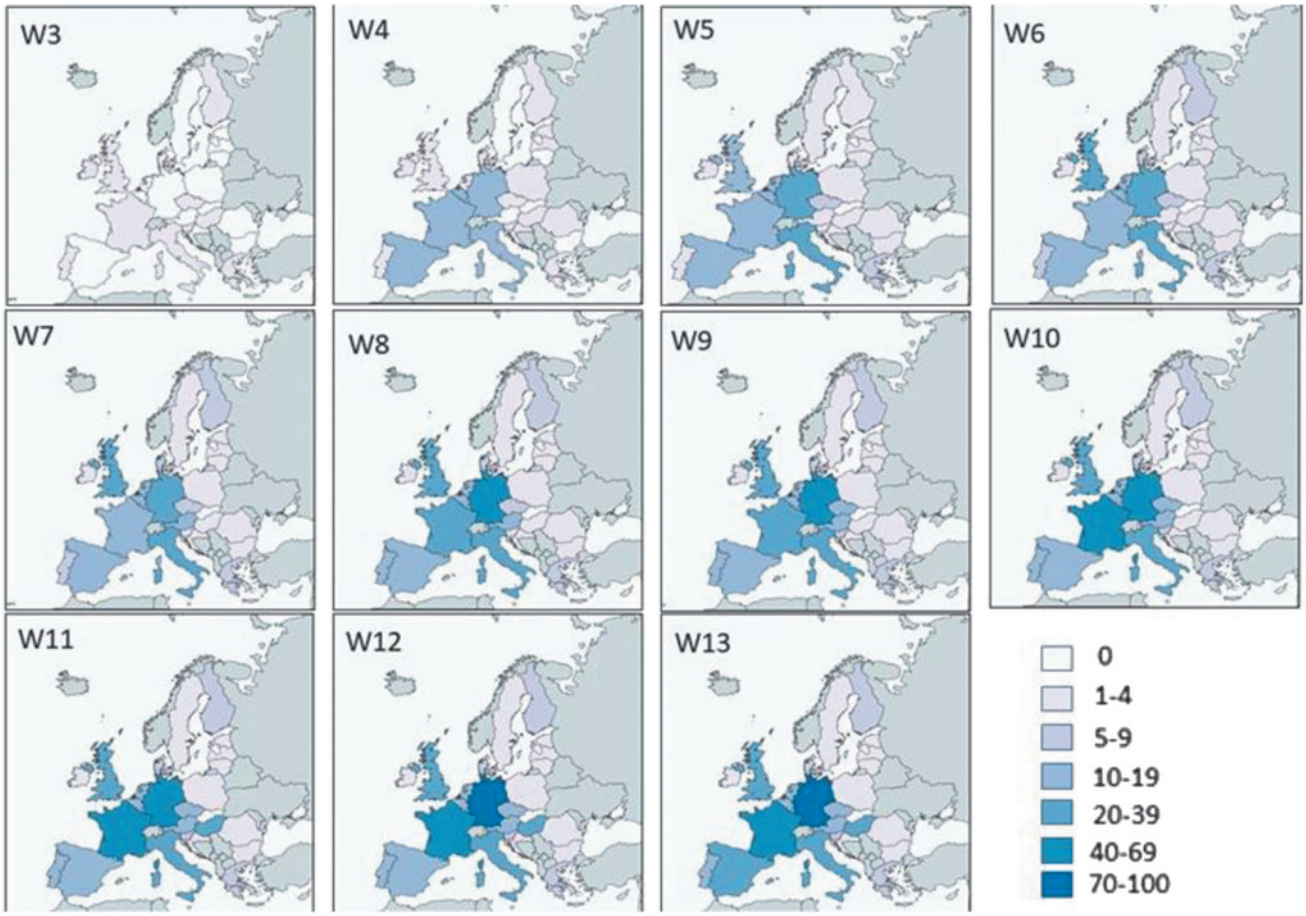

FIG. 5. Number of SARS-CoV-2 products distributed for diagnostic purposes to Public Organizations per EU country per week in 2020. EU, European Union.

In our analysis, Germany was the most proactive country with 100 laboratories having passed orders by week 13; in France and the United Kingdom, 60 and 37 orders were recorded, respectively, for the same time period. In other EU countries, an average of 9 orders were passed by week 13.

We then looked at the level of response from the R&D perspective, including from academic teams and private organizations (Fig. 6). By week 13, 54% of EU countries had ordered products related to an R&D purpose (15/28), from public or private organizations. Private companies from the following countries placed the most orders by week 13: Germany (103), Italy (19), Spain (56), and the United Kingdom (40).

From all data cumulated, EVA partners involved in the COVID-19 response distributed 777 products to EU countries, for diagnostic purposes and for R&D, from both academic and industrial laboratories.

EVA did also provide products to the rest of the world, as shown in Figure 7. Unlike for the Zika crisis, the country coverage for COVID-19 diagnostic products was very good in the Americas, but still quite poor in Africa at the beginning of the pandemic. The orders of products for R&D purposes both from academia and industry were mainly restricted to North America, Europe, and Southeast Asia. The United States again represented 28% of the non-EU orders.

Within 10 weeks after the beginning of the COVID-19 outbreak, EVA had distributed 1564 products worldwide.

Logistics

The quick response of EVA partners to the ZIKV outbreak and COVID-19 pandemic in developing products meant that they were some of the first PCR controls and strains in the world. The vast quantity of orders that were placed on the website dramatically increased the workload of EVA partner institutions. The responsibility of the partners to distribute and ship products in the shortest time frame possible, given the then unknown dynamics of the new virus, also competed with their other responsibilities in conducting their own research on the virus and their respective national responses to the pandemic in diagnostics and testing.

In response, some strategies that the partners developed were to divide personnel into teams to handle different product types. For example, one of the EVA partners had a team to handle requests for diagnostic controls and another to handle the isolated strain. Each had a main contact person who was supported by one or more colleagues, and each team had a specific joint email address that each member of the team could access.

One of the main roles of the EVA management team was to handle inquiries from individuals who had contacted EVA by email. These inquiries would generally fall into the following categories: requests for further information about the products; questions on what products EVAo held; quotation requests; and, requests for updates on the status of their order. Thousands of emails were received, and to keep customer support as efficient as possible, a series of template emails were written, to be used for each of the cases described above.

On the subject of communication, early in the time line of the pandemic, a webpage was created within the News section of the EVAG website. This page provided a summary of SARS-CoV-2-related products, services, and training that were offered by EVAG partners. Importantly, it also summarized the steps to be taken to apply for free access to the products. This page was constantly updated as new products were added to the catalog and as clearer instructions on the order process were found to be needed. This resource was useful for end-users, and also for management as a reference to direct end-users to when they inquired about available products.

The usual time between ordering and receiving products from EVA is 2–3 weeks. We were able to reduce this time

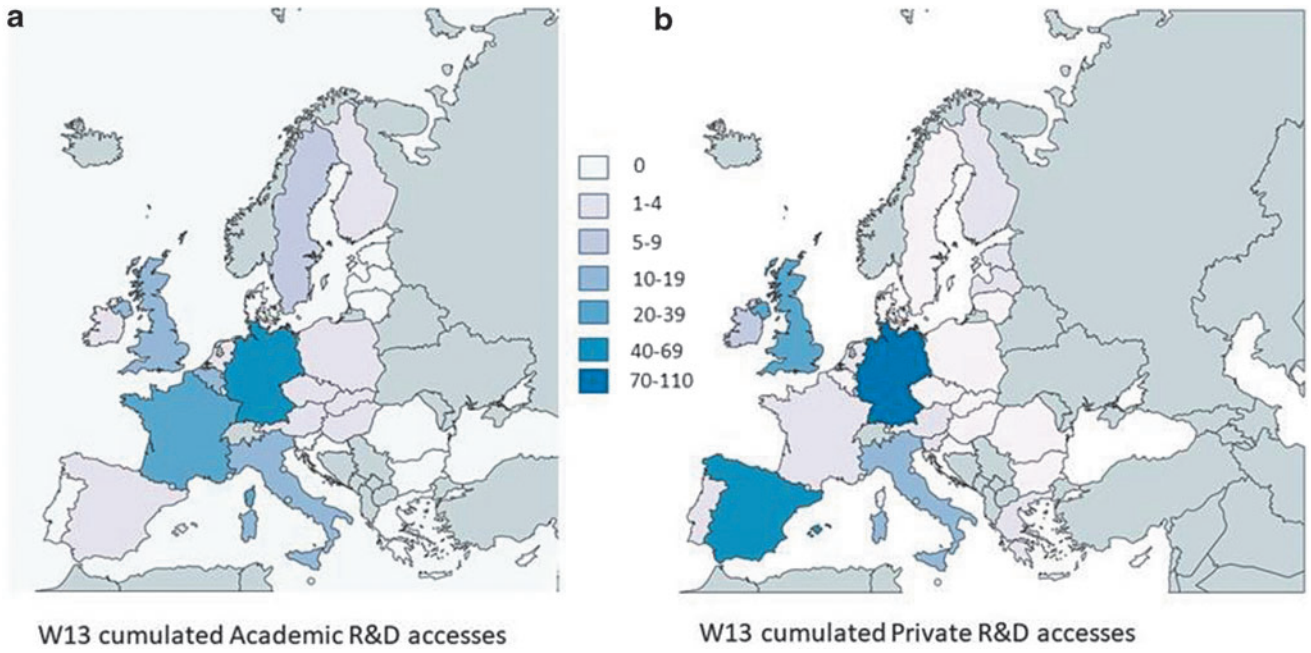

FIG. 6. Cumulated number of EVA products distributed per EU country at week 13 in 2020. **(a)** R&D purposes from public organizations; **(b)** for R&D purposes from private organizations. R&D, Research and Development.

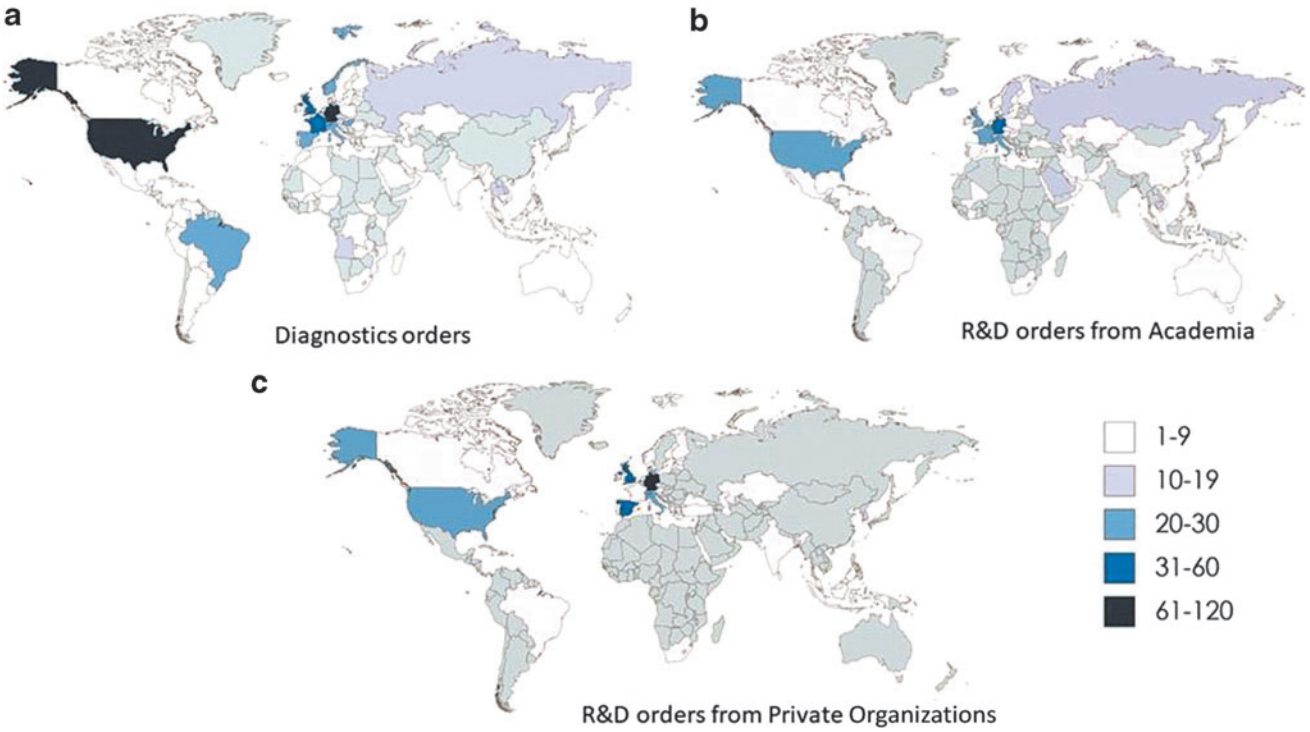

FIG. 7. : Cumulated number of SARS-CoV-2-related products distributed per country at week 13 in 2020. (**a**) For diagnostic purposes; **(b)** for R&D purposes from public organizations; **(c)** for R&D purposes from private organizations.

frame during epidemics (from days to 1 week) by relying on the acceptance of Terms and Conditions instead of the signature of an Material Transfer Agreement (MTA) for products other than viral strains; by having an emergency procedure in place to check and approve or deny access to SARS-CoV-2-related products in less than 24 hours (compared with 1 week in normal times); and by liaising with the courier companies we used, so that they were aware of the urgency of the situation and could prioritize our shipments. We have several testimonials of end-users being very grateful for the speed at which the products were received. Another example comes from industry: 31% of the companies that had marketed diagnostic kits at the end of April 2020 had ordered from EVA, probably a good indication that they had received the material in an appropriate time frame.

The EVA network also puts an emphasis on sharing knowledge and experience. At each relevant General Assembly, partners that have recently been involved in public health response in the framework of EVA are invited to give their feedback and lessons learned. This sharing process, together with an in-depth analysis of the activity of the biobank during those times, is of course extremely important to be better prepared to the surge in the number of orders typically observed in case of viral outbreaks.

Financing

At the beginning of an outbreak of an emerging virus, there is no distribution market by definition, as products simply do not exist yet. For the first few months, biobanks are the main providers of essential viral resources. In the EVA project, these times of public health crisis are anticipated by having a contingency fund. This contingency fund is a sum of money set aside at the beginning of the project, with flexibility for use in response to the emergence of the virus. It allows for injecting money into the budget of specific partners that are involved in the response. The beneficiaries are not known in advance, as each viral emergence requires the implication of different expertise in the consortium.

The fund is used to sustain the development of a pipeline of products, and to distribute the resulting products free of charge. This sum of money represents around 5% of the total budget of the consortium, and is available immediately, without the need to respond to a financing call. Instead, an EVA committee, the Outbreak Assessment Board (OAB), is the decision-making body for invoking of outbreak response activities and the release of the contingency fund to selected consortium members. The OAB uses the vigilance systems of established, corepresented networks (e.g., Prepare, Compare, ECRAID-plan), source information from public health bodies (WHO, European Center for Disease Control and national institutions), as well as public resources such as ProMED mail, to gather information on early epidemiological data in disease outbreaks.

Publication rate

We wanted to know how many EVA end-users had redirected their research programs to work on ZIKV. To do so, we looked at previous publications from each research scientist who ordered a Zika-related product, in the general field of flaviviruses, considering that it was the closest field related to this new emerging virus at the time. We found that 56% of them had never published on that subject before placing an order for a ZIKV-related product on the EVA website. We then looked at their publication records on ZIKV up to May 2020, that is, up to 5 years after their order

on the EVA website, and showed that 70% of them never ended up publishing in the field of ZIKV. Compared with this, of the 44% end-users having previously published in the field of flaviviruses, 70% of them indeed published on ZIKV in the next 5 years.

In the light of these data, we analyzed the SARS-CoV-2 end-users using similar methods. We considered related fields to be from coronaviruses, enteroviruses, influenza viruses, picornaviruses, flaviviruses, and hepatitis C—a much broader spectrum. In 2020, among the end-users having ordered products related to SARS-CoV-2 via EVA, 70% had already published in the selected fields. Interestingly, 100% of the ''early publishers,'' defined as end-users publishing on the new SARS-CoV-2 virus in the first 4 months after the release of the sequence of the virus in January 2020, had already published in the selected fields, 44% of which were in the field of coronaviruses.

Discussion

During the recent ZIKV and COVID-19 Public Health Emergencies of International Concern, the EVA network has shown that it can mobilize in a matter of days to provide essential tools for the diagnostics of the emerging virus, and also for broader research goals. We observed that during the Zika outbreak, the two virus strains that were already in the catalog at the outset of the alert were the most ordered. We also observed that other products related to Zika, clinically, epidemiologically, or virologically, were ordered at the same time, such as the chikungunya virus and dengue virus. For preparedness, these observations need to be taken into account. The observations clearly demonstrate that to understand an emerging virus there is a need to compare it with other known viruses, and then advocate for the need of having already characterized and biobanked viral strains that have no apparent or immediate interest for public health for preparedness purposes.

Preparedness is addressed within the consortium: (1) by having a biobank of carefully curated viruses evaluated as important using various criteria established by a panel of experts, our Collection Executive Board; (2) by having a unique mode of access to resources through the EVA website; (3) by having a strong quality system that allows the distribution of quality controlled material; (4) by having the logistics to distribute quickly and efficiently the material all over the world, including one single MTA template ratified by the EVA centers. This preparedness activity constitutes one of the pillars of the EVA biobank.

With thousands of orders placed in a very short amount of time via the online catalog, the logistics of distribution can be very challenging. The biobank has put in place procedures to alleviate the burden on EVA partners. We created distribution hubs of Zika or COVID-19 products in Russia, China, Japan, and the United States. We use a common MTA that facilitates quick access to resources, especially from industrial end-users, and we have a task force dedicated to the logistics of shipments and end-user support. The first publications using EVA products were published no later than 2 months after reception of the ZIKV ordered products,[10,15–17] an illustration of the use of EVA to facilitate access to emerging virus material.

We observed in both pandemic cases a strong increase in the number of orders concomitant to PHEIC announcements, and most probably to funding calls. This may be explained by the fact that scientists must wait for strong signals before they can redirect their research effort on the new pathogen, in a sector constrained and limited by funding. This underlies the importance of a good prepared network for response to quickly evolving situations such as the ones encountered in the two PHEIC studied here.

Preceding the PHEIC declaration, both in the case of Zika and COVID-19, there were individual demands for reference material, illustrating that in many countries, reference national laboratories set up and validated diagnostic procedures to anticipate the possible pandemics and resulting public health needs.

The addition to the EVA catalog of lyophilized primers, probes, and positive controls for the molecular detection of COVID-19 has played a major role to help laboratories in Europe prepare for detection of cases. A large part of the delay in establishing diagnostic capacities can be attributed to multiple contamination incidents at the production sites of industrial distributors of primers and probes,[18] and this EVA product was a timely solution to that problem. Especially at these early stages of the viral emergence, giving access to reference material is mandatory as there is no economic market meeting these needs.

The striking differences observed between countries for the number of emerging virus products ordered need to be further investigated. For example, during the Zika outbreak, the majority of demands outside of Europe came from the United States. Despite the existence of virus and specifically arbovirus biobanks there, a large number of scientists ordered through EVA. This could be due to more restrictive intellectual property conditions in place in the United States at that time that have been considerably reduced for the COVID-19 crisis, as any product related to COVID-19 is now distributed from the US biobanks with an Emergency Use Simple Letter Agreement, and not a formal MTA.

In the case of South America, it is probable that countries showing low EVA orders during the Zika epidemic participated in other Zika preparedness networks, with the American Centers for Disease Control and Prevention for instance. The observations we made also ask the question of how the preparedness system is organized *in situ*. Could the differences by sector be explained by differences in funding opportunities, with, for example, some countries, in the case of an emerging virus, funding more industrial research than public research?

Given the correlation observed between the data presented in the EVD-LabNet diagnostic survey at week 5 and our data resulting from EVA website orders, we show that the observations of the EVA activity in times of virus outbreaks provide a realistic picture over time of the organization of the response in different countries and sectors.

The data presented here from the Zika and COVID-19 PHEIC, caused by viruses, highlight the role played by virus biobanks in preparedness to virus emergence, by collecting viruses with potential for emergence, and developing reference material associated with the collection. The contribution these biobanks are making for the response to the emerging diseases is also important, with the aim to increase capacities for the production and distribution of the material for immediate local response to the sanitary crisis, and also, for longer term, to better understand the new infectious agents.

Workgroups

EVA ZIKA workgroup: Aix Marseille university (Baronti C, Lieutaud P, Bardsley M, de Lamballerie X), University of Ljubljana (Resman Rus K, Korva M, Petrovec M, Avsic-Zupanc T), INMI (Matusali G, Meschi S). **EVA COVID-19 workgroup:** Aix Marseille university (Baronti C, Bardsley M, Lieutaud P, de Lamballerie X), Charité Berlin (Bleicker T, Drexler JF, Drosten C, Fischer C, Niemeyer D, Schmidt M), Erasmus Medical School (Koopmans M, Haagmans B), Institut Pasteur Paris (Van der Werf S, Behillil S, Enouf V, Albert M, Donati F), INMI (Matusali G, Meschi S).

Correction added on May 7, 2021 after first online publication of November 11, 2020: The names of two members of the EVA COVID-19 workgroup, ''Blecker T, Drexler F,'' were misrepresented in the acknowledgments. Their names have been corrected to ''Bleicker T, Drexler JF.''

Author Disclosure Statement

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