Zika virus epidemic legacy: the impact of causal association beyond laboratory science

Legado da epidemia de Zika vírus: o impacto da associação causal para além da ciência de laboratório

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Abstract

More than four years after the Zika virus epidemic, we are left with the task of investigating its legacy. Here, we describe the impact of the causal association between the Zika virus and the abnormalities seen in fetuses, a search that marked the scientific and press agenda at the time. By using the Social Studies of Science and Technology, which establishes the scientific fact as co-produced by science and society, we carried out 17 semi-structured interviews between scientists, managers, health professionals and families of the children in eight Brazilian cities. We observed that causality had a partial and dubious impact on the organization of services – with the overlap between surveillance and care initially generating asymmetries in the Brazilian Unified Health System. Between families and health professionals, there are demands for research on interventions and care, considered as not being prioritized among scientists. Among the researchers, we notice a gap between study and coping, with the social being constituted by demands that are not integrated into the scientific field. For future public health crises, we point to multiplying the number of research questions and study designs, so that social demands find flow in scientific doing.

Keywords: Epidemics, Zika Virus, Public Health, Dissensus and disputes, Social Studies of Science and Technology

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Resumo

Passados mais de quatro anos da epidemia de Zika vírus, tem-se a tarefa de continuar a investigar o seu legado. Aqui, descreve-se o impacto da associação causal entre o Zika vírus e as alterações observadas em fetos e bebês, uma busca que marcou a pauta dos cientistas e da imprensa entre 2015 e 2017. Por meio dos estudos Sociais de Ciência e Tecnologia, que vê o fato científico como coproduzido pela ciência e pela sociedade, realizamos 17 entrevistas semiestruturadas entre cientistas, gestores, professionais de saúde e famílias de crianças em oito cidades brasileiras. Vê-se que a causalidade teve impacto parcial e dúbio na organização dos serviços – com a sobreposição entre vigilância e atenção, gerando, inicialmente, assimetrias no Sistema Único de Saúde. Entre as famílias e profissionais de saúde, nota-se demandas por pesquisas de intervenções e de cuidado, consideradas como não sendo prioridade entre os cientistas. Já entre os pesquisadores, observa-se distanciamento entre estudo e enfrentamento, com o social sendo constituído por demandas não integradas ao campo científico. Para que demandas sociais encontrem fluxo no fazer científico, sugere-se para crises futuras de saúde pública a multiplicação do número de perguntas da ciência e a maior diversidade dos desenhos de pesquisa.

Palavras-chave: Epidemias, Zika Vírus, Saúde Pública, Dissensos e disputas, Estudos Sociais de Ciência e Tecnologia.

Introduction

In Brazil, the Zika virus has mobilized the scientific community since its identification in the territory, in April 2015; and, mainly, when it was credited with being responsible for the changes in the nervous system observed in infants in November of that year, with the main characteristic being microcephaly – decreased head circumference – (or "small head", as popularly referred to at the time) (Oliveira, 2021), an aspect characterized by inadequate brain development (Zika, 2019). During the analyzed period, the causal relationship between Zika and these changes in fetuses and infants was disclosed by the Brazilian government with preliminary evidence – such as the coincidence between the first months of pregnancy and the greater circulation of Zika in the Northeast of the country, as well as the presence of the virus in the amniotic fluid in two pregnant women and in one stillbirth (Brasil, 2015).

Over time, the causal relationship between the Zika virus and the observed condition was consolidated in science by *in vitro* tests on animals, as well as by case-control and cohort studies (Araújo et al., 2018; Brasil et al., 2016; Cugola et al., 2016): The outcome spectrum also became more complex than microcephaly, with varied alterations that later resulted in the description of Congenital Syndrome, associated with Zika Virus infection (SCZ)[1]. Past the most critical period of the emergency, still the involvement of an arbovirus in congenital alterations led the Oswaldo Cruz Foundation to characterize the period as one of the "greatest public health emergencies in the history of Brazil" (Zika, 2019).

Despite the importance of the causal relationship, the period was also marked by several other phenomena relevant to scientific investigation. The purpose of this article is to explore the impact of this relationship on those involved in the epidemic, through a qualitative analysis. More precisely, it investigates the centrality given to the causal relationship in the scientific agenda and

1 The description of SCZ appears in the International Classification of Diseases (ICD 10), with code P35.4, according to a technical note from the Ministry of Health: <http://plataforma.saude.gov.br/anomalias-congenitas/nota-tecnica-17-2022.pdf>. Access on: Sep. 16, 2022.

points to the lowest priority given to intervention studies. Thus, scientists who were at the forefront of establishing the causal relationship in research institutions (mainly sanitarians, epidemiologists and virologists), but also health professionals and families of infants affected by the epidemic at the time, were interviewed. For this, we have as a theoretical framework the Social Studies of Science, Technology and Society (STS), an area that understands scientific fact as a co-production between science and society - which means conceiving the Zika epidemic not only through scientific studies, but through performance and choice of those involved.

It should be noted that this is not a study of perception, but an investigation that conceives science as formed by different elements, which include humans, non-humans, discourses and the prioritization of certain perspectives; for this reason, science also becomes a political fact. By science, we mean the scientific research carried out during the Zika epidemic, with a focus on the performance of virology laboratories and epidemiological study designs, as well as a focus on the attempt to establish the causal relationship between Zika and the changes in infants observed in 2015. The objective here is to insert this science into society, with no demerit to it, nor does the emphasis given to the social aspect of the constitution of the scientific fact install in it a denunciation or a problem to be solved. Such highlight is intended to emphasize that the result of a scientific investigation is a tangle of different elements, rather than a materiality or truth that resists temporalities or whose social impact is justified by itself (Latour, 1994; Latour; Woolgar, 1997).

It is understood that research carried out during the epidemic is part of the community and must share problems and questions, constituting a shared world. Such a problem in the field of STS is raised because it is not uncommon for science to constitute itself as a world apart, with problems that concern more the scientific field than society as a whole (Callon, 1986; Felt, 2017; Jasanoff, 2004; Latour, 2012; Sismondo, 2010). This has already been much problematized by an author outside the field of STS, Pierre Bourdieu, for whom the scientific field has relatively autonomous microcosms, capable of refracting external issues. Depending on the scientific capital of the researchers and the institutions to which they belong, the author argues, certain agents can guide which topics are most important in science (Bourdieu, 2004). Given this perspective, one of the questions of this investigation - regarding the complex outcome observed in infants at the time - is the centrality given to the investigation for causality, a priority for science, and also for unicausality, since an etiologic agent was sought that was responsible for the outcome.

The idea of unicausality in health has a history that is confused with microbiology. Actions in this field are guided by specific diseases, with also specific causes - the effect of a rationality resulting from the importance given to the search for the biological cause developed from the 19th century onwards (Czeresnia; Maciel; Oviedo, 2013). In the classic ways of thinking about causality in the philosophy of science, for example, the perspective is multicausal. If we go back to Aristotle (1984), the cause was multifaceted, received several names, and did not have the assumption of a universal narrative. Formal cause, material cause, efficient cause and final cause used to be considered. This narrative of several causes brought together from the origin of the object to its purpose and had, in its varied definitions, the aim of explaining phenomena in their entirety. Such varied perspectives, however, were being lost with science's distancing from metaphysics. Science, since the 16th century, invested in an enterprise of separating itself from the great explanations, limiting itself to restricted objects - but it is observed that it did not give up an effect of totality, in which the idea of rationality is confused with the understanding of observed constant movements (Novello, 2010).

For some authors, there is something fundamentally reductionist in science, because the scientific explanation is intended to produce familiarities, so that its effect is to reduce what is unknown, not necessarily providing explanations (Salmon et al, 1999). Another point is that science, by traditionally trying to distance itself from social values, opting for a neutral perspective, may also have reduced its explanatory capacity - insofar as,

in an attempt to purify the data, it ends up selecting micro contexts (Lacey, 2009).

Already in the late 1970s, Bunge (1979), in a famous book on causality, described how the category had an ontological and epistemological dimension. To arrive at this proposition, the author departs from the ancient debate in the philosophy of science (from Locke, Hume and Kant) on causality not being an observable fact, but a category of reason: "a mental construction". For these philosophers, it is not empirically observable that a cause produces an effect, but that something called a cause is invariably associated with an effect. Disagreeing with this position, Bunge proposes that the idea of causality should not be seen through dichotomous categories (as a fact in itself or as a mental construction): the description of a causal relationship has an epistemological and ontological status and, therefore, is onto-epistemological. It is a construct grounded in reality. There is an interdependence of the idea of causality with empirical phenomena, even though it is only possible to describe an approximate reality (Bunge, 1979).

Other authors point out that causality has a functionalist aspect. Through the causal relationship, they claim to want to know whether a problem can be predicted or not, as well as the risk of it being persistent. The cause is also a way of explaining the phenomena, not only of the past, but of what may eventually happen, in such a way that it is through the description of the cause that we can know what can be done about the problem (Illari; Russo, 2014). Thus, the search for the cause of the complex outcome in infants, observed in 2015, shows the need for a scientific perspective to impose order on the chaos of the disease, with the assumption of the search for a course of action that can be effective in the midst of different directions.

However, the choice to establish a causal relationship by searching for an etiological agent implies costs and compromises the understanding of complex conditions from a social and biomedical point of view (Singer; Clair, 2003). It is therefore up to the scientific community to be aware of the costs involved – an assessment that is also social and interdisciplinary; and, to this point, this research intends to make a contribution.

Methods

Based on the Social Studies of Science and Technology, the research presented here is part of an investigation carried out for doctoral research approved by Conep (National Research Ethics Committee), with process number 01208718.9.0000.542 (Oliveira, 2021). The investigation consisted of collecting varied reports and materialities about the causal association between Zika and the outcome of SCZ, without stabilizing actors, in the sense that, regardless of specialty or profession, all those who were associated with the epidemic – with impact actions on its course – have a positional experience on the subject, in addition to a consistent approach with the STS (Latour, 1994, 2012; Latour; Woolgar, 1997). In practice, a variety of approaches are used to trace causality, taking care not to remove from the sample subjects who can contribute to an experiment – whether human or non-human, scientists or people outside professional science. Some notes placed here dialogue with ethnographies written on the subject, in which clashes with the priority of science and family members were observed (Scott, 2020; Simões, 2022). Thus, in the doctoral research, observations were made, research was carried out in official documents and scientific articles, in addition to 50 semi-structured interviews carried out in 2019 in eight Brazilian states, namely: Bahia (Salvador), Brasília (Federal District), Pará (Ananindeua and Belém), Paraíba (Campina Grande), Pernambuco (Recife), Rio de Janeiro (Rio de Janeiro), Rio Grande do Norte (Natal) and São Paulo (Jundiaí, São Paulo, and Campinas).

The stage presented here is a selection of this whole investigation, with 17 interviewees' testimonies about the causal association and the social relevance of this institution, based on the methodology of oral history, whose justified use is to present unrecorded historical facts, in documentation made from interviews with subjects of a common episode (Lima, 2016; Queiroz, 1987). Specifically in this study, the impact of the causal relationship and individuals' experience with this process are registered. As the selection was made based on previous mapping research, based on the STS's theoretical framework, oral history

is presented in view of this connection and also the stabilization processes of science, as well as the voices and questions that remain along the way.

Results

The following items show interviews with: 1) scientists involved in studies that tried to describe the causal relationship; 2) a conversation circle with families of children potentially affected by SCZ; and 3) health professionals and Ministry of Health professionals involved in care management. The findings were selected according to the problematization made from the impact of the question of causality and its relevance to the public interest and to coping with the epidemic.

Scientists

The researchers who were interviewed - and involved in studies whose aim was to describe the cause of the changes in infants observed - understand that the social impact of SCZ is much greater than causality, but tend to separate the role of research from problem solving, which would be left to other actors. Among the scientists who carried out research focused on the description of causality, there are reports that call into question the relevance of the causal question to the generation facing the problem. A virologist from one of Fiocruz's units in the Northeast, involved in studies to establish the causal relationship between the Zika virus and SCZ, talks about how causality had very little practical relevance for families that were already dealing with the consequences of the epidemic.

> *Proving that Zika causes microcephaly, ok, but for a mother, what's the benefit? She is pregnant, if it is microcephalic, what will she be able to do? She will have a sacrificed life, the mothers are very young, it was a tragedy. The average age was 19, there are mothers who are only 13 (...) a child having a child full of sequelae.* (Interviewee 1)

The same Fiocruz scientist described above comments that science managed to "study it", but "not to cope with it". According to him, the constitution of effective policies that mitigate the problem did not come at the same speed as the studies, although Brazilian science has demonstrated autonomy in the description of the causal relationship, even more so when compared to countries with more research resources. Likewise, for the virologist whose studies, carried out in Bahia, identified the presence of the virus in the territory, Zika "brought a very large social impact"; an impact that scientific research has not been able to account for.

Another virologist, involved in causal association studies at a public university in São Paulo, questions the role of this type of research in coping with an epidemic. The researcher discusses the focus on causality which, depending on the situation, can be an "argumentative farce". Referring to the Zika epidemic, he quotes a text published in the press at the time by a famous biologist, who said that little could be done without the causal relationship being fully established. "*I thought it was silly because (...) when you suspect something, you have to take full risk. This is the more or less obvious predicate of the risk theory*". For him, the issue of causality comes in the wake of interventions that can be put in place. "*It is not necessary to know the causality between Zika and microcephaly to take some action*", he adds.

The reports above are a sample of the reservations regarding the centrality of the question of the causal relationship to the various ongoing demands of the epidemic, even among scientists involved in laboratory studies with this objective. It should be noted that none of the interviewees considered that the causal question was irrelevant, but that, when it came to the multiplicity of demands that occurred in the period, limits were cited regarding the ability of the description of the cause to mitigate such adversities. For example: to the extent that the description of the cause states that an arbovirus (Zika) is related to the development of SCZ, there were difficulties in disseminating information about sexual transmission, resulting in an impact on prevention measures. Campaigns from that time are remembered by interviewed researchers, such as this professor from the Federal University of Pernambuco, who criticizes the individualizing aspect of campaigns that, according to her, tend to bring back the outbreak of arboviruses in full.

The Ministry got into a lot of the individual prevention thing. You take the advertisement of the Ministry of the time it is like this: "Saturday is cleaning day". Then the other one was like this: "If it's a mosquito, it can't live", something like that. Then the other one was, I don't remember, but it was in that direction, but that one disappeared. Then there was another one that went like this: "The mosquito cannot be bigger or stronger than a nation". And the focus was on the repellent. (Interviewee 4)

Another caveat regarding the centrality of the causal question in the epidemic was the fact that such question points to the future in which a vaccine could be developed; a fact that, at least until 2022, had not occurred. While it is known that there are no guarantees for the development of an immunizer under all conditions, the volume of resources destined for the development of an immunizer is questioned. For a researcher in Paraíba, it is not the researchers' fault that more studies focus on the question of the cause. According to her, there is no money to test effective methods in care, and the funding released was focused on the characterization of the disease.

In the wake of this question, another reflection mentioned in interviews was the fact that, once the disease and the relationship between Zika and the outcome of SCZ were described, it was as if the problem had disappeared. For the aforementioned researcher from Paraíba, each scientist arrived in the territory to carry out research according to their approach and the problem of families was not really an object. According to her, there are few studies on assistance interventions because there is almost no look at questions from outside the scientific community, in addition to the few resources available for this type of study design. For this reason, in the case of Zika, says the researcher, protocols were "copied" from other conditions to increase the quality of life and treatment, so there was a need for specific studies for the condition.

Children with conditions associated with SCZ take up to nine different medications and it is not known exactly which substance or set of medications are most effective, reports the researcher. Likewise, the early stimulation kit was made - materials distributed in primary care that could contain mats, balls, rollers and toys, with the aim of contributing to the development of children affected by SCZ[2] -, but its effectiveness was not measured or evaluated.

The impact of the Zika epidemic still falls on the family members of affected children, especially the maternal figure responsible for care – an aspect problematized by some scientists. In addition to the causes, there are consequences, points out a researcher from Fiocruz in Bahia. In the context of Zika, he cites a study that showed that mothers of children with disabilities have a higher mortality rate than others. "That means that the energy that the mother spends to treat that child somehow reduces her own life". He warns that there is a range of issues and problems, often indirect, that still need to be studied in the context of the Zika epidemic, requiring a large data set and many perspectives for understanding.

Families

"When he was born with clubfeet and crooked arms, I asked: Doctor, why is he like that?" reports one of the mothers in a conversation circle with 13 mothers held at a support center in Campina Grande, Paraíba, in 2019. According to the mother, the doctor replied that everything was normal and what she observed was because the baby had just been born; later on "everything will be fine". She went into the bedroom; and, the next day, she warned that the baby's hands and feet were still crooked. "She said: it's okay, mom. That's when I remembered that I had Zika, two months into my pregnancy, I did not even know I was pregnant". The report demonstrates the families' difficulty in obtaining information about what was happening in the face of the outbreak of changes in infants that occurred in 2015 and 2016 in Brazil. While

2 The use of the kit in the context of the Zika epidemic, as well as its content, was regulated by Ordinance No. 3,502 , of December 19, 2017. Available from: <https://bvsms.saude.gov.br/bvs/saudelegis /gm/2017/prt3502_22_12_2017.html >. Access on: Sep. 21, 2022.

scientists tried to understand the sudden increase observed in services - in search of a cause for what happened - many mothers received conflicting information about what actually happened. Such conflicts of information or with flows mediated by the press were also observed in other works, such as Diniz (2016) and Simões (2022).

The feeling demonstrated by this mother, that the questions she had were not answered, was shared by others in the conversation held in 2019. According to the reports, the flow of scientific information to them was time consuming, or mediated by what came out in the media, and not by health professionals to whom they were linked or the scientific studies they participated in. As the causal relationship was disclosed in the press, the mothers' anxiety increased and the need to have a test showing that, in fact, it was Zika, increased. Those who participated in collective efforts organized by researchers and health professionals, so that the diagnosis of the infants was made, complained about the tests' lack of feedback that could say if the alterations they saw in their children really had the Zika virus as a cause.

A grandmother of a set of twins regrets that she "wasted time trusting" doctors. She mentions having learned about Zika from a woman at the local health center. When questioning the doctors about what they had heard at the health center and in the press, they would have said that with twins it would be different. "*They just postponed it and I wanted them to refer it to another specialist, who was a neurologist*". Her report points out that doctors minimized the changes observed, stressing that she should not worry, even when she saw a report on television about the effects she observed on her grandchildren, complained about the lack of follow-up and threatened to no longer attend consultations. "*That's when a social worker knocked on my door*".

One of the mothers interviewed in Paraíba recalls that she heard from doctors that her son's problem existed because she had started taking folic acid late during pregnancy: "*They said it was a formation that was necessary for the spine; hence, microcephaly*". Another one mentions that she had allergies and a high fever, but there is no laboratory confirmation that it was Zika: "*When I did the ultrasound at 9 months to find out if he was in the position, the doctor told me that he looked like a 6-month-old boy, but he didn't tell me what it was.*"

At the same time that families report anxiety for information and for the feedback of the tests they had taken; from a practical point of view, they mention the discovery of the cause as information that is not so important for their routines – although the causal relationship facilitated the entry of children into the health system and mediated access to social benefits (Oliveira, 2021). In the conversation held in Paraíba, causality and factors associated with the formal description of cases, although relevant for dealing with the health system and other institutional demands, were not so required. Because, in everyday life, it was the possibilities of intervention and care that were most demanded. "*I never even researched what microcephaly is, people tell me, I don't have time for that*", said one of the mothers.

Health professionals: The impact on care

At the Ministry of Health, informing mothers about Zika without having anything to offer was an issue posed in care protocols. "*For some time, we were against testing during pregnancy*", says a professional in the ministry's care management. The issue was complicated, ponders the employee, because the country does not offer the option of interrupting pregnancy, the social benefit was only for those with very low income, and not for all, there was no treatment or possibility of intervention, support for the caregiver or specialized daycare, or anything to be done but wait for the birth. "*It's almost like a nightmare, isn't it?*", she ponders. For those in the ministry's care management, the relationship with the cause and the centrality given to the issue was smaller, and even with the involvement of Zika in changes in infants being attested by several studies, many questions still remained in 2019.

> *It didn't change much, my problem was posed, regardless of the cause, right? This does not mean that we did not invest in research to be more sure, right? We even have some research still in progress*

that will bring us more... evidence. In fact, to this day I think everyone involved in this agenda has a lot of questions, right? Why more [cases] in the Northeast? Why more in Brazil, right? I think these are questions that are unanswered. (Interviewee 12)

As for the organization of services, the association of Zika with the changes observed in infants had an immediate effect on the care management for children with disabilities. During the emergency situation, due to the number of children arriving and the need to provide a diagnosis, exclusive services were created for the Zika demand, which generated asymmetries in the services. A reference hospital in Salvador organized an outpatient clinic to monitor children with Congenital Zika Virus Syndrome. "*We saw that they were having difficulty accessing services*", says a nurse interviewed in Bahia. It was a multidisciplinary initiative by the professionals who already provided care. The outpatient clinic at the time had a neuropediatrician, an infectious pediatrician, an occupational therapist, a physiotherapist, a speech therapist, a psychologist, a nutritionist, a dentist and an odontologist.

The differentiation in services, with a specific clinic for children potentially affected by Zika, ended up generating resentment and complaints from those patients who did not have a disability associated with a specific cause. A researcher from the Federal University of Bahia who follows pregnant women in a cohort recalls that she heard an emblematic report from a mother in a rehabilitation service who "wish her son had had Zika". Likewise, a coordinator of the mothers' association in Recife regrets that those who did not fit into the SCZ were victims of "writing off" in some institutions, although they also needed care.

I think it's terrible to be written off. It looks like you are not useful anymore. And those who had microcephaly too, but it wasn't Zika, even today do not have any support, there's no emergency. If it is from another vector, or from another cause, one goes to the queue like any other child (...) Even today, those who do not have Zika, join an endless queue for people with disabilities. (Interviewee 16)

At the Secretary of Surveillance of Pernambuco, a professional expressed that this difference in services was indeed a problem, because surveillance data began to mix with that of care, although the services had completely different logics. "*A case notified for surveillance is one thing, and for assistance is another (...) if you start forming a network for these children, other networks will appear that also need support*". At the Ministry of Health, there was a perception that, with the attention given to cases, a "Zika elite" was being created, a term cited by a health care management professional at the Ministry of Health in Brasília. The fact observed here was also explored by other authors, who named the phenomenon "priorities among priorities" (Scott, 2020). With this perception, an effort was made to regionalize services - both for a greater integration of different cases, and for mothers to be able to access what was needed close to their homes. It was necessary to observe where the virus was circulating and make an active effort to think about strengthening the SUS, so the work had to be interdisciplinary, bringing together various areas of the Federal Government. A professional from the ministry admits that it was a challenge to think of research, assistance and surveillance together. "*This is a limitation from a public health point of view (...) I think we have weaknesses in the conformation of these fields of knowledge and this reflects on our work process.*"

With regard to the relationship between care and science, a physiotherapist at a reference hospital in Salvador raises another question about the knowledge published in journal articles, which either does not get to be applied in routine care or has its application made difficult after implementation of some processes. Ophthalmological changes, seen later, took a while to be included as established case criteria. Another issue not addressed by science is that the outcome and development of children differ greatly from each other. There are children who "*don't change their posture and stay in the one you put them on*", even those who walk and talk, she continues. This report reinforces reflections also reported by scientists in a previous item, about the lack of intervention studies.

Discussion

The testimonies show the range of events, phenomena and questions that occurred during the period in which changes in the nervous system were observed in newborns and fetuses in Brazil. Such questions go beyond the question of causality and also demand attention from science to other questions; among them, the focus on intervention studies. While the scientific field has relative autonomy from external pressures, which can be beneficial in some cases; for others, there is distancing from the phenomenon and questions posed by subjects not directly linked to science or its hegemonic production centers. This issue was also pointed out elsewhere: an ethnography carried out with families in Recife, for example, focused on the relationship between families and biomedicine, with conclusions that showed demands for the child to be seen as a subject that is integrated in their context (Simões, 2022).

As demonstrated, even the scientists involved in the description of the causal relationship report such distancing between the study they do and coping. Although causality is a relevant focus for scientists – and also, in some cases, for society –, the question does not account for the entire phenomenon. The demand for intervention studies and for those that point to a greater amplitude of the outcome, as well as a greater dialogue between scientists and affected families and their needs, are issues pointed out by the investigation. Likewise, even if causality has not had an impact, at least until 2022, towards the production of a vaccine, the causal question has consequences beyond its most immediate intentions, as demonstrated in the consequence in the organization of services, with an overlap between surveillance and care at the beginning of the epidemic – with priority given to the care of children with Zika, generating asymmetries in the Brazilian Unified Health System –, a lesson that Zika has taught us for future epidemics.

This investigation showed how the social field is not separated from materialities and also makes scientific demands – there is no society isolated from science with issues that only politics can deal with, there are also demands for investigations of the scientific doing. This fact exemplifies what the STS field has highlighted: the hybrid character of contemporary issues (formed by social, collective, material, scientific and discursive connections). This call, however, has not been part of research designs, which denote a preference for questions produced internally in the scientific field, without a broader dialogue with the other actors involved – so that they are also formulators of questions and not just research objects.

The claim for a causal narrative can be defined as the enunciation that something happened in one way and not in another (Ryan, 1977). That is, there is an excluding factor, as it restricts the phenomenon to a certain set of conditions that must be described based on what scientists observe, what they choose as a hypothesis, and research design's methodological constraints. In this way, the trap of causal relationships is established, because, if to express a causal relationship other phenomena are excluded, this relationship pulls a primacy for itself that obscures other possibilities.

This hybrid and multifaceted character of epidemics led to the conception of the term syndemic to describe complex public health crises, such as the Zika virus. Based on his research with HIV, the anthropologist Merrill Singer (2003) proposed the syndemic term for this type of interaction, which points to the interdependence of biomedical and social conditions in a relational and non-hierarchical space without temporal distinctions. Like the term epidemic and pandemic, the syndemic suffix comes from the Greek "*demos*" (people) and indicates the spread of diseases not only by various etiological agents that interact with each other, but by living and social conditions that cause the outcome.

The application of the syndemic concept to the phenomenon of the Zika virus epidemic was proposed by the anthropologist who coined the term (Singer, 2017). In a 2017 article, Singer reports that the complex and ecological nature of the *Aedes aegypti* cycle and the evidence of co-infections with other arboviruses characterize Zika as a syndemic. The phenomenon is explained, according to him, by a dynamic of planetary health, which also

considers global issues of climate and the production of poverty. The proposal of the Zika event as a syndemic was also followed by other authors; among them, Brazilians.

With the analysis carried out in this work, it is actually observed that the concept of syndemic is applicable to SCZ. However, it is worth problematizing with more emphasis the impact that causality and the search for etiological agents had on the Zika epidemic. In the idea of an epidemic, unicausality is implicit – a single etiological agent is associated with the outcome –; this result, in turn, spreads as the agent spreads, and this guarantees a simple direction for solving the problem: by fighting the virus, the disease will end.

Scientists understand the complex and social aspect linked to the outcome of SCZ; however, the path adopted by science that favored causality to solve the problem is to find the virus, adopt preventive measures associated with its life cycle, and search for a vaccine. While the concept of syndemic helps to problematize the idea of unicausality in a forceful way – something that was not observed among the interviewees associated with the laboratory, who tend to describe other factors as secondary to the etiological agent's action –, the concept does not replace the resolving symbolic effect provoked by the idea of an epidemic, in which a single agent can be fought in such a way that the problem is solved. Despite some cases in which this idea applies, it is necessary to consider cases in which there is no clarity and dialogue with society.

In the covid-19 pandemic, some issues related to this problem are observed, which can be explored in future studies. While initially the manifestation was understood as a flu-like syndrome, later the extent of the observed symptoms was noted. Patients began to report persistent conditions after the viral cycle, which culminated in the so-called "long covid", with more than 50 symptoms described (Lopez-Leon et al., 2021) It is hypothesized that the idea of unicausality, with the virus being responsible for such a wide range of symptoms in an extensive social crisis, can be problematized for a better management of these conditions, as well as the need for a description that takes into account the complexity of the reported outcome.

Final considerations

Finally, it is considered necessary to include research designs and science priorities, with the incorporation of questions that multiply the possibilities for action. Issues emanating from the social milieu are not just political or from citizens' arenas; as hybrids, they are also scientific. It is not about replacing one question with another, or of placing science in a villainous position amidst dichotomies, but of thinking about a democratic reform of its foundations.

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Contribution of the Authors

Oliveira carried out the interviews, analysis, writing and revision of the text. Akerman guided the research, participated in the analysis, writing and revision of the text.

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