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Disseminar conhecimentos e estimular a reflexão e o debate, apoiando o desenvolvimento dos servidores, o seu compromisso com a cidadania e a consolidação de uma comunidade de praticantes, especialistas e interessados nos temas de políticas públicas e gestão governamental.

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Editorial

Brasília, September 1st

Dear Reader,

The team of Revista do Serviço Público (RSP) hopes you are well and healthy. These are not easy times. As always, mankind has a new problem and must fight against it. This is no “new normal” situation. This is exactly what we human beings have been doing since the beginning of our existence on Earth. It is the old and good “ordinary normal” and we have all the skills needed to win this war.

Of course, one of these skills is the ability to perform research and RSP has long been a journal open to high quality research. It is not different now. However, this special edition on *Governments and Covid-19* intends to be a hallmark in the long history of this journal. How? First this special edition is an initial step to a more dynamic RSP, as we saw with the *online first* submission system. Second, submissions to this edition were only in English and Spanish. We believe Brazilian research must reach a broader audience.

We received many high-quality submissions and it was not easy to choose among them. We finished with eleven articles.

To begin with, we all know that the pandemic is a complex phenomenon with many dimensions. For example, how do the health and the economic dimensions relate to each other? Our first article, from Ornelas, offers a simple theoretical benchmark to address this. The main message is that the optimal level of lockdown depends on economic costs and health benefits. His model allows us to avoid pitfalls during discussions regarding the optimal level of lockdown.

Economic costs are the main subject of the second article, from Oliveira. Using a Kalman Filter, this article found that, for the Brazilian state of Rio Grande do Sul (RS), the accumulated costs of the state’s lockdown policy, in 27 days, would be around BRL 43 billions, a conservative estimate, considering that this would be a measure of tax collection foregone because the article only examined the formal sector of RS economy.

Another way to examine the economic dimension is to study a specific sector of the economy. The third article, from Castro and coauthors, highlights the problems that the pandemic brought to municipalities that are economically dependent on mining. They analyzed municipalities in Pará and Minas Gerais and found that there is a greater proportion of Covid-19 cases in mining municipalities and also stability in the supply of jobs in the mining sector.

Some would argue that the decision regarding the optimal answer from policymakers should be made under a more authoritarian background, with a (supposedly) small sacrifice of democratic aspects of the decision-making process. Lins and coauthors, using survival analysis, found that autocratic and democratic regimes did not differ in their reaction to the pandemic.

The *institutional* aspect of the governmental reaction to pandemics is yet another dimension that deserves more discussion. In a more speculative article, Del Ponte and coauthors focus on the limits and possibilities of public-private partnerships (PPP) as a tool to fight the pandemic. In a context of difficult fiscal imbalances, PPP could be useful in building hospitals, health centers or even in the development of vaccines.

Rodrigues and coauthors study another important institutional aspect in the role of Brazilian municipal governments: *transparency*. Using a sample of municipalities, they highlight variance of the quality of information provided on local governments' websites but also offer evidence for the importance of using social networks in disseminating data.

By the way, the importance of open public data in the context of the pandemic is not new. Researchers have been discussing ways to improve the forecast of Covid-19 infections and deaths. Duan and coauthors use a *Continuous Intelligent Pandemic Monitoring* in order to improve the forecast in the Brazilian state of Santa Catarina (SC) using governmental open data. The importance of this type of open data requires the attention of the policymakers[1].

Health problems demand public initiatives, and these must be carefully thought in terms of their regulatory aspects. Mota and coauthors use the pandemic to show how *problem analysis and definition*, an important phase in Regulatory Impact Analysis (RIA), could be useful to the regulatory agencies. The worsening of mental health and low population adherence were two problems identified as integral to an optimal design of regulation by the Brazilian Health Regulatory Agency (ANVISA).

Brazilian government response to the pandemic is not a *free lunch*. Figueiredo and coauthors investigates so- called *judicialization* using a sample of actions. She found that about one third of the cases are related to restrictive economic measures adopted by governments (suspension of commerce and services' activities).

Technological shocks are one important ingredient in mankind's response to situations like this devastating pandemic. Our tenth article, from Mendonça & Dantas, presents an ongoing project relating big data analysis, specifically collecting human vital signals for public health monitoring to minimize the numbers of COVID-19 tests required.

Finally, Vidal offers his thoughts regarding the role of the state in this war against the new virus based on his analysis of the initial response of three European governments: Spain, Germany and Sweden, and speculates about potential reconfigurations in the relationship between State and society in a post-pandemic world.

We hope our readers will find inspiration in one or more of these articles and, of course, we are hopeful that the war against this pandemic will be won soon.

Diana Coutinho, Chief Editor

Claudio D. Shikida, Adjunct Editor

[1] Recently, during ongoing research, a coauthor of one of the adjunct editor found *negative* numbers recorded as cases of Covid-19 in another Brazilian state which is an anecdotal confirmation of the need to review open public records in empirical work.

Lockdown 101: Managing economic lockdowns in an epidemic[1]

Emanuel Ornelas[1]

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Countries worldwide have implemented lockdown measures to contain the covid-19 pandemic. After more than three months of restrictions to economic activities in many countries, the question has turned to the best ways to lift lockdowns while keeping the epidemic in check. Here I use basic economic principles to shed light on the key tradeoffs. A central message is that there is no "health vs. economics" dichotomy. Rather, some degree of lockdown is typically optimal in crises like this, balancing its economic costs against its health benefits. Moreover, the optimal lockdown is dynamic, changes over time and eventually becomes more lenient, although the path is not necessarily monotonic.

Keywords: Pandemic, covid-19, optimal policies

JEL codes: H0, I100, I180

Lockdown 101: Gerenciando lockdowns econômicos em uma pandemia

Países em todas as partes do mundo implementaram medidas de *lockdown* para conter a pandemia da covid-19. Após mais de três meses de restrições a atividades econômicas em muitos países, a principal pergunta agora é sobre as melhores formas de sair do *lockdown* e ao mesmo tempo manter a epidemia controlada. Neste artigo, eu uso princípios econômicos básicos para esclarecer os principais *tradeoffs*. Uma mensagem central é que não existe uma dicotomia "saúde vs. Economia". Ao contrário, algum grau de *lockdown* é tipicamente ótimo em crises como essa, equilibrando custos econômicos e benefícios para a saúde. Além disso, o *lockdown* ótimo é dinâmico, mudando no tempo e em algum momento se tornando mais leniente, embora o caminho não seja necessariamente monotônico.

Palavras-chave: pandemia, covid-19, políticas ótimas

Código JEL: H0, I100, I180

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Lockdown 101: Gerenciando lockdowns económicos en una pademia

Países de todo el mundo han implementado medidas de *lockdown* para contener la pandemia del covid-19. Después de más de tres meses de restricciones a las actividades económicas en muchos países, la pregunta principal ahora es sobre las mejores formas de salir del *lockdown* y al mismo tiempo controlar la epidemia. En este artículo, uso principios económicos básicos para aclarar los principales *tradeoffs*. Un mensaje central es que no existe una dicotomía "salud versus economía". Por el contrario, cierto grado de bloqueo puede ser excelente en crisis como esta, equilibrando los costos económicos y los beneficios para la salud. Además, el bloqueo óptimo es dinámico, cambia con el tiempo y en algún momento se vuelve más complaciente, aunque el camino no es necesariamente monótono.

Palabras clave: pandemia, covid-19, políticas óptimas

Código JEL: H0, I100, I180

1. Introduction

Since January 2020, numerous countries and regions of the world have adopted measures of mandatory closures of economic activities — "lockdowns"— to fight the covid-19 epidemic. The severity of those measures has varied enormously across countries, across regions within countries, as well as over time. They are mediated by other health and economic measures, which depend on state capacity and affect the desirability and the stringency of the lockdowns. Some policymakers seem to have gotten it about right, but many have not.

This short article is an updated and extended version of Ornelas (2020), written in March, when the world was only starting to implement lockdowns. The exceptions were the earlier experience in Wuhan, China, with a nearly full lockdown in January, and the approach followed by a few Asian countries, of which South Korea is probably the best example, of partial or localized closures since the beginning of the virus outbreak in early February, guided by a strict policy of testing-tracing-isolation (TTI). Then, after the world observed, in shock, the tragedy unfolding in Italy and Spain since late February, lockdown policies became widespread during the subsequent month.

Here, I outline the key tradeoffs policymakers should consider when managing lockdowns in an epidemic. The analysis relies on basic economic principles. While some of the conclusions are fairly straightforward, others are subtler. Not all seem to have been understood by most governments.

Two caveats are in order. First, the problem is inherently dynamic, but my analysis is static. Fully dynamic models have been developed in the last months, integrating, in different ways, standard epidemiologic models into an economic structure.[2] Those models, often designed for quantitative analysis, can be very useful. The cost is that some key elements of the problem are difficult to formalize and therefore may be left out.[3] Here, instead, I try to capture the key elements in the simplest possible manner, in a way that can be explained to first-year undergraduate students[4]—a lockdown 101 discussion—but can (hopefully) be useful for professional economists, too. To overcome the static nature of the framework, I rely on well-known facts about

[2] See, for example, Alvarez et al. (2020), Fajgelbaum et al. (2020), Gonzalez-Eiras and Niepelt (2020) and Hellwig et al. (2020).

[3] See, for example, the discussion in Avery et al. (2020).

[4] As has happened successfully in my own department—I thank Bernardo Guimaraes for running the "test drive".

epidemiologic dynamics and argue about the parallel economics dynamics to carry out comparative statics that seek to “mimic” the dynamic nature of the problem.

The second caveat is that the analysis is best viewed from the perspective of countries that do not have an effective TTI system in place. Strictly speaking, one could interpret their approach in my framework, as I indicate later, but the analysis is not designed to capture the precise, targeted nature of their interventions. Instead, the analysis here applies more aptly to the approaches followed by most of Europe, North America, and almost all developing economies, which relies on blunter lockdown measures.

The main takeaways of the analysis are:

(1) At the peak of a serious epidemic, a near-full lockdown is better than nothing in unprepared countries. However, the lockdown should not be long-lasting, with its duration being determined by its marginal (health) benefits and (economic) costs.

(2) Activities to be suspended in the lockdown should be ordered from those that yield higher health benefits and impose lower economic costs to those that have the opposite effect; in serious cases, as with covid-19, initially a large number of activities will need to be suspended in unprepared countries.

(3) The optimal extent of lockdown measures changes over time and eventually decreases, but does not drop to zero quickly.

(4) Better health measures to cope with the epidemic allow for more lenient lockdown policies.

(5) Measures that ease the economic pain during the lockdown pave the way for stricter lockdown policies.

(6) The economic and health costs of the epidemic will be higher for developing economies than for rich ones, even though it is generally ambiguous which should have stricter lockdown policies.

(7) When the government is unable to use an effective TTI system and the capacity of the health system is likely to bind, the optimal lockdown policy is such that it just prevents the collapse of the health system.

This article proceeds as follows. In the next section, I consider the choice between the two extreme scenarios of a full lockdown or of no restriction to economic activities. There, the variable that changes over time is time. In section 3, I consider instead the optimal extent of a lockdown in a given period but take into account the time-related issues established in section 2. In section 4, I discuss how other health and economic policies affect the optimal stringency and duration of a lockdown policy. In section 5, I discuss how country characteristics affect the optimal lockdown policies, with special focus on the differences between developed and developing economies.

Finally, in section 6, I show how the analysis changes when hospital capacity binds. Section 7 concludes.

2. The desirability of a full lockdown

The problem caused by an epidemic is that it makes some people sick and ends up killing some of them. This, of course, is costly for the society. The shutdown of some economic activities—that is, the implementation of lockdown policies—lowers that cost, by containing the spread the virus, reducing the number of infections and allowing the health system to treat those infected (as well as those that require health services unrelated to the epidemic) better. On the other hand, it hurts the economy, because it averts mutually beneficial economic activities that would otherwise take place.[5]

A lockdown policy has two components, its stringency (the extent of economic activities that are shut down by decree) and the duration in which it is kept in place. A social planner wants to minimize the aggregate costs of the epidemic, mediated by the lockdown, to the society. Thus, its problem can then be described as

$$Min_{l,d} HC(l,d) + EC(l,d),$$

where HC(.) denotes total health cost and EC(.) denotes total economic costs from the policy, *l* indicates the stringency of the policy and *d* its duration. Both *l* and *d* have opposite effects on HC and EC, increasing the latter while decreasing the former.[6]

As it turns out, a more intuitive formulation uses the inverse of HC, which we call the health benefit (HB) of a lockdown. In that case, the problem of the social planner can be written as

$$Max_{l,d} HB(l,d) - EC(l,d).$$

We characterize this problem in steps. First, in this section, we consider the desirability of imposing a full lockdown (L) of the economy. In that case, the problem boils down to the optimal duration of a full lockdown.

[5] Naturally, the epidemic also has direct economic costs, on top of those created by the lockdown, as sick and dead people leave the workforce and numerous others change their behavior in response to the threat of the virus. Accounting form that would not change my qualitative conclusions, however.

[6] Economic costs are easily measured in terms of income foregone. Health costs can be easily measured in terms of the number of people that get sick or the number of people who die. However, to compare the two we need a common measurement unit. I sidestep this problem by simply assuming that the two can be measured in the same unit. I acknowledge that this is a delicate and subtle issue, but note that it is common practice in economics. Although a variety of methods has been used, the most common is probably through the calculation of the statistical value of a life. See, for example, Hall and Jones (2007).

An elemental, but often forgotten, point is that the benefits and costs of L change over time. At the peak of an epidemic, stopping human interaction has a very large health benefit, as it halts contagion (completely, in the case of perfect enforcement) and prevents additional overloads to a collapsed heath system. After L is in place for a while, however, those benefits fall, as the health situation becomes more manageable. That is, the *marginal health benefit* (MHB) of L decreases with its duration.

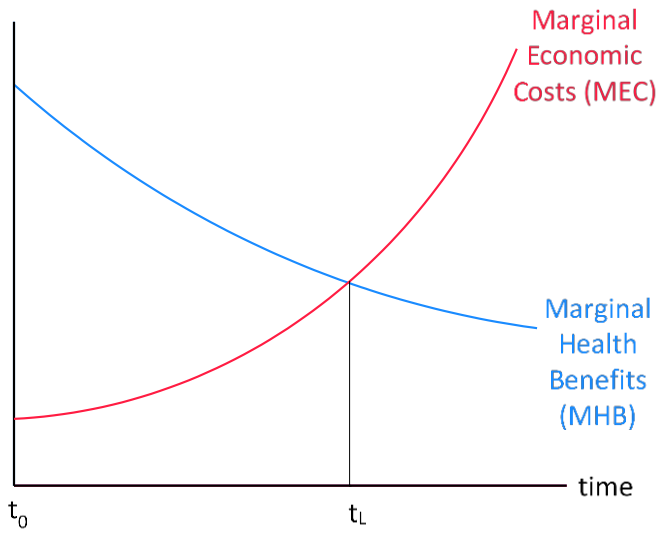
At the same time, the economic cost of L increases over time. As Baldwin (2020) puts it, we are used to having (partial) lockdowns during weekends and national holidays, but those have little cost, because we know they last just a few days. However, maintaining L for longer periods imposes increasing costs on society, as firms go bankrupt, individuals are laid off and, ultimately, consumption levels drop sharply and continuously. That is, the *marginal economic cost* (MEC) of L increases with its duration.

Figure 1 illustrates this point. During regular times, MHB(L, 0) < MEC(L, 0) at t_0, and therefore nobody even discusses the possibility of a full lockdown.[7] However, at the peak of an epidemic for which countries were ill prepared to handle, as with covid-19, MHB(L, 0) > MEC(L, 0) at t_0, so at first having L is better than not having it. That changes with time, however, as the health situation becomes more manageable and the economic cost increases. Eventually, it becomes better to lift L and restore economic activities.[8] The optimal duration is represented by $d^*(L) = t_L - t_0$ in the figure, which is the duration that equalizes MHB(L, d^*) and MEC(L, d^*).

[7] Observe that having MHB < MEC at t_0 does not mean that a full lockdown would not save lives in normal times. For example, crime drops dramatically and car accidents are eliminated with a full (and enforceable) lockdown, just to mention two of the main causes of death worldwide, especially in developing countries. Still, societies agree that it is worthwhile to bear the cost of those daily deaths to avoid the economic costs from preventing them.

[8] Enforcement of L is also likely to decrease with its duration. This tends to lower both its economic costs and its health benefits, with an ambiguous effect on its optimal duration.

Figure 1: Optimal duration of a full-lockdown policy



Source: Elaborated by the authors.

My first conclusion is therefore very simple:

Result 1: At the peak of an epidemic, a full (or near-full) lockdown is better than nothing in countries that were unprepared for it. However, the lockdown should not be long lasting, and its duration should be determined by its marginal (health) benefits and (economic) costs.

This is, however, too simplistic, because it presents the problem as dichotomous: either to have a blanket lockdown L or no restriction at all on economic activities. As with the vast majority of public policies, the optimal policy is often interior, not at the corner.

3. The optimal level of lockdown over time

Let us consider, then, the more realistic possibility of *partial* lockdowns. That is, consider a variable *l* that goes from 0 (no restrictions on economic activities, as in, say, 2019) to L (full lockdown, where people do not interact with each other outside their homes and most economic activities stop). Now, to keep the analysis simple, instead of considering the benefits and costs of a full lockdown over time, let us consider the benefits and costs of different degrees of lockdowns at specific points in time.

When *l* is very close to zero, the health benefits from increasing *l* are greatest, because it would have the greatest impact on reducing contagion. Once *l* gets very close to L, however, the

additional health benefits from increasing *l* are small, as there are already very few people interacting with each other and the virus is spreading at a very low rate. Hence, the MHB decreases with *l*.

Conversely, when *l* is very close to zero, the economic costs of increasing *l* are small, because it will not disrupt any key activity. However, as *l* gets very close to L, the additional economic costs from increasing *l* are huge, because some essential economic activities will need to be shut. Hence, the MEC increases with *l*.

Implicit in the discussion above about how MHB and MEC change with *l* is the assumption that there is an *optimal order* in which activities are ordered as *l* moves from 0 to L. This is key: a progressive lockdown must first affect the activities that generate least economic costs and most health benefits. Obviously, designing a perfect ordering is a daunting activity, especially because societies have very little experience in doing that.[9] Nevertheless, it is relatively easy to place several activities near the two extremes with much controversy.

For example, office work that can be carried out online should be one of the first, because it imposes very small economic costs and generates some health benefit, as people do not mingle in the office. Large live events should also be one of the first, because preventing them generates large health benefits, even if the economic costs are far from negligible. Moreover, the activities involving those in the high-risk group (for covid-19, the elderly and those with comorbidities) should be the first to be averted. Near the other extreme, we should have activities for which their prohibition would cause large economic costs and small health benefits (e.g., trash collection, news provision, grocery stores and, most obviously, health services, which would cause a negative MHB).

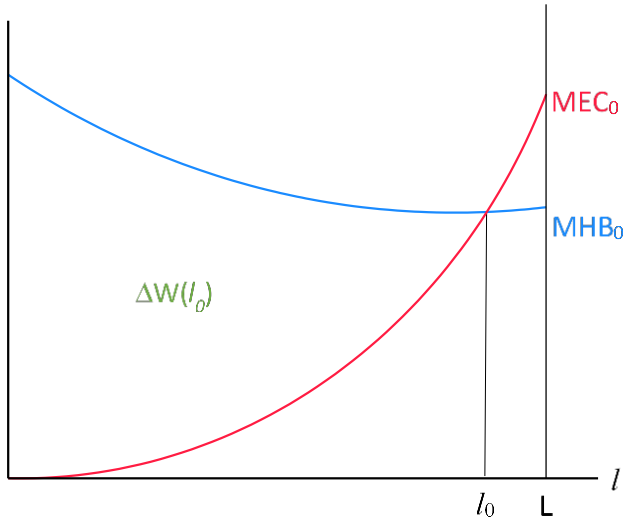
Figure 2 illustrates this discussion at the peak of the epidemic crisis. At that moment, the case for an almost-complete lockdown is strong, in line with what the previous dichotomous analysis suggests. Even then, a full lockdown would not be optimal, as we want to keep essential services and production of essential products (food, medicines) active. However, the optimal *l* is probably relatively high initially, as the figure indicates (l_0).

My second conclusion is therefore also very simple:

Result 2: The activities to be suspended should be ordered from those that yield higher health benefits and impose lower economic costs to those that have the opposite effect; the optimal level of lockdown then equalizes marginal health benefit to marginal economic cost.

[9] This explains the variation in the definition of "essential and semi-essential activities" across countries. For example, construction was one of the last activities to be reopened in Europe, but it never stopped in Brazil.

Figure 2: Optimal lockdown policy tends to be severe at the peak of the pandemic



Source: Elaborated by the authors

Typically, the solution will be interior during an epidemic, reflecting the suspension of some activities. Especially when the epidemic is very serious, and governments are unprepared to deal with it, as with covid-19, initially a large number of activities will need to be suspended, including some that cause significant economic harm.

At the optimal level of lockdown, l_0, the welfare gain to the society, relative to not having any such restrictions, is the area between MHB_0 and MEC_0 from $l \in [0, l_0]$, indicated by $\Delta W(l_0)$. Naturally, any measure of lockdown that is strictly positive but below l_0 also brings welfare relative to doing nothing, but not as much as l_0. For example, if $l = l' < l_0$, increasing l a bit yields a relatively small economic cost but a relatively large benefit in terms of preventing illnesses and deaths.

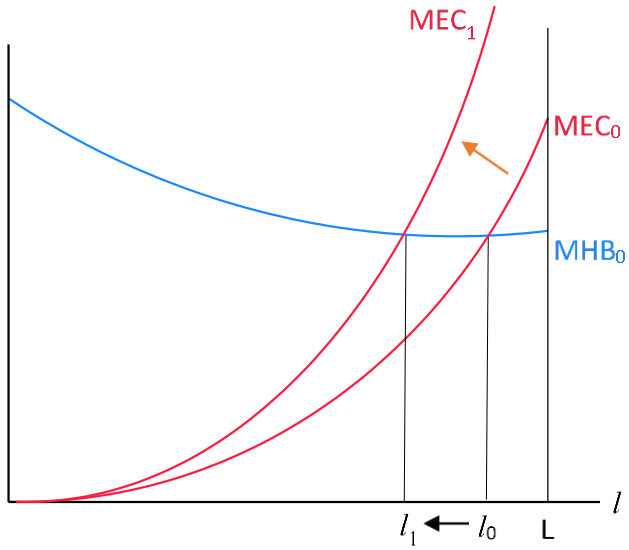
Now, as l_0 remains in place for a while, the curves change, as suggested by Figure 1. In particular, the MEC curve will shift up for any level of l. At the same time, once the epidemic is better controlled, the MHB curve should shift down. However, in its raises stages that curve could be going up for “exogenous” reasons—that is, following the contagion dynamics of the epidemic.

Figure 3 illustrates those changes. For the sake of clarity, it simply assumes that l_0 is such that it just offsets those exogenous forces at first, so that MHB remains unchanged in the next period. In that case, because of the shift in the MEC curve, the new level of the optimal l, l_1, is lower than l_0. That is, because economic costs increase over time, restrictions on economic activity should be relaxed somewhat (say, some retail stores employing low-income workers may be partially allowed to reopen).

This does not need to be the case. If the exogenous dynamics of the epidemic is such that the MHB curve moves up very quickly, as in its early days, the optimal policy may be an even stricter lockdown in period 1 than in period 0. However, epidemics eventually run their courses and come to an end, even if left untreated. Thus, the MHB curve will eventually shift down, and so will the optimal *l*, with economic restrictions being lifted accordingly.

Nevertheless, it will typically take time to bring *l* back to zero. This reinforces the point that the solution is not dichotomous. Suspension of some economic activities is optimal until the epidemic is completely controlled. The optimal time-path is typically smooth and long-lasting, with restrictions being lifted over time.

Figure 3: Optimal lockdown policy becomes more lenient over time



Source: Elaborated by the authors

This also has implications for the dynamics of the epidemic: the goal of the restrictions on economic (and social) activities is *not* to eliminate the epidemic quickly, but to keep its health costs aligned with the adjacent economic costs of the restrictions.[10] Thus, increases in cases, as has often happened in countries that appear to have brought the epidemic under control, are not a

[10] A handful of countries, of which the most prominent is New Zealand, actually envisaged to eliminate the virus from their territory. This is, however, very difficult (and costly) to accomplish and to maintain, because it requires imposing a nearly total ban on international travel until the rest of the world achieves herd immunity or a vaccine becomes widely available. Indeed, after declaring victory against the new corona virus in early June, New Zealand detected some new cases from residents returning from abroad.

reason to think that “their system is not working.” Instead, that is a consequence of an optimal monitoring of the epidemic, which should not aim to eliminate it at once.

My third conclusion is, therefore, more subtle:

Result 3: The optimal extent of lockdown changes over time and eventually decreases, but does not drop to zero quickly. Instead, it manages the health-economic tradeoff over time.

As mentioned in the introduction, the problem is inherently dynamic, since the position of the two curves in a point in time depends on the policy of the previous period, as well as on the exogenous epidemiological forces. What figures 2 and 3 do, by illustrating different points in time, is to mimic that dynamics from an intuitive standpoint. It is obviously incomplete, but hopefully instructive enough to drive home the qualitative message that a truly dynamic model would deliver.

4. Policies that keep the MHB and MEC curves low

Rightly so, much of the debate in the last five months has been about the best health policies to contain the spread of the epidemic and prevent collapses in health systems. These include keeping the vulnerable people isolated, widespread testing and subsequent monitoring, with isolation also of those tested positive and of their contacts (and of the contacts of their contacts), building of hospital beds, production of medical equipment to treat the ill, etc. Despite the direct economic costs of such measures, they pale next to the economic costs of lockdowns.

In my setup, health measures to contain the spread of the virus and better prepare the health system to cope with the ill can be interpreted as policies that push the MHB curve down. Clearly, as can be seen from Figure 2, if the MHB curve shifts down, it will, at any point in time, reduce the severity of the optimal lockdown. Thus, not only they bring about a direct health benefit, they also allow for an indirect economic benefit by permitting a more lenient lockdown policy (and yes, they also require a direct economic cost to be put in place).

This yields my fourth conclusion:

Result 4: Better health measures to fight the epidemic allow for a more lenient lockdown policy, therefore curbing their economic costs.

The part of the current debate that is not on health policies is on the best economic policies during the crisis. Most of them go in the direction of, in the words of Baldwin and Weder di Mauro (2020a), “keeping the lights on” until the epidemic is controlled. They include policies to preserve employment, to avoid bankruptcies, to expand credit to firms and consumers, etc.[11] Typically, they

[11] See the collection of articles in Baldwin and Weder di Mauro (2020b) for a variety of such proposals.

aim to (1) prevent current disruptions in the economic system from becoming permanent, and to (2) mitigate the welfare cost to the most vulnerable people.

In my setup, those policies can be interpreted as measures that push down the MEC curve, as they make a lockdown less painful in the short run and lower its long-run deleterious effects. Clearly, if the MEC curve shifts down, it will, at any point in time, *increase* the severity of the optimal lockdown. That is, by easing their costs, those policies allow for stricter lockdowns, which will help contain the epidemic more quickly and effectively (and yes, they require a hefty direct economic cost to be put in place).

This yields my fifth conclusion:

Result 5: Measures that ease the economic pain during the fight against the epidemic pave the way for stricter lockdown policies, thus bringing larger health benefits.

5. Country characteristics that affect the MHB and MEC curves

The MEC and MHB curves vary significantly across regions/countries depending on their socio-economic characteristics.

Starting with the MHB curve, it can be very different depending on cultural traits and the demographics of the country, even for a given stage of the epidemic. For example, if it is common for different generations to live together, or if the elderly share of the population is high, then the MHB curve will be relatively high—compare, say, Italy and Germany. This implies that, for otherwise similar countries in terms of development, one with a high share of elderly who tend to live with younger relatives (Italy), will need stricter lockdown policies than another with the opposite characteristics (Germany).

Even more critical is the structure of the health system of the country. Much of the attention so far has been on rich countries, which, as a group, were affected earlier by the epidemic than developing economies. Those countries have relatively solid health systems in place. In developing countries, however, access to health care is more restricted and its quality is lower. Therefore, the MHB curve tends to be much higher in developing economies than in rich ones. That, in itself, would push for stricter lockdown policies.

However, we must also look at how levels of development affect the MEC curve. It will be relatively low where individuals have access to liquid savings and the government can, directly and indirectly (through incentives for the private sector), keep incomes and payments flowing, limiting bankruptcies and layoffs during the peak of the crisis. On the other hand, in countries where few households have savings, the informal sector (which tends to be more affected) is large, and the government is unable to provide much help to keep incomes and payments flowing,

the MEC will be much higher. As we have seen, the government handouts and employment maintenance schemes in the U.S. and in the E.U., for example, have been indeed vastly larger than what governments in developing countries have been able to provide.[12]

Taken together, we have that both curves will be higher in developing countries. The impact on the optimal lockdown policy is therefore ambiguous. It will depend on how good/bad the health system is relative to the economic system. In places where the health system is better equipped to cope with the epidemic than the economic system is to cope with the restriction of activities, a more lenient lockdown would be advisable. The opposite would happen otherwise.

Now, what is clear is that, for developing countries, both the economic and health costs of the epidemic will much higher than for rich countries. The curves will intersect at a higher level both because the economy is ill suited to sustain a lockdown and because the health system is ill suited to deal with an epidemic. The optimal lockdown policy trades off those two costs optimally, but the outcome is nevertheless dire. As it happened, the pandemic reached most developing economies later then it reached the rich ones. This lag implies that it is still too early to compare the outcome in the two groups of countries. Being affected later does have the benefit of learning from best (and worst) practices observed in the first affected countries. Nevertheless, the drama we have seen in some parts of Europe and the U.S. may be dwarfed by what can still happen in poorer countries affected by the epidemic.[13]

Thus, my sixth conclusion is:

Result 6: It is generally ambiguous whether the optimal lockdown policy should be stricter in rich or in developing economies. Regardless, the latter will suffer more than the former with the pandemic, economically and health-wise.

6. Hospital capacity

One of the reasons why the MHB is downward sloping is the finite capacity of the health system. As observed in several places, if the epidemic reaches a point where there are no intensive care units, or no respirators, or simply no hospital beds available, then the death rate

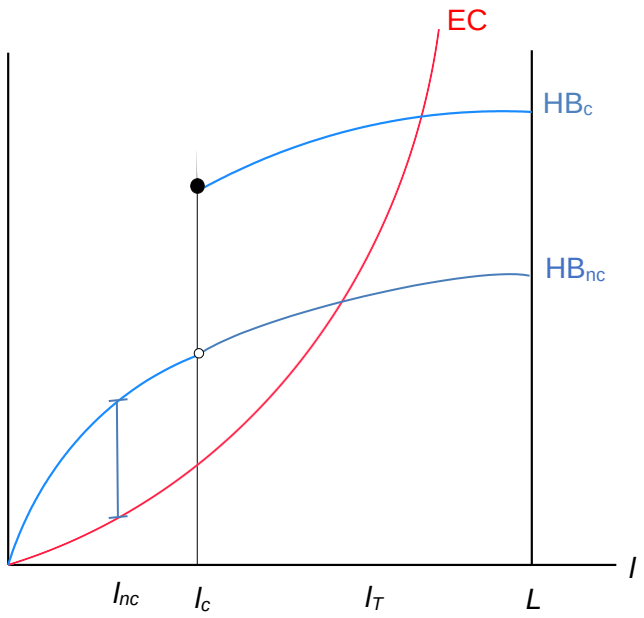
[12] For example, in the U.S., a large share of the recipients of the weekly US$ 600 transfer by the federal government to the unemployed experienced an *increase* in their available income after losing their jobs during the pandemic.

[13] Early on in the pandemic, there was an expectation that a warmer climate could make the covid-19 pandemic weaker. In that case, the MHB curve for developing countries with warmer temperatures would be lower, implying weaker lockdown policies and lower overall health and economic costs. That expectation/hope has not materialized, however, and there has not been yet any evidence that temperature has a meaningful impact on the reproductive speed and the strength of the virus.

from covid-19 skyrockets. In addition, lack of hospital capacity also implies more deaths from other causes, simply because those patients cannot be properly treated.

All that implies that MHB is likely to be particularly steep around the point where the health system is about to reach its capacity and collapse. Thus, unlike depicted in Figure 2, a better representation of this constraint needs to account for a discontinuity in the MHB curve. That discontinuity in the MHB curve stems from a discontinuity in the original HB curve (in levels), as depicted in Figure 4.

Figure 4: Optimal lockdown policy with a capacity constraint in the health system; curves in levels



Source: Elaborated by the authors

When looking at the HB and EC curves in levels, the optimal lockdown policy maximizes the difference between them. If there were no capacity constraints, as represented by curve HB_{nc}, then the optimal policy is the relatively lenient I_{nc}. Now, when accounting for capacity constraints in the health system, HB is best represented by curve HB_c, which is identical to HB_{nc} for $I \in [0, I_c)$, but jumps at I_c. In that case, the best policy is the stricter I_c, which is set just to prevent the collapse of the health system, which would represent a sharp fall in the benefits of the lockdown (that is, a large increase in the health toll of the pandemic).

In the few countries that have put in place an effective TTI system, the health system is never in danger of collapsing, so their relevant HB curve in HB_{nc}. For them, lockdowns will be

generally lighter and adjust to the new levels of the MHB and MEC curves, as seen before. For most other countries, which have been unable to implement an effective TTI system, the best solution will often be simply to restrict economic activities so that the health system does not collapse. This means that optimal lockdown policies will follow mostly the changes over time of the HB_c curve alone. That is, governments should simply adjust l so that hospital/ICU utilization is below 100%. Or more realistically, after taking into account uncertainty about the exact progression of the epidemic, governments should attempt to keep hospital/ICU utilization between, say, 80%-90% of its capacity.

Here, an important observation is in order. For the non-TTI countries, establishing an initially very tough lockdown policy, like l_T in the figure, can be very harmful in the long run. From a static point of view, it imposes excessive economic cost on the society. From a dynamic point of view, the longer it stays in place, the higher it pushes the EC (and MEC) curve, as we have seen. Moreover, with a tough and early lockdown, the HB curve hardly moves over time, because transmission is strongly contained. But the epidemiological process is such that it first needs to expand before it comes down, when a larger fraction of the population becomes immune to the virus—that is, as society approaches herd immunity. The result is that, with l_T, the epidemic remains tightly controlled but the economic costs shoot up. Eventually, EC becomes so high that it makes l_T unsustainable. A policy of lowering l is then put in place, but by then the economic cost curve in Figure 4 has already become much higher and steeper. The consequence is that it becomes more expensive for the society to maintain l_c—conceivably, in some cases even the optimal policy may prescribe $l < l_c$, if for example more people start to die from hunger than from lack of hospital treatment in a collapsed health system.

The upshot is that an excessive lockdown policy at the start of the epidemic can be very harmful in the long run. While the policy may appear extraordinarily effective in its early stages, because economic costs are still bearable and few people are getting sick, it wastes scarce hospital capacity from a dynamic perspective. When the epidemic actually takes off, society can barely cope with the economic cost of an even longer lockdown.[14]

Policies like that have been observed in several countries, from India to the Philippines to Argentina, and in regions within countries, where lockdown policies have been roughly homogenous despite vast heterogeneity in terms of the evolution of the epidemic, from Italy and

[14] The assessment of a seemingly excessive lockdown policy at the onset of the epidemic is different if the country/region uses that initial period to improve its preparedness to tackle the virus. For example, that period could be used to prepare an effective TTI system and to increase hospital capacity. Indeed, that was part of the official narrative in many places that adopted early lockdown policies. Unfortunately, those promises have rarely been materialized.

Spain to Brazil and the U.S. In the last two countries, although lockdown policies have been largely in the hands of mayors and state governors, the first round of lockdown policies took place about the same time throughout the countries, even though the epidemic was in full course in some areas (e.g., New York and Sao Paulo), but only starting to develop in others (e.g., California and Minas Gerais). The latter were broadly lauded by their early and strong intervention, which resulted (inevitably) in very low death rates initially. However, unless an effective covid-19 treatment is found soon, the long-run health and economic costs in those regions may end up being greater than in regions that managed to keep hospital utilization high but below capacity throughout the first months of the crisis (as in São Paulo, though not in New York, to return to the previous examples).

Hence, my seventh and last conclusion is:

Result 7: When the government is unable to keep the epidemic in check through an effective TTI system and the capacity of the health system is likely to bind, the best lockdown policy is the one that just prevents the collapse of the health system. More lenient policies make the health cost of the epidemic shoot up in the short run. Stricter policies make the economic and the (long-run) health costs of the epidemic unnecessarily high.

7. Conclusion

The debate about the desirability of an economic lockdown to deal with the covid-19 pandemic is often dichotomist: to have it or not. That is misleading. The optimal lockdown policy is very likely an intermediate one. For countries caught off guard with the current epidemic (i.e., most of them), a severe form of lockdown is optimal when the epidemic takes hold of the country. After an initial period, that policy should become more lenient, but should remain in place for as long as the epidemic poses a threat to society, although in increasingly milder forms. That is, a return to the 2019-level of economic and social freedom will probably take several months. The last restrictions to be lifted should be the activities that cause little economic harm if performed remotely and those that would cause most harm to society's health by allowing a wider spread of the virus.

Importantly, the stringency of the lockdown, its duration, and the underlying economic and health costs depend critically on the capacity of the economic system to navigate through a period of suspended economic activities without compromising its structure and on the measures that improve the ability of the health system to cope with the epidemic. In particular, if the epidemic threatens a collapse of the health system, the best lockdown policy will be the one that just prevents such an outcome.

Naturally, to provide precise answers to those questions we need a quantitative dynamic model, as for example in Atkenson (2020), Eichenbaum et al. (2020) and Krueger et al. (2020). Nevertheless, the qualitative conclusions of this article should be useful to students as well as to economists who are not engaged in the research of "covid economics," but are interested in grasping the main tradeoffs involved in the management of lockdowns. More ambitiously, it may also be useful as a guideline for future models and, more importantly, for current policymakers that need to make decisions before those models are fully developed.

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A Preliminary Estimation of the Economic Costs of Lockdown in Rio Grande do Sul[2]

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This article seeks to estimate the initial economic costs of the measures adopted to mitigate the spread of COVID-19 in Rio Grande do Sul. To this goal, it uses a structural time series model estimated through Kalman Filter to obtain a counterfactual path of daily sales in the state after many municipals' decrees and the state decree number 55.128 of March 19, 2020. The results show that the accumulated costs of the lockdown policy in terms of losses on sales in the formal sector of the economy would be around BRL 43,34 billion and in terms of tax collection the losses would be around BRL 1,56 billion in only 27 days. Although the article has the limitation of using only information from the formal sector of the economy, it concludes that the costs of these measures are relevant and grow exponentially. It also concludes that it would be necessary for these measures to be able to prevent at least 13.158 deaths caused by COVID-19 in the state of Rio Grande do Sul for their benefits to outweigh their costs.

Keywords: COVID-19 , Lockdown, Kalman Filter, Rio Grande do Sul.

JEL Classification: C22, D61, K32

Uma estimativa preliminar dos custos econômicos do lockdown no Rio Grande do Sul

Este artigo busca estimar os custos econômicos iniciais das medidas adotadas para mitigar a propagação da COVID-19 no Rio Grande do Sul. Para este fim, utiliza um modelo estrutural de séries de tempo estimado através do Filtro de Kalman para obter uma trajetória contrafactual das vendas diárias no estado após vários decretos municipais e o decreto estadual nº 55.128 de 19 de março de 2020. Os resultados mostram que os custos acumulados da política de isolamento social em termos de perdas com vendas no setor formal da economia seriam de cerca de R$

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43,34 bilhões e em termos de perdas de arrecadação de ICMS seria algo em torno de R$ 1,56 bilhão em 27 dias. Embora, o artigo possua a limitação de utilizar somente informações do setor formal da economia, este conclui que os custos dessas medidas são relevantes e que estes crescem exponencialmente. Conclui também que seria necessário que essas medidas fossem capazes de evitar pelo menos 13.158 mortes causadas por COVID-19 no estado do Rio Grande do Sul para que seus benefícios compensassem os seus custos.

Palavras-chave: COVID-19, isolamento social, Filtro de Kalman, Rio Grande do sul.

Classificação JEL: C22, D61, K32

Una estimación preliminar de los costos económicos del lockdown en Rio Grande do Sul

Este artículo busca estimar los costos económicos iniciales de las medidas adoptadas para mitigar la propagación del COVID-19 en Rio Grande do Sul. Para este fin, utiliza un modelo estructural de series de tiempo estimado a través del filtro de Kalman para obtener una ruta de ventas contrafactual en el estado después de varios decretos municipales y el decreto estadual n.55.128, del 19 de marzo de 2020. Los resultados muestran que los costos acumulados de la política de aislamiento social en términos de pérdidas en ventas em el sector formal rondarían los BRL 43.34 mil millones y en los términos de las pérdidas de cobro del ICMS serían de alrededor de BRL 1,56 mil millones en 27 días. Aunque el artículo tiene la limitación de usar solo información del sector formal de la economía, concluye que los costos de estas medidas son relevantes y que crecen exponencialmente. También concluyó que sería necesario que estas medidas pudieran prevenir al menos 13,158 muertes causadas por COVID-19 en el estado de Rio Grande do Sul para que sus beneficios superen sus costos.

Palabras-clave: COVID-19, Lockdown, Filtro de Kalman, Rio Grande do Sul.

Clasificación JEL: C22, D61, K32

1. Introduction

Faced with an undeniable serious public health problem caused by the fast spread of SARS-COV-2, many policymakers had to quickly implement many measures to prevent overloading the health system to avoid, as much as possible, the deaths caused by lack of adequate medical care. This is because it is a new virus, easy to spread, which still does not have a vaccine and that generates a disease, COVID-19 , that is still without a scientifically proven cure. For these reasons, it has been causing many deaths wherever it spreads.

The obvious recommendation in this case is to consider the knowledge of the health area, especially of infectious disease experts and epidemiologists. In these cases, what they indicate is the use of "non-pharmaceutical interventions", which consists of a series of measures ranging from hygiene recommendations, limitations to movement of people, closure of sites that potentially generate agglomerations to the isolation and quarantine of the infected people. It seems that there is also a consensus among researchers in the area based on the studies of Hatchett et al. (2007) and Markel et al. (2007) that the sooner measures aimed at reducing the agglomeration of people are implemented, the better their results in terms of reduction of peak contagion (flattening of the curve) and deaths[15].

These ideas brought by researchers and health professionals certainly inspired several mayors and the governor of the state of Rio Grande do Sul to take some measures even before there were records of infected or widespread of the virus in the state. Thus, since March 18, 2020, about 1,600 municipal and state decrees related to the spread of the virus have been published in the state[16]. The most important are the state decrees No.55,128 of March 19, 2020 and No.55,154 of April 1, 2020, which instituted measures to limit the movement of people and established business closures (lockdown) throughout the state of Rio Grande do Sul. These measures are the ones that potentially have the greatest economic impacts and have the capacity to generate high costs for society. This is because these restrictive measures reduce or eliminate the ability of many people to work and/or to obtain income, which potentially affects their ability to support themselves economically in the present and in the future.

However, many of these measures are unprecedented and have been implemented without having a dimension, even approximate, to their costs and results, because the lockdown,

[15] Jackson et al. (2020) evaluate the impact of social isolation on different types of viruses from hospital records after a natural experiment caused by a heavy snowstorm in Seattle-WA that lasted two weeks. They show an opposite conclusion since they conclude that measures with short duration of social distancing can reduce the incidence of a virus if they are implemented close to the epidemic peak. Rashid et al. (2015) and Fong et al. (2020) also criticized these articles concluding that they present weak evidence in favor of these measures.

[16] These decrees can be accessed at https://leismunicipais.com.br/coronavirus.

that is, the prohibition of virtually every type of activity involving public contact, is a new experience that has never been used in other pandemics and that has been tested only now by a large number of countries[17], but still without robust assessments of its effectiveness[18] at reducing the number of deaths by COVID-19 and its more general effects, in terms of well-being in the Kaldor-Hicks sense, that is, through a cost-benefit analysis. In this context, a literature that deals precisely with trying to evaluate the economic impacts of the pandemic and to carry out cost-benefit assessments in all sectors of the economy is quickly appearing. This can already be seen, for example, in Acemoglu et al. (2020), Baldwin and Mauro (2020) and Ludvigson et al. (2020).

Nevertheless, in these studies, the impacts are estimated through simulation models of future scenarios, since economic information, unlike health statistics, usually takes a relatively long time to be publicized. This hinders the work of researchers, because there is virtually no daily economic information to allow the evaluation of the economic costs of lockdown measures while they are still in their implementation phase. Another difficulty in this evaluation process is the identification of control groups to create a counterfactual scenario to evaluate the real impact of these measures. In this type of policy, all sites are usually are treated or influenced by measures adopted elsewhere, because there is an economic connection among regions that generate externalities that are difficult to control.

Therefore, there are few methodological alternatives left. The simplest alternative, making a comparison of the same period of this year with the previous year, ignores many changes that occurred over this long period between one year and another, so information from the previous year is not a good predictor of current values. In this context, aiming to overcome these limitations, this study proposes to estimate the preliminary economic costs of the lockdown measures imposed by the decrees issued by the government of the state of Rio Grande do Sul and several municipalities from sales information obtained through the total value of electronic tax documents (DF-e) sourced by the state revenue department of Rio Grande do Sul. The empirical strategy used in this article consists in estimating a structural time series model with the use of Kalman's Filter (KF) from daily information over five months, from November 11, 2019 to April 15, 2020, to obtain an estimate of the counterfactual scenario (the total value in sales without the lockdown measures), which, when subtracted from the observed values, allows a more robust estimation

[17] For a brief description of these countries can be seen in https://www.businessinsider.com/countries-on-lockdown-coronavirus-italy-2020-3.

[18] Recent studies tried to evaluate these measures through models that allow inference about causality. But, not much is known so far, since Qiu et al. (2020) and Fang et al. (2020) use Chinese data that were significantly rectified after these studies had been conducted and Gupta et al. (2020) use American data that they also define as unreliable.

of the costs of these measures to be obtained than through a simple comparison with the previous year or month[19].

The choice of this methodology is justified by the lack of daily economic information and of comparable states not treated with similar measures to build a data panel that allows an analysis trough synthetic control or difference in differences models. Moreover, it is a more flexible and transparent methodology than the traditional Interrupted Time Series methodology, which is based on the traditional Box and Jenkins (1976) ARIMA models, such as the Gottman (1981) and Crosbie (1993) models. Structural time series models allow working with non-stationary series at their level, that is, with stochastic trend, something that is not possible in ARIMA models, and allow dealing with series with high variability, besides allowing the modeling of interventions, such as state decrees that are in force, through transparent statistical criteria (Harvey, 1989; Vuijic, Commandeur and Koopman, 2016).

Seeking to meet these objectives, the article is organized with three more sections besides this introduction. The next section describes in detail the empirical strategy. The third section describes the data and presents and discusses the obtained results. At the end of the article, some conclusions and future studies guidelines are presented for those who seek to carry out an evaluation of the efficiency of these measures.

2. Empirical strategy

This study uses the econometric model known as structural time series model. Following this model, the total values in sales is a univariate time series that can be represented in the following measurement equation:

$$y_t = \mu_t + \psi_t + \gamma_t + \varepsilon_t \quad (1)$$

where μ_t is the trend, ψ_t is the cycle, γ_t is the seasonal component and ε_t is the error that reflects the shocks suffered by the series. According to Jalles (2009), an advantage of time series modeling with the use of structural models is its flexibility in identifying differences in the behavior of a series considering its different components as stochastic processes governed by random disturbances, so that each component has a transition equation, as follows:

[19] This method, which was popularized by Harvey (1989), Commandeur, and Koopman (2007) and Durbin and Koopman (2012), has been applied to assess the impacts of interventions in many areas of knowledge, including Harvey and Durbin (1986), which analyses the effects of the Law that mandated wearing seat belts in Britain on the deaths of drivers, and the study of Vujic, Commandeur and Koopman (2016), which analyzes the effects of the revocation of parole in the state of Virginia on crimes registered in the state.

a) Trend (μ_t): This component refers to the part capable of capturing smooth movements over long periods within the time series (Maia, 2003). A stochastic trend model can be written by:

$$\mu_t = \mu_{t-1} + \beta_t + \eta_t$$
$$\beta_t = \beta_{t-1} + \varpi_t \quad (2)$$

which μ_t defines the level of the trend and β_t defines its slope. In turn, η_t it is a stochastic component of the level transition equation and ϖ_t is the stochastic component of the slope transition equation.

b) Cycle (ψ_t): in many economic time series it is important to distinguish between a long-term trend and cyclical or short-term movements, which may have a deterministic or stochastic specification. A deterministic cycle perfectly describes a periodic behavior with a given frequency, so that it can be described as a function of sines and cosines in the following form:

$$\psi_t = \alpha\, cos(\lambda t) + \beta\, sen(\lambda t) \quad (3)$$

It is possible to add stochastic components in this equation, as well as including a damping factor within the equation, making the cycle more flexible and able to adapt to various functional forms. Doing this, we have:

$$\begin{pmatrix} \psi t \\ \psi t* \end{pmatrix} = \rho \begin{pmatrix} \cos\lambda & \sin\lambda \\ -\sin\lambda & \cos\lambda \end{pmatrix} \begin{pmatrix} \psi t-1 \\ \psi * t-1 \end{pmatrix} + \begin{pmatrix} \kappa t \\ \kappa t* \end{pmatrix} \quad (4)$$

where ρ is the parameter that determines the decay (damping) of the cycle, λ is the parameter that determines the frequency of the cycle and κ_t is the stochastic error component of the cycle transition equation.

c) Seasonality (γ): it is a movement that presents a repeated pattern over sub periods of a period considered. Following Koopman et al. (2007), the function for this component has the following form:

$$\gamma_t = \sum_{j=1}^{s-1} \gamma_{t-j} + \delta_t \quad (5)$$

where δ_t is the stochastic component of the seasonality transition equation.

d) Error (ε): the error, or also called innovations or the random movement of a time series is defined by Maia (2003) as a sporadic displacement of the time series, which is not captured by any of the other three components: trend, cycle and seasonality.

Therefore, following these specifications, any time series can be described in the state-space form, that is, through a measurement and transition equations for each component. Specifically in the model to be used in this study, in addition to the structural components, interventions will be added so that it is possible to capture possible structural breaks caused by the decrees in the levels of economic activity measured by the sales that use some type of electronic invoice. Thus, the time series of sales can be decomposed as follows:

$$y_t = \mu_t + \psi_t + \gamma_t + Interventions + \varepsilon_t \quad (6)$$

This model has a set of latent variables that can be estimated using the Kalman Filter. This filter is a recursive algorithm that can be described as a set of mathematical equations constituent of an efficient recursive estimation process that minimizes the squared errors[20]. To be applied, it is necessary that the models are written in the state-space form as described in the equation (6), or in its matrix form, given by:

$$Y_t = Z_t X_t + d_t + \varepsilon_t \quad \text{with} \quad t = 1, 2, \ldots, \quad T \quad (7)$$

in which Z_t it is an N × *m* matrix, d_t is an N × 1 vector, ε_t is a serially uncorrelated vector with zero mean and covariance matrix H_t, and X_t is an *m×1* vector that contains the unobservable state variables. If the state variables (structural components) can be represented through an Markovian process of order one, such as the transition equations described by equations (2), (3), (4) and (5), the matrix version that represents the set of transition equations is given by:

$$X_t = T_t X_{t-1} + C_t + R_t N_t \quad \text{with} \quad t = 1, 2, \ldots, \quad T \quad (8)$$

Where T_t is an $m \times m$ matrix, C_t is an *m* ×1 vector, R_t is an *m×g* matrix, and N_t is a vector *g×1* not serially correlated stochastic components with zero mean and covariance matrix given by Q_t. Written in this form, the unobserved components of the structural models of time series can be obtained recursively by the filter.

[20] Other point to be emphasized is that KF allows the estimation of unknown parameters of the model by maximizing likelihood via decomposition of prediction errors.

In turn, structural breaks can be identified visually or from the knowledge of periods in which changes may have generated a significant change in the time series (Campbell and Ross, 1968). In this case, it is assumed that any change in another covariate moves more slowly and gradually than the variable that generated the intervention (structural break). For this structural break identification to have internal validity, i.e., for the model to be able to estimate causal effects, it is necessary that the change generates permanent effects so that the different behaviors of the series before and after the intervention are evident (Linden and Arbor, 2015). This is a crucial point of the empirical strategy used in this study, because obtaining the counterfactual scenario that allows an estimate of the costs of lockdown measures is only possible if there is a separation of the treatment effect that is performed through the identification of these structural breaks.

In this context, structural time series models are useful precisely to minimize these problems, as they allow the robust identification of structural breaks. So, unlike traditional methods that use deterministic trends to build the forecast that serves as a "placebo" series, structural time series models treat all components as stochastic and independent of model errors. Thus, we have a much more accurate forecast that allows us to obtain a robust counterfactual analysis based on the identification of the structural breaks presented by the series, that is, it allows us to generate a "placebo" series and to measure the treatment effects.

Considering these aspects, the strategy of identifying the costs of lockdown measures implemented in the state of Rio Grande do Sul through state decrees No.55,128 of March 19, 2020 and No.55,154 of April 1, 2020 and several other municipal decrees consists of two stages, suggested by Vujiceur, Commandeur and Koopman (2016).

The first stage establishes the use in the intervention model on the relevant dates related to historical events. The coincidence implies a strong indication of a causal relationship between the changes imposed by the decrees and the total sales. In this case, the internal validity is not complete unless there is the omission of any relevant variable that moves at the same speed of the intervention.

In this study, two interventions are evaluated. The first is the state decree No.55,128, of March 19, 2020, which among other measures establishes[21], the prohibition of the movement of interstate public and private buses, the stores closure at shopping malls, the limitation of the service capacity of supermarkets, pharmacies, ATMs and restaurants, the prohibition of public gatherings and meetings of any nature, including excursions, face-to-face courses, religious events with more than 30 people, limitations to intercity transport within the stateof up to 50%

[21] The complete decree can be accessed in https://www.diariooficial.rs.gov.br/materia?id=396798.

capacity, and requires that buses for urban and rural public transport to operate only with seated passengers, among other measures with less economic impact. The second intervention is state decree No.55,154 of April 1, which determined the business closure[22] throughout the state of Rio Grande do Sul except for activities considered essential described in Article 17 of the same decree.

The second stage consists of estimating a "placebo" trajectory of the sales series based on its components excluding shocks (irregular component or innovation), since these cannot be predicted before they occur and, the measured effects of the interventions. This makes possible to obtain an estimate of the costs, in terms of total daily sales, of lockdown measures when comparing their observed (real) trajectory with their counterfactual estimate (placebo).

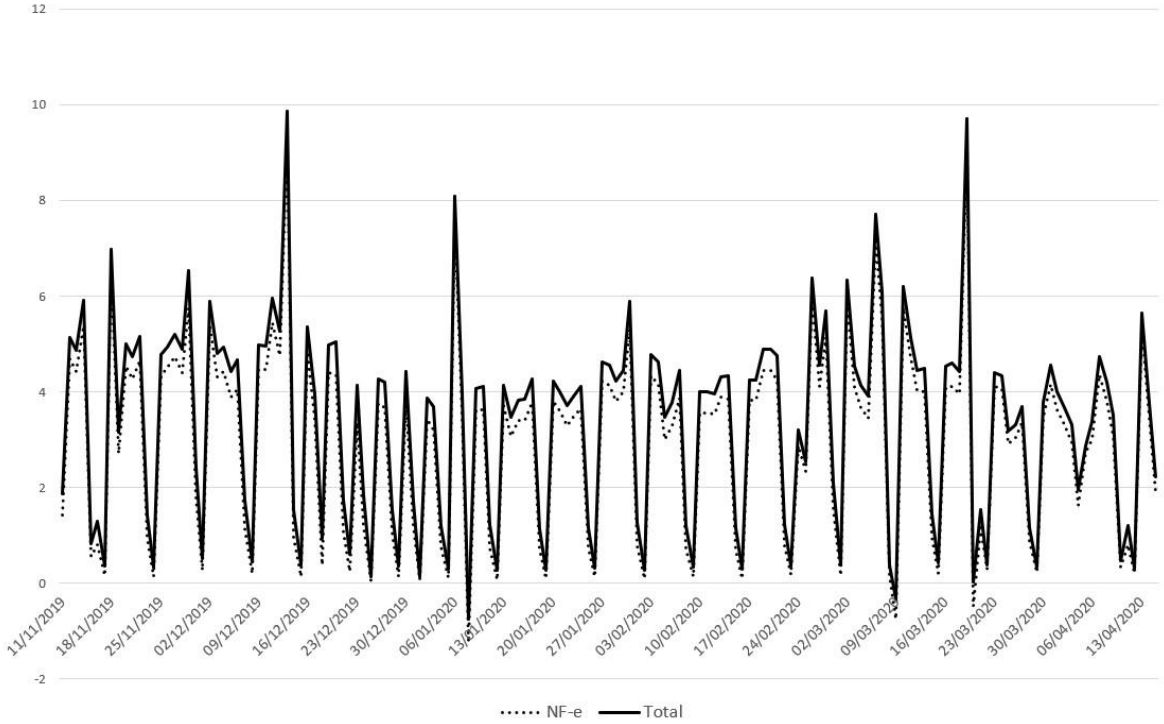
3. Results

The data for the execution of this study were extracted from the database of the state revenue department of Rio Grande do Sul. For the estimation of the model, the daily statistics of the total amounts of tax documents issued in Rio Grande do Sul (output) in the period between November 11, 2019 and April 15, 2020 were used. The study ends on the date of publication of a new decree, state decree nº 55.184 of April 15, 2020, which transferred the responsibility to decide about the business opening to city halls, with the exception of those located in the metropolitan area of Porto Alegre, state capital and region of the state with the highest number of registered cases and deaths by COVID-19 . Electronic tax documents (DF-e) comprise the sum of electronic invoices (NF-e), which are issued as in all commercial transactions involving the movement of goods, such as sale to legal entities, return, transfer, among others; Electronic Invoice of Consumers (NFC-e), which are issued in face-to-face sales or home delivery to the final consumer; Electronic Transportation Knowledge (CT-e), issued to cover operations of delivery of cargo transportation service; Electronic Ticket (BP-e) issued to register the services of passenger transportation, such as road transport, waterway, rail, among others.

Graph 1 shows the trajectory of the used series. As can be observed the total value is composed in its almost totality by NF-e. Moreover, it is possible to observe that the series has a well-defined daily seasonal pattern, with abrupt reduction at weekends, which makes it difficult to identify any trend or structural break in the series through simple visualization.

[22] The complete decree can be accessed in https://saude-admin.rs.gov.br/upload/arquivos/202004/01140149-decreto-55154.pdf.

Graph 1. Total value issued per day in NF-e and DF-e (Total) in Rio Grande do Sul (BRL billions)



Source: State revenue department of Rio Grande do Sul.

As already mentioned, the identification strategy involves including interventions in the structural models. Once the dates of possible discrepant information and/or structural breaks are established, structural time series models are estimated with three types of possible specifications for the dates: outlier, slope break and level break.

Starting from the most complete to the simplest model, models with specifications with statistically significant coefficients are chosen. The results of this process of searching for the best adjustment to the data generating process can be seen in Table 1. The model with the best adjustment does not present a residuals autocorrelation problem[23] as can be seen in the Ljung-Box test, however, the Jarque-Bera test indicates that the model does not have normality in the distribution of its residuals[24].

[23] Table A.1. appendix shows the residual's distribution and correlogram.

[24] It is noteworthy that even if the hypothesis of normality of the residuals is not satisfied, yet the so the estimator obtained by the Kalman Filter is an optimal linear estimator that minimizes the mean quadratic error (Harvey, 1989).

Table 1. Results of estimates for the sales in Rio Grande do Sul.

T	***p***	**Normality (JB)**	***q***	***Q* (*q*, *q*-*p*)**	R^2_d
157	2	62.762	13	21.021	0.7488
		(0.000)		(0.0725)	
Regression effects in the last period (15/4)					
	Coefficient	**RMSE**	**t test**	**P-value**	
*Slope break (*20/3)	-1.8356	0.76594	-2.397	0.0177	
Slope break (21/3)	1.8542	0.78751	2.354	0.0198	
Monday	4.00839	0.42017	9.539	0.0000	
Tuesday	3.62839	0.42091	8.620	0.0000	
Wednesday	3.15359	0.42146	7.482	0.0000	
Thursday	4.04882	0.42597	9.504	0.0000	
Friday	3.96883	0.43538	9.330	0.0000	
Saturday	1.20312	0.42446	2.834	0.0005	

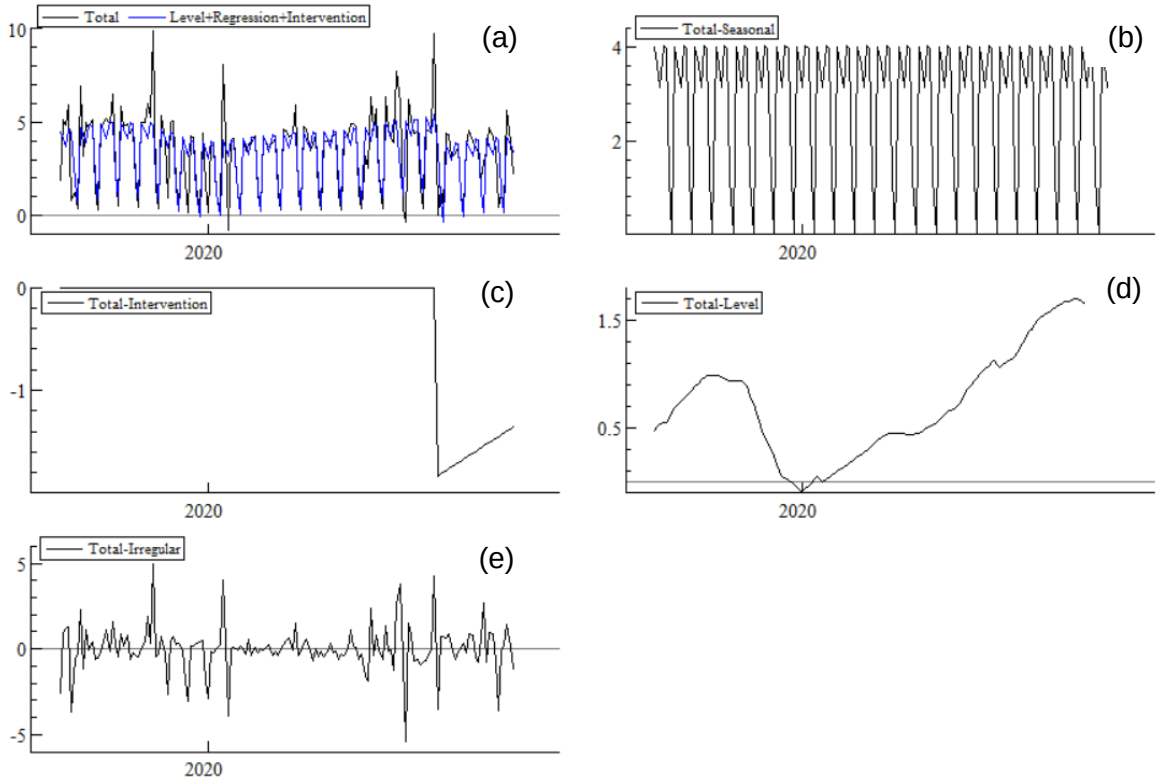
Source: Own elaboration with the use of Stamp software

As can be seen in Table 1, statistically significant changes in slope breaks were identified in two periods[25], one with a negative impact on total sales and the other with a positive impact. The first of these occurred shortly after the first wave of municipal decrees and state decree nº 55.128, on March 20, while the second breach has a positive impact and occurs on the following day, however, as can be seen in the Figure 1-c, the sum of the two breaks generates a negative net effect that starts at around BRL 1.8 billion per day and that is reduced in the subsequent periods, but remains negative in net terms until the final period in April 15th.

In addition, figure 1 graphically presents the other components of the series, which, as can be seen in figure 1-d, it shows a growing (stochastic) trend until April 1, date of state decree nº 55.154, which prohibited activities of commerce throughout the state of Rio Grande do Sul. From that date on, the trend shows a decrease in sales. In other words, this decree was not able to generate a structural break in the sales series, but it changed its trend, which became negative. The estimation also shows that the daily seasonal component of the series is quite statistically significant, and that Thursday and Friday are the days that usually present the highest sales volume in Rio Grande do Sul. These are, on average, about BRL 4.04 billion higher than what is usually registered on Sundays. It is also possible to observe that Saturday is also a day of the week with low sales volume.

[25] No statistically significant structural breaks were identified in subsequent periods, including after State Decree No. 55,154 of April 1.

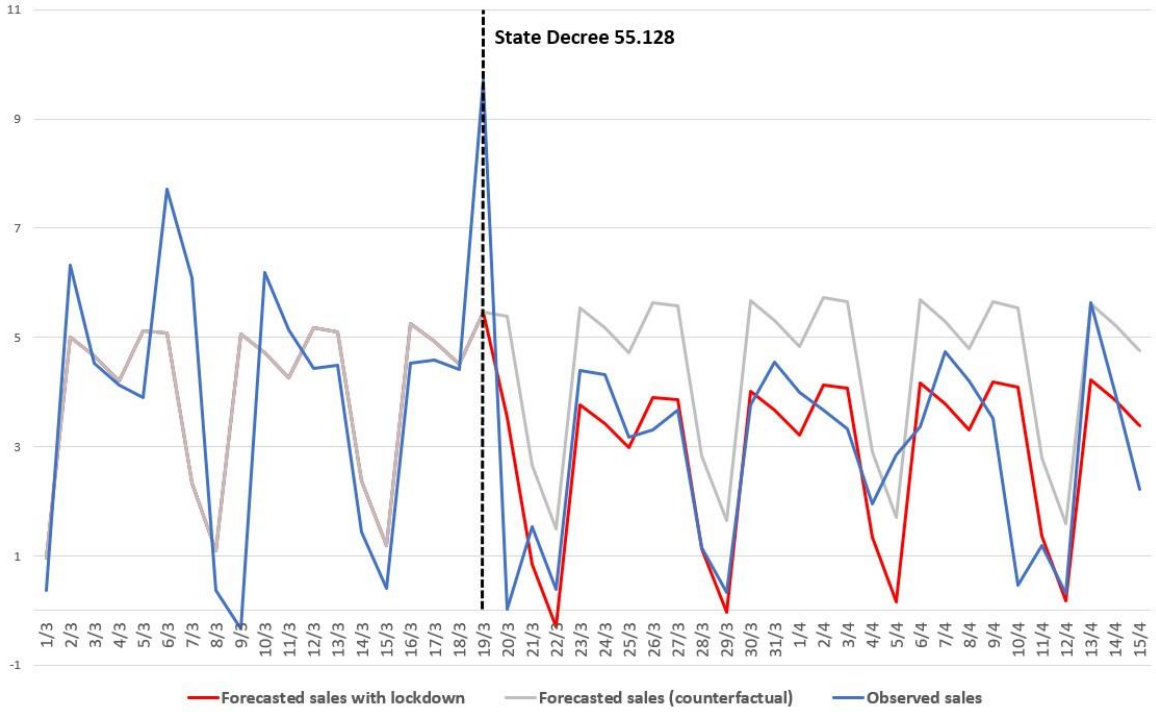
Figure 1. Structural components of the sales series in the state of Rio Grande do Sul



Source: Own elaboration with the use of Stamp software.
Note: Values in vertical axis are in BRL billions.

As described in the previous section, the identification strategy involves estimating a "placebo" series from the structural components of the total value in sales using some electronic invoice in Rio Grande do Sul. This is obtained by adding the components of the series excluding shocks, so called irregular in figure 1, and the intervention components, so called intervention in the same figure. This "placebo" series is represented by the gray line in Graph 2. It should be noted that this gray line is the adjusted series before interventions occur and that this becomes the "placebo" series only after these occur. After the first intervention, the adjusted model, represented by the red line, follows a different trajectory because of the lockdown measures (treatment).

Graph 2. Total sales estimated and observed using electronic invoice in Rio Grande do Sul (March 1-April 15, 2020)



Source: Own elaboration with the use of Stamp software. Note: Values in vertical axis are in BRL billions.

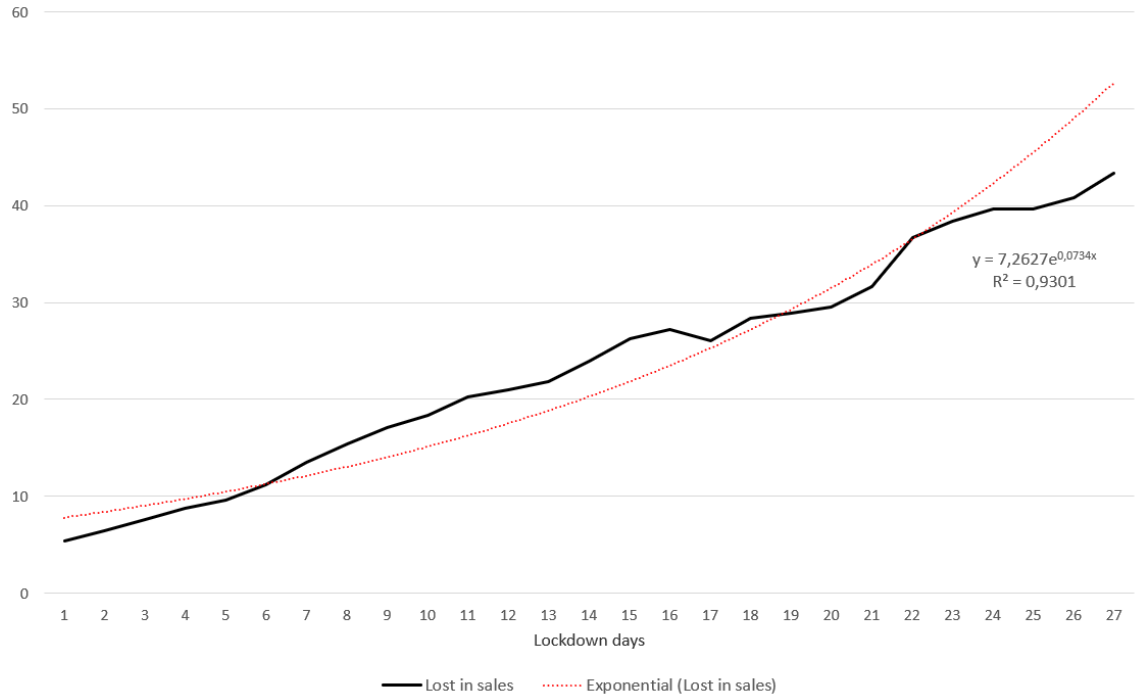
In this way, the adjustment of the model can be assessed[26] by comparing the observed values, represented by the blue line in the graph, with the estimated values (gray line) before the interventions and with the estimated values considering the impacts of the interventions (red line), after interventions occur. Considering these aspects, it is possible to observe that the model was not able to predict the sudden increase in sales that occurred on March 19, as soon as the announcements of the first decrees that limited the mobility of people in the state of Rio Grande do Sul occurred. There was an increase in sales of food and hygiene products on this day because many consumers faced the prospect of staying at home for a long time and there were rumors that there might be a shortage of basic products, such as toilet paper. These shortages ended up not being confirmed. However, the model shows a strong adjustment between 27 March and 5 April and 11 and 12 April.

Following the analysis of the results, it remains only to present the main conclusion of the article, which is an estimation of the total cost, measured in terms of sales losses, of the lockdown measures in Rio Grande do Sul. This is obtained by adding the difference between series

[26] This can also be done through the R^2d observed in table 1, equal to 0.7488, and observing Figure 1-a.

counterfactual (gray line) and the observed series (blue line), from the first intervention on March 19, identified in the graph by the first vertical dotted line. Using this empirical identification strategy, the estimated impact was a reduction in sales of approximately BRL 43.34 billion, which represents a reduction of approximately 43.18% of the expected sales for the period. This value allows, for example, to have an estimate of the loss of tax collection with the ICMS, since the revenues from this tax usually represent 3.6% of the total sales value with the use of electronic invoices. Thus, the collection losses with this tax, which is the most relevant tax collected by states in Brazil (VAT equivalent), would be around BRL 1.56 billion, that is, approximately 51% of the expected collection for this tax for the month of April. This loss of revenue is certainly relevant considering that the state has severe financial issues and usually pays its public employees' wages in parts.

Graph 3. Estimated accumulated losses on sales due to lockdown measures in Rio Grande do Sul (March 20-April 15, 2020)



Source: Own elaboration. Note: Values in vertical axis are in BRL billions.

Since the losses have a daily periodicity and vary from day to day, it is possible to build a graph with the costs accumulated since the implementation of social isolation measures in the state of Rio Grande do Sul. This exercise is shown in graph 3.

The graph shows that the accumulated (sales) losses grow in a non-linear manner. These started growing at an exponential rate lower than estimated and shown on the graph until the sixth

day of the lockdown. From that day on, growth was higher until the sixteenth day, which coincides with the fifth day of April, the day on which the counterfactual model predicted a drop greater than that observed possibly because it was the first Sunday of the month, a period in which people are getting their wages. However, this small interruption in the growth of losses was followed by a more accelerated growth in the following periods until the twenty-second day, April 11th. From this day onwards the estimated losses show a slowdown. Even so, these are not negligible, since, for example, on the last day evaluated, on April 15 the estimated loss was more than BRL 2.5 billion.

Therefore, it is possible to conclude that it is not only the spread of the virus that can generate exponential costs. The results obtained in this article indicate that the losses in the economy, as well as the potential number of infected and deaths caused by the virus, also grow exponentially.

4. Conclusion

The main objective of this article was to obtain estimates for the initial economic costs of lockdown measures imposed by municipal decrees and state decrees nº 55.128 of March 19, 2020 and nº 55.154 of April 1, 2020. To this end, we estimated a “placebo” series obtained through a structural time series model, which allowed us to conclude that the costs, measured in terms of sales losses realized in the state of Rio Grande do Sul, would be approximately BRL 43.34 billion in 27 days of effective social isolation measures.

It should be noted that these costs involve only losses in the formal sector of the economy that uses an electronic system for paying taxes. Therefore, the model does not allow estimating lossesin the informal sectors of the state's economy, which are possibly even more affected by the measures. Assessing the costs of these measures in terms of employment and income is a natural extension of this study, as well as carrying out an assessment of the impacts of these measures in the long term, which will only be possible to be done after the first after the pandemic outbreak has ended.

In any case, the cost estimation presented in this study, despite its limitations, is the first step to conduct a cost-benefit analysis of lockdown measures. However, for it to be done, it is necessary to evaluate the benefits of these measures, which also involves obtaining a counterfactual scenario, since, for example, the number of hospitalizations and deaths avoided are not observed. In this case, the task of obtaining a “placebo” series is much more complicated because when a new virus spreads, information from other outbreaks is not informative and does not contribute to building forecasting models. Therefore, unlike the economic variables in which

the past usually helps to project the future, the past behavior of the variables of interest in the health sector does not contribute too much to setting up a counterfactual scenario.

It is worth remembering that the epidemiological literature shows that the only way to reduce deaths is with the treatment of the population with drugs or vaccines (Fong et al, 2020). Social isolation measures would be necessary only to postpone people's infection and what is expected is that the postponement is sufficient to prepare a minimum structure to give care for the infected and find a form of treatment capable of reducing deaths. However, this is not something simple to happen and it usually takes much longer than 15 or 30 days, which are the periods of validity foreseen for lockdown measures in most of the decrees established in Rio Grande do Sul.

Thus, the cost-benefit assessment of these measures must balance the number of lives saved by treatment in the future, since without effective treatment, there is only a postponement of deaths and the number of lives disorganized and lost by loss of their ability to earn a living[27]. In other words, there is no guaranteed gain for the lockdown, because, if treatment is not discovered in time, this gain does not exist, while in return its costs in the economy, as shown in this study, grow exponentially when economic activities are subject to many restrictions.

At this time, when there is no reliable estimate of the benefits of these measures[28], the only possible analysis that resembles a cost-benefit assessment is to compare the costs estimated in this article with the estimated values for the value of life. Mesquita et al. (2020) estimate that the Value of Statistical Life (VSL) in Brazil is around BRL 3.294 million. These values are close to those found by Viscusi and Masterman (2017) in their meta-analysis on VSL performed for several countries in the world. Thus, this value can be used as a reference to do a reverse reasoning, that is, how many lives should be saved to offset the costs imposed by the lockdown measures.

The results obtained in this article indicate that in Rio Grande do Sul at least 13,158 people should be saved in this period or in the future so that their costs are offset by their benefits, measured in terms of lives saved. If only this period in which the measures are in force and that until April 15, 19 deaths by COVID-19 were recorded in the state, this implies that the lockdown

[27] It can be argued that it is at this point, then, that government aid should be offered to the groups that are most affected by lockdown measures through programs including cash transfer programs, company subsidies and postponement of tax payments. Programs of this type are already underway; however, it cannot be ignored that governments in all their spheres in Brazil have financial problems and that they will also have significant losses of revenue, so it is impossible to build a program equivalent to the level of the private sector losses. For example, the estimated costs in this study for about four weeks of lockdown in Rio Grande do Sul are equivalent to almost 62% of the expected revenues for the state government in 2020. In fact, only a small portion of the losses is possible to be replenished.

[28] Oliveira (2020) and Desmet and Wacziarg (2020) tries to estimate these benefits using Brazilian and American daily panel data, respectively. They both found that these measures are capable to reduce cases and deaths by COVID-19 ; however, caution is needed when interpreting these results because their models do not have a design that allows inferring about causality.

measures should have an effectiveness of 99.8%, or that is, they would be able to reduce deaths caused by the virus by this percentage. It is clear that this percentage changes as the costs of maintaining the lockdown increase and the number of deaths also increases.

Finally, it is necessary to reaffirm the need for lockdown measures to be carefully analyzed in a perspective of cost-benefit analysis. As already mentioned in this study, when imposing an economic lockdown, policy makers entered an unknown environment, as, to date, there are no studies that attest to its effectiveness or that evaluate its costs, so there is a strong possibility that significant losses (even if not intentional) are generated that are not expected by their proponents. There is not even a guarantee that this type of measure will actually be implemented in the desired way, since the population have incentives not to comply with them considering that it is a measure with extremely high monitoring costs by the State and with benefits of not complying with it as the lockdown continues and the need to seek support from the population increases.

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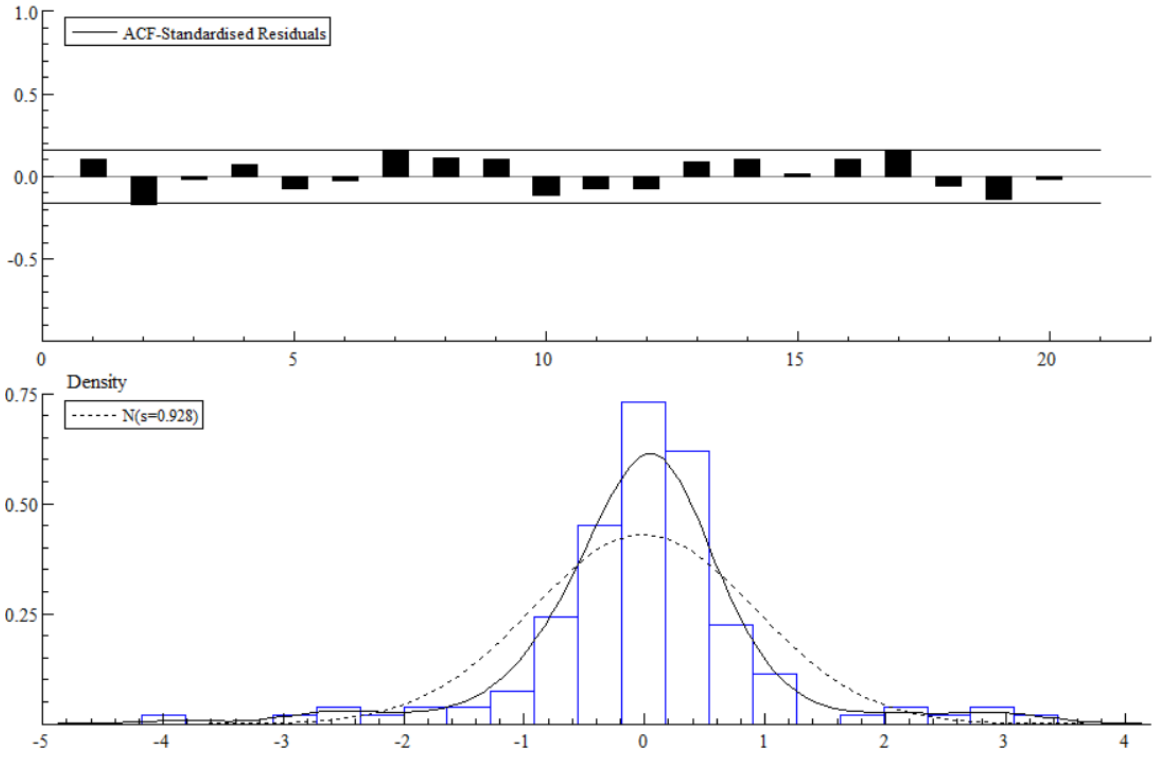
Appendix

Figure A.1. Correlogram and residuals distribution from the estimated model



The impacts of Covid-19 on the major mining municipalities in Brazil[3]

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This paper discusses the influences of mining on the spread of the new coronavirus in the largest mining municipalities in Brazil, since its determination as an essential activity to face Covid-19. The theoretical discussion approaches the issue of whether the virus is spreading further or not among workers who have maintained their activities in the mining sector. The objective of this article is to investigate the impact of Covid-19 on mining and whether the maintenance of this activity is related to a higher incidence. To measure incidence rates, the qualitative methodology involved a case study of mining municipalities selected by the amount of royalties collected and for the maintenance of activities by monitoring the supply of jobs during the pandemic. The incidence of cases was georeferenced on maps and the results analyzed by population range. The Sustainable Development Goals (SDGs) applied to the mineral sector were used as a purpose for this investigation. The results found that: (i) among 997 municipalities in the states of Pará and Minas Gerais, the incidence of Covid-19 is relatively higher in selected mining municipalities; (ii) there is a greater proportion of Covid-19 cases in the selected municipalities than in others in the same population range; (iii) the supply of jobs in the mining sector in the selected municipalities remained stable compared to the period before the pandemic.

Keywords: Brazil, mining, Covid-19.

Os impactos da Covid-19 nos maiores municípios mineradores do Brasil

Este artigo discute as influências da mineração na disseminação do novo coronavírus nos maiores municípios mineradores do Brasil, desde sua determinação como atividade essencial para o enfrentamento do Covid-19. A discussão teórica aborda a questão da disseminação do

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vírus ser maior ou não entre os trabalhadores no setor mineral que mantiveram suas atividades. O objetivo deste artigo é investigar o impacto da Covid-19 na mineração e se a manutenção dessa atividade está relacionada com uma maior incidência da doença. Para mensurar as taxas de incidência, a metodologia qualitativa envolveu um estudo de caso de municípios mineradores selecionados pelo valor dos royalties arrecadados e pela manutenção das atividades por meio do monitoramento da oferta de empregos durante a pandemia. A incidência de casos foi georreferenciada em mapas e os resultados analisados por faixa populacional. Os Objetivos de Desenvolvimento Sustentável (ODS) aplicados ao setor mineral foram utilizados como justificativa desta investigação. Os resultados verificaram que: (i) entre 997 municípios dos estados do Pará e Minas Gerais, a incidência da Covid-19 é relativamente maior em municípios mineradores selecionados; (ii) há uma proporção maior de casos Covid-19 nos municípios selecionados do que em outros na mesma faixa populacional; (iii) a oferta de empregos no setor de mineração nos municípios selecionados permaneceu estável em comparação com o período anterior à pandemia.

Palavras-chave: Brasil, mineração, covid-19.

Los impactos de Covid-19 en los municipios mineros más grandes de Brasil

En este artículo se analizan las influencias de la minería en la propagación del nuevo coronavirus en los mayores municipios mineros de Brasil, desde su determinación como actividad imprescindible para enfrentar al Covid-19. La discusión teórica aborda la cuestión de si el virus se está propagando más o no entre los trabajadores del sector minero que mantuvieron sus actividades. El propósito de este artículo es investigar el impacto delCovid-19 en la minería y si el mantenimiento de esta actividad está relacionado con una mayor incidencia de la enfermedad. Para medir las tasas de incidencia, la metodología cualitativa involucró un estudio de caso de municipios mineros seleccionados por el monto de las regalías recaudadas y por el mantenimiento de las actividades mediante el monitoreo de la oferta de empleos durante la pandemia. La incidencia de casos fue georreferenciada en mapas y los resultados analizados por rango poblacional. Los Objetivos de Desarrollo Sostenible (ODS) aplicados al sector minero se utilizaron como justificación para esta investigación. Los resultados encontraron que: (i) entre 997 municipios de los estados de Pará y Minas Gerais, la incidencia de Covid-19 es relativamente mayor en municipios mineros seleccionados; (ii) hay una mayor proporción de casos de Covid-19 en los municipios seleccionados que en otros del mismo rango de población; (iii) la oferta de empleo en el sector minero en los municipios seleccionados se mantuvo estable en comparación con el período anterior a la pandemia.

Palabras clave: Brasil, minería, Covid-19

1. Introduction

Brazil is the second country with the largest number of confirmed cases of the new coronavirus pandemic, with more than 3 million accumulated cases and 100,000 deaths registered until August 9th (MS, 2020). The country's public health system can be considered one of the best coverages in Latin America; however, given the challenges of overcoming the vast territorial length and the spread of the disease, the pressure on health institutions has been worrisome.

The pandemic affected the Brazilian economy in three dimensions: (i) strong drop in external demand, caused by the closure of other countries' economies, (ii) reduction in domestic demand, due to the Brazilian economy closure; and (iii) shock in oil prices, which impacted Brazil as a net oil exporter (World Bank, 2020). According to the Brazilian Institute of Geography and Statistics (IBGE, 2020), the combined impact of these three shocks is pushing the economy into a recession. This situation causes chain effects throughout the Brazilian economy, especially in its most vulnerable parts, such as small municipalities and indigenous communities.

Like most countries, Brazil closed a large part of its economy to fulfill the social distancing policy necessary to avoid the spread of the virus, except for some economic activities that were considered essential, including mining. Without specifying which activities in the mining sector would be essential for the maintenance of the country most important activities, it was questioned, specifically for the mining sector, what were the risks of maintaining this activity with a growing spread of Covid-19? Once it was determined that this would be one of the activities kept in operation, it is necessary to assess how mining is affected by the economic scenario in the context of the effects of the pandemic.

The objective of this research is to investigate how mining has been affected and whether maintaining mining activity has increased Covid-19 in the selected mining muncipalities. In particular, with the application of qualitative methodologies for surveying and analyzing socioeconomic and health data, the aim is to assess the incidence of contagion in the selected mining municipalities in comparison with other municipalities, the variation in formal jobs and, finally, which conclusions can be taken as contributions to the decision making of public agents. The hypothesis to be investigated deals with the risks that involve mining as an essential activity, which may contribute to spreading COVID-19 to the interior of the country.

The analysis proposed in this article is justified by the fact that Brazilian mining is characterized as an essential economic activity and with the capacity to mobilize human, physical, technological and financial resources whose performance can contribute to the achievement of the goals of the Sustainable Development Goals (SDG).

Due to its characteristics of seeking a natural resource, mining activity is often located in remote, ecologically sensitive and less developed areas, including indigenous territories. When effectively managed, it can create jobs, stimulate innovation and bring investment and infrastructure in the long-term. However, if poorly managed, mining can lead to environmental degradation, displacement of populations, inequality, deepening conflicts and increasing local economic dependence on mineral extraction.

The source of income of the population involved in mining is an important aspect related to the SDG's and its consequent effects, such as the health risks that workers in the sector are exposed to while continuing their activities amid the danger of contracting Covid-19. From this approach, a set of actions related to the SDGs was identified that can be useful, if applied, in the context of measures to confront and mitigate the pandemic by decision makers and public managers.

The Appendix I summarizes the interface points of the SDGs with the mineral sector in the context of the Covid-19 pandemic, providing elements for the continuation of studies related to the theme: mining and Covid-19.

In addition to this introduction, this paper approaches in the second section the macroeconomic dimension of the Brazilian mineral sector. The third section shows the normalization of mining as an essential activity. The fourth section presents the databases and the methodology used. The fifth section discusses the results obtained. The sixth section shows the evolution of jobs. Finally, the last section concludes the paper.

2. Covid-19's impacts on the Brazilian mineral sector

The effects of the Covid-19 Pandemic were remarkable throughout the world and considerably affected the Brazilian economy in several aspects, especially those related to international trade, which in the specific case of Brazil are strongly dependent on the export of Mineral commodities. These effects can be assessed by the amount of mineral production, collection of royalties, entitled as Financial Compensation for the Exploration of Mineral Resources (CFEM), in terms of jobs supply and among others, which are useful indicators to measure the dimension of the effects of the pandemic in the economic scenario regarding mineral resources.

The Covid-19 epidemic impacted the performance of the Brazilian mineral economy by reducing the demand for exports of Brazilian ores (until April 2020), the drop in the price of ores (except for gold) together with the worsening in terms of trade, due to an increase in market volatility and a consequent increase in global risk aversion (with a strong negative reaction in the

prices of mineral assets). In addition, the reduction in the flow of people and goods as a result of social distancing policies affected both the demand side and the supply side of the mineral market.

Table 1 summarizes the drop in Brazilian mineral production in the first quarter of 2020, when it reached 220.4 million tons, which represents a 17.7% drop compared to the previous quarter and a 17.0% drop compared to the same quarter in 2019.

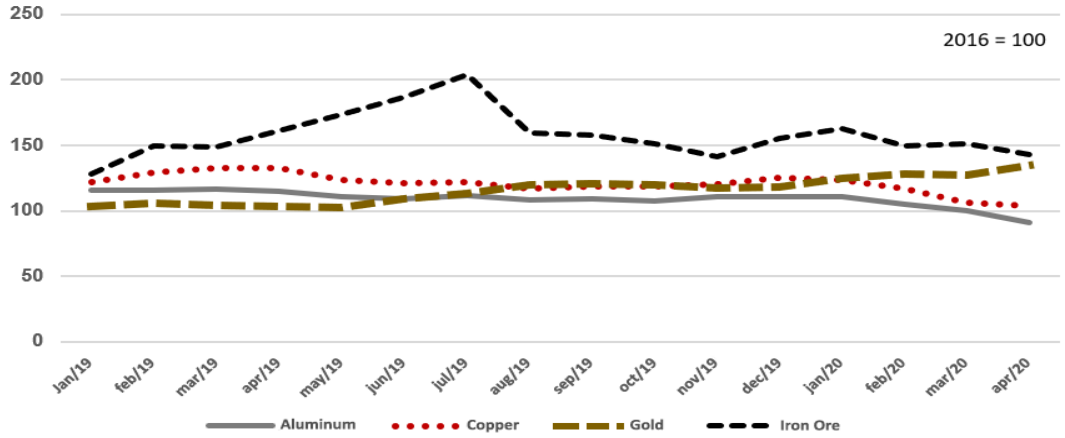
Table 1. Percentage of Brazilian Mineral Production (BMP), in millions of tons.

	1st q/19	4th q/19	1st q/20	Relative to the previous quarter (%)	Relative to the quarter of the previous year (%)
BMP (millions of tons)	265,5	267,8	220,4	-17,7	-17,0

Source: IBRAM (2020). Prepared by ECOMIN/CETEM.

This result can be explained by global and domestic factors. Graph 1 shows, in global terms, the drop in the prices of the main mineral commodities, which is associated with a lower demand for mineral goods worldwide.

Graph 1. Price of the major mineral goods exported between January (2019) and April (2020).



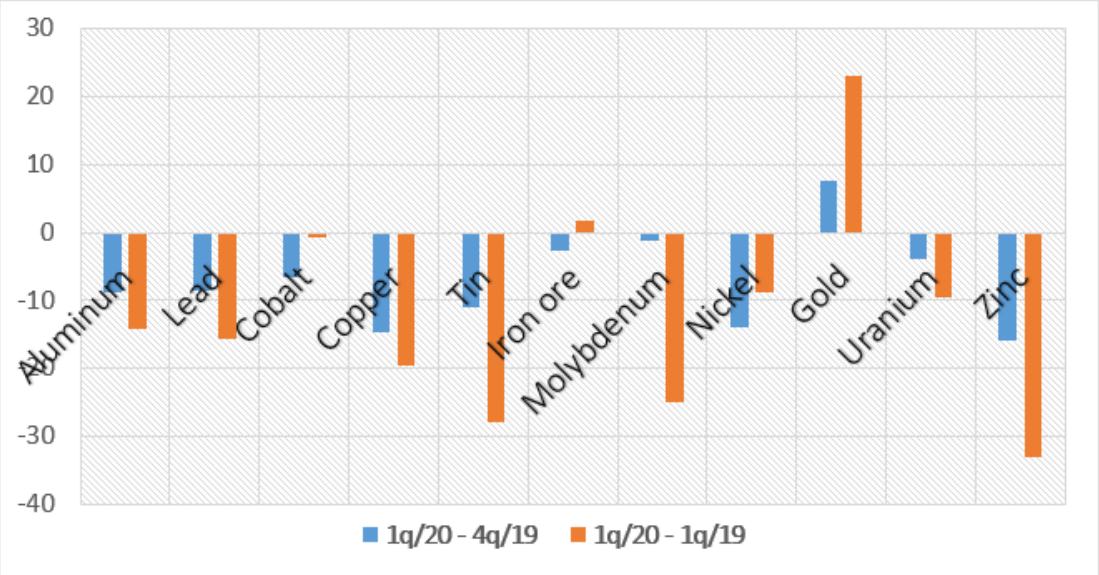
Source: IMF (2020). Prepared by ECOMIN/CETEM.

In addition, the volatility of the international economic environment, especially in regard to logistical restrictions on foreign trade, ended up impacting countries most dependent on exports of mineral commodities, such as Brazil. According to the United Nations Conference on Trade and Development (UNCTAD, 2020), the effects of the Covid-19 pandemic on the economy of emerging

countries will tend to be worse than those seen in the period following the great recession of 2008/2009.

Among the most traded mineral goods, practically all of them presented a drop in prices in the first quarter of the year (Graph 2), except for gold ore, whose growth approached 8%.

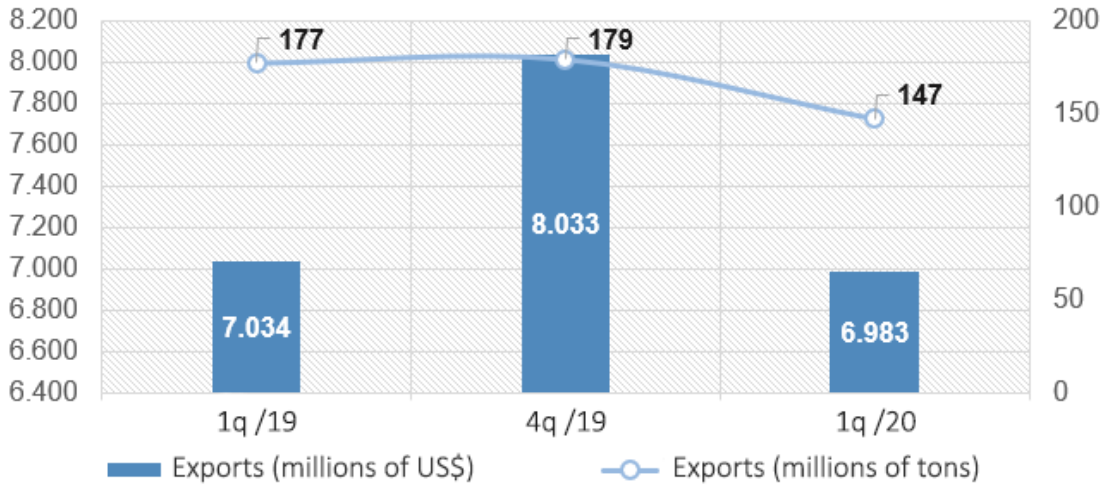
Graph 2. Price of metallic commodities (percentage change).



Source: IMF (2020). Prepared by ECOMIN/CETEM.

The reduction in mineral production in the first quarter of 2020 reflected in the volume and value decrease of mineral exports. In this sense, there is a reduction of approximately 18% in the volume exported and 13% in the value exported, when compared to the 4th quarter 2019 (Graph 3).

Graph 3. Brazilian mineral exports (value and physical production).



Source: IBRAM (2020).

Iron ore is the most exported mineral product in Brazil (ANM, 2020). In terms of production value, this mineral good ranks second in the world supply and accounts for 64.2% of mineral exports, according to FMI. In the first quarter of 2020 there was a slight drop in its value, compared to the previous quarter. This reduction caused a lower percentage of iron exports in the total value of mineral exports.

In Brazil, these exports totaled 70.07 million tons in the first quarter of 2020, which represents a decrease of approximately 17% compared to the same period in 2019. In comparison to the fourth quarter of 2019 (88.40 million tons of iron), this reduction was 21%.

In terms of the collection of royalties in Brazil, entitled CFEM (Brasil, 2017), Table 2 below shows an 18% drop in the first quarter of 2020, compared to the fourth quarter of 2019. This reduction is evidenced by the drop in prices of all major mineral substances, with the exception of gold, which grew 14.1% in the first quarter of 2020.

Table 2. CFEM collected (in millions of reais).

	1st q /2019	4th q /2019	1st q /2020	Var % 1st q 20 / 4th q 19
Iron ore	645,8	975,2	786,7	-19,3
Gold	50,4	53,6	61,1	14,1
Copper	43,2	60,9	45,0	-26,1
Aluminum (Bauxite)	30,9	38,0	31,8	-16,5
Total	876,8	1.251,3	1.023,2	-18,2

Source: IBRAM (2020).

Another important aspect of the pandemic effects is the labor market, which has been impacted worldwide by Covid-19, as the risks to worker's health are aggravated. In addition to this dynamic, informality is a major obstacle for the success of social isolation actions in developing countries (Loayza & Pennings, 2020). In the Brazilian case, there is a large contingent of workers who do not have social security benefits and other coverages that are provided to those with formal employment.

In this sense, the reorganization of the mining market will depend on the consistent resumption of demand from the main importers of mineral goods, especially Asian nations, such as China. However, health impacts can compromise the economic recovery if the spread of the virus is not controlled. In order to broaden the assessment of the impacts of the pandemic on the mining sector, the assessment should consider the definition of the activity as essential during the pandemic.

3. The regulation of mineral activities as essential

One of the first actions taken by the Brazilian government was determining which activities are considered essential, in order to sustain the economy and guarantee the means to overcome Covid-19 proliferation. The essential nature of mining activity was regulated as a consequence of the pandemic, through Law No. 13.979 of February 6th, 2020 (Brasil, 2020a) and by Decree No. 10.282 of March 20th, 2020 (Brasil, 2020b). In Article 3, paragraph 1, it was established that "essential public services and activities are those essential to meeting the urgent needs of the community, thus considered those that, if not met, endanger the survival, health or safety of the community. population, such as: [...] L [50] - mining activities, processing, production, commercialization, flow and supply of mineral goods. " (Brasil, 2020b).

The Ministry of Mines and Energy (MME) added to this regulation action with the Ordinance No. 135 of March 28th, 2020 (MME, 2020), that was the first to consider mining, processing, production, commercialization, flow and supply activities of mineral goods as essential in a broad

way. Finally, Decree No. 10.329 of April 28th, 2020 (Brasil, 2020c), maintained the decision and ratified the MME ordinance, however it did not specify which types of mining activities are essential, and which are not in this scenario.

From the regulation of this decree, the operation of extractive activity was guaranteed. However, maintaining the operation of the activity to face the health crisis raises some questions: - How will the sector be monitored in the major mining municipalities? - Which mining is effectively essential for the "survival, health or safety of the population"? - What were the consequences observed, since the regulation of the decree, and the incidence of cases in the major mining municipalities in Brazil?

The infection of the Brazilian population by Covid-19 has not been stabilized so far, as it continues to increase and is spreading throughout the wide territory. In the Brazilian mining scenario and considering the current health issues, the response of municipalities to the pandemic should be evaluated. To this end, the methodological steps and data sources used to carry out this investigation will be presented below.

4. Data sources and methodology

The qualitative methodology of this research initially involved bibliographic research to assess the economic performance and mining development of Brazil in 2020 and 2019 respectively. The major mining municipalities were selected based on mining royalties collection (CFEM) and such selection was carried out non-randomly for the states of Pará and Minas Gerais (main Brazilian mineral provinces). The next step was the definition of databases for data collection on Covid-19 cases in all municipalities for both states. In parallel, employment data were collected for the year 2019 and 2020 (January to May) in the selected mining municipalities (shown in Metadata[29] Table 3). The analysis and discussion of the preliminary results for the selected mining municipalities were based on the comparison with other municipalities in the respective states.

[29] Special thanks to the anonymous referees of RSP Journal and in particular for the inclusion of the metadata table.

Table 3. Metadata table.

Topic	Database	Data collection (Variables)	Period	Territorial dimension
CFEM (royalties)	Royalties collection system (ANM)	Royalties collected (current values)	2019 (jan.-dec.)	Selected Mining Municipalities
Covid-19	Painel Coronavírus (Ministry of Health)	Accumulated cases (number of cases)	Until 9 (July 9th, 2020)	997 municipalities from Pará and Minas Gerais state
Jobs supply	CAGED (Ministry of Economy)	Monthly variation (admissions and dismissals)	2019 (jan) – 2020 (may)	Selected Mining Municipalities
Economic Activities	Gross Domestic Product of Municipalities (IBGE)	1st and 2nd largest economic sector	2017 (lastest available)	Selected Mining Municipalities

Source: Prepared by the authors.

From the open data[30] on mining royalties in Brazil (ANM, 2019), it was observed that the states of Pará and Minas Gerais occupy the top of the municipal ranking of mineral producers in 2019 and 2020. Therefore, the selection criteria for municipalities with revenues exceeding 30 million reais (5,57 million dollars) in 2019 in these two states was adopted, which resulted in the selection of 19 municipalities, 6 of which are located in the state of Pará: Canaã dos Carajás, Curionópolis, Marabá, Oriximiná, Paragominas e Parauapebas; and 13 in the state of Minas Gerais: Belo Vale, Brumadinho, Catas Altas, Conceição do Mato Dentro, Congonhas, Itabira, Itabirito, Itatiaiuçu, Mariana, Nova Lima, Paracatu, Rio Piracicaba and São Gonçalo do Rio Abaixo.

In order to assess the economic performance of these selected mining municipalities, the Municipal Gross Domestic Product Index (Municipal PIB, IBGE) was evaluated, and for the mineral extraction sector, the open data from National Mining Agency (ANM) and the Ministry of Mines and Energy (MME) was evaluated.

Covid-19 incidence data were evaluated for all municipalities in both states. At the beginning of the pandemic in Brazil, the Ministry of Health (MS) launched the Coronavirus Panel, an online platform gathering the historical series of infections and deaths based on information

[30] CFEM collection system of the National Mining Agency (ANM, 2019).

from the State Health Secretariats. The evaluation of the methodological structure of this system was necessary to define the base data to be collected.

The Coronavirus Panel (MS, 2020) is updated daily with information disaggregated by municipality, with the beginning of the data series in February 2020. The platform presents the number of accumulated cases, new cases identified, accumulated deaths, new deaths, recovered and monitored cases. The recovered and monitored cases were incorporated in the system in May, while the number of cases and deaths were registered since the beginning of the records. Regarding new cases of Covid-19 at the municipal level, the panel reports that they do not mean the date of commencement or place of the infection.

Considering some limitations in the data related to the exact location of deaths and the revision of the incidence[31] of new occurrences, the "accumulated cases" at the municipal level was adopted as the research parameter, which was collected for all municipalities in both states, Pará and Minas Gerais, until July 9th, 2020.

The data collection of all municipalities in both states aimed to compare the mining municipalities selected in this research with other municipalities in the same population range, in order to calculate the municipal incidence rate, which corresponds to the number of cases accumulated over the local population. Then, the average number of cases by population of the other municipalities was calculated to compare the results with the selected mining municipalities.

The data collection on the evolution of job supply sought to evaluate the mineral extraction industry scenario compared with the national scenario from the General Register of Employed and Unemployed System (CAGED) which represents the main Brazilian source, with data compiled since 1986. CAGED monitors monthly the evolution of the numbers of unemployed and admissions to the various sectors of economic activities, with data disaggregated at the municipal level. The scope and methodology of data collection on employment have evolved significantly and the last change occurred between 2019 and 2020, with incorporation of information on social security from other bases.

At the municipal level, data collection can be carried out by geographical or occupational level (sector of activity); and from the total number of employees by sector at the beginning of the year, it is possible to calculate the monthly variation, in terms of admissions and dismissals. With the new methodology, the database started to evaluate not only formal hired employees, including temporary workers, independent workers and public agents. Regarding the sectors of economic

[31] More details are described on the official website under "About the Coronavirus Panel" (MS, 2020).

activities, the new system, CAGED 2020, includes more subcategories, among which the mineral extractive industries sector has been expanded.

For the collection of data in the year 2019 of the selected municipalities of Pará and Minas Gerais, the Ministry of Labor's online information system called ‘municipality profile’ (CAGED, 2019) was used. On this platform, the total number of employees in the extractive industry and the number of employees formally registered in all activities at the municipal level were collected from January to December 2019. This methodology included the Oil and Gas industries in the same category as the mineral extractive industries.

In relation to the data for the year 2020, with the new subcategories of economic activities in the new CAGED (PDET, 2020), the mineral extraction sector was separated from the oil and gas industry. This change did not affect the quality of the data analyzed, since in these states there is no oil and gas production. In order to compare data, the stock of employees in December 2019 was used as a reference for the calculation of the total and sectoral stock in January 2020. From this reference, the monthly variation in percentage could be calculated for the rest of the year 2020.. Due to the methodological recategorization for the extractive sector, which provided greater detail in the data, only the percentage variation was evaluated, disregarding the quantity of jobs in order to give consistency to the assessment of 2019 and the period from January to June 2020, according to the data available until the date of the survey.

5. Covid-19's impact on selected Brazilian mining municipalities

To evaluate the impacts of Covid-19 on mining municipalities, the tradeoff between economy and health must be considered because social isolation policies are relevant to reduce Covid-19 infections; however, they reduce the level of economic activity as explained by Ornelas (2020), because “a central message is that there is no “health vs. economics” dichotomy”.

As explained in Section 4, the criteria for selecting mining municipalities was based on those with more than 30 million reais (5,57 million dollars) of royalties collected in 2019. Therefore, the following are presented in Table 4: (i) the selected mining municipalities, (ii) the percentage of the royalties (mineral operation / collection of royalties in current dollars) and (iii) the main substances produced in each municipality.

Table 4. Largest mining municipalities in Brazil based on the collection of royalties.

Selected Municipalities	State	Collection of Mining Royalties by municipality			Main substances	
		Mineral Operation (US$)	Royalties Collected (US$)	%	1st	2nd
Parauapebas	PA	6.026.652.430,33	214.712.268,55	3,56	Iron	Manganese
Canaã dos Carajás	PA	3.813.434.296,61	131.127.376,99	3,43	Iron	Copper
Congonhas	MG	1.545.988.753,89	52.772.251,48	3,41	Iron	*
Itabira	MG	1.299.374.559,99	44.771.829,56	3,44	Iron	Emerald
Nova Lima	MG	1.013.563.064,25	36.735.370,19	3,62	Iron	Serpentinite
Conceição do Mato Dentro	MG	959.891.252,94	33.596.194,14	3,50	Iron	*
São Gonçalo do Rio Abaixo	MG	845.933.325,59	29.719.456,97	3,51	Iron	Sand
Marabá	PA	1.162.860.615,07	24.904.037,58	2,14	Copper	Manganese
Itabirito	MG	548.831.124,57	19.854.172,17	3,61	Iron	Phyllite
Mariana	MG	432.763.047,44	15.430.948,75	3,56	Iron	Steatite
Brumadinho	MG	397.426.027,82	13.487.723,57	3,39	Iron	Water
Belo Vale	MG	320.675.000,63	10.991.351,85	3,42	Iron	Manganese
Itatiaiuçu	MG	322.077.667,68	10.749.545,81	3,33	Iron	Water
Catas Altas	MG	284.813.730,85	9.972.892,70	3,50	Iron	*
Paracatu	MG	643.941.408,56	9.873.658,96	1,53	Gold	Zinc
Paragominas	PA	240.693.740,38	7.221.961,32	3,00	Bauxite	Sand
Oriximiná	PA	229.876.079,48	6.823.560,36	2,96	Bauxite	Sand
Rio Piracicaba	MG	191.355.668,87	6.799.956,16	3,55	Iron	Steatite
Curionópolis	PA	202.378.883,40	6.750.748,26	3,33	Iron	Copper

Source: ANM (2019).

From the selected mining municipalities, data collection was carried out on the number of cases of Covid-19 in the states of Pará and Minas Gerais. The following facts are observed until July 9 th, 2020, as Table 5 presents:

(i) The number of Covid-19 cases in the state of Pará was 120.731 (accumulated cases), with an average incidence rate of 1,40%, higher than the state of Minas Gerais with 66.864 accumulated cases and an average incidence rate of 0,32%;

(ii) Among the selected mining municipalities, Canaã dos Carajás is the second with the highest incidence of cases (6,20%), followed by Parauapebas in third (5.18%) and Curionópolis in fifth (4,22%), considering the total of 997 municipalities in both states;

(iii) All selected mining municipalities in Pará had a higher average incidence rate of Covid-19 cases than those selected in Minas Gerais.

Table 5. Ranking of Covid-19 cases incidence of the selected mining municipalities over the total number of municipalities – Pará and Minas Gerais.

Ranking	State	Selected mining municipality	Population	No. of cases	Average incidence rate
2nd	PA	Canaã dos Carajás	37085	2300	6,20%
3rd		Parauapebas	208273	10793	5,18%
5th		Curionópolis	17929	757	4,22%
24th		Oriximiná	73096	1469	2,01%
40th		Marabá	279349	4682	1,68%
47th		Paragominas	113145	1718	1,52%
Pará State			8602865	120731	1,40%
75th	MG	Itatiaiuçu	11146	130	1,17%
77th		Mariana	60724	697	1,15%
83th		Itabirito	51875	579	1,12%
99th		Conceição do Mato Dentro	17842	182	1,02%
138th		Brumadinho	40103	296	0,74%
148th		Itabira	120060	824	0,69%
152th		Nova Lima	94889	642	0,68%
165th		Rio Piracicaba	14339	90	0,63%
210th		São Gonçalo do Rio Abaixo	10920	53	0,49%
268th		Catas Altas	5376	20	0,37%
279th		Paracatu	93158	331	0,36%
288th		Belo Vale	7715	26	0,34%
386th		Congonhas	54762	123	0,22%
Minas Gerais State			21168791	66864	0,32%

Source: MS (2020); IBGE (2020).

A point to be highlighted in the results is that the selected mining municipalities have a higher average incidence rate for Covid-19, compared to municipalities in the same population range. One possible reason for this is the maintenance of mining activity and the consequent greater circulation of people and other related economic activities, which can increase the incidence rate of Covid-19. Table 6 below shows the ratio between the sum of accumulated cases of Covid-19 of the selected mining municipalities and the others in the same state. The average incidence ratio is greater than or equal to one, pointing that there is a higher incidence of cases of Covid-19 in these municipalities compared to other municipalities in the same population range.

Table 6. Incidence of Covid-19 ratio between the selected mining municipalities and the others by population range - Pará and Minas Gerais.

population range	Pará				Minas Gerais			
	Total Municipalities	Miner	Other municipalities	Ratio	Total Municipalities	Miner	Other municipalities	Ratio
200 to 500 K	4	3,17%	1,05%	3,01	0	-	-	-
100 to 200 K	12	1,52%	1,52%	1,00	20	0,69%	0,31%	2,19
50 to 100 K	28	2,01%	1,03%	1,95	38	0,67%	0,26%	2,53
30 to 50 K	34	6,20%	1,33%	4,66	0	-	-	-
10 to 20 K	28	4,22%	1,33%	3,18	192	0,84%	0,18%	4,60
Less than 10 K	0	-	-	-	476	0,35%	0,15%	2,28

K = 1.000 inhabitants.

Source: Prepared by the authors, adapted from MS (2020); IBGE (2020).

Another relevant point in the analysis of the results was the number of cases of Covid-19 per municipality in the same population range. These results are illustrated in Appendix II and III with further details, with the following highlights:

(i) In the state of Pará, most of the selected mining municipalities had a higher Covid-19 incidence rate than others in the same population range, with the exception of: (a) Benevides in the Oriximiná population range (from 50 to 100 thousand inhabitants) which presented 2,11%; (b) and four other municipalities in the same population range of Paragominas (from 100 to 200 thousand inhabitants)[32]: Itaituba (3,01%), Cametá (2,85%), Altamira (1,87%) and Barcarena (1,71%).

(ii) In the state of Minas Gerais, the same pattern of incidence was confirmed, that is, the selected mining municipalities had a higher incidence rate than that of the other municipalities in the same population range, with the exception of the following municipalities: (a) Coronel Fabriciano (0,83%) e Muriaé (0,99%) in the population range of 100 to 200 thousand; (b) Leopoldina (0,92%) in the population range of 50 to 100 thousand; (c) 60 municipalities in the population range 10 to 20 thousand inhabitants.

[32] For further informations: 1) The municipality of Itaituba can be considered a mining municipality (26th largest collection of CFEM - gold and tin); 2) Cametá refers to a port city, cut by a federal highway and state network; 3) Altamira is known for its small scale gold mining activities and 4) Barcarena stands out for its mineral processing industry. These details highlight the incidence of cases in mining, manufacturing or other cities that stand out for their port or road infrastructure.

Comparing the COVID-19 incidence rate between the selected municipalities and the other municipalities in the same population range, Table 7 below lists the number of municipalities that present a higher incidence of Covid-19 than the selected mining municipalities.

Table 7. Number of municipalities with a Covid-19's higher incidence rate than the selected mining municipalities - Pará and Minas Gerais.

Population Range	Pará		Minas Gerais	
	No. of municipalities[1] with higher incidence	Total of municipalities[2]	No. of municipalities[1] with higher incidence	Total of municipalities[2]
200 to 500 K	0	4	-	-
100 to 200 K	4	12	2	20
50 to 100 K	1	28	1	38
30 to 50 K	0	34	-	-
10 to 20 K	0	28	3	192
Less than 10 K	-	-	60	476

K= 1.000 inhabitants.
[1] Municipalities in the same population range (not selected).
[2] Selected mining municipalities and other municipalities.
Source: Prepared by the authors.

From the results presented in Table 6, it is observed that only 5 out of 106 municipalities in the state of Pará and 66 out of 726 municipalities in Minas Gerais had a higher incidence of Covid-19 cases than the mining municipalities selected in the respective population ranges. This fact can be further explained by other factors related to the epidemiological dynamics of Covid-19 or characteristics of the local socioeconomic dynamics.

Based on these results, there is a correlation between the maintenance of mining as an essential activity during the pandemic and the higher incidence rates of accumulated cases of Covid-19 (by population range) in the selected municipalities.

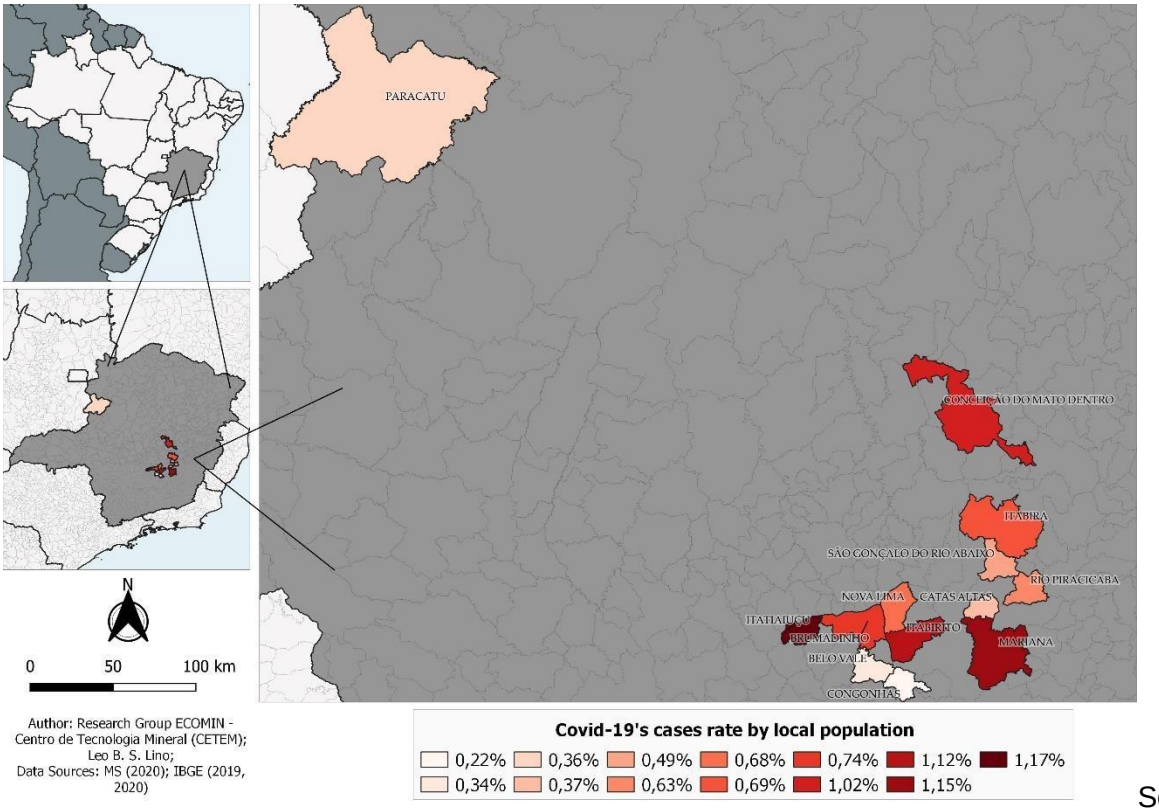
As can be seen in the previous tables, the high incidence rates in these municipalities sound a warning as to the local consequences of the definition of certain economic activities considered essential, which must be further investigated by the formulators of public policies, whether facing Covid-19 or other possible pandemics.

In addition to the presented results, two maps were drawn for each state that locate the municipalities in order to reveal the patterns of proximity and their possible relationship with the incidence of Covid-19. The following Figures 1 and 2 show the spatial distribution of the selected

mining municipalities in the state of Minas Gerais (Southeastern Brazil) and Pará (Amazon Region). The higher percentages of Covid-19 within the local population can be seen on the map by the intensity of the color.

The state of Minas Gerais has a greater concentration of mineral occurrence and the cases of Covid-19 are also higher in neighboring cities, which may be related to the maintenance of mineral activities in the southeastern region of the state (Figure 1).

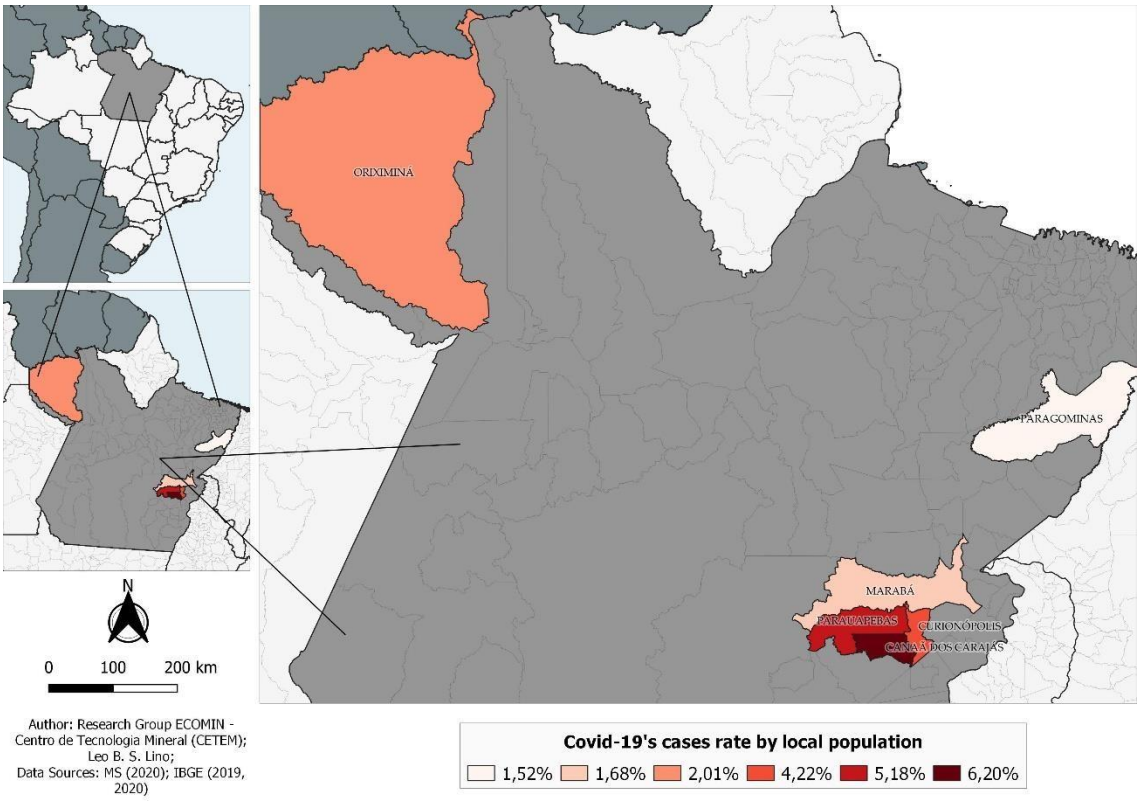
Figure 1. Covid-19 incidence map of selected mining municipalities in Minas Gerais.



Source: Prepared by ECOMIN/CETEM, adapted from MS (2020).

The state of Pará, located in the Amazon Region, presents a greater spatial dispersion of mining municipalities, although there is also a concentration of mineral occurrence in some municipalities. However, Covid-19 incidence rates are much higher than in Minas Gerais, which can be explained by locational factors related to the greater dispersion of the population in the Amazon Region and the lack of or precariousness of health services. These reasons explain the different spatial pattern, where high rates of Covid-19 incidence occur in remote areas but with intense activity in the mineral extraction sector.

Figure 2. Covid-19 incidence map of selected mining municipalities in Pará.



Source: Prepared by ECOMIN/CETEM, adapted from MS (2020).

The next section presents the variation in total municipal formal employment and in the mining industry.

6. The evolution of jobs in selected mining municipalities

In order to broaden the analysis of the employment evolution of the selected mining municipalities, it is necessary to assess the main economic activities (shown in Table 8) based on the Municipal Gross Added Value (VAB), a component of the municipal Gross Domestic Product Index.

Table 8. Major economic activities of the selected mining municipalities.

Selected Mining Municipalities		First Economic Activity	Second Economic Activity
Pará (PA)	Canaã dos Carajás	Extractive industries	Construction
	Curionópolis	Extractive industries	Other services
	Marabá	Other services	Extractive industries
	Oriximiná	Extractive industries	Other services
	Paragominas	Other services	Extractive industries
	Parauapebas	Extractive industries	Other services
Minas Gerais (MG)	Belo Vale	Public administration	Other services
	Brumadinho	Extractive industries	Other services
	Catas Altas	Extractive industries	Other services
	Conceição do Mato Dentro	Extractive industries	Other services
	Congonhas	Extractive industries	Other services
	Itabira	Extractive industries	Other services
	Itabirito	Extractive industries	Other services
	Itatiaiuçu	Extractive industries	Other services
	Mariana	Extractive industries	Other services
	Nova Lima	Extractive industries	Other services
	Paracatu	Other services	Extractive industries
	Rio Piracicaba	Extractive industries	Other services
	São Gonçalo do Rio Abaixo	Extractive industries	Other services

Source: IBGE (2017).

Based on the assessment of major economic activities, it is pertinent to assess the size of the labor market and the evolution of formal jobs in the selected mining municipalities. It was noted that between 2019 (January to December), the variation in the number of jobs showed high growth rates in the municipalities evaluated, both in total and in relation to jobs in the mining industry.

In 2019, among the 19 municipalities 8 showed a significant increase (above 7%) in the total supply of formal jobs and 6 of them obtained a moderate increase (between 3,5 and 7%). In the mineral extraction industry, 8 municipalities presented a significant increase (above 7%) in the jobs offer in the sector and two municipalities had a moderate increase (between 3,5 and 7%). Only Conceição de Mato Dentro had a significant reduction in the number of jobs (-10,3%), while 2 municipalities, Paracatu (-6,41%) and Curionópolis (-3,84%) showed a moderate reduction. Regarding the reduction of jobs in the mineral extraction sector, only Curionópolis (-16,63%) had a significant reduction, which was compatible with the total variation of jobs in the municipality,

while Brumadinho (-4,38%) had a moderate reduction inversely proportional to the total variation in formal jobs.

Between January and May 2020, there was a notable change in the outlook observed in 2019, since 8 of the 19 municipalities evaluated presented a reduction in the total number of jobs, among which Oriximiná had a significant reduction (-8,42%) and São Gonçalo do Rio Abaixo had a moderate reduction (-5,58%).

As shown in table 9, in relation to the municipalities that increased their jobs supply, there was a slight increase (less than 3,5%), except for 4 municipalities that presented a significant increase: Conceição de Mato Dentro (12,44%), Itabirito (8,03%), Itatiaiuçu (8,23%) and Paracatu (12,68%). For the mineral extraction sector there is also less significant variation, as only Marabá (-5,98%) presented a moderate reduction in jobs in the sector and 2 municipalities, Itatiaiuçu (4,52%) and Curionópolis (4,02%) had a moderate increase in jobs in the sector.

Table 9. Variation of formal jobs in the largest mining municipalities of PA and MG, according to CAGED, from 2019 to 2020.

Selected Municipalities	2019			2020		
	Pop.in formal jobs (%)	Total jobs Variation (Jan-Dec) (%)	Extractive sector jobs variation (Jan-Dec) (%)	Pop.in formal jobs (%)	Total jobs Variation (Jan-Dec) (%)	Extractive sector jobs variation (Jan-Dec) (%)
Parauapebas (PA)	20,68	14,58	1,35	22,27	2,48	0,63
Canaã dos Carajás (PA)	29,91	13,16	13,42	30,09	0,16	1,23
Congonhas (MG)	26,56	0,03	9,53	28,11	2,69	-1,26
Itabira (MG)	21,30	7,17	0,00	20,70	-0,36	0,50
Nova Lima (MG)	56,11	11,88	6,73	51,80	-3,08	1,65
Conceição do Mato Dentro (MG)	25,33	-10,30	7,65	29,23	12,44	0,69
São Gonçalo do Rio Abaixo (MG)	36,01	3,69	0,00	36,40	-5,58	-1,56
Marabá (PA)	13,72	6,69	10,93	13,63	-1,05	-5,98
Itabirito (MG)	23,21	6,98	3,24	24,87	8,03	0,24
Mariana (MG)	23,27	15,16	2,75	25,36	6,75	0,20
Brumadinho (MG)	21,03	6,59	-4,38	21,88	0,69	-1,97
Belo Vale (MG)	8,11	12,19	18,79	8,04	0,32	1,01
Itatiaiuçu (MG)	25,67	9,53	9,99	27,72	8,23	4,52
Catas Altas (MG)	12,33	5,91	5,59	13,02	2,34	-2,72
Paracatu (MG)	20,12	-6,41	-1,23	24,99	12,68	-1,75
Paragominas (PA)	14,06	2,85	12,96	13,59	-1,54	0,32
Oriximiná (PA)	6,95	9,77	9,53	6,24	-8,42	-1,76
Rio Piracicaba (MG)	12,94	2,04	-1,57	13,01	-0,27	1,40
Curionópolis (PA)	16,75	-3,84	-16,63	14,84	-2,10	4,02

Source: CAGED (2019); PDET (2020).

Based on the evolution of formal jobs presented in table 9, it was found that 2019 was a year of growth in the jobs supply in the mineral extractive sector, while 2020 showed significant fluctuations in the variation of total formal jobs and a less pronounced variation in the extractive sector, which indicates that the extractive sector remained stable in relation to the previous year.

7. Conclusions

This paper discussed the interaction between mining and the accumulated cases of the new coronavirus in the population of the major mining municipalities in Brazil, after being considered an essential activity to face Covid-19 challenge in the country. The analysis and discussion of the results showed that:

(i) Between 997 municipalities in Pará and Minas Gerais, a higher degree of Covid-19 cases incidence was relatively greater in the selected mining municipalities.

(ii) There is a higher ratio of Covid-19 cases in the selected mining municipalities than in the other cities in the same population range in Pará and Minas Gerais states;

(iii) The jobs supply in the mining sector from the selected mining municipalities remained stable compared to the period before the pandemic, which in some cases was inversely proportional to total formal jobs in the selected municipality. This could indicate that employees were maintained in the mining sector during the pandemic.

Among the aspects described in the present paper, it is signaled that there is a link, although not yet fully established, between the risks of infection and the maintenance of economic activities, which, in the case of mining, can be better observed by monitoring the situation in mining municipalities compared to other municipalities in the same region. This paper analyzed the selected major mining municipalities and the other municipalities in the same state by population range. In order to broaden this analysis, it is important to extend this scope to other dimensions besides population range.

The results warn that mining activity, although essential and fundamental for people's livelihood and for the economy to function, is carried out within the parameters of people's integrity and quality of life, aimed at long-term local sustainability to overcome the pandemic. Continuation of this research may offer recommendations for decision-making by public agents and local governments.

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9. Appendix

Appendix I. The SDG's possible actions for the Brazilian mineral sector during the pandemic.

SDG goals whose achievement is directly affected by the Covid-19 pandemic	
SDG 1	The pandemic undermines equitable access to employment, the provision of training programs, the directing of royalties (CFEM) towards sustainable development and other consequences that affect local labor. The mineral sector should provide subsidies for the subsistence of local workers involved in mining operations that were affected by the pandemic.
SDG 2	The loss of jobs and income has a side effect of worsening food security, if unaccompanied by another source of income in economic activities that were paralyzed by Pandemic. In this sense, the action of emergency public policies is essential to mitigate the effects of the crisis.
SDG 3	While it is necessary to establish that some economic activities are essential for the maintenance of the economy and the livelihood of the population, aspects of the health risks of workers must also be considered, which must be evaluated in the context of economic activities that need to remain active,

since they expose workers to risks of contamination, such as what is happening in mining and other activities that are in operation.

SDG 8	Pandemic effects on the mining-related labor market are twofold. The first is directly related to the health risk of workers and the loss of hours worked due to illness in mining municipalities. The other way is related to the demand for mineral goods, which is being affected by the generalized drop in national and global economic activity, which has negative effects on the labor market for a product subject to volatility in the international commodities market. The guarantee of health to workers and actions to promote essential jobs are vital for the economic recovery after the pandemic.
SDG goals indirectly affected by the Covid-19 pandemic	
SDG 9	Pandemic coping measures will certainly need an input of knowledge and production planning with technological improvements, not only in the safety and health of workers, but also in the choice and prioritization of the production of mineral goods that will be necessary for the recovery of economic activity, in the context of the new normality that is taking shape.
SDG 10	The worsening inequality and the higher social cost of Pandemic has caused approximately 71 million people to return to extreme poverty in 2020, the first increase in global poverty since 1998 (UN, 2020). Loss of income, limited social protection and rising prices mean that even those who were safe can be at risk of facing poverty and hunger. Public policies to reduce inequalities, focused on the areas where mining is developed, must prioritize the internalization of the benefits of this economic activity. The more efficient use of royalties can be an instrument to reduce inequalities in the context of vulnerable population groups and disadvantaged regions.
SDG 12	The pandemic unequivocally revealed several weaknesses in the current economic model. The closing of borders, the availability of goods and confinement have caused a change in habits around the world. Some of these changes have accelerated new and emerging sectors that support responsible consumption, which, together with alternative forms of work, study and consumption, can reach a level that allows a leap towards sustainability. Some recovery alternatives for the post-pandemic period should be based on new sustainability paradigms, such as investments to encourage circularity, an inclusive approach aimed at sustainable consumption and the alignment of public and private finances with resilient and sustainable societies. This moment represents an opportunity to meet this demand by stimulating renewable energy, smart buildings and cities, green public transport, local sustainable food and agricultural systems as well as alternative lifestyle options. All of these are related to the sustainable

use of mineral resources, especially with regard to their rational use, the technology applied and the search for new materials for emerging technologies, among others.

SDG 16

To confront the Pandemic, mining companies, especially the largest ones, can help by contributing to peaceful societies by remedying company-community conflicts, providing access to information, respecting human rights, supporting representatives in decision-making and carefully managing their security approach to ensure a decrease in Covid-19 cases. The health care of workers in the mineral activity and, consequently, in the mining municipalities, depends on mechanisms of transparency and information sharing about the real effects of activities that impact society, as well as the public discussion of the prevention of the risks assumed by the continuity of activities. It is necessary to ensure transparency in the use of revenues related to local commitments.

Source: Adapted from UNDP (2017); UN (2020).

Appendix II. Covid-19 cases between the largest mining municipalities in the state of Pará and the other municipalities by population range.

			Pará					
Population range	Mining municipalities	No. of Cases	Population	Covid-19 / Pop. (%)	Other municipalities	No. of Cases	Population	Covid-19 / Pop. (%)
200 to 500 k inhabitants	Marabá	4682	279349	1,68%	Castanhal	1659	200793	0,83%
	Parauapebas	10793	208273	5,18%	Santarém	3664	304589	1,20%
average				**3,17%**				**1,05%**
					Abaetetuba	2378	157698	1,51%
					Altamira	2145	114594	1,87%
					Barcarena	2134	124680	1,71%
					Bragança	1842	127686	1,44%
					Breves	1376	102701	1,34%
100 A 200 k inhabitants	Paragominas	1718	113145	1,518%	Cametá	3925	137890	2,85%
					Itaituba	3052	101247	3,01%
					Marituba	687	131521	0,52%
					São Félix do Xingu	681	128481	0,53%
					Tailândia	1107	106339	1,04%
					Tucuruí	1206	113659	1,06%
average				**1,518%**				**1,52%**
					Acará	492	55591	0,89%
					Alenquer	634	56789	1,12%
					Benevides	1321	62737	2,11%
					Breu Branco	216	66046	0,33%
50 to 100 k inhabitants	Oriximiná	1469	73096	2,01%	Capanema	887	69027	1,29%
					Capitão Poço	519	54303	0,96%
					Dom Eliseu	635	59719	1,06%
					Igarapé-Miri	1043	62698	1,66%
					Ipixuna do Pará	417	64053	0,65%

					Itupiranga	242	53269	0,45%
					Jacundá	536	59155	0,91%
					Juruti	765	57943	1,32%
					Moju	1169	82094	1,42%
					Monte Alegre	666	58032	1,15%
					Novo Repartimento	197	75919	0,26%
					Óbidos	381	52137	0,73%
					Portel	832	62043	1,34%
					Redenção	1590	84787	1,88%
					Rondon do Pará	210	52357	0,40%
					Rurópolis	503	50510	1,00%
					Santa Izabel do Pará	463	70801	0,65%
					Santana do Araguaia	174	72817	0,24%
					São Miguel do Guamá	1028	58986	1,74%
					Tomé-Açu	703	63447	1,11%
					Ulianópolis	519	59210	0,88%
					Vigia	255	53686	0,47%
					Viseu	934	61403	1,52%
average				**2,01%**				**1,03%**
30 to 50 k inhabitants	Canaã dos Carajás	2300	37085	6,20%	33 municipalities	16110	1211736	1,33%
average				**6,20%**				**1,33%**
10 to 20 k inhabitants	Curionópolis	757	17929	4,22%	27 municipalities	5441	409883	1,33%
average				**4,22%**				**1,33%**

Source: MS (2020); IBGE (2020).

Appendix III. Covid-19 cases between the largest mining municipalities in the state of Minas Gerais and the other municipalities by population range.

Minas Gerais

Population range	Mining municipalities	No. of Cases	Population	Covid-19 / Pop. (%)	Other municipalities	No. of Cases	Population	Covid-19 / Pop. (%)
					Araguari	750	117267	0,64%
					Araxá	283	106229	0,27%
					Barbacena	396	137313	0,29%
					Conselheiro Lafaiete	175	128589	0,14%
					Coronel Fabriciano	913	109855	0,83%
100 to 200 k inhabitants	Itabira	824	120060	0,69%	Ibirité	386	180204	0,21%
					Ituiutaba	123	104671	0,12%
					Lavras	148	103773	0,14%
					Muriaé	1081	108763	0,99%
					Nova Serrana	120	102693	0,12%
					Passos	84	114679	0,07%
					Patos de Minas	674	152488	0,44%

					Poços de Caldas	255	167397	0,15%
					Pouso Alegre	419	150737	0,28%
					Sabará	351	136344	0,26%
					Teófilo Otoni	890	140592	0,63%
					Ubá	177	115552	0,15%
					Varginha	194	135558	0,14%
					Vespasiano	246	127601	0,19%
Average				**0,69%**				**0,31%**
					Alfenas	74	79996	0,09%
					Bom Despacho	95	50605	0,19%
	Brumadinho	296	40103	0,74%	Campo Belo	202	54029	0,37%
					Caratinga	403	92062	0,44%
					Cataguases	130	75123	0,17%
					Curvelo	184	80129	0,23%
					Esmeraldas	121	70552	0,17%
	Congonhas	123	54762	0,22%	Formiga	222	67683	0,33%
					Frutal	147	59496	0,25%
					Guaxupé	129	51917	0,25%
					Itajubá	114	96869	0,12%
					Itaúna	134	93214	0,14%
	Itabirito	579	51875	1,12%	Janaúba	263	71648	0,37%
					Januária	19	67742	0,03%
					João Monlevade	343	79910	0,43%
					Lagoa da Prata	283	52165	0,54%
					Lagoa Santa	108	64527	0,17%
50 to 100 k inhabitants	Mariana	697	60724	1,15%	Leopoldina	483	52587	0,92%
					Manhuaçu	285	90229	0,32%
					Ouro Preto	192	74281	0,26%
					Pará de Minas	78	93969	0,08%
					Patrocínio	232	90757	0,26%
					Pedro Leopoldo	123	64258	0,19%
	Nova Lima	642	94889	0,68%	Pirapora	114	56428	0,20%
					Ponte Nova	175	59742	0,29%
					São Francisco	37	56323	0,07%
					São João del Rei	269	90082	0,30%
					São Sebastião do Paraíso	60	70956	0,08%
					Timóteo	428	89842	0,48%
	Paracatu	331	93158	0,36%	Três Corações	181	79482	0,23%
					Três Pontas	66	56746	0,12%
					Unaí	562	84378	0,67%
					Viçosa	74	78846	0,09%
Average				**0,67%**				**0,26%**
	Conceição do Mato Dentro	182	17842	1,02%				
10 to 20 k inhabitants	São Gonçalo do Rio Abaixo	53	10920	0,49%	188 municipalities	3872	2514333	0,15%
	Itatiaiuçu	130	11146	1,17%				
	Rio Piracicaba	90	14339	0,63%				
Average				**0,35%**				**0,15%**

Less than 10 K inhabitants	Belo Vale	26	7715	0,34%	474 municipalities	3872	2514333	0,15%
	Catas Altas	20	5376	0,37%				
Average				**0,35%**				**0,15%**

Source: MS (2020); IBGE (2020).

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Is Democracy Really the Best Medicine? - How different regimes react to pandemics[4]

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Pandemics are nothing new to humans. From the Plague of Justinian to the current Covid-19, the world has seen all sorts of contagious diseases. But do different political regimes react differently? We argue that the political regime has no major influence. More specifically: democratic and autocratic regimes have similar performances in taking action to combat the disease. The reasoning for this, however, vary. We do believe that the volatility is higher within the authoritarian group. To test this hypothesis, we will conduct a survival analysis, having the adoption of a strict social isolation policy as the event of interest. We will control for institutional variables, such as the presence of local governments; and for other social variables, such as population density. We will also take in consideration previous experience with SARS. Our findings corroborate our hypothesis. The difference between the two types of regime is not statistically significant. The economy, however, seems to play small role: The wealthier the country is, the longer it takes to adopt restriction measures.

Keywords: pandemics, democracy, dictatorship.

A democracia é realmente o melhor remédio? Como regimes diferentes reagem à pandemia

Pandemias não são novidades para a raça humana. Da praga de Justiniano à atual Covid-19, o mundo viu todo tipo de doenças contagiosas. Mas diferentes regimes políticos reagem de maneira diferente? Nós argumentamos que regimes políticos não têm grande influência. Mais especificamente: regimes democráticos e autocráticos possuem performance similar no que diz respeito às ações de combate à doença. O raciocínio para isso, no entanto, varia. Para testar a nossa hipótese, nos conduzimos uma análise de sobrevivência, tendo a adoção de medidas restritivas de isolamento social como variável de interesse. Controlaremos por variáveis institucionais, como a presença de governos locais; e por outras variáveis sociais, como

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densidade populacional. Também levaremos em consideração a experiência anterior com a Sars. Nossos resultados corroboram nossa hipótese. A diferença entre regimes não é estatisticamente significante. A economia, no entanto, parece desempenhar um pequeno papel: quanto mais rico o país é, mais tempo ele toma para adotar medidas de restrição.

Palavras-chave: pandemia, democracia, ditadura.

¿Es la democracia realmente la mejor medicina? Cómo reaccionan los diferentes regímenes ante la pandemia

Las pandemias no son nada nuevo para la raza humana. Desde la plaga de Justiniano hasta el actual Covid-19, el mundo ha visto todo tipo de enfermedades contagiosas. ¿Pero los diferentes regímenes políticos reaccionan de manera diferente? Argumentamos que el régimen político no tiene una influencia importante. Más específicamente: los regímenes democráticos y autocráticos tienen desempeños similares al tomar medidas para combatir la enfermedad. El razonamiento para esto, sin embargo, varía. Creemos que la volatilidad es mayor dentro del grupo autoritario. Para probar estas hipótesis, llevaremos a cabo un análisis de supervivencia, teniendo la adopción de una política estricta de aislamiento social como evento de interés. Controlaremos las variables institucionales, como la presencia de gobiernos locales; y para otras variables sociales, como la densidad de población. También tendremos en cuenta la experiencia previa con Sars. Nuestros hallazgos corroboran nuestra hipótesis. La diferencia entre los dos tipos de régimen no es estadísticamente significativa. Sin embargo, la economía parece desempeñar un papel pequeño: cuanto más rico es el país, más tiempo lleva adoptar medidas de restricción.

Palabras clave: pandemia, democracia, dictadura.

Introduction

Are democratic governments more prone to react to pandemics accordingly? The traditional literature points to a positive response, mainly based on two theories: (1) that democratic leaders are more sensitive to the public opinion; and (2) that democratic countries are in average wealthier than authoritarian ones. So, with the outbreak of the novel coronavirus – the Covid-19 – that took the world by surprise in the turning of the year 2019 to 2020, should we expect democracy to have a better performance than dictatorships?

When considering the influence of public opinion and continuous threat of the next election cycle, a lack of action may be considered a death sentence to incumbents all over the democratic world. Having the means to combat the illness, we expect democratic leaders to have more energetic attitudes towards combating the pandemic.

We agree with the "response-to-the-public" hypothesis for democracies. Our disagreement is with the reasoning regarding authoritarian governments. We do not believe that authoritarian countries will, necessarily, have a bad performance. They may lack the electoral incentive, but their path to action is free, with few-to-none veto players. They can establish unpopular policies such as a complete lockdown.

Considering the above, we believe that performance is not significantly different in the democratic and authoritarian worlds. The difference is in the reasoning behind their reaction. While democratic leaders act to surpass opponents to get the policies approved (in order to gather public support for the next election); authoritarian leaders are not necessarily very keen in helping their citizens, but they do it anyway because the political costs are very low.

It is important to present upfront a shortcoming of our research design. Given that the Covid-19 is still ongoing and given its wave-like movement through regions of the world, the data will likely be biased. Our effort analyzes the relationship between political regimes and the pandemics response considering the numbers consolidated in June 30th, 2020.

This paper is divided in the following sections: first we will present the debate over the benefits of certain regime types and what the explanations for them are; next, we will present a descriptive analyze of the pandemic; then we will present the data and detailed design of our survival model; and in the following section we will present the results. In the conclusion, we point to a research agenda that can be drawn from our findings.

Social Distancing as an Effective Measure

It has been seven months since the Wuhan Municipal Health Commission reported cases of viral pneumonia in 27 patients, where in 7 of these cases there was a considerable worsening (CHENG & SHAN, 2020). There are now 19,000,000 people infected around the world and more than 700,000 dead[33]. In early March 2020, the World Health Organization (WHO) declared that Covid-19 should be characterized as a pandemic[34]. Since then, several study groups and pharmaceutical companies have been deployed to find a remedy that can combat Covid-19. A race in search of a vaccine that can prevent the novel coronavirus from being contracting has already been tested in at least 21 humans[35].

But, until we neither find the cure for Covid-19 nor an effective vaccine is developed, what to do to prevent it? Although studies are running faster than have been seen before to try to identify the best way to deal with this virus, there is still no verdict on what the fully effective measure against it is. However, previous experience with epidemics and pandemics of infections with influenza viruses allow us to direct a common path for governments to respond to this type of problem (GLASS et al, 2006; Fong et al, 2020). In this sense, agencies such as WHO and the Center for Disease Control and Prevention (CDC) suggest three main actions: recommending the use of masks, conducting mass testing, and practicing social isolation. Similar actions were taken during the Spanish flu pandemic, for example (MARKEL et al, 2008).

Conventional wisdom suggests that infections by the influenza virus are transmitted mainly by close contact and, in this sense, social isolation measures aim to decrease the level of contact and, consequently, the risk of virus transmission (FONG et al, 2020). This is an action that has been taken for a long time, and used as an important tool in combating past epidemics, such as the Spanish flu (YU et al, 2017). In the novel coronavirus pandemic, although still to a limited extent, empirical evidence suggests that of such measures, social isolation is the most effective in preventing the spread of the disease (MAHTANI et al, 2020).

Evidence from the United Kingdom shows that social distance measures imposed by the government reduced the growth rate of infections by 5% after five days of adoption, with the number increasing to 6.8% from the sixth to the fifteenth day of social distancing and 9% up to 20 days of adoption (COURTEMANCHE et al, 2020). Using daily data on cases of novel coronavirus infections and synthetic control techniques, Friedson et al (2020) assess the impact of the Shelter-in-Place Order (SIPO) of the North American state of California on the number of infected

[33] Data available at Worldometers. Accessed in August 5th 2020, 20h50 (GTM+3). For more information, see: https://www.worldometers.info/coronavirus/
[34] https://www.who.int/news-room/detail/29-06-2020-covidtimeline
[35] Watanabe (2020).

individuals and identifies a decrease from 125.5 to 219.7 per 100,000 inhabitants, after a month of movement restriction. Evidence for SIPO adopted in 40 states and the District of Columbia shows that after three weeks of compliance with the order, cases of infection with Covid-19 have dropped by 44% (DAVE et al, 2020).

Despite this, the adoption of social distance policies is not trivial. The implementation of this kind of action generates costs for the government. The response to the crisis is mediated by voter concerns about this type of restriction, ranging from safety in the workplace to the economic pressure it would generate on families (BAUM et al, 2009). In the Covid-19 pandemic, in particular, we are experiencing some politicization. The denial of government officials, including Bolsonaro, Trump, and Daniel Ortega, ended up leading the population to a polarization regarding the Covid-19 threat. Public opinion surveys demonstrate party polarization regarding these restrictions (BADGER & QUEALY, 2020; ALLCOTT et al, 2020). Besides, empirical evidence for the adoption of social distance measures for US states shows that those where the number of supporters of President Donald Trump was higher took longer to adopt policies of social isolation (ADOLPH et al, 2020).

Thus, it is reasonable to think that in the Covid-19 pandemic, government officials have incentives and, consequently, different actions to deal with the spread of the novel coronavirus. It is in this framework that our work is inserted. More specifically, we seek to understand whether differences between political regimes generate different actions to contain the pandemic. The next section discusses this.

Types of Regime and their outputs

The global intuition regarding autocracies and democracies is that the latter will deliver the best social outcomes to its citizens (PRZEWORSKI ET AL., 2000; BOIX, 2003; BUENO DE MESQUITA ET AL., 2003; ACEMOGLU & ROBINSON, 2006). As stated by Sen (1999), no famine took place in a democratic country in the 20th century. The literature has also shown that democracy walks hand-in-hand with wealth (PRZEWORSKI & LIMONGI, 1997) and does instigate economic growth (ACEMOGLU ET AL., 2019). Finally, social spending seems to be higher in democracies (MELTZER & RICHARDS, 1981; KAUFMAN & SEGURA-UBIERGO, 2001; AVELINO, BROWN & HUNTER, 2005), meaning a thicker channel of public investment in health care.

The impact that the democratic regime has on health has also been studied. Ruger (2005) stated that citizens should act as agents of change and that the state's action should be evaluated "in terms of their effectiveness in expanding individual freedom" (RUGER, 2005, p. 300). Looking

specifically to China, the author goes on to argue that the country failed respond promptly to the 2003 Severe Acute Respiratory Syndrome (SARS) crisis and that the government's control of the media had a harmful effect in controlling the virus[36].

Control of the media is one of the most cited problems when dealing with authoritarian regimes (EGOROV, GURIEV & SONIN, 2009). But lack of a free press is not the only negative effect of an autocracy. Just to survive, authoritarian regimes resort to repression and co-optation (FRANTZ, 2018). This entails a series of behavior that can diminish civil liberties (DAHL, 1971). The consequences of having an authoritarian regime is also listed in the literature. They are more prone to practice torture and infringe human rights (VREELAND, 2008); they do not protect property rights (KNUSTEN, 2011); and their provision for safe water, sanitation and education are low (DEACON, 2009).

Examples of harmful dictatorships are abundant and come from all over the world: Latin America (STEPAN, 1991; COSTABLE & VALENZUELA, 1993; MAINWARING & PÉREZ-LIÑAN, 2013; GASPARI, 2015); to Europe (LINZ & STEPAN, 1996; LEE, 2016); Africa (DECALO, 1985; NEGA & SCHNEIDER, 2012), and the Arab world (EL BADAWI & MAKDISI, 2007; PIAZZA, 2007). In a nutshell: institutions seem to matter. And a river of ink has already been written on the democratic bonanza and the dictatorial hardship.

The democratic siren song

When considering everything that have been said so far, we should not expect anything different when dealing with a pandemic. However, we argue to the contrary. Despite the different reasoning, our hypothesis is that the response from democracies and autocracies are not that different, at least when considering the final outcome: the adoption of social distancing policies.

When considering the above paragraphs, it is easy the reconcile the political science literature with the argument that democracies are more prone to have a better performance than dictatorships. Here we present two major reasons more clearly:

(1) In democratic regimes, politicians are always seeking the electors' approval. To have a real chance in maintaining the job comes next election, political leaders must take action to keep the loss of life to a minimum;

(2) And democracies, in average, are more economically developed than dictatorships.

[36] The consequences of government control of the media go beyond press freedom. It is directly associated with the functioning of political and economic markets, for example. See: Djankov et al. (2001).

The above reasons are very fair, and we expect that it explains the core of democratic response of pandemics[37]. But it is not sufficient to back the hypothesis that democracies outperform autocracies[38]. Authoritarian leaders have two institutional advantages to democratic ones. First, they are not concerned with the next electoral cycle. As Pulejo and Querubin (2020) demonstrate, countries that have close elections or whose leader can run for reelection implement milder forms of lockdown. In an autocracy, if there is an electoral schedule, it is most likely that the result is rigged in the incumbent's favor. Second, dictators do not have to deal with a strong opposition (or, sometimes, even with other branches of government). Dictators are freed from the burden of democracy. Due to this, Frey et al. (2020a) found evidence that autocracies impose stronger lockdowns, and that same levels of lockdown's stringency are associated with less social mobility in autocracies compared with democracies (FREY et al., 2020b).

Although presenting different mechanisms, a few authors have already shown that democracies and dictatorships are not so different in relevant political and economic issues. Gandhi (2008) have shown that dictatorial institutions do not have a significant impact over social spending. Gallagher and Hanson (2009) argue that the level of income inequality is not so different across political regimes.

However, we do recognize that the variation on the dependent variable should be higher than in democracies. As stated by Vreeland (2008), different features within the dictatorship group could lead to different outcomes in specific areas[39]. The institutional diversity of dictatorships is a problem that any research on the subject faces (SVOLIK, 2012). The reason is the following: as we take the minimum feature of democracy (election) as the main incentive politicians have to be at their best behavior, this should work on every level of democracy. Dictatorships, on the other hand, come in very different flavors. The base of political sustentation may vary from family and top military officials to the whole economic elite.

We still believe that institutions do matter. However, our argument is one of a more nuanced difference. Different institutions can put countries in different paths but lead to the same outcome.

One important counterargument is also anchored in the effect of elections. Politicians not only wants to gather as much support as possible. They want to do it with as little cost as possible.

[37] Here we are only concerned with the institutional incentives. Moral responses are not considered.
[38] The argument is not all new. Gandhi (2008) had already shown that dictatorial institutions have no significant impact over press freedom or social spending.
[39] Vreeland's (2008) work deals with human rights. More specifically, how dictatorships that practices torture are more likely to be part of the UN Convention Against Torture that dictatorships that do not practice torture.

And given the amnesia that voters seem to have (ACHEN & BARTELS, 2016), the risk of leaders sub-funding response to the pandemic is an ever-present threat.

Data and methods[40]

Methodologically, we have two steps. First, we will conduct a Kaplan-Meier analysis to see the difference of the survival probabilities for each political regime. This is especially relevant given our main hypothesis: there is no difference on how the two political regimes react. Then we will conduct a Cox Proportional Hazard (PH) model, with the adoption of restrictive policy as the event of interest.

Unlike the Kaplan-Meier and other non-parametric estimators, the Cox PH model allows for independent variables in a regression (ALLISON, 1984). It can be symbolized by the following equation:

$$\log h(t) = a(t) + b_1 x_1 + b_2 x_2$$

The Cox model presents the log of the hazard function for time *t*. And as the Cox model does not assume any distribution for the baseline function, a(t) can be a function for any specific time. In addition to this benefit, in the Cox analysis the estimator depends only "on the ranks of the event times, not their numerical value" (GUO, 2010, p. 74). That means that any monotonic transformation will leave the coefficient unchanged[41].

The data covers the period from January 11th – when the first death was registered in China – until June 30, the last month with consolidated data. This adds up to a total of 172 days. All countries enter the dataset when they register their first death and thus becomes in 'risk' of adopting social distancing policies. Cases that are left-censored, i.e., adopted such measures even before registering a death in national soil, will be excluded.

The strict social distancing policy variable

We used the University of Oxford's database for confirmed cases of Covid-19 (ROSER et al., 2020) to identify the first confirmed death of this pandemic. It happened in January 11th, China. This is the day one of our analysis. The last day, June 30, is the 172nd day. A country is only introduced in the analysis when its first case is confirmed, and this is our "start" variable. For

[40] The R script for our analysis is available at: https://osf.io/p9x2k/.
[41] The Cox model has one more appealing feature: it can work with time-varying variables. However, we did not use such variables in our model.

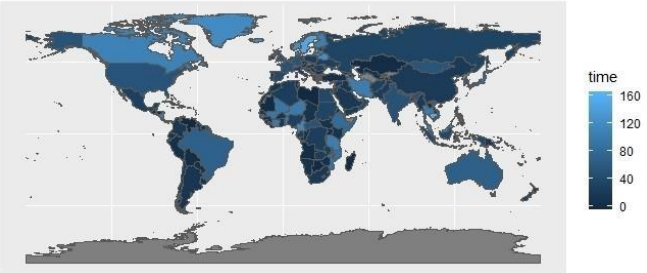
example, Brazil is introduced in the dataset by the 47th day (start variable = 47), since its first confirmed case was on February 26. When a country enters the dataset, its clock starts ticking, counting how many days are passing without a strict social isolation measure.

To identify when such measures were adopted, we used the *Oxford's COVID-19 Government Response Tracker (HALE et al., 2020), a* database for the policies adopted worldwide to deal with the pandemic. One of the variables on this dataset concerns "Stay at home requirements", an ordinal variable ranging from 0, "no measure", to 3 "Require not leaving house with minimal exceptions". For this analysis, we considered as strict social isolation measure a level 2 policy, described as policies that "require not leaving house with exceptions for daily exercise, grocery shopping, and 'essential' trips" (HALE et al., 2020). The day when a country adopted such measure, is our "stop" variable. For the Brazilian example, May 5th is the day indicated in the dataset when a level 2 social isolation policy was adopted[42] – this is the day 116 in our analysis (stop variable = 116). With this information, we can build our "time" variable, simply decreasing the day when the policy was adopted by the day when the first case was confirmed (stop – start = time). To finish our example, the time variable for Brazil scores (116 – 47 =) 69.

From the 168 observations contained in the Covid-19 dataset, 128 enacted policies of social distancing whilst 40 did not. And from those that did act, five took measures of protection even before the first death occurred. Those countries are Fiji, Kosovo, Libya, Puerto Rico and Venezuela. The following figure shows a map indicating how fast a country enacted strict social distancing policies, since the first registered death.

Figure 1

Speed of public policy adoption



Source: Elaborated by the authors.

[42] We used the database's date as a reference for all cases, including federalist countries where different measures were adopted in the subnational levels at different times. Following the database's methodology, when a subnational entity adopted a more stringent measure, this is reflected in the coding for the whole country. This is the case for Brazil, where a level 2 social isolation measure was only coded when some state governors imposed what they called "lockdown" measures by May.

The darker the blue, the faster a country reacted. This is the case for countries such as Venezuela and Libya, which enacted isolation policies even before the first novel coronavirus-related death. On the other hand, the lighter the blue, the slower a country reacted. This is the situation of Canada, the Northern Europe, and some countries in the African continent.

Political Regime

For our explanatory variable, we use the Varieties of Democracy (V-Dem) dataset. We draw our dichotomous variable from the work of Lührmann, Lindberg and Tannenberg (2017). Their "Regimes in the World" breaks the continuous variable from the V-Dem into four categories. However, first they divide the countries in democracies and autocracies. And it is following this concept that we elaborate our dummy variable for political regime. Using this variable has one major advantage when comparing with other binary measures of democracy. Przeworski et al. (2000), for example, employ a minimalist approach to democracy and only consider election-related themes when conceptualizing their measure. Using the V-Dem variable we can consider a wider concept of political regimes, such as "freedom of association, suffrage, clean elections, an elected executive, and freedom of expression" (LÜHRMANN, LINDBERG AND TANNENBERG, 2017).

Thus, political regime is coded as 0 for democracies and 1 for autocracies. For the 154 valid entries for our model in the dataset, we have almost a perfect balanced division between democracies and autocracies:

Table 1 – *Political Regimes*

Regime	Frequency
Democracy	78
Autocracy	76

Source: Elaborated by the authors.

Control variables

During the Covid-19 pandemic, several leaders decided to downplay the consequences of the disease. Those leaders did not react properly, but in some cases, local governments made the difference. This was the case of Brazil[43] and the United States[44] for example. Thus, to control for the actions of local governments, we use a dummy variable to indicate the existence of such type of government.

Economy may also play a significant role. As we already saw, an upbeat economy may help democracies in fighting a pandemic. But it can also prevent political leaders to act fast. As

[43] "*Medidas serão baseadas...*" (2020).
[44] Mervosh and Rogers (2020).

the economic situation of a democracy plays a significant role in the voters' decision making (ACHEN & BARTELS, 2016; VOETEN, 2016), presidents and prime ministers may hesitate before taking action. If the incumbent is scheduled to face the voters in an election in the next few months, the incentive to hold the restrictive response is even higher. According to Achen and Bartels (2016), voters have a myopic behavior. They tend to forget past neglect and consider only the recent history of the government. So, in fear of hurting the economy, generating mass unemployment and economic stagnation, incumbents in a democracy will wait, hoping that the pandemic does not destroy the change of being reelected. Considering this, we also control for GDP per capita and create a dummy variable to indicate if 2020 is an election year for each country.

Following Cheibub, Hong and Przeworski (2020) and Cepaluni, Dorsch and Branyiczki (2020), we also control for previous experience with SARS. Specifically, we use a dummy variable indicating countries that had at least 100 confirmed cases during the 2002-2003 SARS outbreak. We expect that previous experience with SARS makes governments more prone to react fast. Those countries already know how to deal with respiratory diseases with fast transmission. They also have a better idea of what the consequences of not tackling the pandemic early on can be.

Finally, we control for population density. Given that the novel coronavirus is an extremely contagious disease, we expect countries with high density to act faster than countries less populated. Table 2 shows all variables used in the model, as well as its sources.

Table 2 – *Variables*

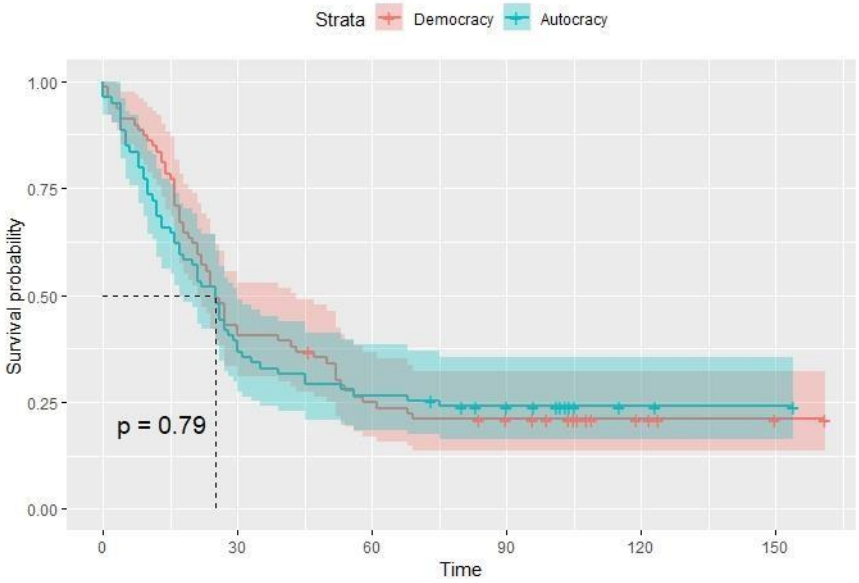
Variable	Source
Confirmed cases	Roser et al. (2020)
Policy adoption	Hale et al. (2020)
Democracy	V-Dem (2020)
Local government	V-Dem (2020)
GDP per capita	World Bank
Sars	Cepaluni et al. (2020)
Population density	OWID (2020)
Election year	IFES

Source: Elaborated by the authors.

Results

Considering that our main hypothesis is that there is no significant difference in how democracies and autocracies react to the Covid-19 pandemic, we first present a Kaplan-Meier curve (figure 2) to see the survival probabilities (probability to not take action) of the two regime groups.

Figure 2 - *Kaplan-Meier curve*



Source: Elaborated by the authors.

According to the Kaplan-Meier analysis, there is no significant difference in how the two different regime types reacted. The p-value is far from being significant (p=0.79). We can draw more valuable information from the figure. As the blue line appears below the red line in the first days of the analysis, we can affirm that autocracies are slightly faster in adopting such measures. The gap increases between 30 and 50 days. After that, the lines cross one another and the probability of not taking more time to act becomes smaller for democracies. Moreover, the dashed line represents the median. That means approximately half of the countries did take action and did so relatively soon: within 30 days from the first registered death.

Finally, to test our hypothesis, we used a Cox Proportional Hazards Model. The results can be seen in the following table[45].

[45] We also ran a model for decreasing returns of GDP per capita. However, the coefficient was not significant, and, in the name of parsimony, we decided to leave it out. The model is available in our R script.

Table 3 - *Cox PH model*

	Coefficient	Exp(Coef)	Coefficient	Exp(Coef)
	(1)	(2)	(3)	(4)
Regime	0.016	1.016	−0.076	0.926
	(0.184)	(0.184)	(0.266)	(0.266)
Local government			−0.269	0.764
			(1.049)	(1.049)
GDP per capita			−0.00002***	1.000
			(0.00001)	(0.00001)
Sars			−0.606	0.546
			(1.014)	(1.014)
Population Density			−0.0003	1.000
			(0.0005)	(0.0005)
Election Year			0.045	1.046
			(0.349)	(0.349)
Regime*Election Year			−0.789	0.454
			(0.553)	(0.553)
N	154	154	106	106
R^2	0.00005	0.00005	0.128	0.128
Log Likelihood	−529.009	−529.009	−338.458	−338.458
LR Test	0.008 (df = 1)	0.008 (df = 1)	14.512** (df = 7)	14.512** (df = 7)
Score (Logrank) Test	0.008 (df = 1)	0.008 (df = 1)	13.508* (df = 7)	13.508* (df = 7)

*p < .1; **p < .05; ***p < .01

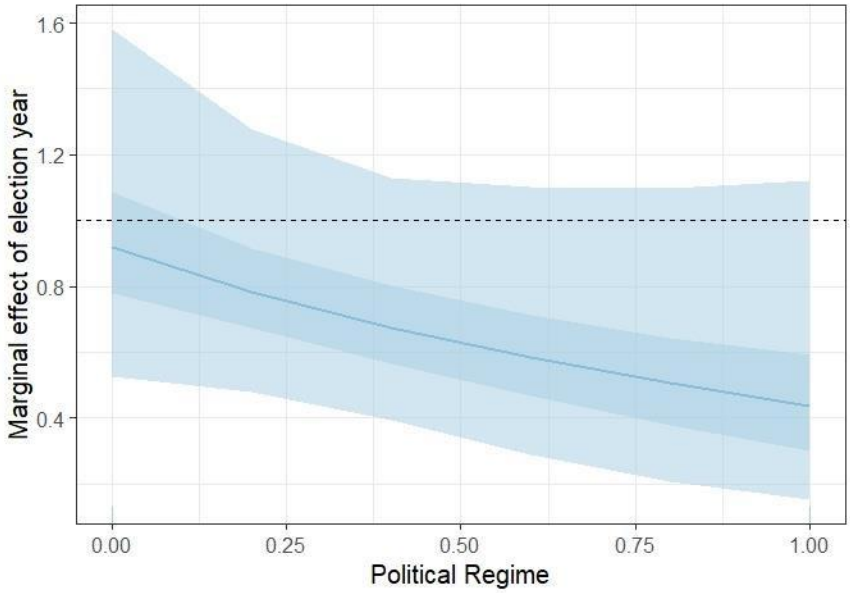
Source: Elaborated by the authors

The results seem to corroborate our main hypothesis. When looking at the bivariate model, we already see the lack of statistical significance. This pattern is maintained when we introduce our control variables. In a nutshell, we can say that there is no significant difference in how democratic and autocratic leaders reacted to the pandemic. Even if we discard the p-value and consider the output, autocracies have only 7.4% less chance to adopt the social distancing policies.

The results regarding the institutional variables go even further. There is no statistically significant difference between countries where local governments exist, i.e., decentralization plays no role. This specific result could indicate an important next step: if decentralization does not matter, and at the same time we know that in some federalist countries the local governments are responsible for moving social distancing forward, the only possible scenario where decentralization would matter would be in a world filled with populist leaders ruling unitary countries.

Being in an election year is not important. And this statement works for both regime types. The interactive term shows that even jumping from one regime type to another, the variable does not become statistically significant. Figure 3 shows the marginal effect of election year for political regime.

Figure 3 - *Marginal effect of election year*



Source: Elaborated by the authors.

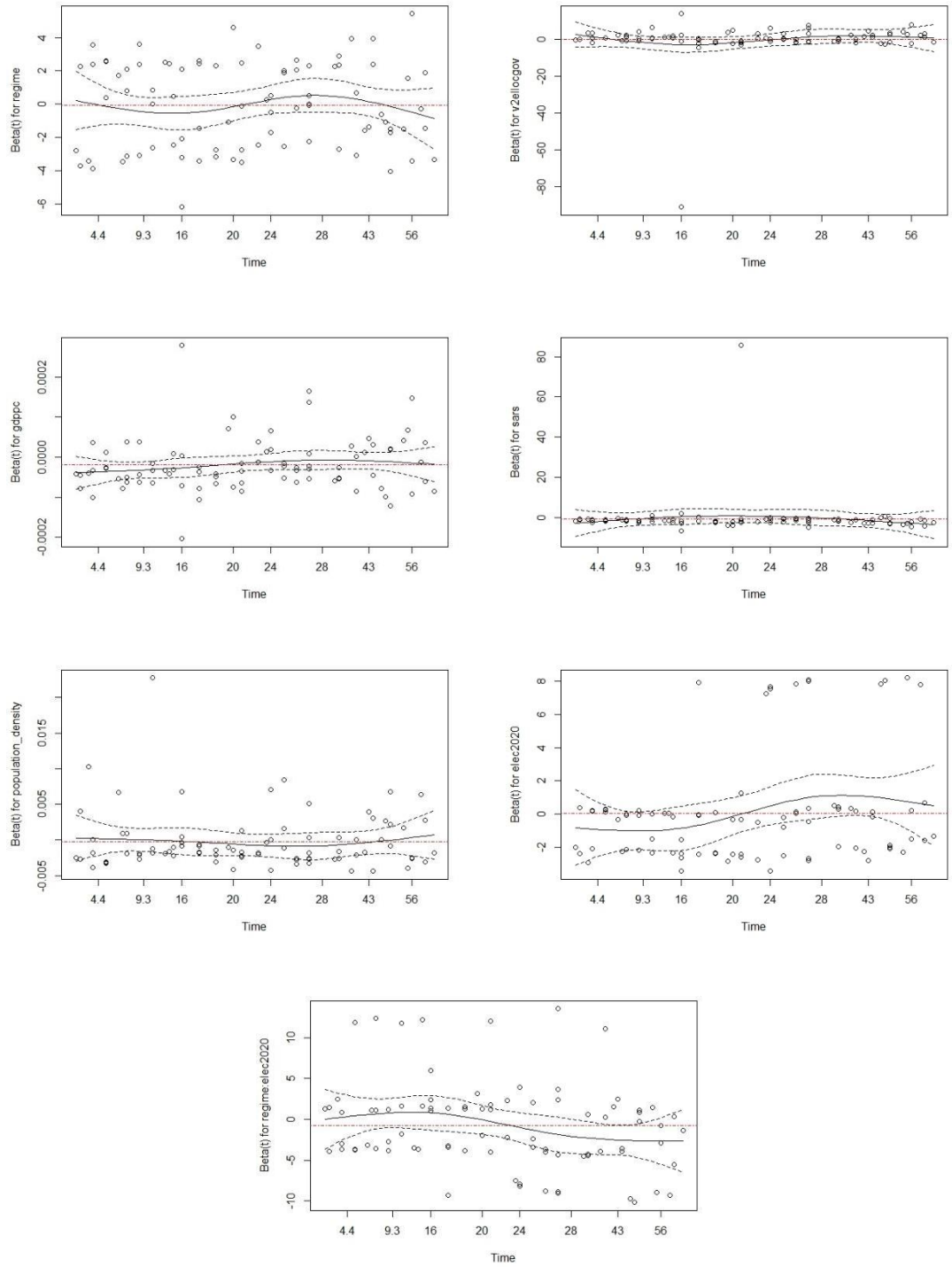
The figure above shows that as the political regime moves from the democratic regime (0) to the autocratic alternative (1), the marginal effect presents a negative slope. However, the marginal effect is always between zero and one. This means that coefficient signal for election year is not related to the type of political regime.

Even the only significant result tells us little. The result for GDP per capita is statistically significant, indicating that rich countries are slightly less likely to adopt strict measures to combat the novel coronavirus. But what its hazard ratio shows is that there is no real difference between rich and poor countries. The difference is smaller than 0%.

Residuals

To check the fitness of the model, we conducted analysis of the Schoenfeld residuals. This analysis' main goal is to observe if the proportional hazard has been fulfilled. If the line is confined within the confidence interval, we can assume that the proportional hazards has been respected (CARVALHO ET AL., 2011). Figure 4 shows the graphs for each covariate.

Figure 4 - *Schoenfeld residuals*



Source: Elaborated by the authors.

Almost all variables show clearly that the lines are within the range of the confidence interval. For the political regime explanatory variable, we see that its effect seems different in the

end. The dummy variable for national elections in 2020 and the interaction between political regime and election years, however, present a slightly problematic pattern. Although they are still within the confidence interval, they are barely so. Still, the global linear correlation of the residues is non-significant (p=0.07). This means that the model as whole fulfill the assumption of proportional hazards.

Conclusion

The novel coronavirus has social scientists looking for clues to help understand why governments react the way they do. A good number of researchers have deposited their efforts in political institutions (CEPALUNI, DORSCH & BRANYICZKI, 2020; CHEIBUB, HONG & PRZEWORSKI, 2020; GREER et al., 2020). Among those institutions, we looked for responses in the political regime.

Our main hypothesis – corroborated by the findings – was that there is no significance difference in how democracies and autocracies react to pandemics. We recognize, however, that very different paths lead each of those political regimes to the final destination: the adoption of social distancing policies. Whilst democratic leaders are concerned with how voters may react to more restrictive measures, authoritarian rulers do not have to bother with such scrutiny. This may pave the way for a timelier respond for authoritarian leaders. However, as we have seen in the Kaplan-Meier figure, democratic governments eventually close the gap with dictatorships. This could be explained by the number of veto players in each regime. A greater number of actors debating before to reach a decision can lead to a slower reaction. Further research could explore this pattern.

So, in a brief statement, we can argue that different political regimes do not react differently to the pandemic. Not only that: it does not matter if the political system is decentralized; if it is election year; if the country had previous experience with SARS; nor the population density. However, even if the coefficient is very close to zero, our model shows that richer countries are slower in taking action. This could be because they fear worsening the population's economic condition.

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Public-private Partnerships for Medicine Provision: an alternative to the combat to the covid-19 pandemic[5]

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This work aims to verify how the Public-private Partnership (PPP) contracts can be used as a tool for the policy makers to provide infrastructure in health services, specially seeking to fight the coronavirus pandemic, like the construction of hospitals and health centers, plus research and development of vaccines and medicine. An analysis of PPP cases already currently working in Brazil was conducted, based on an empiric literature. The PPPs arise as a feasible alternative of investments in this sector, particularly in a fragile moment of public accounts, in addition to the need of healthcare improvements throughout the country. Besides being more efficient, this kind of contract, in a short term, also attenuates the pressure on the public accounts since it is financed by private investments.

Key words: Public-private partnership, Medicines, Hospitals, Coronavirus.

Parcerias público-privadas para a provisão de medicamentos: uma alternativa para o combate da pandemia do covid-19

O presente trabalho tem como objetivo verificar como os contratos de Parcerias Público Privadas (PPP) podem funcionar como ferramentas de política pública para a provisão de infraestrutura de serviços de saúde, em especial visando o combate à pandemia do coronavírus, como a construção de hospitais e postos de saúde, além da pesquisa e desenvolvimento de vacinas e medicamentos. Foi feita uma análise de casos de PPPs já vigentes no Brasil, com base empírica na literatura. As PPPs surgem como uma alternativa viável de investimento nesse setor, principalmente em um momento frágil de contas públicas,

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somado à urgência de melhorias na área da saúde. Além de serem mais eficientes, essa modalidade de contrato, no curto prazo, também alivia as contas públicas ao contar com investimento privado.

Palavras Chave: Parcerias Público-Privadas, Medicamentos, Hospitais, Coronavírus.

Asociaciones público-privadas para la provisión de medicamentos: una alternativa al combate a la pandemia del covid-19

El presente trabajo tiene como objetivo verificar cómo los contratos de Asociaciones Público-Privadas (APP) pueden funcionar como herramientas de política pública para la provisión de infraestructura de servicios de salud, especialmente dirigidos a combatir la pandemia de Coronavirus, como a la construcción de hospitales y puestos de salud, así como a la investigación y al desarrollo de vacunas y medicamentos. Se realizó un análisis de casos de APP ya vigentes en Brasil, con base empírica en la literatura. Las APP aparecen como una alternativa viable de inversión en este sector, principalmente en un momento de fragilidad de las cuentas públicas, sumado a la urgencia de mejorías en el área de salud. Además de ser más eficiente, este tipo de contrato, al corto plazo, también alivia las cuentas públicas al depender de la inversión privada.

Palabras Clave: Asociación público-privada, Medicamentos, Hospitales, Coronavirus.

1 Introduction

In early March of this year, the World Health Organization (WHO) classified the Coronavirus (COVID-19) disease outbreak as a pandemic which, until August 14 of 2020, has killed over 700 thousand of people worldwide. Controlling the spread of this disease appeared to be one of the most challenging economic slumps faced by the mankind in the last centuries.

The virus, known as SAR-COV-2, originated in China, spread fast worldwide, causing numerous deaths and an incalculable economic impact. All in all, governments tried to implement a set of policy measures focusing on fighting the spread of the virus and then being able to provide a minimum appropriate level of healthcare assistance to the people that really needed to use these services.

One of these policy measures defines that only business that are strictly considered essential may work, such as gas stations, markets, supermarkets and pharmacies. Moreover, the use of masks and social distancing is recommended to restrain the spread of the new disease. In this sense, restrictive measures may be important to achieve that goal (EICHEINBAUM *et al.,* 2020; ALVAREZ *et al.*, 2020; FARBOODI *et al.,* 2020).

Although these measures aim to reduce the virus spread, there is no solid empirical evidence that they are effective (FONG et al., 2020; FANG et al., 2020). In the international literature, Friedson et al. (2020) and Bron et al. (2020) used the synthetic control method to assess these restrictive measures, in the United States of America and in Sweden, respectively. Besides these two studies, the work from Dave et al. (2020), Di Porto et al. (2020), Fang et al. (2020) and Gupta et al. (2020) employ the differences in differences method to analyze if government interventions may reduce the number of hospitalizations and deaths caused by the Covid-19, even though the results are contrasting.

In the Brazilian case, Oliveira et al. (2020) apply the differences in differences method, estimating that the economic costs of intensifying the social isolation were about R$ 844 thousand a day, while the benefits in terms of the reduction of cases and deaths from Covid-19 were not statistically significant. Utilizing a dynamic panel approach, Oliveira (2020) estimates that there would be a loss of approximately R$ 43,36 billion in sales and around R$ 1,56 billion in tax collection in the first 27 days of restrictive measures.

Inside this context of uncertainty, which tools can policy makers use to effectively guide the fight against the disease? In a productive way, the federal government, as well as some state governmental research institutes, have been developing partnerships with the private sector in order to produce vaccines and medicine to fight against the coronavirus. Plus, there are some

legal instruments that may be used, such as the provisional measure 926 (PM), that reduced the bureaucracy for bidding contracts during the pandemic. In August of 2020, this PM has turned into law number 14.035.

Under this perspective, a feasible alternative already implemented around the world to provide healthcare services are Public-Private Partnerships (PPP). According to the Brazilian law 11.079 from 2004, a PPP is an administrative contract of concession, which can be sponsored or administrative.

A quite common argument from those who defend the use of PPP contracts is that, since they utilize private sector resources, the provision of infrastructure services to the population is not limited by the constrained public budget, as can be seen at Hart et al. (1997), Hart (2003), Bennett and Iossa (2006), Martimort and Pouyet (2008), Engel et al. (2009), Barros and Giralt (2009), Iossa and Martimort (2012), Nóbrega (2012), Nose (2017), Buso et al. (2017), Iossa and Saussier (2018). Thus, the use of this contract model would allow an amplification of public services in fundamental areas, while removing the necessity for raising public expenditures in the short term.

But how are PPPs being affected by the new coronavirus and how should public parties react to it? The World Bank stresses that is undoubtedly important to have a healthy cooperation with the private sector in order to mobilize its financing and expertise for infrastructure development in general. The short-term impacts are, as expected, revenue losses for PPPs as well as delays in construction schedules, since logistics and labor are heavily affected. In the medium term, impacts in contracts in all stages are expected, whether it is through operations, seeking financial support or constructions currently underway. Capital injection, renegotiation and regulatory flexibility are some measures that can mitigate these impacts. The long-term impacts will depend on how long the pandemic lasts, and the focus will get back to achieving more sustainable and resilient infrastructure PPPs.

In the healthcare context, there is previous experience in using this contractual modality to the construction and the provision of hospital services. According to Taylor and Blair (2002), La Forgia and Harding (2009), Barros and Giralt (2009), the main factor of this type of contract is a guarantee of the service quality that will be offered. When talking about provisioning of vaccines and medicine, Brown (2008), Bagley and Tyarno (2014) highlight the use of PPPs for developing therapies and medicine for the treatment of infectious diseases.

According to Brown (2008), one of these partnerships is The Accelerated Access Initiative, which aims was created to promote access to therapies for people with HIV. This partnership consists in five organizations from the United Nation and six pharmaceutics companies. Another

example of PPP in this sector is the Diflucan Partnership, which was released in December 2000 by the pharmaceutical company Pfizer, one of the biggest in the world in this sector, consisting of a donation program of an antifungal medicine for the treatment of common infections in HIV cases. The program also helps to train health professionals in fighting infectious diseases and has been placed in over 42 developing countries.

This way, this work focused mainly on verifying how contracts in Public-Private Partnerships can be used as a tool for policy makers to provide healthcare service infrastructure, especially for fighting the coronavirus pandemic, as well as the construction of new hospitals and development of vaccines and medicines for mass distribution.

To accomplish this task, this work is organized as follows: a brief consideration of laws regarding PPPs in the Brazilian context is made; then we review the literature about these contracts in the health scope; a discussion about the main possibilities that this contract modality may bring to providing new medicine and building new hospitals is made subsequently; finally, we present the concluding remarks.

2 Some considerations about the PPPs

First, it is necessary to make a few considerations about the traditional concessions governed by law 8.987 and the specials concessions (PPP) regulated by the law 11.079. The first is used as a model for the administrative contracts pass the provision of a certain service to a private firm.

According to Bandeira de Mello (2008), the traditional concession contract/model is the legal institute by which the State designed the public service provision to a third party that accepted to provide the service at their own risk and that the public party has the majority control of the contractual clauses.

This way, according to Brazilian legal guidelines, a PPP contract could be defined as the one that: i) has a value equal to or above ten million reais; ii) the period of service provision will not be less than five years or over thirty-five years; iii) aims to provide more than one service, for example, the construction and the operation of a facility.

From here, the possibilities of contract through public-private partnerships are divided into two modalities: sponsored or administrative. In the first one, the private party can be remunerated by receiving a fare collected from the users, as well as receiving financing from the public sector itself. A quite common example of this type is a road under the responsibility of a firm (concessionary) via PPP.

In the administrative type, the private party provides the Public Administration a pre-determined direct or indirect service. A possible contract in this modality is the construction and operation of a hospital. The patients (citizens) would be the direct users of the service and the administration would fit in the indirect use and pay for the service.

Within this context some previous limitations should be emphasized as the federal, state and city governments must accomplish contracts in this form. The federal government can only hire PPPs when the sum of all continuous expenditures of contracts in this modality do not exceed, in the past year, 1% of the net revenue of the exercise, and also the annual expenditures of the current contracts in the next 10 years do not exceed 1% of the net income projected for the respective projects.

Besides that, this public party can only guarantee or perform voluntary transference to states, federal district and cities if the sum of all their continued expenditures from the set of partnerships already hired by these parties did not exceed, in the past year, 5% of the current net revenue or if the annual expenditures of the current contracts in the next 10 years do not exceed 5% of the projected net revenue for the respective exercises.

A procedure prior to signature of a PPP contract is the constitution of a Specific Purpose Society (SPS), which seeks to promote the development of the proposed project by the contractual arrangement. The SPS can have the form of an open company and should comply with the international corporative government standards. However, the public administration cannot be the biggest voting holder in this organization.

According to the tenth article of law 11.079, the hiring of a PPP should be preceded by the authorization of a competent authority and must be reasoned by a technical study that shows the socioeconomic justifications for hiring by this contractual arrangement.

The sixth chapter of law 11.079 has provisions applicable to the Federal Union, since article 14 specifies that the Federal Entity Institute, which is a managing body with duties, among others, to define the priority services for the execution in the PPP regime and to regulate the procedures for honoring and execution of these contracts. This article was complemented by the Decree 5.385 from 2005, which instituted the Manager Committee of Public-Private Partnership in the federal scope; however, the Decree 9.784 from 2019 revoked this legislation and, currently, there is no regulation on this subject.

Another important mechanism is the Fundo Garantidor de Parcerias Público-Privadas (FGP), *Guarantee PPP fund*, which has the purpose to guarantee the pecuniary obligation assumed by public federal (state and municipal)).

In short, another key feature that differentiates PPPs from conventional concession frameworks are risk sharing between the public and the private parties. As stated before, the special concessions have legal mechanisms that aim to guarantee that this mutual risk is minimized. The fiscal guidelines, the demand for viability projects and the supervision by the regulatory agencies formed by members of the State may be important tools for the risk reduction related to this contractual modality.

3 PPPs and the provision of healthcare services

There are many factors related to the quality of the healthcare services. In his classic work, Arrow (1963) highlight two main points: the infrastructure provided to patients and the doctors' ability to prescribe the best treatment. The high prices for the provision of these services is related to the high costs of empowering and forming professionals in the health science area. Considering that economic agents consider the provision of these services to be an important factor to their welfare level, governmental investments in infrastructure and capacitation of qualified professionals are welcome by the population.

In relation to these investments, Hart et al. (1997) developed a theoretical model that seeks to identify which conditions the government should be responsible for providing the service or alternatively when it can be transferred to the private sector. The authors' arguments suggest that the service provision when done by the government is stable when the cost reduction have great effects in the project quality, and in situations when the quality innovation is not relevant. On the other hand, privatization is preferable when cost reduction can be controlled by a competitive contract or when the innovation process can improve quality characteristics of the project . The healthcare sector suffers enormous damage due to cost reductions coming from the private parties and historically the hospitals concession contracts have been realized in the contractual form *cost-plus*[46].

With the intention of evaluating if the property of the assets should be public or if the public party should only be responsible for providing the service, Bentz et al. (2001) compared two models of providing services, the conventional model or a consortium of private financing. The main factor that guides the government choice is the service delivery costs, since, if the costs are low, the government will strictly prefer to hire the final service instead of buying the asset. The problem of building a new facility is the information asymmetry. Even in complete contracts, the

[46] This kind of contract allows a private firm to be refunded for its costs, which are bound until a certain level, plus an additional payment that allows the firm to have a profit margin.

new facility design might show some problems during the construction and, in this case, the firm that already provides the service may already know how to fix the problem, in addition to knowing its costs (if it's high or low), while the government does not have this information clearly. Thus, the government chooses to pay for the service if the building and delivering costs are low.

In an analysis more focused on the operational methods, Campos et al. (2011) investigate articles in the PPP literature for the health sector, seeking to understand the fundamental elements of the partnership process. In the developing stage, the most common subjects were *win-win* agreements, synergy of expertise, stakeholder engagement, local health capacity and infrastructure and the public and private sectors' perception regarding each other. In the development stage, communication, knowledge exchange, participatory management and organizational skills were the most common topics. It is important that the law helps keep these important pillars in order to receive the most efficiency from PPP contracts.

This way, governments should use the private sector's ability to finance, build or provide hospital services only when the efficiency level of the private partner is superior to the government's (BETTIGNIES AND ROSS, 2004). According to Mckee et al. (2006) the use of PPPs in hospitals made sure the projects were realized within the deadline specified in the contract, and also that the deal was within the expected budget. However, these efficiency improvements may cause costs related to the project quality. In this sense, Taylor and Blair (2002) say that mechanisms such as independent regulatory agencies are necessary to guarantee that the rules specified in the contract are being respected.

In the incomplete contracts scope, Hart (2003) develops a PPP model where the public entity is the owner of the asset after the project conclusion and that there are two options: hiring a third party to build and operate the project, or hiring two different companies. The author evaluates the PPP as a good alternative when service quality can be specified in the initial contract but building quality cannot. The principal example would be prisons and hospitals.

Under another point of view, Bennett and Iossa (2006) point out that PPPs worked quite well for roads and prisons, causing cost reductions, bringing new design and administrative innovations, but this process did not show the same returns for schools and hospitals. PPP projects for hospitals demand investments in high quality materials and equipment, which raises the building and operational costs, and creates a need for training health area professionals, which in the short term may cause maintenance costs to raise. In this situation, signing unbundled contracts is a better alternative, according to the authors, who support that at the end of the PPP contract, the asset should be owned by the public entity in the case of hospitals, prisons and schools.

As for the government's budget perspective, Maskin and Tirole (2008) report that the bundling type will not always induce the responsible firms to internalize operational cost reductions for the building and operating process. The bundling may lead to an efficiency loss because the builder is not necessarily the best operator. Moreover, bundling may encourage choices that induce the reduction of future costs at the expense of service quality or because of a collusion between the operator and their regulator, that together might manipulate the project in their favor.

The analysis from Iossa and Martimort (2009) stress that the efficiency gain brought by the PPPs arrangements may be superior to the governmental traditional contract forms. However, PPPs might be inappropriate in some cases, as schools and elderly care facilities. That is because the quality of service is determined by the investment in capital human or in IT services (Information Technology) where the demand changes quickly over time. In the case of hospitals, the asset property may return to the public entity after the end of the contract, even though the private party can still provide the service.

Talking about the PPP contractual model for hospitals, Barros and Giralt (2009) point out that it is necessary to detail quite well the project to encourage the firm competition process. However, the public entity might not be as efficient as the private party to define and then supervise the expected quality in the hospital service. If quality measures are not well defined in the contract process, then the innovations brought by the private sector may get lost.

Another important point is the evaluation by Balduzzi (2011) who extends Hart's model (2003), analyzing the role of workforce on PPPs. According to the author, the public provision is the best pick when the employer and worker efforts are complementary and relevant. In general, services like healthcare demand a high level of investment from the private company and should be kept with the public sector. Otherwise, PPPs are the best choice.

A key issue in the opinion of La Forgia and Harding (2009) and the Asian Development Bank (2013) is the supervision of a hospital PPP contract. Therefore, the contract should contain measurable goals, procedures for quality measure and a responsible organ for making reports. The responsible unit should develop a procedures manual for performance verification in relation to the contract and to answer to any contract deviations.

In addition to providing hospital services, PPPs can also be utilized to connect private and public interests related to research and development in the medicine production area (VRUEH AND CROMMELIN, 2017). In general, there are 2 main types of PPPs that stimulate R&D in the pharmaceutics area: i) The product developing PPP, which aims to develop medicine, vaccines, etc; ii) The precompetitive PPP, where both parts contribute to improve mainly infrastructure, in an effort combination between the private and public parts.

The pharmaceutics industry, like any other, needs incentives to make firms keep investing in research and development, and to create new medicine and vaccines. Insurance coverage policies play a crucial role in this matter, since they can cause significative changes in the firms' investments, depending on the way they are applied. A smaller coverage from insurance plans might cause firms to invest less in R&D (AGHA, KIM AND LI, 2020)

Peculiarly for that industry, a contract in the PPP mode serves as a link between new scientific discoveries and the final product that goes to the consumer. As stated by Wheeler and Berkley (2001), the majority of these partnerships includes the following stages: focus on a specific disease; receive funding from the public and philanthropic sectors; seek in-kind contributions from the industry through project partnerships; fund projects that involve for-profit partners, besides giving importance to R&D investments and to intellectual property rights. The biotechnology companies and academics collaborate with pharmaceutical companies to define which discoveries have a more attractive technical and commercial potential.

Some diseases have fewer incentives for investments in R&D, since they do not reach a vast number of patients, or they exist mostly in developing countries, where the population has limited financial resources and cannot access vaccines and medicines. In addition to that, the regulations in these countries may not be welcome for the innovation market for new drugs. PPPs can be a way to stimulate R&D in this sector, decreasing costs and risks for both involved parties, private and public (NWAKA AND RIDLEY, 2003). The government system is also important, in view of the fact that the political debate translates how important subjects such as intellectual property rights are treated in each country, as well as innovation and access to essential medicine. Thus, it is important to keep these questions crystal clear and also guarantee good project management, in order to obtain beneficial agreements to both parts.

At the same time, only patent protection itself does not secure a bigger investment in R&D for diseases with small market potential in rich countries (KYLE AND MCGAHAN, 2012). Apart from that, if there is market potential in developed countries, treatments and medicines developed may also benefit poor countries.

4 Discussion

The majority of the PPP literature says that this kind of contract may be efficient in extending public service offerings in fundamental areas, taking into consideration increasing budget constraints (AKITOBY, et al., 2006; ENGEL et al., 2013; BUSO et al., 2017). This contractual modality is a good opportunity for Brazil, which is facing a tight public budget, even

causing the country to pass a constitutional amendment law (n. 95) limiting the level of government expenditures for twenty years.

To fight the coronavirus pandemic, PPPs can be used to provide medicine and health infrastructure, as building new hospitals and health centers. However, it is important to point out that according to the legal aspects of this form of agreement, it cannot be used to buy vaccines, for example, but for research and development of these new medicines.

In pecuniary terms, the PPP contract would fit quite well for medicine development. According to the Statistical Yearbook of the Pharmaceutical Market Design by Agência Nacional de Vigilância Sanitária (ANVISA)[47] from 2018, this market involved more than R$ 76 billion in this year.

Another important point is the time horizon scheduled for this contract. However, the activities related to research and development of medicine and vaccines usually are not developed in short periods of time. Even though this can be a negative due to the urgency in the need for a vaccine as in the case of the coronavirus pandemic, the contract can still be valid beyond that. As for the service provision, the research, development and commercialization of pharmaceuticals also fits in the basic definitions of PPPs based on the Brazilian law.

Within that scope, it is worth stressing that the national experience with that contractual arrangement is new. According to information from Radar PPP[48], a leader in following this contractual modality in Brazil, the country ended the year of 2018 with 120 contracts in the PPP type, with only three related to healthcare.

The first PPP contract signed in Brazil was in May of 2010, the PPP for the Hospital do Subúrbio from Bahia state, executed between Prodal Saúde S.A. and Secretaria do Estado da Bahia, seeking the administration of Unidade Hospitalar da Bahia. The concession has a 10-year term and a value of over R$ 1 billion. As a result of the efficiency gain from the administration and financial and technological innovation, the hospital has received a prize given to the ten best partnership projects in Latin America and Caribbean from the World Bank in 2013 .

The second hospital from this type of PPP contract is the Hospital Metropolitano de Belo Horizonte, which was signed in March of 2013, between Novo Metropolitano S.A. and Secretaria Municipal de Saúde do Município de Belo Horizonte, to the realization of services and engineering works and administration of the hospital. The concession has a 20-year term and roughly the same value as the first one. The most recent one is the Hospital da Zona Norte, executed between Zona Norte Engenharia, Manutenção e Gestão de Serviços S.A. and Secretaria de Saúde do Estado

[47] The Brazilian Health Surveillance Organ.
[48] https://www.radarppp.com/

do Amazonas, in concession for the construction, equipment supply and non-assistance service maintenance and administration to the Hospital da Zona Norte de Manaus.

As stated in the previous section, PPP agreements are an alternative to the government provision of necessary medicine, when the government has interest in investigating and providing solutions to a certain disease, through research and development. It is possible to find an interaction that is effective between public entities (researchers in general, health entity, etc) and private companies with the intention that both share the same final objective of providing treatments or medicines for that disease.

PPPs for the health area cannot be used for purchasing products, only for the development of research aiming to provide vaccines. For that, there are productive developing partnerships, which are partnerships between two or more public institutions, or between public and private institutions, that seek to promote national public production of medicine and products for healthcare considered essential for the Sistema Único de Saúde (SUS), the Brazilian national healthcare system, through a boost to the industrial sector in Brazil. The main purpose is to promote the national development of medicine and health products that are currently imported or that represent a high cost for SUS, therefore seeking to reduce the purchase costs of these products. However, for a medium-term objective, when talking about the provision of hospitals, PPPs projects are more appropriate.

On the other hand, all the risks involved in the project, are shared between the parties, like failing to produce a vaccine. Also, the project making process usually takes around two years (MORAES AND REYES, 2017). In pandemic cases, such as right now, time is a quite valuable resource and this process should be done quickly, even though it is a rigorous process which demands attention to include everything that is necessary to encourage and ensure all the parties involved in the contract.

A feasible solution for reducing the project plan creation time is PM 926 which was converted into law 14.035, which seeks to facilitate the procedures on the acquisition of goods, services and work hiring and inputs intended to fight the coronavirus pandemic. These are exceptional measures for fighting the current situation of emergency in the country.

In addition, the federal government also has as an alternative for buying medicine the Product Developing Partnerships (PDP) that intend to increase the buying of medicine and healthcare products for the SUS. However, this proposal also aims to strengthen the national industry for the costs reduction for providing new drugs for the healthcare system. It is also included in the PDP, the innovation and development of new technologies helpful to the sector.

An advantage of the PPPs have over PDPs is the flexibility of the service provision that the first one allows. Even though it is not possible to exclusively buy medicine, the possibility of combining several service provisions is a benefit from the special concession. However, the PPP contracts tend to be complex and that is why the period from the expression of interest to the beginning of the project is reasonably high, which is a barrier during the actual crisis moment. That way, it is necessary to minimize the bureaucracy what about contracts between public and private parties.

However, PPPs can be seen as a long-term loan, where the government receives financial investments from private parties, but give up on providing the service that might be profitable. In other words, the government is investing an opportunity in the private sector, trading off a potential income for a more efficient service. In this sense the point Bettignies and Ross (2004) make is especially important when they say the government should only use the private sector in contracts if their effectiveness is higher, since that, on average, PPP contracts tend to be more expensive than conventional concession contracts (MORAES AND REYES, 2017).

A different approach, even though still related to healthcare, is the Covid Radar[49], which is a cooperation between over 40 companies and organizations, sharing data and combining efforts to face the coronavirus challenges in Brazil. It is possible to check real time information about coronavirus cases in every state and also a tool to connect people from all over the country, where is possible to offer or demand a specific product or service, as food, equipment, inputs, general services. Even though there is not a contract between the parties, it is still a public-private partnership intending to help those in need during this pandemic.

5. Concluding Remarks

This work intended to verify how PPP contracts may be used as a public policy mechanism for providing infrastructure in healthcare services, especially while fighting the coronavirus pandemic, where fast solutions are needed in order to contain the virus spread, treating already affected people, building new hospitals and for the research and development of new vaccines and medicine for mass distribution.

To accomplish this task, the PPP laws in the Brazilian context were considered, followed by a literature review of works that included these contracts especially in the health and

[49] https://www.covidradar.org.br/

pharmaceutics areas, and then a discussion on how these contractual agreements could be applied in Brazil.

When fighting pandemics, the PPPs can be a valuable ally to promote the research and development of new vaccines and medicines for diseases as in the actual case of coronavirus. Considering that it is a viral infection, as in the H1N1 case, where the virus spreads quickly, the P&D of these products should be done constantly, to make it easy to have an answer for that situation and to accomplish the objectives quickly.

The PPP contracts are not simple, since they can be related to a vast variety of services within each sector, for example, in the health scope, the building of hospitals and health centers, the provision of medical services, the management and administration of hospitals, etc. Plus, the contract should meet several requirements to guarantee that the partnership is effective, among them ensuring that both parties have the same final objective and engage to achieve it. Also, independent regulatory agencies should be created to ensure that both parties carry out the contract and respect the rules. The sophistication of these contracts to the pharmaceutical and health fields is a topic with high potential to be expanded in future works. There is a wide range of contracts that can be signed through PPPs to improve the basic Brazilian infrastructure.

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Transparency on Covid-19 pandemic: an evaluation of Brazilian municipalities[6]

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This work aimed to understand how Brazilian municipalities have been disclosing information on the novel Coronavirus pandemic. Starting from a representative sample of urban and rural municipalities according to Brazilian Institute of Geography and Statistics (IBGE) typology, it analyzes active and passive transparency aspects based on the search for information on institutional websites and responses to requests for access to information. Next, it presents descriptive statistics for the collected data, identifying the transparency profile of data related to the virus in the municipalities. It was possible to observe problems related to the quality of the information provided and a very low rate of responses to the information access requests. Regarding to data on expenses and revenues to fight Coronavirus, most municipalities make this information available due to the approval of the Law 13,979/2020, exemplifying the importance of legislation to guide the municipalities and of legal factors on the transparency levels observed in the analyzed case. Also, it finds that the studied municipalities show a high rate of use of social networks to disseminate information related to COVID-19.

Keywords: Covid-19, municipal transparency, transparency

Transparência na pandemia de Covid-19: uma avaliação dos municípios brasileiros

O presente trabalho teve como objetivo compreender de que forma as informações sobre a pandemia do novo coronavírus estão sendo disponibilizadas pelos municípios brasileiros. Partimos de uma amostra representativa de municípios urbanos e rurais, construída com base na tipologia do IBGE (2017) e analisamos fatores de transparência ativa e passiva, realizando buscas em *sites* institucionais e pedidos de acesso à informação. Posteriormente, realizamos estatísticas descritivas das informações coletadas, identificando o perfil de transparência dos dados relacionados ao vírus nos municípios. Foi possível observar problemas relacionados à

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qualidade das informações disponibilizadas e um nível muito baixo de resposta de pedidos de acesso à informação. Com relação a dados de gastos e receitas no combate ao Covid-19, boa parte dos municípios disponibilizam essas informações devido a aprovação da Lei nº 13979/2020, ilustrando a importância de normativas que instruam os municípios e de fatores normativos para explicar os níveis de transparência, no caso analisado. Além disso, identificamos que os municípios estudados apresentaram um alto índice de uso das redes sociais como forma de divulgar informações relacionadas à doença.

Palavras-Chave: Covid-19, transparência municipal, transparência

Transparencia en la pandemia del Covid-19: una evaluación de los municipios brasileños

Este estudio tuvo como objetivo comprender cómo los municipios brasileños disponen la información sobre la pandemia del nuevo coronavirus. Iniciamos el análisis con una muestra representativa de municipios urbanos y rurales, de acuerdo con la tipología del IBGE (2017) y analizamos factores de transparencia activa y pasiva, realizando búsquedas en sitios web institucionales y solicitudes de acceso a la información. Después, realizamos estadísticas descriptivas de la información recopilada, identificando el perfil de transparencia de los datos involucrados con el virus en los municipios. Se pudo observar problemas involucrados con la calidad de la información y un nivel muy bajo de respuesta a las solicitudes de acceso a la información. Con respecto a los datos de gastos e ingresos para combatir el Covid-19, la mayoría de los municipios disponen esta información de acuerdo con la Ley n.13979/2020, que ilustra la importancia de las regulaciones que instruyen a los municipios y de los factores políticos y regulatorios para explicar los niveles de transparencia, en el caso analizado. Además de esto, identificamos que los municipios estudiados tenían una alta tasa de uso de las redes sociales como un intento de difundir información sobre la enfermedad.

Palabras clave: Covid-19, transparencia municipal, transparencia

1 Introduction

The use of technology and the disclosure of information can be important tools in combating the coronavirus pandemic. In this work we aimed to understand how Brazilian municipalities have been disclosing information about the disease, considering the country Access to Information Law, Nº 12.527/2011, and to describe the quality of the passive and active transparency by examining the responses to the requested information and the information available in institutional websites and social media.

Transparency is a necessary condition to promote accountability, since voters will only be able to control their representatives and the public service itself if they have reliable information. For this reason, these concepts have often been worked together when we speak of democracy, so that it can be said that transparency is an essential condition for a truly democratic government, although it is not the only one.

In the pandemic context, information is even more necessary, being decisive for population to get informed about the reality of the disease, to combat fake news and adopt the best action in order to prevent the virus. The case of South Korea shows how the use of technology and information disclosure as up-to-date statistics on infected cases were important to the control of COVID-19 (MOON, 2020). Transparency, also, allow citizens to identify if governments are dealing with the sanitary crisis, a condition that will possibly influence voters' assessments - the Brazilian pandemic is ongoing in a municipal election year.

In Brazil, democratization and the process of decentralization increased municipality participation in public policies, once after 1988 Brazilian municipalities became federative entities with financial autonomy and broad political and legislative power (ABRUCIO & GRIN, 2019). In addition, the municipalities are the closest federative entities to the population and the most important for the implementation of public policies (ARRETCHE, 2002).

An important decision from Federal Supreme Court (STF), the Direct Action of Unconstitutionality (ADI) 6,341, recognized that the Federal Government, states municipalities have in common the power to legislate public health, ensuring autonomy to mayors to adopt nonpharmaceutical measures, such as quarantine in the cities. Although facing different capabilities and social and economic inequalities, Brazilian cities revealed the prominence of their action against the pandemic. Therefore, considering their importance and the importance of accountability, we should investigate transparency locally in face of this moment for humanity.

In order to achieve our goals, a representative sample of urban and rural municipalities according to Brazilian Institute of Geography and Statistics (IBGE) typology was drawn. Subsequently, for data collection, an active search was carried out on municipalities institutional websites and social

networks, with the aim of collecting data on active transparency. Also, we made two types of requests for access to information about coronavirus, in order to collect data on passive transparency.

We analyze descriptive statistics of the data collected to find out the means and what is actively disseminated, as well as what information is possible to be obtained through requirements. As the variables are categorical, we have tables showing the different percentages on items related to the two types of transparency, thus assessing the profile of transparency in these municipalities. Furthermore, through the correlation matrix of variables representing the two types of transparency, we can see the existing relationships that configure transparency. The relationship with socioeconomic factors and the severity of the pandemic was analyzed using logistic regression with robust standard error.

The number of confirmed COVID-19 cases are related to daily disclosure of information through epidemiological bulletins and social networks. Furthermore, the results are clear about the positive correlation of the number of confirmed COVID-19 cases with daily release of epidemiological bulletins and the use of social networks for information disclosure. Additionally, the fact that a municipality have more or less cases does not influence the disclosure of expenses and revenues, since there is a law that requires disclosure of the expenses related to the disease. Another interesting fact is that, in contrast with the evidence of recent researches about municipalities transparency in pre-pandemic context, socioeconomic variables do not present a significant relation with these representative variables of active transparency. On the other hand, the results about passive transparency presented that around 19.7% of the analyzed municipalities presented problems or did not have a system to submit information requests. Only 24.3% municipalities replied both information request send to them. Active and passive transparency have no correlation between their variables. For instance, although many municipalities publish information about the pandemic on their transparency portals, there was no higher rate of responses on the subject when analyzing passive transparency.

In the next section we discuss transparency and access to information, followed by a brief presentation about transparency in times of COVID-19. Next, we explain the methodology adopted by this work and the results of the analyses in both passive and active transparency. Lastly, we discuss our findings and conclusions.

2 Transparency and access to information

The concepts of accountability and transparency occupy an important position in the contemporary discussion of democracy. The notion of accountability, according to Filgueiras

(2011), serves as a normative framework for state reforms in modern democracies. This concept concerns a duty of the democratic State to account for its actions, in which voters exercise control over the management of public policies. It is necessary to adopt instruments to punish (or not) governments for the results they produce – as the vote, for example. But for the voter to be able to exercise this control and hold the government responsible for its actions, they must access information.

Transparency is essential for citizens to exercise their right to free expression and access to information, as the article XIX of the Universal Declaration of Human Rights prescribes. In a short analogy presented by Angélico (2012), transparency is the property of being transparent. Therefore, in an optical system, it means that the system allows the light to go from one point to another, permitting the visualization of the whole set. Applied to the public sector, transparency allows a visualization of government acts, which were considered confidential for a long time.

Transparency qualifies democracy and strengthens interactions between the State and society, mainly, providing the citizen with the necessary information for them to participate in public policy processes (CUNHA FILHO, 2019). In this way, laws on access to information provide the opportunity to bring the State and society closer together. They are also considered an instrument for the promotion of social rights. In Brazil, the Access to Information Law (Law 12.527/2011, hereafter referred to as the AIL) lays down guidelines for governmental transparency at the three levels of government[50], including indirect administration, which encompasses independent agencies administratively related to government bodies and public companies. Still, the law innovated by including recent technological tools, a correct move given the increase in documentation and the ease of disseminating information in recent decades.

The implementation and approval of the AIL in Brazil was a gradual process that had the support of an important state agency, the Brazilian Office of the Comptroller General (BOCG), and social movements, such as the Brazilian office of non-governmental organization Article 19, at the time of discussion at the Chamber of Representatives (ANGÉLICO, 2012; CUNHA FILHO, 2019; RODRIGUES, 2020).

Shortly after the approval of the AIL, Paes (2011) pointed out the need to build public policies that would make it possible to increase the access to regulated information provided for in the legislation.

[50] As Souza shows, a particularity of Brazil is the triple federalism. “Unlike many federations, the Brazilian, as well as the Belgian, is a three-tier system (triple federalism) because it incorporated the municipalities, together with the states, as integral parts of the federation, reflecting a long tradition of municipal and scarce autonomy control of states over local issues ”(SOUZA, 2005, p.110, free translation).

> "The creation of a law is only one step in the construction of a transparency policy in the country. The rule must be transformed into actions and facts, by the Executive and other powers, for its effectiveness, allowing the population to be more aware of government acts, trying to overcome distrust without losing interest" (p. 416, free translation)

Besides, it is important to observe that more information or increased transparency does not necessarily lead to active citizen participation or better results in public policies; it would be necessary, in this case, to adopt a broad process of civic participation and social criticism (FILGUEIRAS, 2011).

It is also necessary to respect the quality conditions when providing information and compliance with laws by the different institutions and mechanisms of civil society participation. Still, it is possible to speak of two conditions: visibility and inferibility (MICHENER; BERSCH, 2013). The first concerns the completeness and ease of finding information. In this case, transparency can only be talked about when the information is visible and available in its entirety. In addition, it must be relatively easy to find information, so that it is actually visible to third parties. The second, on the other hand, concerns in which extent information is accurate and how truly useful it is for appropriate conclusions. That is, it is related to the quality of the information, whether it is available in raw data, verified and it is available in a simplified way.

The emergence of the internet and new technologies has boosted the availability of information, enabling people from anywhere to quickly learn about different institutions, issues related to budget and public policies. Through institutional websites and electronic government, government agencies can make their performance more transparent and efficient (CRUZ et al., 2012). Although the internet alone does not guarantee quality and that its access by the entire population is still far from being a reality, especially in developing countries such as Brazil, the online circulation of information and in plain language facilitates the dissemination of important social interest facts.

Several works and initiatives seek to understand how transparency and AIL have been implemented in Brazil. Cruz et al. (2012), in the first year of the AIL implementation, analyzed 96 municipalities among the 100 most populous based on *Índice de Transparência da Gestão Pública* (ITGP-M, freely translated as Municipal Public Management Transparency Index) formulated on the basis of international codes of good transparency and governance practices. They concluded that the municipalities presented low levels of transparency, incompatible with their high socioeconomic development levels (together they represented 60% of Brazilian GDP). Although the transparency levels were in general low, when compared the municipalities presented a relation between their socioeconomic conditions and their levels of transparency in the dissemination of information.

If this first study examines transparency in the first year of implementation of the AIL, a survey carried out by Michener, Contreras and Niskier (2018) in the following years concluded that there are major flaws in passive transparency in Brazil, based on the compilation of 3,550 information requests made to different federative entities from 2013 to 2017. Despite the federal government presenting satisfactory numbers (91% of response), state governments answered only 53% of the requests. Municipal governments had even lower rates, by responding to only 44% of them. Angélico (2012) remarks that one of the significant challenges to the implementation of the AIL in Brazil is the country federative aspect. As the author states, public policy research has shown that there are difficulties in implementing policies throughout the national territory, arising from the political division between the Federal Government, the States and the Municipalities. In this case, as a federative entity that is closer to the population, the municipality becomes crucial regarding the implementation of social policies and, consequently, the act of informing population about them.

Thus, these studies reinforce that, even if important, the approval of AIL alone is not an end in itself, but the first step towards a paradigm shift from an opaque public management to a more transparent one. Actions regarding transparency and access to information do not end with the implementation of AIL and they must be continuous in order to overcome institutional and sociocultural obstacles that hinder a transparent government attitude (ANGÉLICO, 2012; PAES, 2011).

3 Transparency in times of COVID-19

The coronavirus pandemic has imposed great challenges of different kinds upon governments - health, social, economic, administrative. The fact that the virus and its consequences are still little known by the scientific community makes the choices for containing the disease more complex, making nonpharmaceutical interventions (NPIs) essential[51]. Social distance and isolation strategies are defended by international organizations, such as the World Health Organization, as the best alternatives to contain their dissemination. In addition to them, other actions, such as adopting emergency income, granting credits to companies affected by social isolation distancing and investing in science are important and contribute to mitigate the social and economic effects resulting from the pandemic. Besides, the correct use and dissemination of information and clarification by the people about the effects of the coronavirus are essential for the population to

[51] "NPIs are public health measures with personal, environmental and community scope" (GARCIA & DUARTE, 2020). As the authors explain, these include hand hygiene, respiratory etiquette, social distancing. use of masks, rooms kept well-ventilated, adoption of indoor environments and surfaces routine cleaning and so forth.

maintain confidence in actions to prevent the spread of the virus and avoid the dissemination of false information. In this sense, Moon (2020) shows how South Korea raised social cooperation and participation in social distance and personal sanitization practices, adopting a massive social distance campaign and transparency policy. South Korean government embraced the use of technology and information disclosure as up-to-date statistics on infected cases, the fatality rate and details of the movement path of each individual infected patient prior to being quarantined.

Taking the opposite direction of international standards and the stand of civil society, which reinforce the importance of using data to combat COVID-19, President Jair Bolsonaro signed in March a Provisional Measure, no. 928/2020 in March, which suspends the AIL deadlines for the duration of the public calamity period. In a Technical Note released by the Institute for Applied Economics Research, (IPEA, 2020), the justifications for the suspension of deadlines, such as the adoption of telework, which would affect the work of the officials responsible for responding to access to information requests, and their redirection to emergency functions in the fight against COVID-19, are not reasonable since, according to the National Congress, 99.3% of requests for access to information are made virtually. Thus, the teleworking system would not impair the provision of information remotely. Also, not all the officials were redirected to work in actions related to the pandemic.

That said, the cost of suspending AIL deadlines would be significant. Public information is the basis for discussion about COVID-19, as data contributes to build evidence-based public policies (SANTOS & MOTA, 2020). In addition, information related to the pandemic should be prioritized, as they need to circulate quickly and efficiently. Ideally, information of great relevance should be actively available, avoiding the need of excessive work by the public servants to respond to requests for access to information. However, if civil society or the media are unable to access information in active transparency, the response system should work normally, for the reasons already listed.

As a way of contributing to the understanding of the coronavirus situation faced in Brazil, some civil society initiatives emerged. The developers' community Brasil.io[52] has made information related to the pandemic accessible, by making databases available in open format and especially contributing to the compilation of municipal data, which are extremely important and permit measuring the pandemic over the territory. Another civil society initiative is the Transparency Index developed by Open Knowledge Brasil (OKBR)[53]. The index assesses the quality of pandemic data

[52] <https://brasil.io/home/>

[53] When the index was first launched at the beginning of April 2020, 90% of the Brazilian states presented insufficient data on the pandemic. In June, 89% of them had a high level of transparency. For further information on the index and the evolution of methodologies developed by the organization, visit: <https://transparenciacovid19.ok.org.br/>.

disclosed by states, their capitals and the Federal government, and has largely contributed to the quality and availability of data (OPEN KNOWLEDGE BRASIL, 2020).

Likewise, the Brazilian chapter of NGO Transparency International built a Transparency Ranking disclosing data on emergency public contracts from the same federative entities as OKBR's index. This ranking also pointed to good results in most states. BOCG also launched a panel for COVID-19 related contracting data[54] to monitor expenses for all Brazilian states, the Federal Government and municipalities of more than 500,000 inhabitants and other 200 that are partners with the agency.

While absolutely important, capitals and major cities are not a representative sample of Brazilian municipalities. Although 50 million Brazilians live in the capitals, residents of Brazilian cities with less than 150,000 inhabitants represent approximately 50% of the population[55].

Municipalities reveal and reaffirm themselves as the smallest units of governmental action in face of the usual public policy challenges and, therefore, of the pandemic. Considering the need for accountability for democratic regulation and the role of municipalities in Brazilian federalism, the analysis of the transparency of the epidemiological issues at the local level and the actions of the local authorities in combating the coronavirus are an essential part in the global understanding of governmental action to fight the pandemic.

4 Research Methodology

4.1 Sample Selection

A random sampling was drawn from the total of Brazilian municipalities. In order to guarantee representativeness, the typology defined by IBGE (2017) for rural and urban municipalities was considered.

By taking the municipality classification into account, it is possible to investigate if different patterns of interaction between urban and rural areas are related to the transparency level. In that case, economics activities, behavior patterns, culture, among other factors that distinguish urban and rural municipalities (IBGE, 2017), could influence citizens' preferences. Hence, different kinds of preferences plus different capacities in offering public policies could constitute different scenarios

54 https://app.powerbi.com/view?r=eyJrIjoiYTE0Nzc4NDctMTI0OC00OWVjLThjMmQtM2U3MTFkY2U2MTU2IiwidCI6IjY2NzhkOWZlLTA5MjEtNDE3ZC04NDExLTVmMWMxOGRlZmJiYiJ9

55 According to the estimate of resident population in Brazil in 2019 made by IBGE, municipalities with less than 150.000 inhabitants have 104 millions residents. In turn, the smallest capital, Palmas - TO, has almost twice as much - 299.127 inhabitants.

to urban and rural municipalities. Soon, it is relevant to comprehend if these differences are correlated to the transparency.

The IBGE (2017) typology employs a new methodology constituted by three dimensions: (i) population density, by new methods adequate to the international practices; (ii) population proportion in dense areas; and, (iii) accessibility to nearby urban centers. Based on the crossing of these variables it is possible to distinguish three types of spaces: urban, intermediate and rural[56].

Taking this typology as source[57], we calculate a random sample with 90% of confidence level and 10% of margin of error[58], totalizing 193 municipalities selected to analysis. The sample is better visualized in the Table 1, which presents the different kind of municipalities, the amount of the sample, the median of population size and the number of infected per 100,000 inhabitants. It is possible to observe that the municipalities general features are preserved, since the median of the urban municipalities size are superior in the universe, as well as in the sample. The same situation is observed in the number of infected by coronavirus. Furthermore, the low median just exposes the fact that Brazilian municipalities are mostly small compared to the big cities. This can be explained by the fact that only 17 municipalities have more than 1 million inhabitants, what represents 0.3% of the total (in our sample 1%). Even so, considering Brazilian population, the majority lives in small cities. For example, approximately half of Brazilians (50.7%) live in cities with less than 160.000 inhabitants, while 22% live in cities with more than 1 million. Thus, this research contributes to the empirical literature about transparency, since a representative sample of all the Brazilian municipalities is used, even when most of the works only analyze big cities.

Table 2 describes the sample in relation to the municipality distribution in regions. Although the percentages of the number of municipalities and the median of confirmed cases of the novel coronavirus in the sample are apparently consistent with the universe distribution, the median of the population shows some deviation regard to the universe distribution, the most notable being the fact that the sampled municipalities in the South have more inhabitants than actually are.

[56] Considering the third dimension, accessibility to urban centers, the rural and adjacent intermediate categories (close to urban centers) and remote categories are divided. However, in order to maintain a feasible sample size for analysis, we do not consider these subcategories.

[57] As the classification was carried out in 2017, there was no classification for 5 municipalities created after the date: Mojuí dos Campos - PA; Pescaria Brava - SC; Balneário Rincão - SC; Pinto Bandeira - RS; Paraíso das Águas - MS

[58] Despite the comprehensive values of the parameters (level of confidence and margin of error), this guaranteed us a feasible sample size to employ the qualitative analysis of transparency in Brazilian municipalities in a short period of time.

Table 1 – Proportion of municipalities according to rural and urban type

	Universe				Sample			
	Size	(%)	Population median[a]	Infected median[b]	Size	(%)	Population median[a]	Infected median[b]
Urban	1456	26.2	41687	334.1	65	33.7	39387.5	414.6
Intermediary	746	13.4	18703	283.6	62	32.1	18837	335.9
Rural	3363	60.4	7836	221.6	66	34.2	5861.5	195

[a] Data source: IBGE population estimation for 2019.
[b] Last rate of infected per 100,000 inhabitants available at July 4th, 2020. This data was not available for 401 municipalities (13 in the sample). Data source: State Secretariats of Health, compiled by Brasil.IO project.

Table 2 - Proportion of municipalities according to region

	Universe				Sample			
	Size	(%)	Population median[a]	Infected median[b]	Size	(%)	Population median[a]	Infected median[b]
Midwest	467	8.4	10186.5	190	20	10.4	13774	251.6
Northeast	1794	32.2	14701	414.3	52	26.9	18290.5	451.9
North	450	8.1	16981	867.9	12	6.2	10903	793.6
Southeast	1668	30	12540	188.6	70	36.3	18683	220
South	1191	21.4	8270	171.5	39	20.2	13448	174.4

[a] Data source: IBGE population estimation for 2019.
[B] Last rate of infected per 100,000 inhabitants available at July 4th, 2020. This data was not available for 401 municipalities (13 in the sample). Data source: State Health Secretariats, compiled by Brasil.IO project.

4.2 Data Collection

In order to understand if municipalities are disseminating and sharing information about the coronavirus pandemic, both active and passive transparency are analyzed. We consider AIL Articles 8º and 10º, which define that it is the duty of public agencies both to promote collective interest disclosure and provide information for the request of any interested. In addition, we have included social networks as a tool of active transparency, since many Brazilian municipalities use them for disclosure and information sharing.

4.2.1 Passive transparency

For the analysis of passive transparency, we submitted two sets of questions through institutional websites used to request for information on July 11, 12 and 13, 2020. After 32-35 days we

confirmed the answers, considering period defined in the AIL[59] for responses. The first set of questions concerned information related to:

- **Epidemiological issues:** number of cases, deaths, hospitalizations, suspected cases.
- **Legislation:** mandatory use of masks and closing of shops.
- **Health structure:** number of Intensive Care Unit beds intended for the treatment of the disease.

The second set contained questions related to:

- **COVID Budget:** how much was invested to fight the disease, purchases made with no bidding and transfers received by the municipalities from the federal and state governments and private institutions.

Also, the possibility of sending requests for access to information by electronic system in the institutional website and the average response days for both sets were analyzed. Answers were tabulated informing the dates they were received and if the questions made were answered completely or partially, if they redirected to active transparency and if the information available answered the questions, or if there was a deadline extension.

4.2.2 Active transparency

In the case of analysis on active transparency, we conducted an active research on the municipalities institutional websites and social networks (Facebook and/or Instagram). The analyzed variables were:

- **COVID information on website:** if the municipality provides information about the disease on the website, if there is an exclusive website for this purpose, if information is available on the transparency portal[60] and if information is available on social networks.
- **Data presentation: i**f the municipality provides information through health bulletins and if they were up to date in the week of collection, if they are daily updated daily, and if the information available is in an open format, in a history series or in a data panel.
- **COVID Budget:** if the municipality presents information on expenses and revenues.

Subsequently, the information was organized in databases and analyzed through the comparison of descriptive statistics and logistic regression. In this way, we intend to understand the profile of

[59] AIL defines that requests must be answered within a period of up to 20 days, which can be extended for a maximum of 10 days more, upon justification.

[60] According to AIL, Brazilian municipalities are required to disclose information on official websites.

the municipalities and the relation that exists between the main factors of information disclosure and the social and economic characteristics of the municipalities.

4.3 Descriptive analysis

Based on the data collected, the profile of Brazilian municipalities in relation to active and passive transparency was built by comparing descriptive statistics, mainly by mean and median (presented as a percentage, since information was compiled as binary variables). In other words, the data collected were encoded in order to show: (i) whether Brazilian municipalities disclose information regarding the epidemiological and budget situation; (ii) by which means and how often they share information; (iii) the disclosed information format; (iv) if requests for more complex information are answered; (v) if they answer information about expenses and revenues; and, (vi) if the answer are satisfactory or complete. While the first three items are related to active transparency, the others are related to passive transparency. In addition, we compared the municipalities results by its classification (urban or rural).

We also select variables that are representative of each type of transparency to see whether there is a correlation between practices. For that, Pearson correlation coefficient were performed, and arranged in a correlation matrix with significant coefficients highlighted in bold. The level of significance considered was the p-value of the T statistic less than 5%. The chosen variables are the same ones used as dependent variables in the logistical changes, described in the next subsection.

4.3.1 Logit model

Given the quality of the compiled database, it was possible to identify how transparency worked in Brazilian municipalities, the relationships that exist between important factors in the dissemination of information and comparable characteristics between municipalities. Transparency on the municipality health context is crucial regardless of its status. However, it is expected that the local severity of the pandemic would increase the pressure for the availability of information about it in the city, as it is also expected to have higher demands on the numbers of cases and their condition (confirmed, suspected, deaths, recovered), treatment capacity (number of ICU beds and occupancy rate) and information related to the budget allocated to fight the pandemic. Thus, it is expected that factors that explain transparency in a non-pandemic context are also related when there is a pandemic. This is the case, for example, of human development, as it is expected that the population with more education and income will be more demanding for public administration (TOLBERT, MOSSBERGER, & MCNEAL, 2008; BALDESSERA et al., 2020;

MICHENER, CONTRERAS & NESKIER, 2018). Local wealth is also associated with higher levels of transparency, greater availability of resources for municipal governments associated with larger GPD increases pressure for transparency (CRUZ et al., 2012; BALDESSERA et al., 2020). The same is also true for the population, since a larger population increases conflicts of interest and consequently increases the pressure for information. (BALDESSERA et al., 2020). Aspects related to the fact that municipalities are rural, urban or intermediary cannot be disregarded either, since cultural factors may represent different demands and capacity for transparency offers.

Given these possible relationships, the following logarithmic regression with robust standard errors to address heteroscedasticity was estimated for important binary variables related to both active and passive transparency:

$$Tranparency_i = \beta_0 + \beta_1 COVID_i + \beta_2 GPD_i + \beta_3 Urban_i + \beta_4 Rural_i +$$
$$\beta_5 pre\ COVID\ Transparency_i + \beta_6 Education + \beta_7 Longevity + \beta_8 Population + \beta_9 Region$$

The dependent variable represents dummies about the information collected in the random sample of cities. In the case of active transparency, the following binary variable was estimated: (i) daily updated epidemiological bulletin, named as “Daily updated bulletin” in result table 4; (ii) information about expenses and revenues, “Expenses and revenue”; (iii) institutional website with epidemiological information, “Institutional website”; and (iv), disclosure of epidemiological information on social networks, “Social networks”. The value 1 was assigned to variables where these characteristics were observed in each topic, and 0 when not (e.g., if the municipality used social networks to disclose the number of cases and deaths, the value 1 was attributed to the variable "Social networks").

For passive transparency, binary variables were considered as to whether the municipality answered questions regarding the: (i) epidemiological information (recovered, suspected, hospitalized and deaths), named as “Epidemiological data” in results table 6; (ii) treatment capacity (number of beds for COVID and ICU beds), “Treatment capacity”; (iii) whether there are laws on the restriction of commerce and mask use, “Legislation”; and (iv), information on the budget dedicated to fighting the pandemic (expenses, bidding, revenues and donations), “Budget”. I.e., when a municipality answered all questions (partially or completely), a value of 1 was assigned, if it did not answer one or more questions related to the topic, a value of 0 was assigned. E.g., if the municipality answered all questions about epidemiological information, it was the value 1 was attributed to the variable "Epidemiological data".

The first dependent variable, COVID, represents the disease situation in the municipality. It was considering the logarithm of the last number of confirmed cases of COVID-19 made available by

the states of the municipalities on the day of information collection (data compiled by the Brasil.IO platform[61]). It was also considered the logarithm of the municipal GPD available for 2017 by the IBGE in reais (R$). Through the classification of IBGE municipalities, dummies of rural and urban were included (therefore, excluding intermediate). To control and verify whether there is a relationship with the transparency not related to the pandemic, we use the only indicator available for all the municipalities in the sample, *Escala Brasil Transparente* [Transparent Brazil Scale, in free translation] made by Federal Public Prosecutor's Office (MPF, 2016)[62]. Considering human development factors, the HDI specific about education and longevity from 2010 was used. Since we already include GPD and control it with the logarithm of population size, it's redundant to include the HDI for income. For population size, we use the IBGE's estimation for 2019. In addition, since culture and norms differ across different regions, binary variables for the regions were included.

5 Results

5.1 Active Transparency

The table below informs the inhabitants averages, confirmed cases of COVID per 100,000 inhabitants, deaths and the percentages of the active transparency variables collected in the sampled municipalities. In general, urban and intermediate municipalities show better results than rural municipalities. It means that rural municipalities disseminate less information related to the disease and in fewer digital platforms. Analyzing specifically the latter, social networks are the most used means of information disclosure, with 68.9% of the total of municipalities. Considering the municipalities' websites, information is shared in fewer cases on the transparency portal (13.0%) or on specific websites (7.3%), with the information being mostly displayed on the main city hall website in 56% of the cases. In addition, 15% of the sample does not provide information anywhere. Regarding the way in which the information is arranged, in general, data is not made available in more transparent ways, such as raw data (2.6%), time series (10.4%) and data panel (5,7%), being made available mostly by epidemiological bulletins (78.2%) that were not necessarily updated or released daily.

The high rates of budget availability, present in 80.3% of the cities, related to the fight against coronavirus can be related to Law No. 13,979 of February 6, 2020[63], which disposes about

[61] In four municipalities, data were not available. It was possible to access to collect information from three on the city hall website, leaving only one municipality with missing value and 7 with more than two days from the last available information.

[62] Measures the active and passive transparency on public expenditure in 2016.

[63] Available: http://www.planalto.gov.br/ccivil_03/_ato2019-2022/2020/lei/l13979.htm

measures to fight the virus. It determines that all contracts or acquisitions must be made available within a maximum period of 5 working days on the official website.

Table 3 – Active transparency description

Municipalities (means)	**Total**	**Urban**	**Intermediary**	**Rural**
Population	75662.8	200061.6	18046.1	7273.6
Confirmed /10^5 inhabitants	791.2	871.1	855.2	637.1
Deaths	53.4	152.1	4.2	1.5
Website with information on COVID				
Institutional website	56.0%	73.8%	51.6%	42.4%
Specific website for COVID	7.3%	15.4%	4.8%	1.5%
Transparency Portal	13.0%	16.9%	11.3%	10.6%
Social networks[a]	68.9%	75.4%	69.4%	62.1%
Data presentation				
COVID bulletin	78.2%	83.1%	82.3%	69.7%
Daily COVID bulletin	59.6%	69.2%	62.9%	47.0%
Updated COVID bulletin	72.0%	81.5%	71.0%	63.6%
Raw Data	2.6%	4.6%	1.6%	1.5%
Time Series	10.4%	23.1%	3.2%	4.5%
Data Panel	5.7%	10.8%	1.6%	4.5%
COVID Budget				
Expenses and Revenue	80.3%	86.2%	80.6%	74.2%

Note: research results. We consider COVID information data about the number of confirmed cases and death.
[a] Municipality Facebook and/or Instagram accounts

To find out whether the severity of the pandemic is correlated or not with the specific active transparency on the novel coronavirus, even considering factors commonly pointed out in the literature that explain the variation in transparency, we present in Table 4 the logit regression with robust standard errors. The results are clear about the positive correlation of the number of confirmed new coronavirus cases with daily disclosure of epidemiological bulletins and the use of social networks for information disclosure, considering a 10% significance, which is also the case of the use of the institutional website of the municipality. Furthermore, probably due to the aforementioned law that enforces transparency of COVID related expenses in all Brazilian municipalities, there is no significant relation between transparency and higher or lower number of COVID cases. I.e., the fact that a municipality have more or less infected does not matter because the law requires disclosure of expenses for all. Another interesting fact is that, in contrast with the evidence of recent researches about municipalities transparency in pre-pandemic context, socioeconomic variables do not present a significant relation with these representative variables

of active transparency. The only exception is the positive or negative relation of some regions and the MPF's transparency score, which increased the probability of the institutional website with epidemiological information. While cities from Northeast presented more chances to present daily bulletins, Midwest cities are more likely to break the law on transparency in expenditure.

Table 4 – Logit regression for active transparency

	Daily updated bulletin	Expenses and revenue	Institutional website	Social networks
Variables	(1)	(2)	(3)	(4)
COVID cases (log.)	0.349**	0.197	0.280*	0.326**
	(0.163)	(0.197)	(0.161)	(0.164)
GPD (log.)	-0.043	0.923	0.093	0.134
	(0.328)	(0.668)	(0.276)	(0.331)
Urban	-0.120	-0.516	0.767	-0.002
	(0.504)	(0.656)	(0.528)	(0.512)
Rural	-0.369	0.223	0.130	0.173
	(0.459)	(0.566)	(0.462)	(0.504)
Transparency score	0.091	-0.046	0.125**	0.042
	(0.064)	(0.084)	(0.063)	(0.066)
HDI Education index	0.952	5.821	-1.064	-3.853
	(2.837)	(3.863)	(3.055)	(2.974)
HDI Longevity index	2.916	5.207	-5.017	8.181
	(6.781)	(8.365)	(6.642)	(7.456)
Population (log.)	-0.324	-0.982	-0.079	-0.213
	(0.308)	(0.742)	(0.175)	(0.264)
Northeast	2.475***	-0.354	0.262	1.260*
	(0.940)	(1.139)	(0.677)	(0.751)
Midwest	1.819*	-2.972**	0.108	1.084
	(1.030)	(1.270)	(0.878)	(0.894)
Southeast	1.535	-1.601	0.571	1.012
	(0.956)	(1.244)	(0.788)	(0.849)
South	1.229	-2.249*	-0.530	1.331
	(1.001)	(1.342)	(0.832)	(0.903)
Constant	-2.364	-7.166	2.187	-5.877
	(5.241)	(6.642)	(4.745)	(5.312)

Note: *p<0.1; **p<0.05; ***p<0.01. Standard deviation in brackets. N.= 192.

5.2 Passive transparency

The data collected from the sampled municipalities on passive transparency are shown in Table 5. In a considerable number of municipalities, it was not even possible to carry out a request for

information (19.7%), as the access to information system presented problems or did not exist. In the period between 31 and 35 calendar days past the request, only 24.3% of the municipalities replied both requests for information (considering those that answered at least one, 31%). Although many municipalities have already disclosed information related to budget, as seen in the previous section, the second request (exclusively for questions in this subject) was the least replied, despite the small difference of 3.6%. For those that responded to the second request, 72% referred to active transparency in at least one question, while only 17.5% submitted questions in the first request. We can observe that, in general, there was a higher response rate for urban municipalities in relation to intermediate and rural municipalities, a pattern that is repeated in the specific questions of the different subjects.

Table 5 – Passive transparency description

Municipalities (means)	**Total**		**Urban**		**Intermediary**		**Rural**	
Population	75662.8		200061.6		18046.1		7273.6	
Confirmed/10^5 inhabitants	592.4		674.0		616.6		475.4	
Deaths	49.9		143.2		3.3		0.9	
Response to requests								
Possible to request	80.3%		86.2%		80.6%		74.2%	
Replied the 1st request	29.5%		46.2%		24.2%		18.2%	
Days to respond (average)	13.7		13.0		13.4		16.0	
Replied the 2nd request	25.9%		35.4%		24.2%		18.2%	
Days to respond (average)	13.5		11.1		15.1		16.3	
Epidemiological data	Replied[a]	Complete[b]	Replied[a]	Complete[b]	Replied[a]	Complete[b]	Replied[a]	Complete[b]
All	22.3%	20.7%	35.4%	33.8%	17.7%	17.7%	13.6%	10.6%
Recovered	26.4%	22.3%	43.1%	35.4%	21.0%	21.0%	15.2%	10.6%
Suspect	25.4%	23.3%	40.0%	36.9%	21.0%	21.0%	15.2%	12.1%
Hospitalized	23.3%	21.2%	38.5%	35.4%	17.7%	17.7%	13.6%	10.6%
Deaths	26.9%	23.3%	43.1%	38.5%	21.0%	21.0%	16.7%	10.6%
Treatment capacity								
All	21.8%	18.7%	27.7%	26.2%	21.0%	16.1%	16.7%	13.6%
Hospital beds	22.8%	21.2%	35.4%	33.8%	19.4%	19.4%	13.6%	10.6%
ICU beds	22.8%	20.2%	36.9%	32.3%	17.7%	17.7%	13.6%	10.6%
Legislation								
Mask and restrictions	25.4%	24.4%	40.0%	38.5%	21.0%	21.0%	15.2%	13.6%
Budget								
All	21.8%	18.7%	27.7%	26.2%	21.0%	16.1%	16.7%	13.6%
Monthly spend	25.9%	23.8%	35.4%	35.4%	24.2%	21.0%	18.2%	15.2%
Public procurements	25.9%	23.8%	35.4%	35.4%	24.2%	21.0%	18.2%	15.2%
Revenues	23.8%	22.8%	29.2%	29.2%	24.2%	22.6%	18.2%	16.7%
Donations	21.8%	19.2%	27.7%	26.2%	21.0%	16.1%	16.7%	15.2%

Note: research results.
[a] Whether the municipality answered the question completely or incompletely.
[b] If the municipality answered the question completely

Detailing the results on the question topics, we see that the response rate varied between 21.8% and 25.4% considering whether the totality of the questions on a given topic were answered, i.e., leaving no question unanswered. Adopting the exact answer criterion of what was asked (complete answer), values are not so different. They did not necessarily answer all questions, since 44% of the municipalities that answered ignored at least one question. However, although

municipalities are unlikely to answer questions related to the pandemic, if they do, the answer will be satisfactory.

Based on the results of the logistic regression that aimed to ascertain possible relationships between the local severity of the pandemic and socioeconomic factors with passive transparency, the differences in comparison with active transparency are remarkable. Each dependent variable represents whether all question from a topic were replied. Unlike the factors representing the other type of transparency, the confirmed cases of COVID do not explain whether the municipalities answered the questions associated with a theme or not. Considering the significance level of 5%, only the municipal GDP showed a (positive) correlation with the fact that the municipality answered all questions about epidemiological information as well as whether there is legislation about restrictions on commerce or the use of masks. In addition, municipalities with a higher level of transparency in 2016 were more likely to have answered the question about the legislation, and considering the significance level of 10%, the same applies to other variables on whether the municipality answered the thematic questions.

Table 6 – Logit regression for passive transparency

Variables	Epidemiological data (1)	Treatment capacity (2)	Legislation (3)	Budget (4)
COVID cases (log.)	0.112	0.292	0.253	0.292
	(0.219)	(0.218)	(0.233)	(0.218)
GPD (log.)	0.797**	0.495	0.887***	0.495
	(0.341)	(0.381)	(0.343)	(0.381)
Urban	-0.231	-1.031	-0.282	-1.031
	(0.636)	(0.672)	(0.650)	(0.672)
Rural	0.405	0.496	0.575	0.496
	(0.596)	(0.602)	(0.592)	(0.602)
Transparency score	0.174*	0.171*	0.226**	0.171*
	(0.098)	(0.095)	(0.100)	(0.095)
HDI Education index	3.138	5.824*	1.515	5.824*
	(3.345)	(3.390)	(3.466)	(3.390)
HDI Longevity index	3.263	-7.461	0.317	-7.461
	(9.599)	(8.686)	(8.948)	(8.686)
Population (log.)	-0.328	-0.075	-0.327*	-0.075
	(0.203)	(0.200)	(0.198)	(0.200)
Northeast	-0.531	-1.019	-0.208	-1.019
	(0.819)	(0.864)	(0.858)	(0.864)
Midwest	-0.787	-0.256	-0.179	-0.256
	(1.074)	(1.048)	(1.103)	(1.048)
Southeast	-0.784	-0.726	-0.322	-0.726
	(0.976)	(1.014)	(1.054)	(1.014)
South	-0.387	-0.216	0.332	-0.216
	(1.051)	(1.110)	(1.157)	(1.110)
Constant	-13.911*	-5.880	-12.924*	-5.880
	(7.129)	(6.474)	(6.680)	(6.474)

Note: *p<0.1; **p<0.05; ***p<0.01. Standard deviation in brackets. N.= 192

5.3 Relationship between types of transparency

The correlation matrix between the variables representing the active and passive transparency used in the regressions elucidates how information is disseminated in Brazilian municipalities. Based on the significant correlations highlighted with bold numbers in Table 7, considering a p-value less than 0.05, there is evidence that municipalities that actively share information about the pandemic do not necessarily respond to requests for information on the same subject. In other words, active and passive transparency have no correlation between their variables. Based on the previous sections, this can be exemplified with information on the budget to combat the pandemic. Although many municipalities show information about this on their transparency portals, there was no higher rate of responses on the subject when analyzing passive transparency.

Looking at the relationship of variables of the same type of transparency, it appears that the representative factors are correlated with each other. However, the levels of correlation differ considerably in different types of transparency, although in general they are significant and positive. In the case of active transparency, the factors show a weak correlation since the values vary between 0 and 0.5. The correlation variation between the passive transparency factors is considerably greater: between 0.7 and 1. That is, if the municipality completely answers the questions of a certain topic about the pandemic, it tends to answer other topics.

Table 7 - Correlation matrix between active and passive transparency

	Variables	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
Active transparency	(A) Daily updated bulletins		**0.25**	**0.53**	**0.21**	0.03	0.02	0.04	0.02
	(B) Institutional website	**0.25**		**0.17**	0.11	0.07	0.04	0.06	0.04
	(C) Social networks	**0.53**	**0.17**		**0.15**	0.06	0.11	0.11	0.11
	(D) COVID Budget	**0.21**	0.11	**0.15**		0.01	-0.02	0.02	-0.02
Passive transparency	(E) Epidemiological data	0.03	0.07	0.06	0.01		**0.74**	**0.92**	**0.74**
	(F) Treatment capacity	0.02	0.04	0.11	-0.02	**0.74**		**0.79**	**1**
	(G) Legislation	0.04	0.06	0.11	0.02	**0.92**	**0.79**		**0.79**
	(H) Budget	0.02	0.04	0.11	-0.02	**0.74**	**1**	**0.79**	

Note: research results. Same variables from regression. N. = 193. Highlighted in bold text: $p<0.05$.

6 Discussion

The findings of this research show the importance of social networks in informing citizens about COVID-19 information. Do municipalities always use these tools or are we experiencing a moment of exception? Future investigation about public transparency should consider this variable in order to show if cities use this tool to inform citizens in normal conditions. We can assume as a hypothesis that social network was used in this case due to the epidemiological nature of the issue and the speed with which information must reach citizens. Also, that it is being largely used because it is easy to input information and it is a direct line that cities have found to communicate with their citizens and make their actions public. Furthermore, it can improve the visibility of the information, as said by Michener and Bersch (2013). This tool could be relevant in other

epidemiological or urgent issues and for disclosure of public policies that needs cooperation from citizens.

We observe that the number of infected seems to influence on the information disclosure related to epidemiological factors, but socioeconomics variables do not seem to have any relevance, different from the observed by some studies as Ribeiro and Zuccolotto (2012), Cruz et al. (2012) and Baldissera (2020). Even though information related to expenses and revenues is largely published, it is due to legislation enforcement, even in municipalities with less cases of new coronavirus. Yet, other basic information about the conditions of the municipalities in face of coronavirus pandemic - such as number of cases, deaths, hospitalizations, suspected cases - are not largely available on the institutional websites.

The publish of information should be accompanied by the quality of the information disclosure, considering visibility and inferibility (MICHENER; BERSCH, 2013). Our results show that a few municipalities are making raw data available, historical series or even data panels. Data presentation is very important, not only to the understanding of the situation, but also to the usability of the data by journalists or researchers. In this case, the quality of information is harmed. Besides that, time series information is very important to understand how the situation is evolving, in order to give the right picture. Good information and quality in data presentation are also important to build credibility and safety.

On the order hand, the passive transparency analysis presented a worrying situation. Around 19.7% of the municipalities analyzed presented problems or did not have a system to submit information requests. Only 29.5% for the first request and 25.9% for the second request were replied, i.e. even the possibility to ask for information, when it is not available, is inefficient. Even when the requests are answered, 44% of the of the municipalities that answered ignored at least one question. That is, even the answer does not guarantee that the information is being made completely available. Unlike active transparency, but partially aligned with the literature, only local GDP is correlated with the probability of municipalities answering certain questions, with no relationship to the local severity of the pandemic. However, it is important to emphasize that complacency to the law of access to information does not have high costs, being, in reality, dependent on incentives and leadership (MICHENER, CONTRERAS & NESKIER, 2018).

Given that most municipalities provide information on expenditures related to the coronavirus, it could be expected that municipalities would have no difficulty in answering the same information through passive transparency. However, this was not found among the selected municipalities. Our hypothesis is that the fact that there is a law that requires specific information to be made available on the institutional website at a time when institutions and civil society are continuously

monitoring governments and their responses to the pandemic increase the likelihood that municipalities will respect law. For instance, information related to epidemiological factors and its quality were very low. On the other hand, this cannot be reproduced for passive transparency. One possible explanation is because passive transparency is more difficult to monitoring by regulatory institutions or civil society and, as observed by Michener, Contreras and Neskier (2018), is more challenger to answer unexpected questions, that come from requests[64].

7 Conclusions

This work adopted a representative sample of Brazilian municipalities in order to understand how transparency has been functioning in the context of the new coronavirus outbreak. Through quantitative analysis (descriptive statistics, correlation test and logistic regression) we can identify the profile of transparency in rural and urban municipalities. In general, it is possible to say that this profile is constituted by the dissemination of epidemiological information on social networks and the provision of information on the budget to combat the virus, but the availability of data in a more informative and higher quality way such as time series and interactive data panel are less frequent or absent. Another shortcoming is the lack of response to requests for information, i.e., often municipalities do not respond to requests for information about the pandemic.

One possible explanation is that normative factors seem to have importance in the variation in the level of transparency. For example, legislation enforcement was important in order to force municipalities to publish information about expenses and revenues related do COVID-19. On the contrary, information related to epidemiological factors which did not have any law enforcing its disclosure was more infrequent. It could be related to the fact that passive transparency is more difficult to monitoring and is more challenger to municipalities answer unexpected questions. Further inquiring is necessary to check the veracity of this hypothesis. Additionally, a good level of one kind of transparency do not guarantee that the other will perform well too, i.e. active transparency does not mean that the same actively published information will be send as a response in case of requests.

These results show the urge to improve both active and passive transparency. Low rates of response to requests demonstrate the insufficient quality of passive transparency, while the quality of information available in active transparency is very low too. Improving them is important, not only in this pandemic reality, but for the proper functioning of democracy. Additional research will be necessary to monitor how the municipalities deal with the need to increase transparency and

[64] For example, though illegal, it seems to be a common practice among public officials to search for the identity of applicants, affecting the quality and possibility of responses.

deepen the analyses exposed here, such as the relevance of social networks as a tool for disseminating information and different enforcement strategies for both active and passive transparency.

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Appendix

Following, the questions sent to the municipalities through passive transparency, translated into English and the original in Portuguese:

Request number 1:

"Dear,

I address some questions in order to understand the situation of the pandemic in Brazilian municipalities.

In amounts referring to June 30:
1. How many coronavirus deaths occurred in the municipality?
2. Of confirmed cases, how many had already been cured?
3. How many beds are used to treat covid-19?
4. How many of these beds are ICU?
5. How many were hospitalized because of the disease?
6. Were the use of masks in the city and the closing of shops determined?
7. How many cases were suspected or under investigation?

Thanks in advance."

Request number 2:

“Dear,

I address some questions in order to better understand the situation of the pandemic in Brazilian municipalities and what is the financial impact of measures to combat the disease on the municipal budget.

1. How much did the municipality spend on measures to combat the pandemic (report the amounts separately for each month)?

2. What purchases were made with no bidding due to the pandemic? (enter values separately for each month). We would like the contracts or email address where you can access them.

3. Did the municipality receive transfers from another entity (Federal Government and / or State Government) to combat the pandemic? If so, what were the amounts received? (enter values separately for each month)

4. Did the municipality receive funds from private institutions? If so, what were the amounts received? (enter values separately for each month)

Thanks in advance.”

Questionário número 1:

“Prezadas (os),

Encaminho algumas questões com intuito de compreender melhor a situação da pandemia nos municípios brasileiros.

Em valores referentes ao dia 30 de junho:
1. Haviam quantas mortes por coronavírus no município?
2. De casos confirmados, quantos já tinham sido curados?
3. Quantos leitos são destinados para tratamento da covid-19?
4. Quantos desses leitos são de UTI?
5. Haviam quantos internados por conta da doença?
6. Foi determinado o uso obrigatório de máscaras na cidade e o fechamento dos comércios?
7. Haviam quantos casos suspeitos ou em investigação?

Agradeço desde já.”

Questionário número 2:

“Prezadas (os),

Encaminho algumas questões com intuito de compreender melhor a situação da pandemia nos municípios brasileiros e qual o impacto financeiro das medidas de combate à doença no orçamento municipal.

1. Quanto o município gastou com medidas de combate à pandemia (informar os valores separadamente para cada mês)?

2. Quais compras foram feitas com dispensa de licitação por conta da pandemia? (informar os valores separadamente para cada mês). Gostaríamos dos contratos ou de endereço eletrônico onde seja possível acessá-los.

3. O município recebeu repasse de outro ente (Governo Federal e/ou Governo Estadual) para combate à pandemia? Se sim, quais foram os valores recebidos? (informar os valores separadamente para cada mês)

4. O município recebeu recursos de instituições privadas? Se sim, quais foram os valores recebidos? (informar os valores separadamente para cada mês)

Agradeço desde já.”

Open Government Data (OGD) driven decision aid: a predictive model to monitor COVID-19 and support decisions in a Brazilian State[7]

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The objective of this research is to build a forecasting model for the evolution of COVID-19 in the state to assist governmental decision-making. This study adopts the Continuous Intelligent Pandemic Monitoring (CIPM) methodology to evaluate the COVID-19 situation in the state of Santa Catarina, Brazil. By examining data from the state of Santa Catarina, this research examines the reasonableness of current epidemic numbers by using different exogenous variables, determines the severity level of the pandemic in the cities, and simulates its impacts to guide the government in terms of adequate public policy enforcement. The results reveal that the model helps to understand the importance of open data, and highlights the relevance and social contribution of the availability of data in real-time. Additionally, the prediction model contributes to governmental and societal decision making, as it helps to understand the effects of the pandemic on society through the analysis of exogenous variables (Demographic density; Industrial jobs; Percentage of urban population; Territorial extension of the municipality; List of municipalities by region; GDP/Per capita).

Keywords: COVID-19, Open Government Data, Predictive Capacity, Analytic Methodologies, Decision Aid

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Apoio à decisão orientada por Dados Abertos Governamentais (DAG): proposta de modelo preditivo para monitorar COVID-19 e subsidiar decisões em um estado brasileiro

O objetivo desta pesquisa é construir um modelo de previsão da evolução do COVID-19 no estado para auxiliar na tomada de decisões governamentais. Este estudo adota a metodologia Continuous Intelligent Pandemic Monitoring (CIPM) para avaliar a situação do COVID-19 no Estado de Santa Catarina, Brasil. Ao examinar os dados do Estado de Santa Catarina, esta pesquisa examina a razoabilidade dos números atuais da epidemia por meio de diferentes variáveis exógenas, determina o nível de gravidade da pandemia nas cidades e simula seus impactos para orientar o governo em termos de público adequado para a aplicação de políticas públicas. Os resultados revelam que o modelo ajuda a compreender a importância dos dados abertos e destaca a relevância e a contribuição social da disponibilização de dados em tempo real. Além disso, o modelo de previsão contribui para a tomada de decisão do governo e da sociedade, pois ajuda a entender os efeitos da pandemia por meio da análise de variáveis exógenas (Densidade demográfica; Empregos industriais; Percentual da população urbana; Extensão territorial do município; Lista de municípios por região; PIB / per capita).

Palavras-chave: COVID-19, Dados de Governo Aberto, Capacidade Preditiva, Metodologias Analíticas, Apoio à Decisão

Apoyo a la decisión orientada por Datos Abiertos Gubernamentales (DAG): proposición de modelo predictivo para monitorear el Covid-19 y subsidiar decisiones en un estado brasileño

El objetivo de esta investigación es construir un modelo de pronóstico para la evolución del COVID-19 en el estado para ayudar en la toma de decisiones gubernamentales. Este estudio adopta la metodología de Continuous Intelligent Pandemic Monitoring (CIPM) para evaluar la situación del COVID-19 en el estado de Santa Catarina, Brasil. Al examinar los datos del estado de Santa Catarina, esta investigación examina la razonabilidad de las cifras de epidemias actuales con el uso de diferentes variables exógenas, determina el nivel de gravedad de la pandemia en las ciudades y simula sus impactos para orientar al gobierno en términos de público adecuado para definición de políticas públicas. Los resultados revelan que el modelo ayuda a comprender la importancia de los datos abiertos y destaca la relevancia y la contribución social de la disponibilidad de datos en tiempo real. Adicionalmente, el modelo de predicción contribuye a la toma de decisiones gubernamentales y sociales, ya que ayuda a comprender los efectos de la pandemia en la sociedad a través del análisis de variables exógenas (Densidad demográfica; Empleos industriales; Porcentaje de población urbana; Extensión territorial del municipio; Listado de municipios por región; PIB / per cápita).

Palabras clave: COVID-19, datos de gobierno abierto, capacidad predictiva, metodologías analíticas, apoyo a la toma de decisiones

Introduction

Covid-19 originated in Wuhan, China, with the first recorded cases in December 2019. On March 11, 2020, it was declared a pandemic by the World Health Organization (DESJARDINS et al., 2020). This is because Covid-19 reached the epidemiological criteria of a pandemic, with more than 100,000 infected people in 100 countries (CALLAWAY, 2020).

The consequences of the Covid-19 being declared a pandemic by the World Health Organization in March 2020, involved measures in many countries around the world and had a profound impact on society, both from a social and economic point of view. It is the role of the state to safeguard universal rights to health and life, through actions related to public health, political and institutional arrangements, hiring, acquisitions, and directing productive resources in an effective and timely manner to confront the pandemic.

Brazil, with the second-highest number of confirmed cases[65], has become the second most severe hub after the U.S. In Brazil, from February 26 to August 17, 2020, there have been 3,340,197 confirmed cases, with 107,852 deaths. Federal and state governments are proactively seeking a way to control the spread of the disease, provide guidance to the citizens to prevent the infections, and deploy adequate resources to hospitals and regions to ease the impact of Covid-19.

What is already known about this pandemic is that the risk of transmission is considered uncontrollable so far because there is no cure, and the vaccines may not be available for a few months (Atluri, Manchikanti & Hirsch, 2020), which promotes global panic (CHIOLERO, 2020) and serious already perceived economic consequences (XIANG et al., 2020; CANDEAIS; MORHARD, 2020).

Decision making should be performed using the principle of proportionality, weighing compromising usual standards against the optimization of benefits to the greater society (SOLNICA; BARSKI; JOTKOWITZ, 2020).

With the lack of cure or vaccines in the short term, information becomes the only way to confront Covid-19, providing subsidies for government action, engagement and social control. The data and information made available by the government, in turn, becomes the raw material for generating public value, enabling the analysis of the evolution of the pandemic, the prediction of its behavior, and following public action more proactively and effectively. The use of analytical methodologieseis recognized as capable of providing important information for the governmental

[65] Johns Hopkins University COVID-19 Dashboard. https://coronavirus.jhu.edu/map.html

decision-making process in times of considerable uncertainty, such as the current crisis caused by the pandemic (FONG et al, 2020).

This study aims to *propose a predictive analytical model to support the Government of Santa Catarina in decision making* regarding Covid-19, and to demonstrate the potential usage of open government data – OGD – to generate public value. *Continuous Intelligent Pandemic Monitoring* – CIPM methodology (Duan; Hu 2020 a,b) and structured data in an open format, made available by the state of Santa Catarina and other government entities, are used. The CIPM model was implemented using a combination of archival and research data collected from 259 Brazilian municipalities, specifically in the state of Santa Catarina, to validate the related numbers, assess the epidemic severity of the cities and provide guidance to the government to better implement adequate public policies to the regions in need.

Santa Catarina stood out at the beginning of the pandemic for anticipating measures of containment and having a better performance than other Brazilian states in facing the pandemic. In Santa Catarina, Covid-19 has already caused 1,839 deaths, with a lethality of 1.49% in the identified cases. The cases were confirmed in all 295 municipalities in Santa Catarina, with 188 cities registering at least one death (SANTA CATARINA, 17.08.2020).

This study makes significant contributions to current pandemic control in the state of Santa Catarina. It provides an evaluation of the current evolution of the pandemic to the authorities and expands discussions on the use of open data, identifies the risky regions to deploy adequate resources, and guides the authorities to implement different policies at a specific time point and to society for social control. This study applies the CIPM methodology (Duan; Hu 2020 a,b) to the state of Santa Catarina, systematically evaluating the situation in the region. The study not just assesses the reasonableness of the Covid-19 confirmed cases, but also identifies the high-risk cities to better guide the government to deploy the resources and implement preventive actions.

This study is organized as follows. Section 2 discusses the current studies about Covid-19. Section 3 presents the methodology, including data collection and model construction. Section 4 illustrates the results of the evaluation. Section 5 concludes the study and discusses the limitation of this study as well as future research.

2. Literature Review

The risk of transmission of Covid-19 is considered uncontrollable so far because there is no cure, and vaccines may only be available in the next few months (Atluri; Manchikanti; Hirsch, 2020), which promotes global panic (CHIOLERO, 2020). Economic consequences are already

perceived, with the price of oil, the stock market, gold, currencies, and almost all areas of the global market being affected (XIANG et al., 2020). As a consequence, the spread of this pandemic can be considered the "greatest global economic risk" in recent years (CANDEAIS; MORHARD, 2020).

In search for solutions or alleviation of this problem, governments around the world have adopted social isolation as a security measure, following the Chinese case that demonstrated efficiency using the Covid-19 containment quarantine (WHO, 2020). However, social isolation brings an economic impact since companies are unable to produce or provide their services. This causes countries affected by the pandemic to adopt measures to combat the economic effects of the crisis, such as the postponement and exemption from taxes, in addition to social aid (GOPINATH, 2020; KPMG CHINA; LU, 2020; TANNE, 2020).

However, these measures have a paradox that calls into question the fiscal capacity of governments. While there is a reduction in revenue from taxes, at the same time, there is an increase in health and social spending. Besides the reduction of revenue from postponing and decreasing taxes, there is an increase in government spending on many areas including health, since the health system is under pressure from the exponential rise in the number of cases exceeding the installed capacity of the health system. For example, countries have needed to increase the number of ICU beds in hospitals, outpatient testing, hiring health personnel, purchasing materials, and equipment, etc.

Three significant strategies (Rafael et al 2020) have emerged for containing the rising curve of cases and deaths from Covid-19: 1) expansion of testing of suspected cases with quick delivery of results, 2) identification of transmitters of the disease with subsequent and immediate home isolation, 3) investments aimed at protecting health professionals.

The government of the State of Santa Catarina has taken several actions to minimize the social and economic impact of the pandemic, such as: opening data on Covid-19 agility, openness in the public procurement process, expansion of the hospital care network and emergency social assistance.

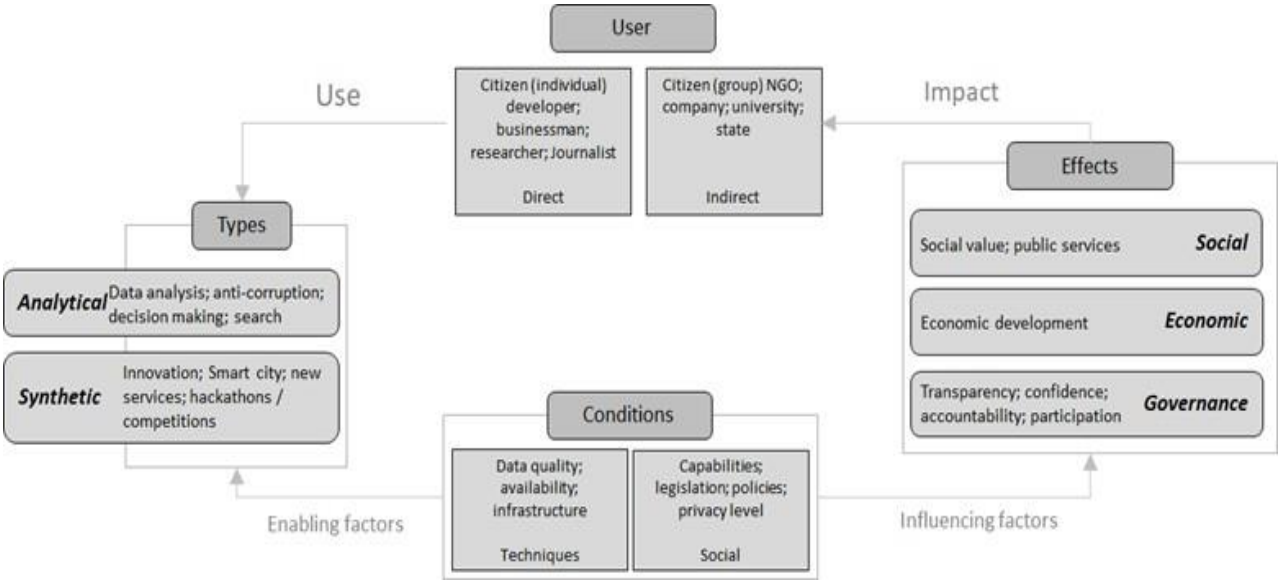
These strategies should lead to expanding assistance capacity of the health system, displacingt professionals focused on assistance, as well as monitoring, and implementing, community control strategies. The current crisis highlights the need to think about future pandemics from a population-based management approach and apply outside the box critical thinking (GONIEWICZ et al, 2020). Following this understanding, involves, on the one hand, the use of OGD to promote engagement and collaboration between government and citizens in the

pursuit of generating public value. On the other hand, there is an essential need for the use of predictive models to support governmental decision-making.

Open Government is defined as a multilateral, political, and social process, which includes transparent, participatory, and collaborative actions by the government, integrating citizens and social groups with the support of Information and Communication technologies. The principles of open government are (i) transparency to provide information through ICT; (ii) participation in promoting public engagement and social control; and, (iii) collaboration within the government and with citizens, social organizations and the private sector using technology and innovation (WIRTZ; BIRKMEYER 2015)

OGD, in turn, is described as data that can be freely used, reused and redistributed by anyone. The opening of data aims to avoid mechanisms of control and restrictions on the data that are published, allowing both individuals and legal entities to explore this data freely (OPEN DEFINITION, 2014). OGD has attracted much attention in recent years, becoming part of the everyday lexicon of transparency activists, NGOs, and public officials (SAFAROV; MEIJER,; GRIMMELIKHUIJSEN 2017). Publishing government data, thereby making it available to the public, could be useful in many ways, such as increasing transparency and accountability in governments, increasing overall efficiency and performance, encouraging public engagement, and achieving trust and reputation (Alzamil and Vasarhelyi 2019). As shown in Figure 1, different users of the information demand different types of use and suffer the effects of opening data. Governments, in turn, need to provide conditions, both technical and social, to enable the use of data and to influence the effects of its use, which incorporate social issues, economics, and governance.

Figure 1: OGD utilization framework



Source:Safarov; Grimmelikhuijsen; Meijer (2017)

The government has a fundamental role in the crisis, either by providing open data to assist decision-making processes of the government itself and for society, or as an agent that defines public policies and directs organizational resources to face the pandemic. For example, the Norwegian government managed to control the pandemic rather quickly by adopting a suppression strategy, followed by a control strategy, based on collaborative and pragmatic decision-making, successful communication with the public, many resources and a high level of citizens' trust in government (CHRISTENSEN; LÆGREID, 2020).

What is known is that the more data disclosed to the public, the more people can construct their perception of reality (LUTHFI; JANSSEN, 2019). In the Covid-19 pandemic, Open Government Data contributes to government and society decision-making, and captures the nuance and variation across restrictions, suspensions, and enforcement mechanisms (Curley and Federman 2020), and makes it available to society assisting in epidemic and economic actions. As more data becomes available, the statistic can be rerun to support timely surveillance of Covid-19 (DESJARDINS; HOHL; DELMELLE 2020).

Open Government Data increases transparency and accountability in governments, enhances the overall efficiency and performance of the government, encourages public engagement and achieves trust and reputation (ALZAMIL; VASARHELYI 2019). The availability of government data promotes the improvement of social participation, the empowerment of

citizens by inspecting the government actions, the enhancement of the information quality, the efficiency of management operations and services offered to the citizens, and the seamless process elaboration and conduction of public policies (FERREIRA-DA-SILVA, VAZ; FONSECA-DOS-SANTOS 2014).

Previous literature on data analytics has long recognized the usefulness and effectiveness of analytical methodologies for expanding predictive capacity and assisting decisions (MANCA; CALDIROLI; STORTI, 2020). It was argued that analytical methodologies provide the necessary information for decision-making during periods of considerable uncertainty, such as the crisis caused by the 2020 pandemic (FONG et al, 2020). However, it is not clear how analytical methodologies can contribute to the government's predictive measures to face the pandemic since the epidemic, and economic uncertainties caused by this pandemic areincomprehensible and unpredictable.

Having this knowledge is essential because the government needs to determine which areas are more susceptible to the disease severity so that the authorities can prioritize equipment and supply distributions and deploy adequate regional resource distribution. Timely access to the supply of medical, PPE, and other equipment is essential to control the pandemic. These resources are an indispensable requirement for medical and non-medical personnel supporting controll pandemic (ENDRAIA, 2020).

Many research studies have examined the current epidemic situation; for example, the traditional epidemic models SIR and SEIR models are widely used by researchers to assess the transmission of the disease (ELLISON 2020; WANGPING et al., 2020; LI; MULDOWNEY; VAN DEN DRIESSCHE, 1999.). Many others are also exploring the use of different machine learning models and time series models. Lima et al. (2020) use an ARIMA time series model to predict the confirmed cases and death cases related to Covid-19. Ribeiro et al. (2020) use ARIMA and several machine learning models to predict the cumulative confirmed cases in ten Brazilian states. Duan and Hu (2020 a, b) propose using the combination of time series models, machine learning algorithms, clustering method, and epidemic models to systematically evaluate the pandemic situation.

Comfort et al (2020) describe implications from this crisis for better decision-making, with collective cognition, amplified by timely, valid communication and supported by sound planning, trained personnel, appropriate technology, and bold leadership, to enable coordinated action needed to bring a large-scale global crisis under control.

3. Methodology

This section presents information on data collection and treatment, in addition to explaining the basis for the proposed model. It first examines Data Collection and then focuses on Model Construction.

3.1. Data Collection

The data for different epidemic numbers, including confirmed cases, hospitalizations, deaths, suspected cases, etc., are collected from various government portals, including State Health Department[66], and the Santa Catarina State Open Data Portal[67].

The state of Santa Catarina has a territory of only 95.4 thousand km², making it the smallest state in the south of Brazil. Santa Catarina has 295 municipalities, and its capital is Florianópolis. Santa Catarina is in the geographical center of the regions with the highest economic performance in the country, South and Southeast, and in a strategic position in Mercosur. The state borders Paraná (to the north), Rio Grande do Sul (to the south), Atlantic Ocean (east), and Argentina (west) (SANTA CATARINA, 2020).

Table 1: Characteristics of the municipalities of Santa Catarina

Regions	**N. Munic**	**Size**	No. Popul
Greater Florianópolis	21	Small (below 20,000 popul.)	234
North	26	Medium (Between 20,000 to 100,000 popul.)	48
West	118	Large (over 100,000 popul.)	13
Mountain	30	**GDP / Per capita**	
South	46	Small (below R $ 20,000.00 /popul.)	40
Itajaí Valley	54	Medium (Between R $ 20,000 / inhab to R $ 100,000 /popul.)	252
		Large (Above R $ 100,000 /popul.)	3

Source: Adapted from Santa Catarina

According to data from the Government of the State of Santa Catarina[68], the state has already registered 120,880 confirmed cases of infection with the new coronavirus, of which 108,039 are already recovered, and 11,044 are being monitored. This number was released as of

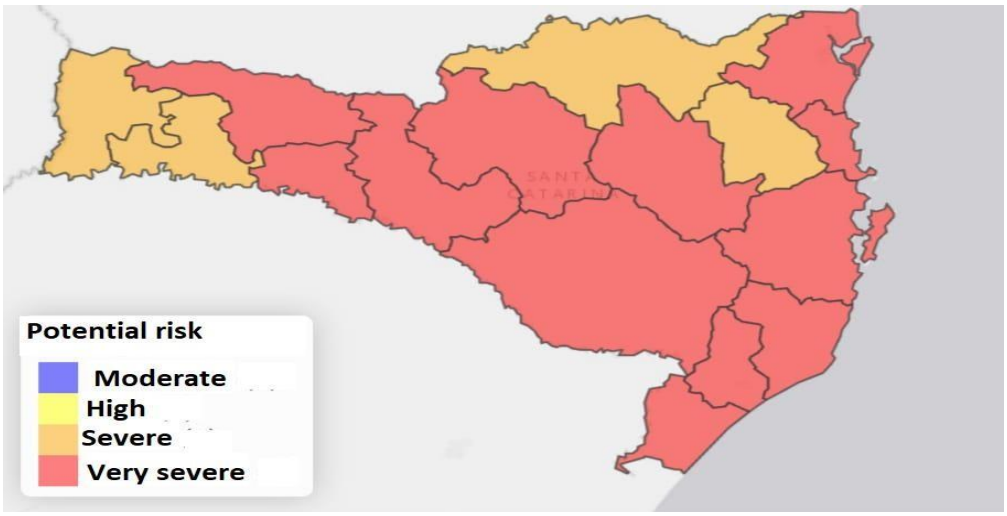
[66] Epidemic related numbers and information is available at: https://brasil.io/dataset/covid19/caso_full/?search=&epidemiological_week=&date=&order_for_place=&state=SC&city=&city_ibge_code=&place_type=&last_available_date=&is_last=&is_repeated=

[67] The Santa Catarina State Open Data Portal. Information is available at: http://dados.sc.gov.br/group/covid-19

[68] https://www.sc.gov.br/noticias/temas/coronavirus/coronavirus-em-sc-estado-confirma-120-880-casos-108-039-recuperados-e-1-797-mortes-por-covid-19

Sunday, August 16, 2020. Covid-19 has already caused 1,797 deaths in the state since the beginning of the pandemic. The current fatality rate is 1.49% of identified cases. Cases have already been confirmed in all 295 municipalities in Santa Catarina, with 188 cities having recorded at least one death. The location with the largest number of people who have contracted Covid-19 is Joinville, with 10,124 cases. Next are Blumenau (7,208), Balneário Camboriú (5,263), Florianópolis (4,965), Chapecó (4,739), Itajaí (4,280), Criciúma (3,898), Brusque (3,660), São José (3,472) and Palhoça (3,310).

Figure 2: Covid-19 in Santa Catarina: Potential risk by region (17.08.2020)



Source: Adapted from Santa Catarina

Exogenous data was obtained from various channels, including Google Trends and the Apple mobility app. Additionally, a set of demographic features for each city in the state of Santa Catarina was collected from the government portal. These features are demographic density, industrial jobs, industrial establishments, percentage of the urban population, territorial extension of the municipality, municipalities by region, and GDP per capita.

3.2. Model Construction

Following the CIPM approach (Duan; Hu 2020), the analysis focuses on three perspectives, as illustrated below: Number Validation; Clustering Approach; and Epidemic Simulation.

3.2.1. Number Validation

This part of the analysis focuses on using a time series model to estimate the evolution of the pandemic by utilizing various exogenous data. This includes the time series model, ARIMA model with a 30-day sliding window approach (Duan; Hu 2020 a,b) to assess the accuracy of the number of current confirmed cases, deaths numbers, the percentage of suspected cases, and the number of suspected cases.

For example, we use data from June 24, 2020, to July 24, 2020, as the training set to predict the respective numbers on July 25, 2020. For the next day evaluation, July 26, 2020, the size of the training set is kept constant, 30 days, which means that the training set is rolling from June 25, 2020, to July 26, 2020.

The model continues iterating this approach for the following days' predictions. Additionally, several exogenous data, including Google Trends[69] and theApple mobility report[70] are included in the model to enhance the accuracy of the model performance. New exogenous variables can be added to the model as the information becomes available.

Chart 1: Search variables

DATA	SOURCE
1. Demographic density	Densidade demográfica: IBGE, Censo Demográfico 2010, Área territorial brasileira. Rio de Janeiro: IBGE, 2011
2. Industrial jobs	2010 http://atlasbrasil.org.br/2013/pt/download/base/
3. Industrial establishments	Not available
4. Percentage of urban population	SNIS 2018
5. Territorial extension of the municipality	Área Territorial: Área territorial brasileira. Rio de Janeiro: IBGE, 2018
6. List of municipalities by region	https://www.causc.gov.br/wp-content/uploads/chamadas/2429/10.-ANEXO-VII-Divisao-do-Municipios-do-Estado-de-SC-por-Mesorregioes.pdf
7. * Volume of passengers carried (SIE) *	Not available
8. * Transported cargo flow (DETRAN) * (origin, destination, volume, date)	Not available
9. GDP per capita	PIB per capita: IBGE, em parceria com os Órgãos Estaduais de Estatística, Secretarias Estaduais de Governo e Superintendência da Zona Franca de Manaus - SUFRAMA

Source: Adapted from Santa Catarina

[69] Google Trends include the searches for COVID-19, Coronavirus, Flu in Brazil. The information can be found at: https://trends.google.com/trends/?geo=Brazil

[70] Apple mobility report can be found at: https://www.apple.com/covid19/mobility

3.2.2. Clustering Approach

After developing an understanding of the current epidemic numbers, the next step is to utilize cross-sectional analytics to identify the time-invariant factors that could have a significant impact on the pandemic, as well as to identify the potential high risky cities by using a clustering method. The cities in the state of Santa Catarina are clustered together with their peer groups based on a similar vulnerability to Covid-19, which can also help extrapolate underlying trends and patterns of the epidemic.

3.3. Epidemic Simulation

By using the epidemic model, SEIQHRF[71], this step enables the users to simulate the model based on different compartments at a different time interval. The impact and consequences are presented to guide adequate policy enforcement. The compartments used in the SEIQHRF model are explained in Appendix I. Based on current policy enforcement, the model generates an alert if the current policy will not sufficiently prevent the spread of the disease or it requires further actions to limit the impact.

4. Results

In this session, the results are presented: Number Validation Results, Clustering Approach Results, Epidemic Simulation Results.

4.1. Number Validation Results

Based on the analysis, the overall recorded epidemic data in Santa Catarina seems unreasonable. As indicated in Figure 3, the forecast trend and the actual development of the percentage of suspect cases, daily confirmed cases, and the daily deaths are reasonably similar within a 95% confidence interval.

However, the fluctuation of recorded data could raise some concerns. From an auditor's point of view, these numbers seem suspicious and unreasonable, so further investigation is required. For example, the fluctuation of daily confirmed cases and deaths cases seems unreasonably large. Also, the number of suspect cases turns flat towards the end of the predicting period after a downward slope. From an auditor's point of view, these numbers seem suspicious and unreasonable, requiring further investigation. Extending the analysis, we examined the

[71] Susceptible, Exposed, Infected and infectious, Self-Isolation, Hospitalization, Fatality, Recovered (SEIQHRF) model.

detailed data collected from the governmental portal[72]. Unusual records are noted in the publicly disclosed files. For example, on May 1, 2020, the state of Santa Catarina has a negative number of new confirmed cases, -290; specifically, the city of Florianópolis has -94, Brusque has -21, Blumenau has -18, Joinville has -14, etc.

These results differ from those presented by several countries around the world, where the behavior of the disease was shown to increase in the first months of the infection (DEJARDINS et al., 2020; CALLAWAY, 2020). In addition to the inconsistent data, it was also not possible to have free access to data on the number of industrial establishments and the movement of people and cargo in the State of Santa Catarina. Inconsistent data and missing data can be a problem of open government data transparency. That is because open government data is a type of data that can be used, reused and redistributed freely by anyone (Open Definition, 2014) which should allow the integration of government, citizens and social groups with the support of information and communication technologies (WIRTZ; BIRKMEYER 2015).

[72] Daily confirmed cases and daily deaths cases are collected here: https://brasil.io/dataset/covid19/caso_full/?search=&epidemiological_week=&date=&order_for_place=&state=SC&city=&city_ibge_code=&place_type=&last_available_date=&is_last=&is_repeated=

Figure 3. Number Validation

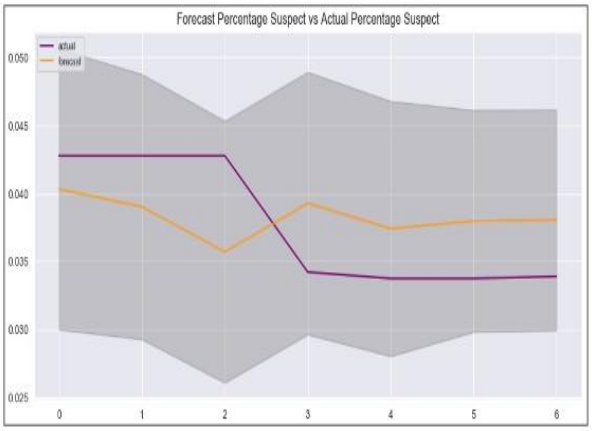


Figure 1-1: Predicted Suspect Percentage vs Actual Suspect Percentage

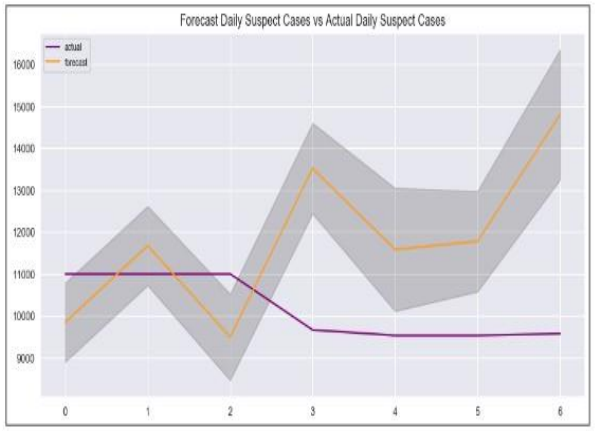


Figure 1-2: Predicted Daily Suspect Cases vs Actual Daily Suspect Cases

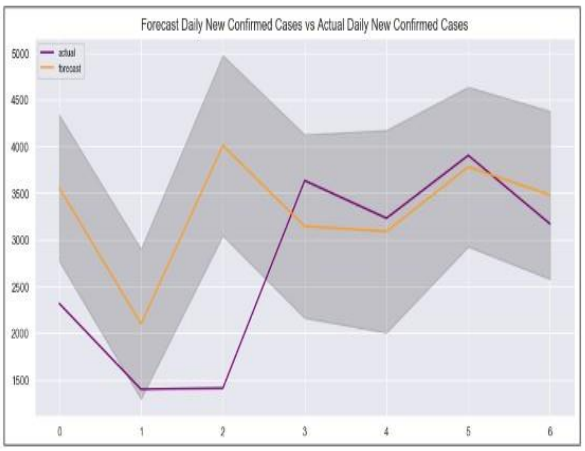


Figure 1-3: Predicted Confirmed Cases vs Actual Confirmed Cases

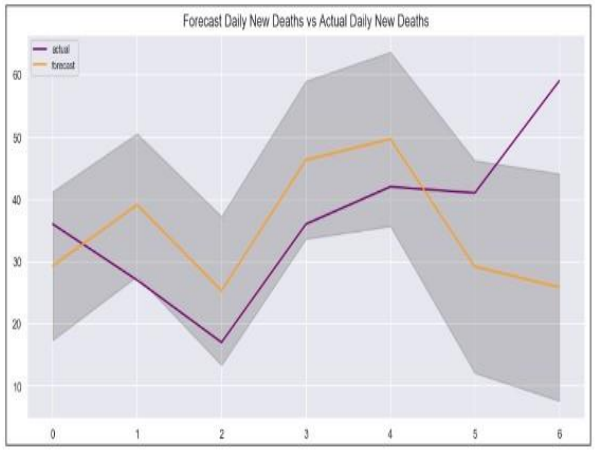


Figure 1-4: Predicted Death Cases vs Actual Death Cases

Source: The authors

Throughout the dataset from March 12, 2020, to July 31, 2020, there are many instances when the daily confirmed cases are reported as negative numbers. It is understandable to adjust the initially reported numbers, considering the time delay of recording the numbers. However, reporting a negative number might not provide sufficiently information to the public or to evaluate the severity of the situation. Based on the above analysis, a better recording system is needed to provide more accurate information to the public, which can improve the government's ability to evaluate the situation and make appropriate policy decisions.

4.2. Clustering Approach Results

A set of time-invariant features are identified based on local geographic features (see Table 2), and local cultures, including demographic density, industrial jobs, industrial establishments, percentage of urban population, territorial extension of the municipality, list of municipalities by region, and GDP per capita.

Table 2. Geographic Features

Data	Variable
DATA 1	Demographic density
DATA 2	Industrial Jobs
DATA 3	Percentage of urban population
DATA 4	Territorial extension of the municipality
DATA 5	List of municipalities by region
DATA 6	GDP / Per capita

Source: The authors

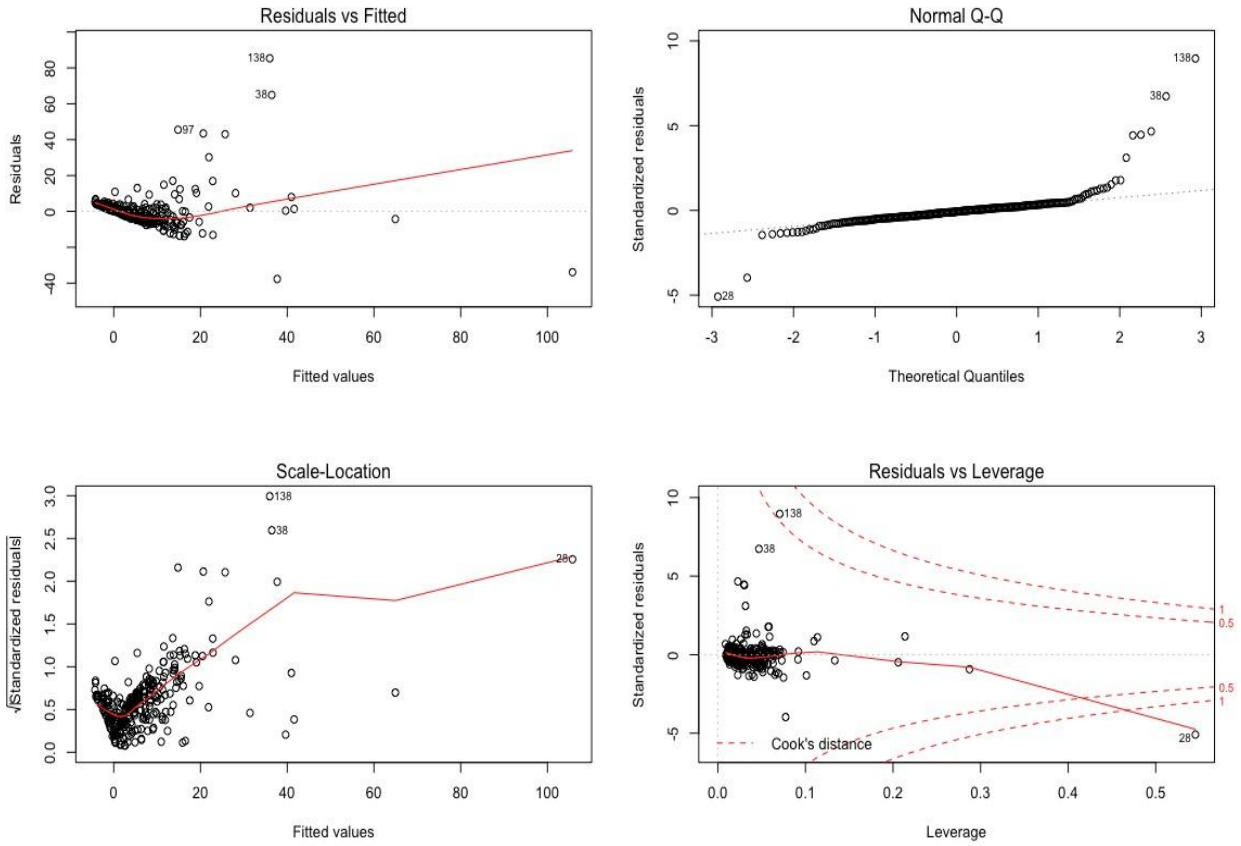
Regression analysis is performed to identify the significant factors associated with the pandemic. In this case, we examine the relationship between the confirmed cases with each factor. We use a 7-day average standard deviation of the confirmed cases as the dependent variable, and the set of geographic features as the independent variables.

Table 3. Correlation Results

```
Call:
lm(formula = X7daysSTDEV ~ DATA1 + DATA2 + DATA3 + DATA4 + DATA5 +
    DATA6, data = data1)

Residuals:
    Min      1Q  Median      3Q     Max
-37.688  -3.675  -0.685   1.879  85.357

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)         -8.259e+00  2.906e+00  -2.842 0.004803 **
DATA1                4.239e-02  3.500e-03  12.112  < 2e-16 ***
DATA2                2.608e-02  4.958e-02   0.526 0.599238
DATA3                9.885e+00  2.858e+00   3.459 0.000627 ***
DATA4                9.294e-03  2.171e-03   4.281 2.56e-05 ***
DATA5Norte           1.000e-01  2.984e+00   0.034 0.973289
DATA5Oeste          -1.418e+00  2.397e+00  -0.592 0.554615
DATA5Serrana        -3.437e+00  2.919e+00  -1.177 0.240066
DATA5Sul             1.341e-01  2.646e+00   0.051 0.959619
DATA5Vale do Itajaí  1.219e+00  2.566e+00   0.475 0.635044
DATA6                8.453e-05  4.065e-05   2.079 0.038477 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 9.879 on 282 degrees of freedom
Multiple R-squared:  0.5314,    Adjusted R-squared:  0.5148
F-statistic: 31.98 on 10 and 282 DF,  p-value: < 2.2e-16
```

Source: The authors

Figure 4. Collinearity Check



Source: The authors

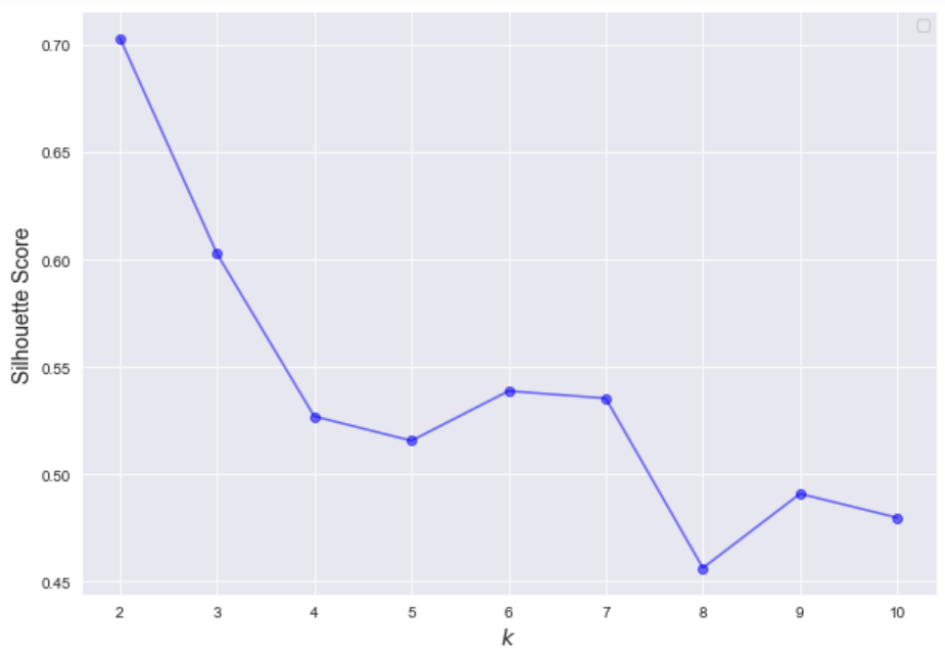
The regression results in Table 3 and Figure 4 indicate that demographic density, percentage of the urban population, a territorial extension of the municipality, and GDP per capita are significant factors. Additionally, the model is robust concerning collinearity issues, although there are some outliers.

Based on the features identified above, a clustering method was used to categorize the cities in the state of Santa Catarina into different clusters. Cities in the same cluster will exhibit similar vulnerability to the disease with their peer groups. Identifying these peer groups, the government can better access the pandemic conditions of a specific city and allocate appropriate resources to the region. Figure 5 (5.1. and 5.2) illustrates the results of this analysis. First, the silhouette score is assessed to determine the proper number of clusters. Silhouette score is used to "measure how close each point in one cluster is to the points in the neighboring clusters; it has a range between -1 and 1.[73]" Based on the silhouette score, obtaining 3 clusters seems

[73] Silhouette score explanation and information is available at:
https://scikit-learn.org/stable/auto_examples/cluster/plot_kmeans_silhouette_analysis.html

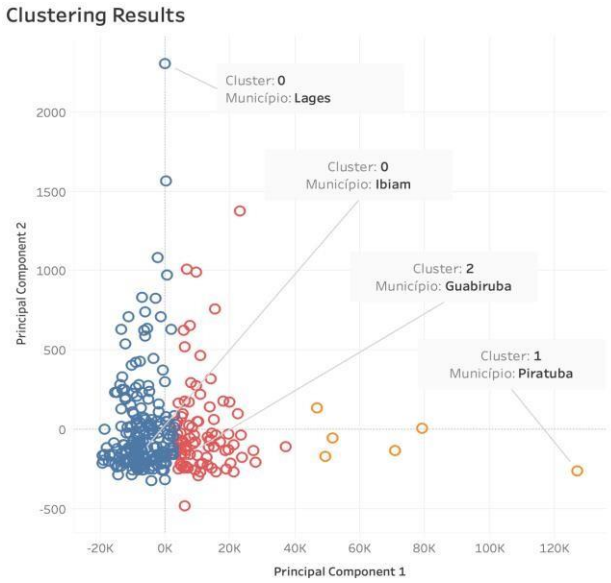
reasonable. Also, the cluster-ID for each city in the state of Santa Catarina can be identified, and each city can find their peer group.

Figure 5.1. Silhouette Score Result



Source: The authors

Figure 5.2 K-Means Clustering Results



Source: The authors

Furthermore, the distance between each point and the centroid point for each cluster was measured. Regression analysis was performed to determine the significant clusters (see Table 4).

Table 4. Cluster regression result

Coefficients:				
	Estimate	Std. Error	t value	Pr (> |tl|)
(Intercept)	140.8277	44.7440	3.147	0.00182 **
Cluster_distance_0	0.7382	0.9962	0.742	0.45863
Cluster_distance_1	-9.1082	3.1814	-2.863	0.00450
Cluster_distance_2	-4.0373	1.4573	-2.770	0.00596
Cluster	-0.9287	1.6515	-0.562	0.57431

Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

Source: The authors

Based on the results, cluster 1 and cluster 2 are significant clusters, which means that the cities within these two clusters are more susceptible to disease severity. In other words, the cities that are closer to the center point in cluster 1 and cluster 2 may suffer from more pandemic risk compared to the others. As such, the government should evaluate the preventive policies and medical resources available in such cities and determine whether the current level of policy can adequately control the spreading of the disease.

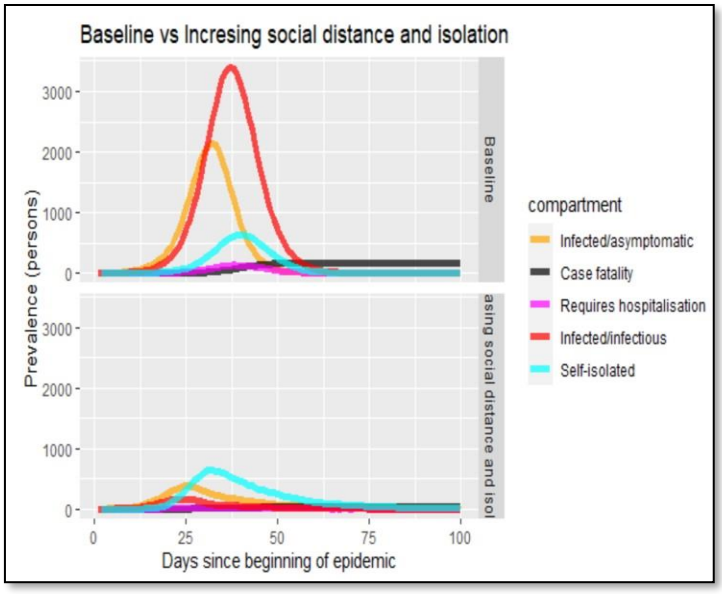
Corroborating previous studies (Li; Muldowney;Van Den Driessche 1999; Endraia, 2020; Ellison 2020; Wangping et al., 2020; Ribeiro et al., 2020), these results demonstrate that the forecast allows policymakers to adopt a proactive stance to face the pandemic, such as knowing in advance which industrial regions may be vulnerable to more severe pandemic risk. This can help the government and civilians to adopt in advance epidemiological prevention measures.

4.3. Epidemic Simulation Results

To assess the adequacy of each policy, such as social distancing or self-isolation, an epidemic simulation model was constructed to assist the government in determining actions. For instance, based on 3 infected cases and 9997 non-infected cases, a baseline model was developed based on no prevention policy put in place, which resulted in the infected cases rising to more than 3,000. After implementing both self-isolation and social distancing policies starting day 15, the infected cases dropped significantly, close to zero. A comparison between the baseline model and a simulated model was performed to assess the effect of a specific policy.

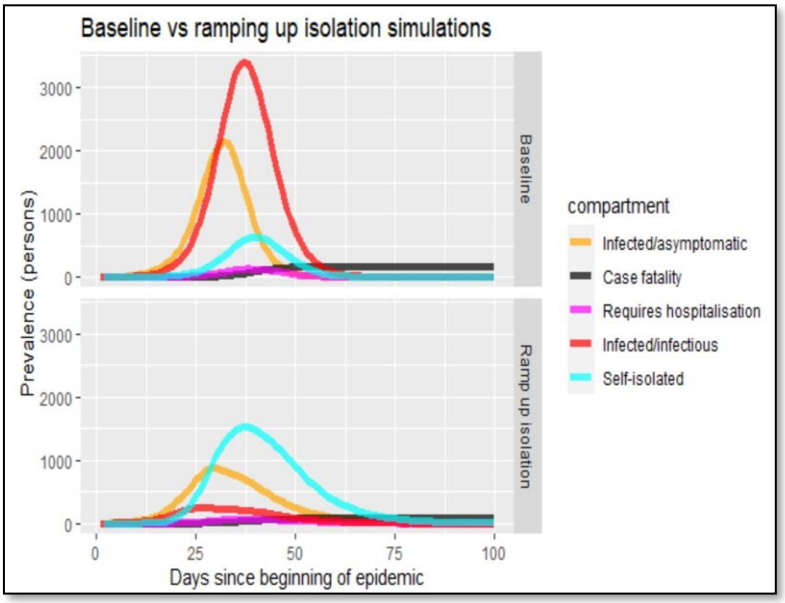
As indicated in Figure 6 (6.1, 6.2, 6.3), we can see the discrepancy between the baseline model and simulated models based on social distancing only, isolation, and the combination of social distancing and isolation.

Figure 6.1: Baseline model vs Increasing social distance and isolation



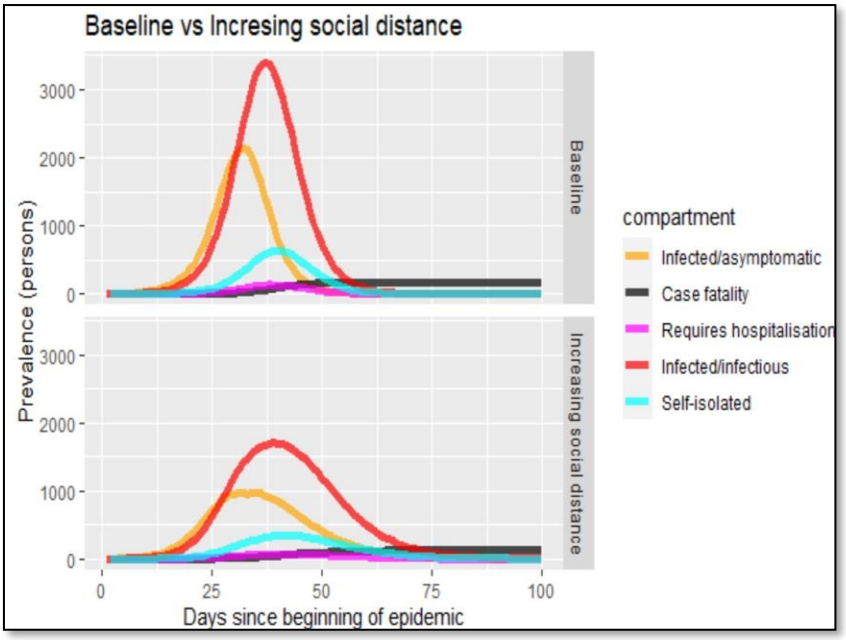
Source: The authors

Figure 6.2: Baseline model vs Increasing isolation



Source: The authors

Figure 6.3: Baseline model vs Increasing social distance



Source: The authors

Figure 6.1-6.3. Use the SEIQHRF model to simulate the impacts of different social intervention policies assuming the total number of populations is equal to 10000. When enforcing self-isolation and social distancing, we can better control the transmission of Covid-19

The results are consistent with previous studies that indicate that social isolation is the most effective preventive measure found so far (WHO, 2020; ATLURI; MANCHIKANTI; HIRSCH, 2020; CHIOLERO, 2020; XIANG et al., 2020; CANDEAIS; MORHARD, 2020; GOPINATH, 2020; KPMG CHINA; LU, 2020; TANNE, 2020).

It is important to consider that OGP can increase the ability of the nation to analyze the behavior of the disease as it encourages public engagement, and achieves citizens' trust and reputation (ALZAMIL;VASARHELYI 2019). For example, OGP allows for free access to society on epidemic and social information, and thus adequate care can be provided in a timely fashion to the public before the pandemic becomes uncontrollable.

Also, the use of SEIQHRF simulates the impacts of different social intervention policies, as it allows authorities to know the dimension and scope of the pandemic. For example, it is possible to predict the movement of Covid-19 from coastal regions to the inland, or from industrial regions to rural areas. This allows the government to launch public social protection policies preventively, by expanding hospital beds or releasing and providing financial assistance to families.

Conclusion

This study proposes a predictive model to support government decision-making to cope with the Covid-19 pandemic using open government data. We adopted an innovative approach (CIPM) to examine the current pandemic situation from the perspective of accountants and auditors (DUAN; HU 2020 a,b). We validate the likelihood of current epidemic numbers by utilizing exogenous data, assessing the disease severity level of each city in the state of Santa Catarina using the clustering approach, and providing guidance for policymakers.

In Santa Catarina, Covid-19 has already caused approximately 2,000 deaths with a lethality of 1.49% of identified cases. Cases were confirmed in all 295 municipalities in Santa Catarina, with 188 cities registering at least one death.

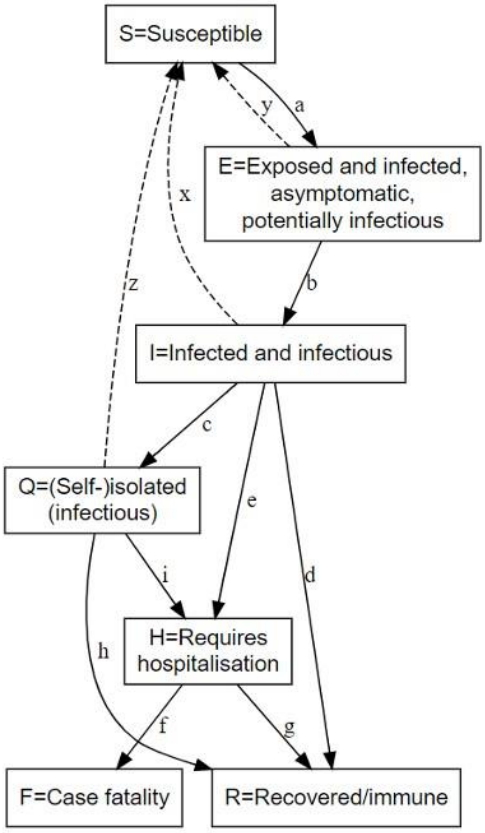
The results of this study point out that the data recording process requires substantive government attention. In many cases, the recorded information seems unlikely, which could significantly impact decision making. Additionally, the study pinpoints specific cities that are highly susceptible to disease severity, which can direct the government's attention. Furthermore, based on a specific situation in a particular city, the model can provide simulation results based on current and forthcoming policies, as well as illustrate the impact of the timing of policy implementation.

Our empirical analysis using a sample of daily confirmed cases, daily deaths,and daily percentage of suspected cases, is consistent with our expectation. In particular, we found that the current publicly disclosed epidemic numbers fluctuate unreasonably, which raises concern regarding the accuracy of the information recorded and provided to the public. Despite these considerations, it is believed that it was possible to present an application based on the use of open government data. Through this data, it was possible to train the model to support decision making at the governmental level. This study has some limitations. First, only a limited amount of exogenous data was collected. The predicted results can be further improved based on additional data. Second, different clustering approaches can be explored. Third, more geographical features can be collected to examine the relationship between pandemic and various factors.

For future research, the fluctuation of confirmed cases and analysis of mortality by regions can help in coping with the epidemic and assist in managing the economic consequences. Assessing the development of the epidemic will allow the local and regional governments to develop public policies and proactive actions, including entrepreneurial actions, to better face the economic fallout from the pandemic.

Appendix I. SEIQHRF model

Susceptible, Exposed, Infected and infectious, Self-Isolation, Hospitalization, Fatality, Recovered (SEIQHRF) model[74]



Compartment	Functional definition
S	Susceptible individuals
E	Exposed **and** infected, not yet symptomatic but potentially infectious
I	Infected, symptomatic **and** infectious
Q	Infectious, but (self-)isolated
H	Requiring hospitalisation (would normally be hospitalised if capacity available)
R	Recovered, immune from further infection
F	Case fatality (death due to COVID-19, not other causes)

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Regulatory Impact Assessment in Pandemic Times: a practical exercise on the COVID-19 context[8]

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This study aims to demonstrate the potential use of problem identification and analysis, one of the Regulatory Impact Assessment (RIA) stages, as an alternative to drive critical, rational, and logic thinking while formulating regulatory policies and actions to face COVID-19. The theoretical foundation included an outlook on regulation, RIA and problem identification and analysis. The authors performed a descriptive study with a qualitative approach to report on the results of the didactic-pedagogical workshop, related to problem identification and analysis on a COVID-19 situation. Seven federal workers and one trainee from the regulatory quality improvement area in Anvisa participated in the workshop. "SARS-COV-2 coronavirus dissemination, as a little- known, untreated and highly contagious virus" was the main problem identified. Ten problem- related consequences were pinpointed, including the worsening of mental health. As an illustration, the study highlighted only five of the 20 causes listed by the workshop participants. One of the investigated problem causes was the low population adherence to prevention and control measures. According to the workshop participants, 30 affected stakeholders were identified in the workshop, such as the high-risk population (elderly and people with comorbidities). Thus, this study aims to contribute to the COVID-19 coping in Brazil, as well as to other future public health emergencies.

Keywords: public administration, COVID-19, regulatory impact analysis

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A Análise de Impacto Regulatório em Momento de Pandemia: um exercício prático no contexto da COVID-19

Este estudo objetivou demonstrar o potencial uso da análise e definição de problemas, uma das fases da Análise de Impacto Regulatório (AIR), como uma alternativa em direcionar um pensamento crítico, racional e lógico para a formulação de políticas regulatórias e ações para o enfrentamento da COVID-19. A fundamentação teórica envolveu um panorama sobre regulação, AIR e análise e definição do problema. Recorreu-se a um estudo descritivo com abordagem qualitativa para relatar os resultados da oficina virtual, de caráter didático-pedagógico, sobre análise e definição do problema principal no contexto da COVID-19. Participaram da oficina sete servidores e um estagiário que atuam na unidade de melhoria da qualidade regulatória na Anvisa. O problema principal definido foi “Disseminação do coronavírus SARS-COV-2, pouco conhecido, sem tratamento e com alta taxa de contágio”. Foram identificadas 10 consequências relacionadas ao problema, sendo o agravamento de problemas ligados à saúde mental uma delas. A título ilustrativo, o estudo destacou cinco das 20 causas elencadas pelos participantes. A baixa adesão da população às medidas de prevenção e controle foi considerada uma das causas do problema. A população de grupos de risco, como idosos e pessoas com comorbidades, foi um dos 30 agentes afetados pelo problema identificados na oficina. Este estudo é uma contribuição ao enfretamento da COVID-19, bem como a outras futuras emergências em saúde pública.

Palavras-chave: administração pública, COVID-19, análise de impacto regulatório

El Análisis del Impacto Regulatorio en el momento de la pandemia: un ejercicio práctico en el contexto del COVID-19

Este estudio tuvo como objetivo demostrar el uso potencial del análisis y la definición de problemas, una de las fases del Análisis de Impacto Regulatorio (AIR), como una alternativa para dirigir el pensamiento crítico, racional y lógico para la formulación de políticas y acciones regulatorias para enfrentar el COVID-19. La base teórica implicaba una visión general de la regulación, el AIR y el análisis y la definición del problema. Se utilizó un estudio descriptivo con un enfoque cualitativo para informar los resultados del taller virtual sobre análisis y definición del problema principal en el contexto de COVID-19. Siete empleados y un interno que trabajan en la unidad de mejora de la calidad reguladora en Anvisa participaron en el taller. El principal problema definido fue "Diseminación del coronavirus SARS-COV-2, poco conocido, no tratado y con una alta tasa de contagio". Se identificaron 10 consecuencias relacionadas con el problema, y el empeoramiento de los problemas de salud mental fue uno de ellos. Como ilustración, el estudio destacó cinco de las 20 causas enumeradas por los participantes. La baja adherencia de la población a las medidas de prevención y control se consideró una de las causas del problema. La población de grupos de riesgo, como los ancianos y las personas con comorbilidades, fue uno de los 30 agentes afectados por el problema identificado en el taller. Este estudio es una contribución para hacer frente a COVID-19, así como a otras futuras emergencias de salud pública.

Palabras clave: administración pública, COVID-19, análisis de impacto regulatorio

Introduction

Infectious diseases, such as influenza, malaria and tuberculosis, pose significant threats to society. While some of these are endemic to specific geographic areas, others can spread rapidly, becoming epidemics when populations from various countries are affected (DELIVORIAS et al. 2020).

COVID-19 disease, which is caused by the new SARS-COV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) coronavirus and originated in Wuhan city (China) in December 2019, was declared by the World Health Organization (WHO) as a pandemic on March 11, 2020 (OPAS, 2020).

In Brazil, after the confirmation of the first case on February 26, 2020, COVID-19 epidemiological and health surveillance actions, along with prevention and control measures and other initiatives, were intensified to minimize the damage to the population, the health care system (RODRIGUEZ-MORALES et al. 2020) and the economy. On March 20, 2020, the Ministry of Health acknowledged the occurrence of coronavirus (COVID-19) community transmission throughout the country (BRAZIL, 2020).

The loss of human lives is the first and most crucial aspect of an epidemic/pandemic. In Brazil, as of June 4, 2020, 584,016 confirmed COVID-19 cases and 32,548 deaths have been recorded (JOHNS HOPKINS, 2020). Other consequences resulting from COVID-19 prevention and control measures, such as increased psychological, behavioral, and domestic violence problems, have been reported in the literature (MOTA et al. 2020).

The SARS-COV-2 dissemination also has important repercussions on a country's economy. Evidence reports that the Brazilian economy will shrink by 5.2% due to the COVID-19 epidemic. The main economic impacts will come from the fall in raw materials commodities value and the shutdown of sectors such as tourism (ECLAC, 2020). Moreover, vulnerable populations, particularly the poor, are likely to disproportionately suffer from the epidemic, as they may have limited access to health care and less income to protect themselves from a financial catastrophe (DELIVORIAS et al. 2020).

These considerations, as well as experience with other past epidemics, demonstrate the attention the COVID-19 problem deserves during its evolvement, leading to the need for governments, health authorities, and professionals to adjust their actions for the preparation, containment and disease consequent mitigation (COVID-19, 2020; LIPSITCH et al. 2020). The

various levels of management and actions needed for epidemic coping can form a complex environment for decision-making in the public sector (KRUMKAMP et al. 2009).

In these conditions, managers, health professionals and specialists who formulate, communicate and guide the population on disease control and mitigation strategies have gained notoriety (COWPER, 2020). In Brazil, the lack of research in public administration creates difficulties for the use of analytical tools for policies and actions formulation to confront COVID-19 (MOTA et al. 2020).

The Regulatory Impact Assessment (RIA), a methodology used in the formulation of policies to address public problems (JACOBS 2004), can be a viable and effective alternative to guide policies and actions in times of epidemic/pandemic. RIA can provide a logical rationale in an environment where the people involved are under pressure, thus ensuring public policies and government actions are more planned and integrated, allowing the development of effective solutions to face the problem.

RIA can be used to indicate regulatory interventions at various public administration levels, through problem analysis and definition, options identification and impacts of each intervention option on society (DASKAL et al. 2019; RADAELLI, 2010). In the case of COVID-19 coping, special attention should be paid to the problem analysis and definition, which is imperative for the establishment of rapid, qualified, effective and integrated public policies and actions.

This study aims to demonstrate, through a practical exercise of didactic-pedagogical nature, the potential use of problem analysis and definition, one of the RIA phases, as an alternative in driving critical, rational and logical thinking to the formulation of regulatory policies and actions to cope with COVID-19. At this moment, no COVID-19 specific study or practical exercise of problem analysis and definition was identified that could help in the efforts to tackle the disease.

The theoretical framework related to RIA and one of its phases, the problem analysis and definition, will be presented in the following section. Next, the research methods, results and discussion along with the final considerations of the study will be presented.

Theoretical framework

Regulation and Regulatory Impact Assessment

Regulation is composed of several instruments, including laws, decrees and rules, through which governments make requirements to companies and citizens (KIRKPATRICK et al. 2004). The regulation objective is related to the promotion of public health, safety, social welfare and the

establishment of legal certainty in the commercialization of goods and services (BALLANTINE et al. 2006).

However, regulation can have a high impact on society (DASKAL et al. 2019) and needs to be adequately developed so that its objectives are achieved and unintended consequences are not produced (CASTRO, 2014; HASSAN, 2015).

Thus, to improve their regulatory system quality, many governments have developed new processes, structures and tools to elaborate new regulations (BALLANTINE et al. 2006). Known as “better regulation”, this movement implies better transparency, social participation and the use of evidence in the process of regulatory formulation (HUGÉ et al. 2011).

According to Radaelli (2004), the main tools used by governments to promote regulatory improvements are: i) RIA; ii) public consultation; iii) simplification; iv) access to regulation; and v) ex-post evaluation of the regulation. For the author, RIA is the most important tool to support regulation improvements.

RIA can be utilized in the formulation of regulatory and non-regulatory policies and is characterized as a systematic process for *ex-ante* evaluation of a government action’s significant impacts (FRITSCH et al. 2013; KIRKPATRICK et al., 2004). It is an evidence-based analysis process that identifies the problem, defines the intended regulatory policy objectives and evaluates whether the public intervention is really necessary. Then, RIA promotes the identification, analysis and comparison of the impacts of possible intervention alternatives, in order to determine which of them is the best choice (FRITSCH et al. 2013; JACOBS, 2004).

Adopted initially in the United States in the early 1970s, RIA is already in use in developed countries and its methodology is advancing in emergent nations (CARVALHO et al. 2019; FRANCESCO, 2012).

In Brazil, RIA has been gradually implemented since 2007, with important differences in application maturity among federal regulatory agencies (AQUILA et al. 2019), especially the Brazilian Health Regulatory Agency (ANVISA), which is in an advanced state of RIA study and application in Brazil (IBRAC, 2019).

Regulatory Impact Assessment in Anvisa

In Anvisa, the RIA guidelines and procedures are described, in general terms, in Ordinance No. 1,741 of December 12, 2018, and in the Service Order No. 56 of December 18, 2018 (ANVISA, 2018a; ANVISA, 2018b). The Ordinance mentions that the process of building RIA includes three phases: I – problem analysis and definition, which aims to promote understanding about the nature, magnitude, causes and consequences of the problem and the intended objectives; II –

regulatory options identification, which intends to map possible solutions and, whenever possible, non-normative options; and III - regulatory options comparison, which aims to identify the regulatory options' impacts and compare them, in order to demonstrate the most appropriate solution to achieve the desired objectives (ANVISA, 2018a).

In the process of developing the RIA phases, Anvisa considers virtual or face-to-face workshops incorporating Design Thinking concepts and tools to organize and stimulate innovation in the RIA collective construction process (ANVISA, 2020). Design Thinking is an approach to solving complex problems which is widely applied by various disciplines, recently emerging in the health care field (McLAUGHLIN et al. 2019).

With Design Thinking adoption in the RIA process, the formulation of regulatory policies began to rely on new dynamics, methods and tools. The focus on the human being emphasizes the importance of considering people's lives and problems, in order to seek solutions and policies that are more appropriate to human needs. Furthermore, people participating who have different perspectives and empathies throughout the process promotes the construction of solutions and policies with fewer biases and better conditions to solve real problems (CAVALCANTE et al. 2019).

During the conduction of the RIA stages, Anvisa pays special attention to the problem diagnosis stage, intending to allow the decision-maker to be able to adopt effective solutions for real needs (ANVISA, 2019).

Problem analysis and definition

The problem analysis and definition can be considered as the first and most important RIA phase. This is where efforts are made to understand the "main problem" that governments intend to face (DUDLEY et al. 2017). The problem causes and consequences are also identified, as well as evidence of its existence. It is from a clear definition of the problem, with its causes and consequences, that identifying solutions for an unwanted situation become possible (BRAZIL, 2018).

In the regulation context, the main problem may relate to a market failure or the inefficiency of government programs in achieving public objectives (MENEGUIN et al. 2020). In the first case, market conditions, which cause the regulation to be less efficient and detrimental to social well-being, are identified. In the second case, public objectives not achieved but desirable to society are identified (DUDLEY et al. 2017).

Regulatory problems can be multifaceted, have many causes, and affect several society stakeholders with different intensities. It is possible to perform a weighting and prioritization of the

identified causes, both to define action objectives and to evaluate alternative solutions. Investigation of the causes allow the problem solution to be determined from the treatment of the causes and not from its symptoms' point of view (BRAZIL, 2018).

In addition to investigating the causes, an analysis should be performed on the consequences, and their magnitudes and extents. This is a fundamental analysis to understand and demonstrate that the regulatory problem is sufficiently relevant. In order to justify a regulatory action, the problem must have sufficient repercussions on society and cannot be a mere isolated or circumstantial fact (BRAZIL, 2018).

In general, the problem analysis and definition involves consideration and knowledge about the following elements: i) problem context; ii) description of the problem and its consequences; iii) identification and analysis of the causes; iv) evidence gathering; v) consultation with affected stakeholders; vi) prioritization of regulatory action; and vii) description of the regulatory action objectives (ANVISA, 2019). The present study focused mainly on these elements: a) problem context; b) description of the problem and its consequences; c) identification and analysis of the causes; d) affected stakeholders definition; and e) description of the regulatory action objectives.

Methods

This is a descriptive study to demonstrate, with a qualitative approach, and through a didactic-pedagogical workshop, the potential use of problem analysis and definition as a "tool" to formulate policies and actions in coping with COVID-19. The pandemic spread of the virus and intense efforts to control it provide an opportunity to employ this RIA phase in an environment where involved managers and health professionals are daily overloaded and under pressure, hindering the development of critical thinking and the sense of collective engagement on how to make decisions in the face of the epidemic. The problem analysis and definition workshop can help decision makers to plan the regulatory challenges and actions, as well as anticipate future threats arising from COVID-19.

Pre-workshop activity of problem analysis and definition

A document was prepared by one of the authors to provide basic information for discussions on the problem analysis and definition workshop. This document contained epidemic/pandemic context data, addressing COVID-19 epidemiological aspects, forms of contagion, symptomatology, main risk groups and geographic distribution, as well as data and information about the social and economic impacts of the disease, including measures adopted

to cope with it, especially those associated with social isolation and health care systems infrastructure.

The document was shared with the participants to provide basic information during the problem analysis and definition workshop, so they could develop critical thinking about the COVID-19 epidemic in Brazil. Participants received the document in advance, so they could read and reflect on its contents.

Main problem analysis and definition workshop

Given the epidemic circumstances, the workshop took place virtually on May 7, 2020. The workshop lasted three hours with two intervals of five minutes each. The method used was inspired by Design Thinking tools.

Participants were encouraged to diverge and converge in the four planned stages of the workshop: i) main problem definition; ii) definition of main problem consequences; iii) definition of main problem causes; and iv) identification of potential affected stakeholders and definition of the degree to which they are affected by the main problem. At the beginning of the workshop, the following recommendations were made to the participants: a) have an open mind; b) avoid any type of judgement; and c) have a bias towards action. In this sense, all ideas presented by the participants, through the use of virtual self-adhesive notes, were considered.

During the first stage of the workshop, the participants were initially asked to reflect individually for five minutes and describe what the main problem related to COVID-19 is in their opinion. They were also recommended to avoid describing the problem as the absence of a solution. The use of self-adhesive notes was limited to two per participant, and each note should have contained a description of the main problem. Then, an affinity diagram was created to group similar ideas. Finally, a vote was held, with each participant entitled to two votes, in order to select the main problem.

In the second workshop stage, the participants were again requested to reflect individually for five minutes on what would be the main problem consequences, based on data and evidence presented in the document received during the pre-workshop activity. As it was a practical and illustrative exercise, the participants were recommended to list three to four consequences, describing each one on a virtual self-adhesive note. Subsequently, another affinity diagram was made to group similar consequences.

In the third workshop stage, participants were asked why the main problem exists, i.e., what would be its causes. They were then encouraged to use the information from the pre-workshop document to describe the main problem causes. Participants were provided with 10

minutes for individual consideration, and they were recommended to identify three to four causes each in one virtual self-adhesive note. Soon after, a new affinity diagram was built to group similar causes.

Finally, regarding the fourth and last workshop stage, the participants were requested to identify the potential stakeholders affected and to what degree of involvement they would be influenced by the main problem.

The participants were recommended to inspire themselves by the scientific evidences, the pre-workshop document, the problem description and its causes and consequences already listed, in order to describe the affected stakeholders.

For the definition of stakeholders' involvement degrees, a scale of five levels was established, the first corresponding to the least influenced stakeholders and the fifth to those most affected by the problem. First, the participants were provided with 10 minutes to think individually, with the recommendation to identify six affected stakeholders each, describing a stakeholder and his degree of involvement per self-adhesive note. One more time, an affinity diagram was elaborated to group similar affected stakeholders. By voting, the participants selected the final involvement degree corresponding to similar affected stakeholders, who, in some cases, previously had different degrees of involvement.

Analysis workshop subjects and main problem definition

Seven Anvisa federal employees and one trainee participated in the workshop. All of them currently working in Anvisa's area responsible for improving regulatory quality. One is an epidemiologist with experience in researching outbreaks and epidemics, two are health surveillance managers and other five participants are experienced in RIA methods and problem analysis and definition. Of the latter, two of them were responsible for the workshop moderation.

The definition of the quantity of eight workshop participants met the recommended by Fulton-Calkins *et al* (2010), who indicates the ideal quantity between seven and 15 people for problem solving and decision-making workshops. Moreover, the literature has suggested that cooperative groups perform better than independent individuals in a wide variety of problem-solving processes (KORIAT et al. 2016).

Although the workshop participants are not specialists in COVID-19, there was no harm in the didactic-pedagogical workshop outcome, as the objective was to demonstrate the potential of the problem analysis and definition as a "tool" for the formulation of policies and actions to cope with COVID-19.

Microsoft Teams and Mural Platforms

The workshop took place using Microsoft Teams and Mural platforms. Microsoft Teams is an application that is part of the Office 365 suite. It is a teamwork hub where conversations, files, meetings, and applications are brought together in a single shared cloud workspace (Microsoft, 2020). During the workshop, Microsoft Teams was used for real-time video and audio interactions, as well as for written chat in a collaborative format.

Mural is a visual workplace that enables collaboration among remote team members, through whiteboards and virtual self-adhesive notes. It allows teams to collaborate visually to solve complex problems, as an easy-to-use software for creating diagrams used in Design Thinking and agile methodologies, in addition to stimulating participants' creativity (Mural, 2020). In this study's case, Mural played the role of virtual whiteboard and self-adhesive notes, using previously created templates based on Design Thinking tools already applied in face-to-face workshops at Anvisa.

Information organization and results analysis and consolidation

As seen in the previous subtopic, the affinity diagram was used to organize the participants' ideas in all stages. An affinity diagram is an approach designed to help organize disparate, loose, and unstructured ideas generated in brainstorming workshops, by consolidating them into clusters based on their natural relationships or priority patterns (NHS, 2011).

After the workshop, the results were analyzed and consolidated, in order to allow a general problem representation, containing the specific consequences, causes and objectives, as well as an affected stakeholders map. During the analysis, the possibility of minor reformulations in writings proposed by the participants was expected, preserving the central idea of the text. As an illustration, the RIA specific objectives were elaborated for some causes chosen by the authors.

Results and discussions

The results and discussions of this study are presented according to each workshop stage.

The main problem

After a process of discussion and convergence of ideas, the main problem to be addressed in the context of regulatory policy actions was defined as: "SARS-COV-2 coronavirus dissemination, as a little-known, untreated and highly contagious virus" (Table 1). For ELLIG et al. (2016), the first principle governing the regulatory review of the executive branch is that an agency must identify the problem it intends to solve, as well as assess its importance. This principle

reflects the sensible notion that, before proposing any regulation, regulators have to understand the problem causes and consequences that the proposed regulation seeks to address.

Table 1. Main problem, consequences, causes, and specific objectives.

Main problem: SARS-COV-2 coronavirus dissemination, as a little-known, untreated and highly contagious virus.		
Consequences	**Causes**	**Specific Objectives**
● Overload or overcrowding in hospitals.	● No available vaccines or medicine for preventing and treating COVID-19	● Vaccines and medicines development to prevent and treat COVID-19.
● Increasing number of deaths.	● Eating habits without proper health control.	● Improve health control over certain eating habits.
● Sudden increase in the number of hospitalizations for severe cases of respiratory diseases.	● Disease asymptomatic cases that hinder prevention and control measures.	● Improve asymptomatics identification mechanisms.
● Increased prices and shortages of medicines, as well as other essential materials for COVID-19 coping, such as hand sanitizer and face masks.	● Low population testing capacity.	● Expand the population testing capacity.
● Insufficiency of the world's production to meet the needs for disease coping, regarding essential material.	● Low population adherence to prevention and control measures.	● Take actions to increase the population's adherence to prevention and control measures.
● Increased self-medication of potential drugs used in the COVID-19 prevention and treatment.		
● Worsening of mental health problems.		
● Work overload of health professionals.		
● Global economic crisis.		
● Fiscal crisis and financial impact on governments around the world.		

Source: Elaborated by the authors.

Besides fitting into the perspective of the conventional RIA approach, which emphasizes the presence of market failures as justification for government intervention (MENEGUIN et al. 2020), the main problem defined in the workshop presents another reason for government involvement, namely the promotion of meritorious goods' consumption. Merit goods are "commodities" considered goods for a person regardless of their own preferences, as they are

partly defended with arguments that people do not always know what is best for them (FOLLAND et al. 2008). In this way, the public policies associated with coping with COVID-19 can be considered in the concept of meritorious goods.

The type of market failures that characterize the main problem includes the presence of incomplete information. Controlling the COVID-19 epidemic requires diagnostic testing, screening of symptomatic and asymptomatic patients, and information and communication about the disease nature and transmission. The information provided by diagnostic tests in asymptomatic patients, for instance, can create beneficial results to accelerate preventive and protective behaviors of the susceptible population (FOLLAND et al. 2008).

Table 2 provides evidence on the existence, magnitude and severity of the main problem, with systemic characteristics, at a national level. So far, the North (43.3/100,000 inhabitants), Northeast (24.9/100,000 inhabitants) and Southeast (22.7/100,000 inhabitants) regions had higher mortality rates per 100,000 inhabitants than the country's average (20.9/100,000 inhabitants). In absolute terms, the North region has the lowest number of hospital beds when compared to other Brazilian regions.

Table 2. Number of hospital beds, cases, deaths and mortality per 100,000 inhabitants, according to geographic regions of Brazil (updated: June 15, 2020, 6:30 p.m.).

Main problem	Geographic regions/country	Number of hospital beds (April/2020)	Number of cases	Number of deaths	Mortality per 100,000 inhabitants
SARS-COV-2 coronavirus dissemination, as a little-known, untreated and highly contagious virus	North	32,056	178,783	7,978	43.3
	Northeast	119,071	315,057	14,232	24.9
	Midwest	37,360	43,602	794	4.9
	Southeast	179,257	311,716	20,062	22.7
	South	74,067	39,114	893	3.0
	Brazil	**441,811**	**888,271**	**43,959**	**20.9**

Source: Prepared by the authors from Coronavirus/Brazil, 2020 and Ministry of Health, 2020.

The conceptual structure called Cynefin proposes that problems can be classified in four distinct domains. In the "simple" and "complicated" domains, problems assume orderly characteristics, with clear relationships between cause and effect, allowing the identification of a

right, ideal and definitive answer. Regarding the “complex” and “chaotic” domains, there is no clear connection between cause and effect, and it is not possible to identify an ideal and definitive response. In the “chaotic” domain, there is high turbulence and decision-making takes place at an emergency level. In the “complex” domain, there is strong unpredictability and the need to experiment responses by monitoring their results (SNOWDEN et al, 2007).

Due to its contextual characteristics, it seems clear that the main problem identified in this study is between the “complex” and “chaotic” domains, which requires emergency measures and decision-making with the need of learning from the results monitoring.

Main problem consequences

The consequences show how the main problem affects people`s lives. This helps to identify groups of affected stakeholders, choose specific objectives for RIA, and define messages for communication with society (VENEKLASEN et al. 2002). Depending on the stakeholder`s perspective, consequences can be positive or negative. In this study, participants identified 10 consequences, which are characterized as negative from the point of view of citizens, companies and government.

The worsening of problems related to mental health was one of the consequences related to the main problem defined in the workshop (Table 1). The results of a study that analyzed the stress levels, anxiety and depression since the virus introduction and the levels of psychological symptoms, according to age, comorbidities and confinement in a sample of the Basque Country population (northern Spain), expose this consequence. According to this study, although symptom levels were low at the beginning of confinement, younger individuals with comorbidities reported more symptoms than the rest of the population. A higher level of symptoms was also detected since confinement, when the population was forbidden to leave their homes (OZAMIZ-ETXEBARRIA et al. 2020).

Another consequence pointed out in the workshop was the global economic crisis due to the main problem. In order to highlight part of this consequence, ECLAC`s report presents a catastrophic scenario for Latin America and the Caribbean. The COVID-19 effects will produce the largest recession that the region has suffered since 1914 and 1930, with a gross domestic product fall forecast of -5.3% in 2020 (ECLAC, 2020). This recession is further accentuated in the forecasts made by the World Bank. According to the bank, multiple internal and external shocks resulting from the pandemic will cause a contraction in the regional economy of 7.2% in 2020. According to projections, Brazil`s economy is expected to shrink by 8% in 2020 due to total

lockdowns, falling investments, supply chain disturbances and lower global primary product prices (WORLD BANK, 2020).

The main problem causes

The identification and selection of appropriate options to solve a problem should be guided by understanding its causes. Often, the problem causes in health systems are complex and uncertain, and it may be more appropriate to consider the underlying causes. The process of clarifying the cause or the underlying cause is unlikely to be simple or linear (COCHRANE, 2011). The problem causes are related to multifactorial aspects. The spread of coronavirus did not occur for just one reason. The various problem causes have to be investigated, considered and prioritized, so as to allow the definition of clear objectives for regulatory and governmental action.

At the workshop, 20 causes were identified from the main problem determined by the participants, five of which are presented in Table 1 and were based on scientific evidence, as an illustration. It is certain that the problem causes are related to individuals and governments behaviors. These are behaviors that lead to the problem or contribute to its occurrence.

Behaviors related to eating habits and consumption of wild animals, without proper sanitary control, may have caused contamination by the virus (CASCELLA et al. 2020; SHEREEN et al. 2020), and the situation may have been aggravated by inaction of the Government of China, since the contagion began on December 16, 2019, until the adoption of severe containment measures on January 23, 2020 (LIN et al. 2020).

Coronavirus probably originated from bats, and then infected other mammalian hosts until it reached humans (CASCELLA et al. 2002). Based on the large number of infected people who were exposed to the wet animal market in Wuhan city (China), it is suggested that this is probably the zoonotic origin of COVID-19 (ROTHAN et al. 2020).

As the contamination progressed, after its early stages in China, some causes favored the high rate of contagion to occur. The existence of asymptomatic disease cases may have made it difficult to adopt prevention and control measures. A study conducted by Noshiura et al (2020) indicated that asymptomatic cases may represent up to 41.6% of all cases of the disease.

Besides the occurrence of asymptomatic cases, there are also symptomatic cases not confirmed by the low testing capacity in some countries and regions (RODRIGUEZ-MORALES et al. 2020). The ability to test everyone periodically through certification and monitoring is a viable way for society to resume life, without increasing contagion (PETO. 2020).

As severity of the pandemic progressed, government authorities started to adopt restrictive measures. However, some populations did not adhere to the restrictions. According to a study

conducted by Dingel et al. (2020), only 37% of U.S. jobs can be fully performed at home. As the authors stated, this percentage is even smaller in lower-income countries. When the worker is unable to carry out his activities at home, it is natural that he does not obey the restriction imposed by his government. Financial needs, among other factors, lead people to leave home and not comply with restrictive measures.

From the identified and evidenced causes, it is possible to design specific objectives. Government action should be related to each of the specific objectives, in order to promote the coping with the causes and, consequently, the main problem. The specific objectives related to the five causes addressed in this study can be found in Table 1.

Potential stakeholders affected by the main problem

Thirty stakeholders affected by the main problem were identified during the workshop, ten of which were included in the highest degree of involvement according to the five-level scale previously established (Table 3). In this highest degree of involvement is, for example, the population of risk groups, such as the elderly and people with comorbidities.

As stated in a study conducted in China, approximately 80% of the patients have mild symptoms and the overall lethality rate is about 2.3%, reaching 8.0% in patients aged between 70 and 79 years old and 14.8% in those aged > 80 years old (WU et al. 2020).

Data from Italy indicate the population groups with higher risk of having a severe stage of COVID-19 and death. These groups are the elderly over 70 years of age and people with comorbidities such as hypertension, diabetes, cardiovascular diseases, chronic respiratory diseases and cancer. Men in these groups seem to be at higher risk than women. Chronic obstructive pulmonary disease, cardiovascular diseases and hypertension were identified as strong predictors of admission to the Intensive Care Unit. The authors also highlight the importance of identifying smokers as a potentially vulnerable COVID-19 group (ECDC, 2020).

In order to obtain more effective participation and support, it is important to understand not only who the affected stakeholders are, but also the nature of their interest and influence on the main problem. By understanding this point, it is possible to involve these stakeholders and even address their concerns by demonstrating how proposing solutions to the problem would benefit them. Depending on the objectives, RIA may focus on those stakeholders with greater interest and influence and/or those who are most affected by the main problem.

Table 3. Affected stakeholders and their degree of involvement with the main problem.

Main problem	Affected stakeholders (n= 30)	Degree of involvement
SARS-COV-2 coronavirus dissemination, as a little-known, untreated and highly contagious virus	*Total = 10* ● Risk group populations, such as the elderly and people with comorbidities. ● Health professionals working on the front line of coping with the disease. ● Hospitals and other health units. ● Ministry of Health. ● Low income population. ● Self-employed workers. ● Manufacturers of sanitizing products. ● Bars, restaurants and clubs. ● Professionals who cannot stay at home. ● Governments (sectors of economics and planning).	+++++ (greater)
	Total = 13 ● Biochemical testing laboratories. ● Local businesses. ● National System of Health Surveillance. ● Middle- and high-income populations. ● Population outside risk groups. ● Researchers and research centers in general. ● Anvisa. ● Ports, airports and borders. ● Health departments. ● Workers from essential sectors, except health and economy. ● Immigrants. ● Big companies. ● Health equipment manufacturers (e.g. artificial respirators).	++++
	Total = 7 ● Electoral process (politicians). ● Startups (innovation companies). ● Professionals working in home offices. ● Children and young people. ● Unions and employee associations. ● Medicine distributors. ● Packaging manufacturers.	+++
	No affected stakeholder was identified	++
	No affected stakeholder was identified	+ (minor)

Source: Elaborated by the authors.

The results of this study need to be considered in light of their limitations when demonstrating, through a didactic-pedagogical practical exercise, the importance of RIA,

specifically in the problem analysis and definition phase. The problem understanding depends on the subjective view of those who are involved with the situation (ANVISA, 2019).

Moreover, not all consequences, causes and affected stakeholders defined in the workshop were fully explored. In a real-world study of RIA, all elements from its phases must be substantiated through scientific and also colloquial evidences (SHARMA et al. 2015). Other important consequences, causes and affected stakeholders may not have been identified in the didactic-pedagogical workshop. Furthermore, it is expected that these elements may undergo changes due to the epidemic/pandemic stages and the levels of government management in coping with COVID-19.

Final considerations

This study is a timely contribution to the COVID-19 response in Brazil, as well as to other future public health emergencies. It was possible to identify that performing problem analysis and definition workshops, within the scope of Regulatory Impact Assessment (RIA) and in a context of epidemic/pandemic, can promote effective solutions for the several stages of a public health emergency. Problem analysis and definition improves the process of generating solutions, that is, people's ability to produce high-quality alternatives to specific problems (NEZU et al. 1981).

The results of this study presented theoretical and practical contributions. From the theoretical point of view, the study contributed to the knowledge field that relates RIA to decision-making in moments of pandemics. The study presented logical concepts and connections with high research potential and application for policies and action formulation to cope with COVID-19, contributing to a research gap identified in the work of Mota et al (2020).

From a practical point of view, the results of this research indicated that public institutions could use the rationale offered by RIA to develop policies and actions to cope with COVID-19 and other public health emergencies. The collaborative workshop, using Design Thinking tools, proved to be useful to promote reflections and information gathering, as well as solutions and actions to deal with the pandemic. RIA offers a logical rationale that can be used in an environment where the professionals involved are directly under pressure, contributing to more planned and integrated public policies and government actions.

In addition, researchers and decision makers can continue this study to fully achieve the objectives of the response to COVID-19, from the development of subsequent stages of RIA, i.e., identification and comparison of regulatory options, monitoring and evaluation of the proposed solutions after implementation.

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Judicialization of administrative measures to tackle the Covid-19 pandemic in Brazil[9]

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This article studied the judicialization lawsuits related to the pandemic of the new coronavirus, within the scope of Administrative Law. The cases that reached the Brazilian Federal Supreme Court (FSC), available at the "Painel de Ações COVID-19", were analyzed, as well as a sample of the cases that reached the state courts, obtained through journalistic reports, consolidated on the "Consultor Jurídico" website. Descriptive analysis and content analysis techniques were used, in the thematic mode, for both sources of information. The following variables were analyzed: procedural classes groups, procedural classes, main subject, notification date, time until the first decision, decisions, decisions groups, and total of cases archived remotely. Near 34% of the actions referred to the flexibilization or tightening of free movement, restrictive measures on and the opening of commerce and services, and another 34% referred to budgeting issues, mainly dealing with the suspension of state debts and untying resources to combat the pandemic. The median time until the first decision made by the FSC was less than five days for all categories. The judicialization of COVID-19 pointed out already known flaws in public health and social policies in Brazil, and it can encourage a lot of actions, both by the Legislative and the Executive, to mitigate these problems. This article demonstrates the importance of observing the responses brought by the judicialization, and of the dialogue between the three powers, to deal with the demands of the pandemic better and with several other demands of society.

Key words: COVID-19, judicialization of health, Administrative Law.

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Judicialização das medidas administrativas de combate à pandemia do COVID-19 no Brasil

Este artigo estudou os processos de judicialização relacionados à pandemia do novo coronavírus, no âmbito do Direito Administrativo. Foram analisados os processos que chegaram até o Supremo Tribunal Federal (STF), disponibilizados no Painel de Ações COVID-19, e uma amostra dos processos que chegaram aos tribunais estaduais, obtida através de reportagens jornalísticas, consolidadas no Portal Consultor Jurídico. Foram utilizadas técnicas de análise descritiva e de análise de conteúdo, na modalidade temática, para as duas fontes de informação. Foram analisadas as seguintes variáveis: grupo de classes processuais, classes processuais, assunto principal, data de autuação, tempo até a primeira decisão, decisões, grupo de decisões e total de processos baixados por meio remoto. Cerca de 34% das ações se referiam à flexibilização ou ao endurecimento das medidas restritivas de circulação da população e à abertura do comércio e de serviços, e outros 34% a questões orçamentárias, versando principalmente sobre a suspensão de dívidas dos estados e sobre a desvinculação de recursos para o combate à pandemia. A mediana do tempo até a primeira decisão tomada pelo STF foi inferior a cinco dias para todas as categorias. A judicialização da COVID-19 apontou falhas já conhecidas nas políticas públicas de saúde e sociais no Brasil e pode impulsionar diversas atitudes, tanto do Legislativo quanto do Executivo, para mitigar esses problemas. Este artigo demonstra a importância de observar as respostas trazidas pela judicialização, e o diálogo entre os três poderes, para melhor lidar com as demandas da pandemia e também com diversas outras demandas da sociedade.

Palavras-chave: COVID-19, judicialização da saúde, Direito Administrativo.

Título: Judicialización de medidas administrativas para combatir la pandemia del COVID-19 en Brasil

En este artículo se estudiaron los procesos judiciales del nuevo coronavirus en el Derecho Administrativo. Se analizaron los procesos que llegaron al Supremo Tribunal Federal (STF), disponible en el “Painel de Ações COVID-19”, y una muestra de los casos de los tribunales estatales, obtenidos a través de informes periodísticos, consolidados en el portal “Consultor Jurídico”. Se utilizaron técnicas de análisis descriptivo y de contenido, en la modalidad temática, para ambas fuentes. Se analizaron las variables grupo de tipos procesales, tipos procesales, tema principal, fecha de actuación, tiempo hasta la primera decisión, decisiones, grupo de decisiones y total de procesos descargados de forma remota. Alrededor del 34% de las acciones se referían a la flexibilización o endurecimiento de las medidas restrictivas de circulación y a la apertura del comercio y de los servicios, y otro 34% a cuestiones presupuestarias, principalmente la suspensión de las deudas de los estados y la desvinculación de los recursos para el combate de la pandemia. El tiempo mediano hasta la primera decisión tomada por el STF fue de menos de cinco días para todas las categorías. La judicialización de la COVID-19 señaló las fallas ya conocidas de las políticas públicas de salud y sociales en Brasil y puede impulsar actitudes de los Poderes Legislativo y Ejecutivo. Los resultados demuestran la importancia de observar las respuestas aportadas por la judicialización, y también el diálogo entre los tres poderes, a fin de afrontar mejor las demandas de la pandemia y también diversas otras demandas de la sociedad.

Palabras clave: COVID-19, judicialización de la salud, Derecho Administrativo.

Introduction

The COVID-19 pandemic is the largest health and humanitarian emergency that has occurred in the world in the past hundred years. Having started in December 2019 in Wuhan, China (ZHU et al., 2020), the new coronavirus has spread rapidly across the globe, causing thousands of deaths, and creating a great impact in the health, economic, and political fields.

To tackle COVID-19, many countries are using a combination of containment and mitigation activities to prevent simultaneous increases in cases, to level the demand for hospital beds and to protect the most vulnerable individuals from infection, including the elderly and people with comorbidities. Actions to achieve these goals vary between countries, and they are based on national risk assessments that, for the most part, include estimated numbers of patients requiring hospitalization and availability of hospital beds and ventilatory support (Bedford et al., 2020).

Besides the consequences to public health and the thousands of lives lost, the debate on measures to combat the new coronavirus in Brazil points to a challenging reality in terms of judicialization.

Judicialization is a phenomenon characterized by the activation of the Judiciary by citizens when they feel that their rights have been harmed or threatened. The Federal Constitution of 1988 provides in Article 5, Paragraph XXXV that "the law shall not exclude any injury or threat to a right from the consideration of the Judicial Power" (BRASIL, 1988). However, there are many criticisms concerning judicialization. Among them are criticisms regarding situations in which Judicial Power is provoked to decide on issues that interfere in the execution and planning of public policies, which are a constitutional attribution of the Executive Power. A judicial decision may compromise the execution of other policies due to the displacement of resources (LEITÃO et al., 2014). When the Executive and the Judicial Power clash in favor of the right to health, there is an impasse, explained by Minister Gilmar Mendes, when saying that the judicial decisions present "a strong point of tension before the elaborators and executors of public policies, who see themselves compelled to guarantee the provision of social rights of the most diverse nature, often contrasting with the policy established by governments for the health sector and beyond budgetary possibilities" (SANTOS; SANTOS; LIMA; et al., 2017).

The Executive Power is responsible for elaborating and managing public policies. Thus, managers of Brazilian states and municipalities started a race to expand hospital beds, acquire materials necessary for the treatment of COVID-19, and decree social isolation to prevent the spread of the

virus through close contact between people. In this context, the judicialization of the new coronavirus developed, with an impact on public policies developed by the Executive Power (SANTOS, 2020). We are facing an Administrative Law problem, as will be explained below.

Law as science is stratified into two major areas, namely Public Law and Private Law (JURÍDICA, 2020). Administrative Law is the branch of Public Law that, according to Di Pietro (2016), "has as its object administrative bodies, agents, and legal entities that make up the Public Administration, the non-contentious legal activity that it exercises and the assets that it uses to achieve its ends, of a public nature". Mafra (2005) presents the three objects of Administrative Law as: "the organization of the public administration and the various administrative persons that compose it; the powers and rights of these entities in the performance of the public service; the exercise of these powers and rights, their prerogatives, and administrative or litigation action".

In the coronavirus specific case, the Judiciary has been provoked at times to contain excesses practiced by the Executive Power, which has resulted in questionable restrictions to the exercise of essential activities, or to determine to the Executive Power to promote restrictions, fighting administrative decisions towards relaxation of preventive measures that may cause damage to the population (NUNEZ, 2020). Also, requests to guarantee admission to the ICU (Intensive Care Unit), which may require the availability of respirators and other limited equipment, are already coming before the Judiciary. The judicialization of medications that have not yet proven their efficacy, such as chloroquine, hydroxychloroquine, and ivermectin, is another reality. It is also worth mentioning the requests to suspend the debt of States and municipalities to the Union and financial institutions, with the argument that they need to deal with pandemic issues.

However, there is an understanding that, although the Judiciary does not have the competence to formulate public policies, it can correct its flaws. And if there was a failure in the implementation of a policy, and it is a priority to the health or social goals of the country, the Judiciary has the legitimacy to act. Inadequacy occurs when the Judiciary encroaches on executive powers and becomes a public policymaker (GOMES, 2020). Thus, Aith (2017) presents the existence of articulation between those involved in the implementation of public policies as essential, so that State actions can be effective (AITH, 2017). Therefore, the current moment points to unprecedented conflicts in the Judiciary. Challenges already recognized in the specialized literature add to those imposed by the pandemic. In this context, more than ever, it is necessary to develop and implement public policies aimed at individual health, in the sense of treating infected people, and also for collective health, to avoid the uncontrolled expansion of the disease.

After only a few months passed since the beginning of the pandemic, it is already possible to perceive a very worrying perspective concerning the multiplication of conflicts of interest of all kinds.

This investigation aims to explore lawsuits within the scope of Administrative Law, related to the COVID-19 pandemic, with a potential effect on public health.

Methods and Techniques

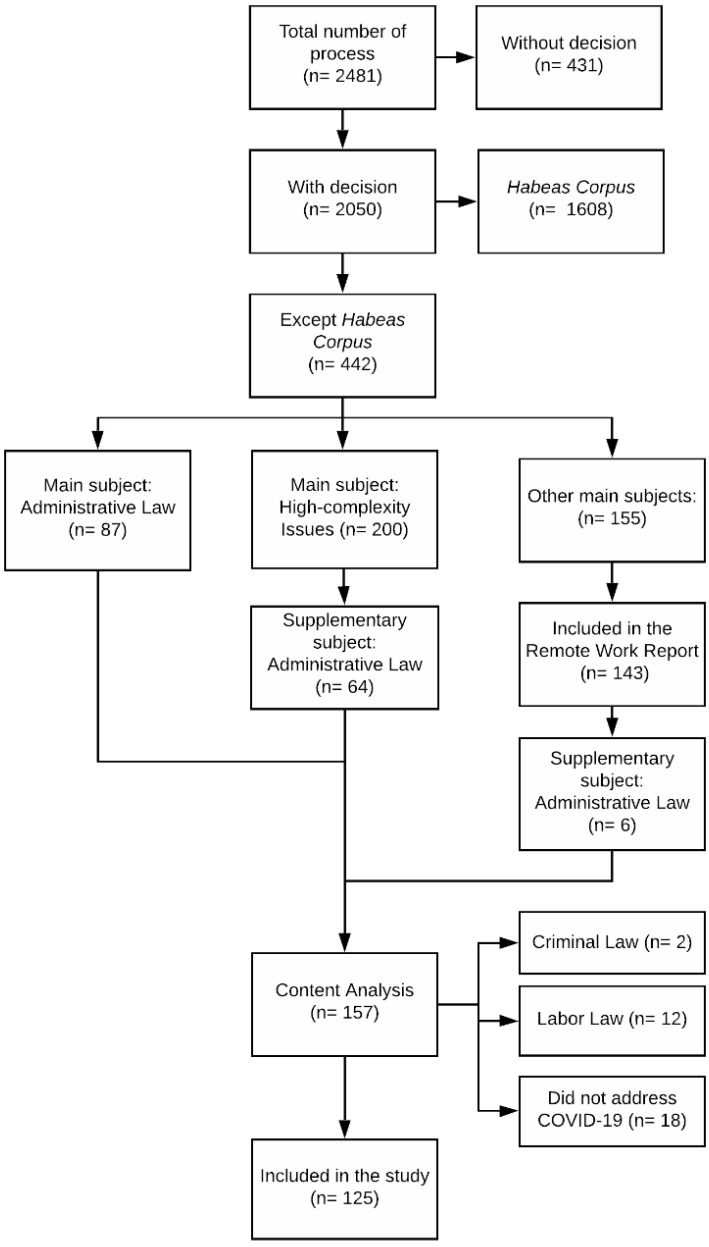
This is a cross-sectional investigation, in which all the cases related to the COVID-19 pandemic received by the Brazilian Federal Supreme Court (FSC), until May 28th, 2020, under the scope of Administrative Law were analyzed. Besides, a survey was carried out in secondary information sources, through journalistic reports, to understand the actions related to the pandemic that do not reach the FSC.

To enable monitoring of lawsuits related to the pandemic of the new coronavirus, the FSC made the “Painel de Ações COVID-19” available. This panel provides updated data on all lawsuits submitted to the FSC related to the COVID-19 pandemic. It aims to inform and allow society to monitor actions on the topic. The lawsuits are separated into classes and subjects. The data on the website is updated every five minutes. A tool tags such lawsuits as preferential and alerts the judges to make the decision process faster (STF, 2020b). Lawsuits initiated before the start of the pandemic can receive the tag during its course and, therefore, can also be part of the panel.

To complement the information on the lawsuits, data were obtained from the “Relatório de Prestação Jurisdicional –Trabalho Remoto”, also from the FSC, on the lawsuits and decisions identified in the COVID Panel and received, archived, and/or which had a decision through remote work (STF, 2020c). This panel was implemented starting March 12th, 2020, the date on which Resolution 663/2020 was issued, which defines the temporary measures to prevent coronavirus adopted by the FSC.

To identify the lawsuits the steps described below and shown in Figure 1 were followed. The first step was the exclusion of lawsuits that had no decision since the decision was used to define the subject of the process in later stages of selecting the ones to be studied. In the second stage, the lawsuits that corresponded to *Habeas Corpus* were removed, as they are not part of the scope of the work, since it is a Criminal Law subject. In the third step, those who had "Administrative Law" as their main or complementary subject were selected, as detailed below.

Figure 1 - Flowchart of the lawsuits included in the study.



Source: prepared by the authors.

Since the COVID Panel database provides only the main subject of the lawsuits, after the selection of lawsuits with the main subject "Administrative Law", we proceeded to the fourth step, which was the identification of the lawsuits that had this branch of law as a complementary subject. For this, two strategies were used: for the lawsuits with the main subject "Issues of High Complexity, Great Impact, and Repercussion", the complementary subject was identified through manual

consultation, process by process, on the FSC website. For the other law branches, with a lower probability of having legal lawsuits of interest to the study, the complementary subject was analyzed only among those received or with decisions rendered through remote work. For these, it was not necessary to perform manual analysis since the information was systematized in the Remote Work Panel.

The fifth and final step of selection was identifying the subject of the lawsuits according to the decisions, manually surveyed in the FSC inquiry area. In this phase, content analysis was carried out, in the thematic modality, according to the typology of Badin (2011), to categorize the lawsuits and group them by similarity. Although they were classified as "Administrative Law" in the COVID Panel, those lawsuits mainly dealing with labor law issues, criminal law issues, or that had no direct relation to the pandemic were excluded. It is important to note that the areas of law relate to each other, so there may be, for example, administrative law lawsuits that intersect with labor law. The choice of this research was to select the administrative lawsuits within the scope of its fundamental precept of the primacy of the public interest over the private one.

The following variables were analyzed: procedural classes groups, procedural classes, main subject, assessment date (process start date), time until the first decision (number of days between the assessment date and the date of the first decision), decisions, group of decisions (final decision, interlocutory, internal appeal, and preliminary injunction), and the total number of cases archived remotely. Since a lawsuit can have several decisions, archiving is the event that marks the end of the process.

As previously explained, not all actions related to COVID-19 reach the FSC, with a vast number of actions and decisions in the State Courts. To research a certain Court to obtain actions that deal with a specific theme, a jurisprudential inquiry is made on the respective website. It happens that the jurisprudential inquiry through keywords only covers the legal actions that present terminative decisions. It is difficult to find the legal lawsuits that are in progress, as it is not possible to find them through keywords, like in the jurisprudential research, requiring knowledge of their specific data to find them.

Then, a survey was carried out in secondary information sources, through journalistic reports, to understand actions related to the pandemic that do not reach the FSC. The chosen source was the “Consultor Jurídico” website (https://www.conjur.com.br/), because it is one of the largest legal news portals in the country and allows filtering the news by law area. Journalistic media from a specific source was adopted, as well as the study by Castanheira, Faulhaber, and Gerschman (2018) as a proxy for the behavior of the media in general. Reports published up to 06/16/2020

were collected. The portal's search tool was used to filter articles with the term "COVID" and related to the Administrative Law Area. For thematic categorization of reports, the content analysis technique was also used (Badin, 2011). The charts were made using Microsoft Excel 2010®, with the exception of the boxplot, which requires more specific analysis resources and, therefore, it was built with the aid of the ggplot2 package of software R, version 4.0.0.

Results

After consulting two sources for the lawsuits that reached the FSC (“Painel de Ações COVID-19” and “Relatório de Prestação Jurisdicional –Trabalho Remoto”), 2,481 different lawsuits were found. Out of the 2,050 that had at least one decision, 1,608 (78.4%) were from *Habeas Corpus* and were excluded from the subsequent analysis (Figure 1).

Out of the 442 remaining cases, 87 had "Administrative Law" as the main subject and remained in the study. Also, 200 had as their main subject "Issues of High Complexity"; 64 were selected due to the identification of the complementary subject "Administrative Law". Out of the 155 lawsuits with other main subjects, six were selected because they are in the Remote Work Report and have a complementary subject "Administrative Law" (Figure 1).

Altogether, 157 lawsuits were included in the content analysis. Out of these, 33 were excluded for referring to the subject "Criminal Law" (n=2), to issues of "Labor Law" (n=12), or for not addressing issues related to COVID-19 (n=18) (Figure 1). The remaining 125 cases were classified into seven categories, as shown in Table 1. Most of them (68%) refer to the "Restrictive Measures" and "Budget" categories (Table 1).

Table 1 - Description and frequency distribution of lawsuits selected for the study, according to categories identified in the content analysis, 2020.

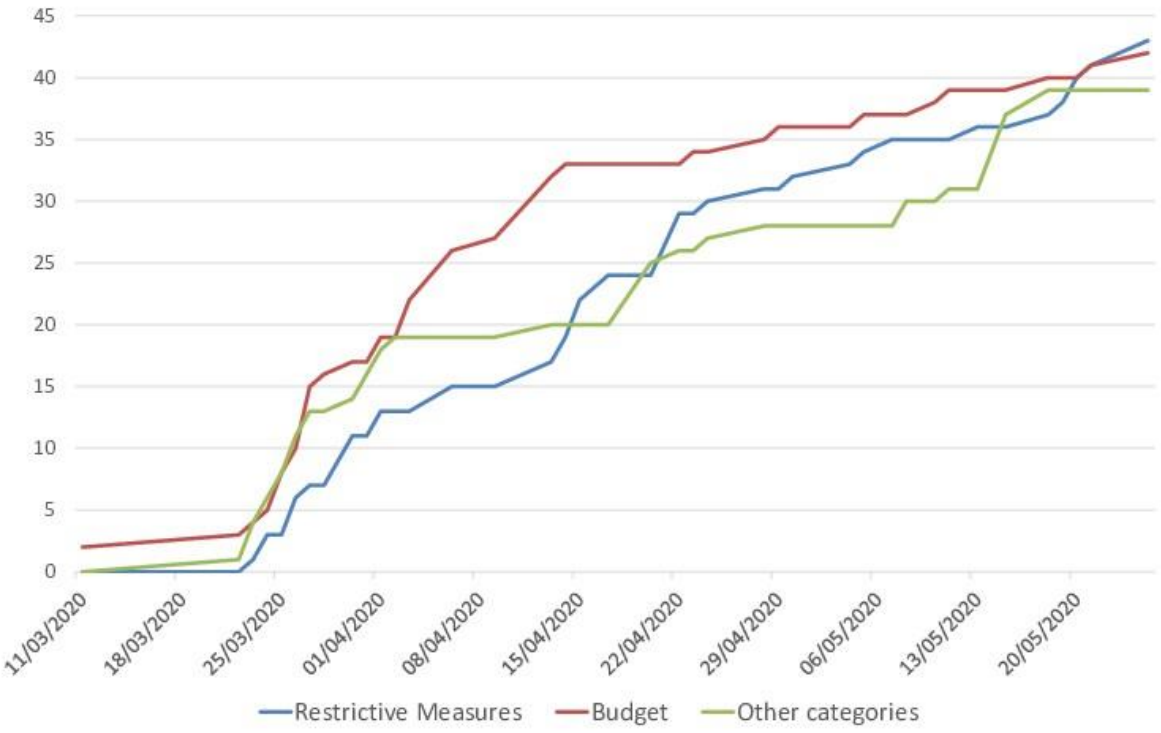
Category	Description	n (%)
Restrictive Measures	These deal with quarantine, restrictions to commerce and transport services, limitations in freedom of movement for the population, “Lockdown”, the campaign "Brazil cannot stop" and others	43 (34%)
Information	These are actions that deal with data sharing by telecommunications companies during COVID-19, restrictions in the Information Access Law and even information about the President's COVID-19 test	10 (8%)
Budget	These address budgeting issues, entities that ask for debt suspension with the Union or with banks due to the pandemic, to use these resources in the fight against COVID-19, the Constitutional Amendment about the "war budget", the COVID-19 emergency aid, the default on payment of electricity service, and the allocation of funds for COVID-19 actions, among others	42 (34%)
Accountability of Public Officials	Actions dealing with Provisional Measure 966, which seeks to exempt some responsibilities of public officials for acts carried out during the pandemic	8 (6%)
Servers	Actions covering topics related to applications for public positions, selection process and creation of commissioned positions in the context of the pandemic	2 (2%)
Procedural	Actions related to changes in procedures due to the pandemic, such as teleworking, suspension or change of deadlines, online hearings, postponement of the National Examination of Middle School, proceedings in Congress	18 (14%)
Health	Actions on single-line processes, regulation of ICU beds and supplies for individual protection and treatment of COVID-19.	2 (2%)

Source: Prepared by the authors, with data from the Federal Supreme Court (FSC).

The cumulative frequency of lawsuits in these two categories and the others grouped can be seen in Figure 2. It is observed that, on April 1st, the most frequent category referred to "Budgets" (38%) and "Other categories" (36%). From this date until April 15th, the "Budgets" category grew more rapidly than the others, while the lawsuits in "Other Categories" stabilized. On April 15th, "Budgets" and "Other Categories" accounted for 44% and 27% of total cases, respectively. The "Restrictive

Measures" category has grown almost linearly since March 23rd, when restrictive measures were first enacted and became the most frequent group (35%) on May 25th.

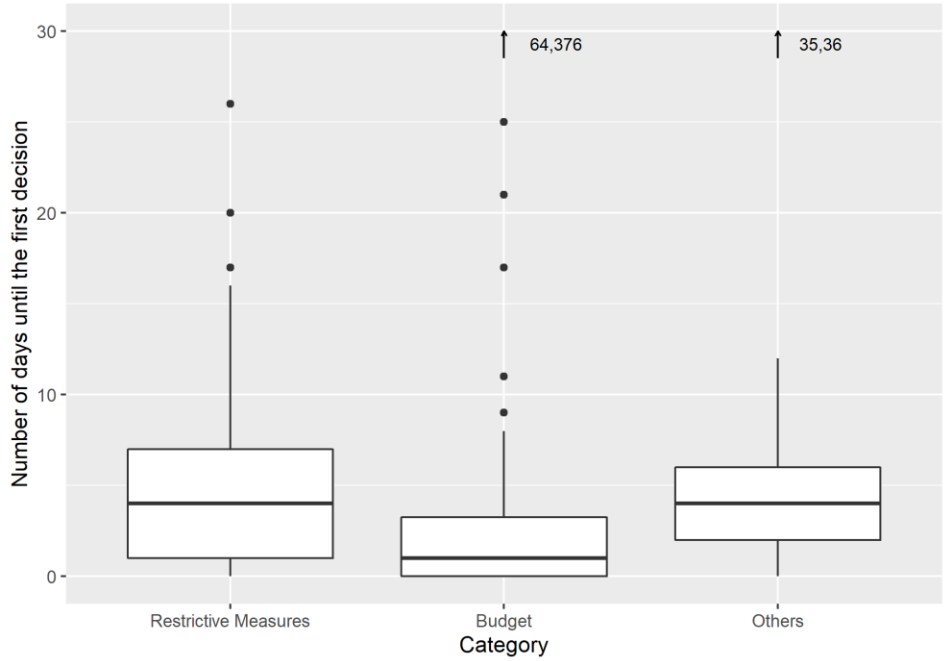
Figure 2 - Temporal distribution of lawsuits related to restrictive measures, budget and other categories according to the date of inclusion, COVID Panel and Remote Work Panel, 2020.



Source: Prepared by the authors, with data from the Federal Supreme Court (FSC).
Note: To improve visualization, a legal process included in 12/03/2019 was excluded.

In the "Budget" category, at least 50% of the first decisions were made on the same day or on the day after the assessment date. The median time to the first decision was less than five days for all categories studied. Besides, at least 75% of cases received the first decision in less than ten days. (Figure 3).

Figure 3 - Boxplot of the time until the first decision (number of days between the date of inclusion and the date of the first decision) for lawsuits related to restrictive measures, budgets and other categories, 2020.



Source: Prepared by the authors, with data from the Federal Supreme Court (FSC).
Note: The arrows indicate lawsuits with time until the first decision over 30 days and the values correspond to the number of days observed.

The majority (81.4%) of the lawsuits in the category "Restrictive Measures" asked the FSC to deliberate about the flexibilization actions established by States and municipalities (permission, limitations or closings in the commerce and transportation operation). Out of these actions on flexibility, 54.3% were requests for opening, and the other 45.7% were requests for the closure of establishments and limitations on the movement of people. The lawsuits requesting opening were almost entirely brought by representatives of the private sector or organizations, such as the Brazilian Association of Car Rental Companies, the National Confederation of Transport, the National Confederation of Tourism, Retail Trade Unions, or Religious Organizations. These lawsuits called for greater flexibility concerning the opening of various categories of commerce, such as convenience stores, law firms, gyms, gymnastics centers, and on-site religious activities. On the other hand, other lawsuits requested greater rigidity in restrictive measures, including: prohibiting productive activity and movement of people, by any means; prohibiting campaigns for a return to their full activities or to minimize the severity of the new coronavirus pandemic; and

lawsuits against the federal government, because of the advertising campaign "Brazil cannot stop".

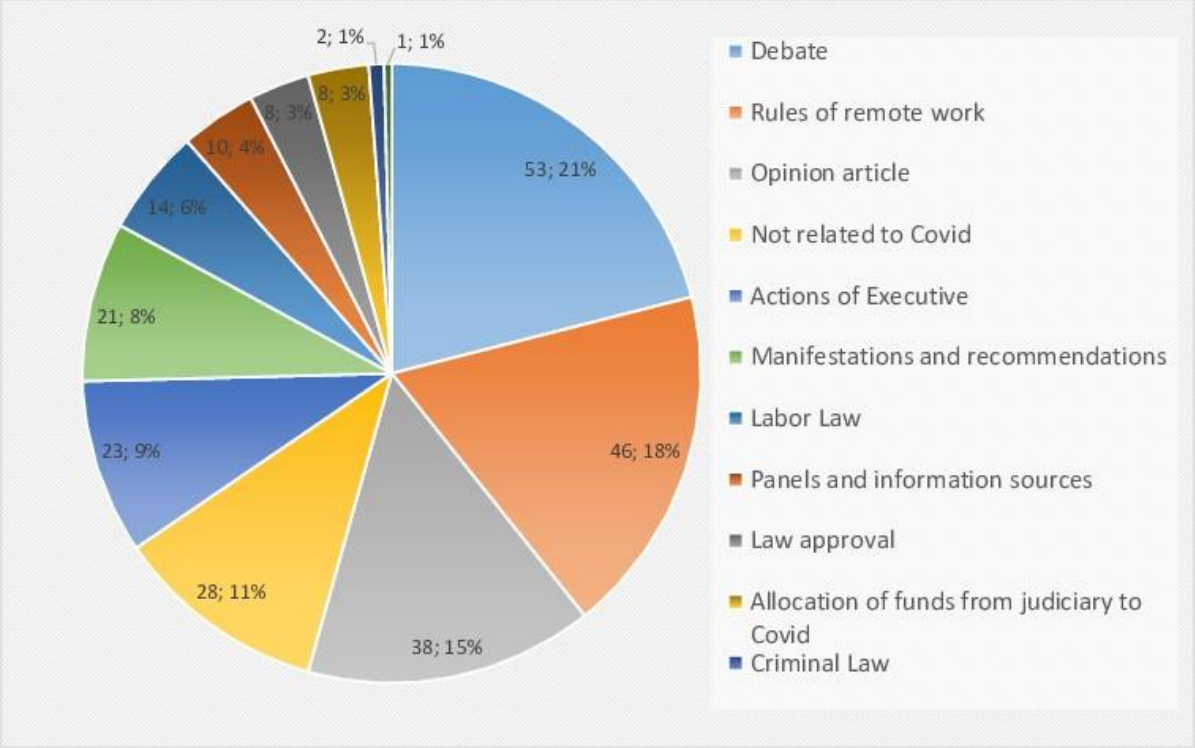
In the “Budget” category, there were lawsuits to suspend debt with the Union by the States of Acre, Amazonas, Rondônia, Pará, Rio Grande do Norte, Maranhão, Paraíba, Sergipe, Pernambuco, Bahia, Mato Grosso, Mato Grosso do South, Espírito Santo, São Paulo, Rio de Janeiro, Santa Catarina, and Paraná. Some municipalities have also requested debt suspension.

There were also lawsuits filed by the states of Maranhão, Tocantins, and Mato Grosso to reallocating financial resources already earmarked for to tackle the COVID-19 pandemic (prevention, containment, and mitigation actions), through its application in other health actions, social assistance, and public security.

We also found lawsuits questioning Constitutional Amendment 106, of 2020, known as the "War Budget", which aims to facilitate federal government spending in combating the pandemic by separating pandemic spending from the Union general budget.

The search on the “Consultor Jurídico” website initially brought 436 news items, of which 252 (57.8%) were not selected. Most of the excluded news referred to debates and conferences via the web (21.0%), resolutions related to remote work in the Judiciary organs (18.2%), and opinion articles (15.1%) (Figure 4).

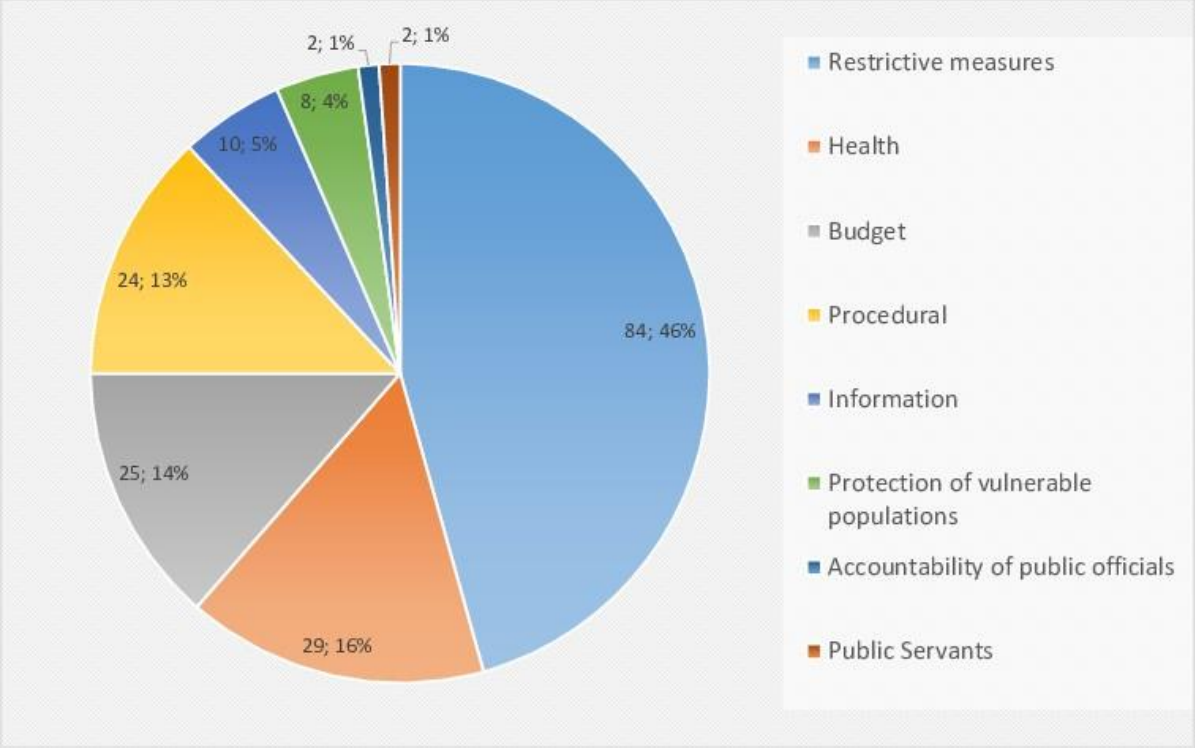
Figure 4 - Absolute and relative frequency of journalistic news not included in the study, 2020.



Source: Prepared by the authors, with information obtained from the “Consultor Jurídico” website.

Considering the 184 (42.2%) selected news, we found 84 (45.6%) referring to restrictive measures, 29 (15.8%) referring to the health area, 25 (13.6%) regarding budgets, and 24 (13.0%) on procedures (Figure 5). Also, 33 (18.0%) news had lawsuits judged by the FSC, six (3.3%) by the Superior Court of Justice (SCJ), and two (1.1%) by the General Accounting Office (GAO). Among the 143 that were from the State Courts, Jurisdiction or Districts, 68 (47.6%) were from São Paulo and 31 (21.7%) from Rio de Janeiro. In addition to these, administrative lawsuits related to COVID-19 were reported in 11 States, such as the Federal District (n=8), Pernambuco (n=8), and Rio Grande do Sul (n=7).

Figure 5 - Absolute and relative frequency of journalistic news included in the study, 2020.



Source: Prepared by the authors, with information obtained from the “Consultor Jurídico” website.

Among the news about restrictive measures (n=84), a large part refers to actions by the Federal Prosecution Service (FPS) and the Public Defender’s Office (PDO) against the States and Municipalities in order to adopt a lockdown, to suspend measures to relax social isolation, or to adopt strategies to tackle the new coronavirus. In this situation and in those dealing with competing competences between the federal entities in the FSC (n=20), in general, the Judiciary has acted to ensure that the restriction measures are met (n=15). The adoption of lockdown was requested in the states of Amazonas, Pernambuco, and Maranhão. The lawsuits against the relaxation of social isolation were filed in Pará, Rio de Janeiro (RJ), Duque de Caxias (RJ), Búzios (RJ), Ribeirão Preto (SP), Santos (SP), São José dos Campos (SP), among others. News about lawsuits against the quarantine flexibilization has been disseminated since April 1st.

Concerning health administrative issues (n=29), the Judiciary acted mainly in disputes between the Union and the other entities of the Federation about the ownership of respirators (n=9). Most of the cases were presented by municipalities that did not receive the equipment because the manufacturers claimed that they could not guarantee the supply, in the face of the Union production requirement of 180 days. In general, the Judiciary's decisions ensured that the respirators stayed in the municipalities.

Also important were lawsuits requesting an increase in hospital beds in the public network (n=8), all of which were filed in the State of Rio de Janeiro. These lawsuits requested hiring more health professionals for hospitals with unused beds because of the lack of professionals and to transfer beds from federal hospitals to the state and municipality Unified Health System (UHS). Also, disputes have been reported between the public and private systems (n=6), most of them related to Law 13.979/2020 (Brazil, 2020), which advances requests for goods and services, both from individuals and legal entities, to combat the pandemic (n=4). Lawsuits with requests for application of this law for the acquisition of masks by the Government of Paraíba and equipment by the municipality of Porto Alegre were observed, as well as actions in the FSC. In one of them, the National Health Confederation (NHC), which represents health service providers at the national level, requested the creation of rules to regulate and control requests made by the government.

Discussion

These findings show the complex scenario and challenges of judicialization of public policies during times of COVID-19. The linear trend of growth in the accumulated number of lawsuits on restrictive measures, with no signs of stabilization, points out that this phenomenon will continue to be relevant for the Judiciary in the coming months. These challenges will have an uncertain duration, since scientific evidence points to a worrying future scenario, in which new waves, with increasing cases and deaths, may be recurrent until the creation of an effective vaccine (FERGUSON et al., 2020; SCHUCHMANN ET AL., 2020). Therefore, the pandemic will affect thousands of people in Brazil in the short, medium, and long term, and will have effects in all areas of law.

Among all the decisions analyzed, the one with the greatest impact is The Direct Action of Unconstitutionality (DAU) No. 6,341/2020 (STF, 2020a), which affected several other lawsuits, declaring the role of health authorities and public managers of States and municipalities as constitutional and legal in the adoption of normative and administrative measures to face the pandemic, without exempting the federal government from its responsibilities.

The STF Plenary decided that states and municipalities, within the scope of their competencies and in their territory, can adopt restrictive measures to commerce and in the intercity and local movement during the emergency state resulting from the pandemic, without the need for authorization from the Ministry of Health to decree isolation, quarantine, and other measures.

As a result of this decision, it is possible to observe great heterogeneity in the mitigation measures adopted, which justifies why actors interested in economic activities resort to judicialization in territories where the measures are more restrictive, as well as the opposite to increase the restriction or duration of measures in those places where flexibilization started to occur in unfavorable health conditions. It is also important to highlight the impact of the federal government's lack of coordination and guidance as the national manager of the Unified Health System (UHS) on the course of the epidemic in Brazil.

This scenario highlights the fluidity of the limit between politics and justice in the contemporary world, observing a transfer of political power to judges and courts, with important changes in the language, arguments, and society participation mode (ALVES, RAMOS, DELDUQUE, 2020).

The urgency triggered by the pandemic led the Judiciary to become the protagonist of restrictive measures, such as the unprecedented decision, which determined that the Maranhão State government should declare lockdown, based on the constitutional recognition of health as a fundamental social right (TJMA, 2020), and imposing a series of obligations on the defendants, without knowing whether the local political agents would be possible to organize and support these obligations (Alves, Ramos, Delduque, 2020).

In face of a health crisis of such unpredictability and with important between different sectors that are directly or indirectly affected by the restrictive measures, the implementation of pandemic mitigation policies while preserving the constitutional autonomy of the federation entities and the observance of the distribution of Powers is a great challenge.

For Brazilian public health, the struggle between a national constitutionally based policy and federative autonomy has been part of the daily management of the UHS since its creation. Cyclical movements of decentralization and new centralization are taking place. Municipalization, which proved to be a great virtue, also led to the difficulty of organizing regional health systems, often due to the omission of states and the lack of coordination by the national manager, thus generating a reality of dispersed and differentiated actions in volume and quality at the local level. This dilemma of UHS was observed in the pandemic, and part of its discussion reached the Judiciary.

The moment is even more complex in Brazil in the face of a political crisis in which there is no convergence between political leaders and between the three powers on how to face the pandemic. The UHS tradition of having spaces built to seek consensus between the three management levels has become a challenge in pandemic times. So, it is not surprising that the Judiciary is called upon to manage policy, as the results of this study showed. Based on a false

opposition between health and economic interests, lawsuits with competing interests became evident in the ongoing discussions in the country.

Despite pressure from different sectors of the economy, current evidence points to the need for governments to maintain and alternate different measures of social isolation and restriction of population mobility (SCHUCHMANN ET AL., 2020; DESHWAL, 2020). The projections suggest a major economic crisis, regardless of the level of adoption of isolation measures: large, reduced, or even absent. What differentiates these measures is the possibility of decreasing mortality from the pandemic (SCHUCHMANN ET AL., 2020). It is important to remember that almost 70% of the lawsuits studied were about mobility restriction, which is consistent with the importance that these measures have in facing the pandemic.

On the other hand, regardless of the lack of national coordination, a fact that should be better analyzed throughout history is that the confrontation of the pandemic in Brazil has shown the importance and vitality of a universal, comprehensive, and enormously decentralized health system, albeit with enormous difficulties and insufficiencies in the network and human and financial resources. There would be no use in a judicial decision assigning obligations to the municipalities, for example, in terms of social isolation measures, if these same municipalities were unable to start a series of actions to control the pandemic and to care for their population.

Another recurring discussion in the FSC lawsuits was the request from States and municipalities to suspend their debts, justified by the need to use these resources to tackle the new coronavirus. In the news, this theme was also present, and most of the lawsuits resulted in the debt suspension by the Judiciary.

Lawsuits with the same objective flooded the FSC, supporting the need for the inclusion of Parliament in this debate. The response was the publication on May 27th, 2020 of Complementary Law No. 173, which established the Federative Program to Combat Coronavirus. Among the Program's initiatives was the suspension of debt payments contracted between the Union and the States and municipalities, the delivery of Union resources via financial assistance to the States, the Federal District, and municipalities in 2020, and in actions to combat the pandemic (LC N° 173, 2020).

The investigation of journalistic reports allowed verification that the judicialization related to COVID-19 also represents an important phenomenon in the Jurisdictions and Courts of several States. Actions on COVID-19 are recent, and most have not yet had final decisions. However, the

journalistic reports analyzed indicated the existence of injunctions about issues involving COVID-19 in several States in Brazil. Soon, this can be seen through jurisprudence research.

Besides the restrictive measures, the reports indicate that judicialization related to the health area has been gaining space in the Jurisdictions and Courts of the different States. Among the orders are the acquisition of equipment necessary to face the COVID-19, such as respirators and masks, and an increase in the number of beds and professionals. The already known weaknesses of UHS have gained even more visibility during the pandemic.

Health, inserted in the Brazilian Constitution as a citizen's right, is a central and frequent theme in political and judicial conflicts. The complexity of the health care system, which encompasses a great diversity of actors in the public and private sectors, as well as several regulatory entities and numerous legal provisions, results in a conflicting field that has promoted the growth, since the 1990s, of judicialization of health care.

As it exposes weaknesses in access to public health policies, highlighting health care gaps, judicialization instigates a necessary debate. It leads to the reaching of solutions, such as the viability of beneficial therapeutic alternatives previously not available in UHS, or the incorporation of new protocols and therapeutic guidelines, increasing the range of treatment options (Neto et al., 2012).

However, the increase in the judicialization of health, especially in the context of a pandemic, raises important concerns about the budgetary impact, particularly for UHS. Judges tend to disregard the impact of their decisions and understand that all federation entities can be equally responsible for providing any patient request. For the Judiciary, in general, issues related to public budgeting, such as the scarcity of resources and lack of expenditure forecast, as well as non-belonging of the medication requested to UHS drug lists, do not justify denying medical treatment since it finds support in the right to health guaranteed by the Federal Constitution. This culture of granting health requests by the Brazilian Judiciary is considered one of the incentives for increasing the number of lawsuits seeking medical care based on the constitutional right to health (Wang et al., 2014).

Recently, the National Supplementary Health Agency (NSHA) included new coronavirus detection tests in the Compulsory Coverage Procedures List for health insurance plans. The inclusion of serological tests took place after a lawsuit. Subsequently, the conquest of this lawsuit was annulled, and they are now awaiting the completion of a public consultation to deliberate on this topic.(ANS, 2020). Although the inclusion of new tests took place along with the disclosure of the Usage Guidelines (UG), fear of the disease and the population's lack of knowledge about when

the tests should be requested and performed could generate many conflicts between the health insurance carriers and their customers, including scope for legal actions related to this topic. It is also worth mentioning that these changes, although important in the context of the pandemic, can generate a large volume of costs not expected by carriers, especially in the long run.

An important point to highlight in this work was the great methodological effort required to classify the subjects of the lawsuits and to identify those related to the new coronavirus, which is a challenge found by the group in other studies of judicialization of health. Standardization of the mandatory data included in the initial petitions, including the appropriate subject classification, would facilitate the study of the judicialization of health. In the specific case of judicialization involving the new coronavirus, the panels made available by other public or private organizations could organize the lawsuits using a classification model similar to the one adopted in this article, to facilitate the jurimetrics analysis by research groups interested in the topic.

Final Considerations

Judicialization during times of COVID-19 tends to increase and, possibly, have consequences for public health and for the economy of all countries over a long time period.

In Brazil, lawsuits related to restrictive measures, budgeting issues, and health aspects have been reaching the Judiciary in large numbers even a few months after the beginning of the pandemic.

The increase in judicialization points to the urgency of efficient public policies to face the pandemic and its health and social consequences. Regarding budgeting issues, the consistency of actions requesting the same object was responded by Complementary Law 173. However, disputes related to restrictive measures and health-related issues are, so far, without robust political proposals, or with proposals that do not fully approach solutions or, at least, alternatives to minimize their impacts.

In this way, judicialization was able to bring a diagnosis of failures in public policies to face the demands arising from the pandemic. It had the importance of driving the creation of law, and it can boost several other actions both from the Legislative and the Executive, to mitigate these problems. This demonstrates the importance of observing the responses brought by the judicialization, and of the dialogue between the three branches of the Republic, to deal with the pandemic demands and other social demands better.

Thus, the pandemic of the new coronavirus and its consequent judicialization has posed new challenges for a country like Brazil, which remains a country with one of the highest volumes of health lawsuits in the world.

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Covid-19: Where is the Digital Transformation, Big Data, Artificial Intelligence and Data Analytics?[10]

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Digital transformation, big data, artificial intelligence and data analytics are probably the most cited computational subjects in the news around the world. Commercial and technical reports (and papers), usually, indicate high level of success in the adoption of these approaches. In contrast, in the present war that the world is facing against Covid-19, it is not common to see many references about these technologies. In this paper, we present an ongoing research work, which observes approaches on how to effectively adopt these technologies for public primary healthcare monitoring, based on Internet of Things devices. Initial results from the proposal, which was partially funding by a public agency, indicates a differentiated approach to tackle large challenges, similar to these created by the actual Covid-19 pandemic scenario. In other words, Covid-19 required a large number of tests that could be minimized by monitoring these specific vital signals, including temperature, heartbeat rate, blood oxygen and pressure. In addition, our experiments show that the adoption of these computational topics require faster digital behavior changes and changes to the procedures from governments and people, to be successful as environments for individual health enhancement and protection.

Keywords: Covid-19, Digital Transformation, e-Health, Public Primary Healthcare.

Covid-19: Onde estão a Transformação Digital, Big Data, Inteligência Artificial e Análise de Dados?

Transformação digital, *big data*, inteligência artificial e análise de dados são, provavelmente, os assuntos computacionais mais citados em noticiários pelo mundo. Relatórios comerciais e técnicos (e documentos), geralmente, indicam alto nível de sucesso na adoção dessas abordagens. Em contraste, a atual guerra que o mundo enfrenta contra a Covid-19, não é

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comum ver muitas referências sobre tais tecnologias. Neste artigo, apresenta-se um trabalho de pesquisa em andamento que aponta abordagens de como adotar, efetivamente, essas tecnologias para monitoramento do cuidado à saúde pública na atenção primária, com base em dispositivos Internet das Coisas. Os resultados iniciais da proposta, que foi apoiada parcialmente por um órgão do governo federal, indicam uma abordagem diferenciada para enfrentar grandes desafios, semelhantes aos criados pelo atual cenário de pandemia da Covid-19. Em outras palavras, a Covid-19 requer muitos testes que poderiam ser minimizados através de monitoração de sinais vitais específicos, incluindo temperatura, frequência cardíaca, oxigenação e pressão sanguínea. Além disso, nossos experimentos mostraram que a adoção desses tópicos computacionais exige mudanças mais rápidas no comportamento digital, nos procedimentos de governos e pessoas, para serem bem-sucedidas como ambientes de aprimoramento e proteção da saúde individual.

Palavras chave: Covid-19, Transformação Digital, e-Saúde, Saúde Pública Primária.

Covid-19: Dónde están la transformación digital, Big Data, inteligencia artificial y análisis de datos?

La transformación digital, *big data*, inteligencia artificial y análisis de datos son probablemente los temas computacionales más citados en las noticias de todo el mundo. Los informes comerciales y técnicos (y documentos) generalmente indican un alto nivel de éxito en la adopción de estos enfoques. En contraste, la guerra actual que enfrenta el mundo contra Covid-19, no es común ver muchas referencias sobre tales tecnologías. En este artículo, se presenta un trabajo de investigación en curso que señala enfoques sobre cómo adoptar de manera efectiva estas tecnologías para monitorear la atención de salud pública en atención primaria, basada en dispositivos Internet de las Cosas. Los resultados iniciales de la propuesta, que fue parcialmente respaldada por una agencia del gobierno federal, similar a los creados por el escenario actual de la pandemia de Covid-19. En otras palabras, Covid-19 requiere muchas pruebas que podrían minimizarse mediante el monitoreo de signos vitales específicos, incluso temperatura, frecuencia cardíaca, oxigenación y presión arterial. Además, nuestros experimentos han demostrado que la adopción de estos temas computacionales requiere cambios más rápidos en el comportamiento digital, en los procedimientos de gobiernos e individuos, para tener éxito como entornos para la mejora y protección de la salud individual.

Palabras clave: Covid-19, Transformación Digital, e-Salud, Atención primaria de salud pública.

1 Introduction

The world is facing a chaotic scenario due to the new coronavirus (called SARS-CoV-2) pandemic scenario that causes the disease named as COVID-19. Currently, millions of people are infected with the new coronavirus and more than three hundred thousand have died due to COVID-19 in the world (WHO, 2020a; WHO, 2020b). However, this is not a new human chapter in this field; similar events have happened, for example, in 1918 with the influenza pandemic. In the United States, it was first identified in military personnel in spring 1918 and caused about 675,000 deaths (CDC, 2019). The main advice from health specialists to everyone is to stay at home. Moreover, all nations, include all those coined as first world (NATIONS ONLINE, 2005), are facing the same scenario of many infected people and lack of resources to avoid and treat this Covid-19 pandemic.

The new coronavirus pandemic exposed not only fragility in the health infrastructure of many countries, but also a lack of accurate information for decision-making processes at the level of public management, at the logistical and operational level and at the level of supporting healthcare professionals in clinical decisions and diagnosis. In other words, it is possible to infer that the health digital transformation has not occured around the world as it was expected to. Digital transformation is understood as the change process carried out through the use of so-called social, mobile, analytical and cloud technologies, which significantly affect three or more dimensions: at the individual, business and/or social level (TOOLBOM, 2016). These types of technology are recognized as those capable of generating business innovations affecting social and economic life (BHARADWAJ et al., 2013; FITZGERALD et al., 2013).

Digital transformation is not a new issue and, in recent years, has been a central theme in several sectors of society, including business, economics and health. Digital transformation and Industry 4.0 were the themes of the 2016 World Economic Forum in Davos (WORLD ECONOMIC FORUM, 2016). Santos and Massó (2016) affirm that digital transformation must be a priority on our agendas and on the agenda of any country, simultaneously with adapting to the competitiveness that today's world naturally demands of us. Zarzalejos (2016) corroborates this thought, stating that the degree of joint modernization of a country, its society and its productive system is based on its degree of digitalization.

Besides the health concerns and very tightly coupled to this problem, the challenge to keep people and economies in an appropriated synchronism is especially hard. The IMF states that: to help lay the foundations for a strong recovery, our policy advice will need to adapt to evolving realities (IMF, 2020). It is important to have a better understanding of the specific challenges, risks

and tradeoffs facing every country as they gradually restart their economies. How can IMF advise without any health digital data for proper analytics research?

Big data has several definitions and views. As is mentioned by ORACLE (2020), to truly understand big data, it is helpful to have some historical background. Gartner's definition, circa 2001 (which is still the go-to definition) states that: Big data is data that contains greater variety arriving in increasing volumes and with ever-higher velocity. In addition, Gartner's definition states that big data includes larger, more complex data sets, especially from new data sources. These data sets are so voluminous that traditional data processing software cannot manage them, but these massive volumes of data can be used to address business problems not possible to tackle before.

Google mentioned that it brings the benefits of Artificial Intelligence (AI) to everyone, with the Google AI – set of AI products and solutions. Google AI conducting research that advances the state-of-the-art in the field, applying AI to products and to new domains**,** and developing tools to ensure that everyone can access AI (GOOGLE 2020).

The definition of data analytics could be understood as shown in SAS (2020): analytics using data and math to answer business questions, discover relationships, predict unknown outcomes and automate decisions. This diverse field of computer science is used to find meaningful patterns in data and uncover new knowledge based on applied mathematics, statistics, predictive modeling and machine learning techniques.

Based on reports from WHO (WHO, 2020a; WHO, 2020b), the actual challenge of Covid-19 is similar in most countries under the computation framework. Therefore, it is important to have a larger discussion on how digital transformation, big data, artificial intelligence and data analytics could be more useful and effective in the future to mitigate this type of pandemic. In other words, how technologies could be key elements for health enhancement and protection of individuals.

In this paper, we present ongoing research to public primary healthcare. The main research question for our contribution is how to gather digital data and treat large amounts of digital data, utilizing off-the-self smart bands and tools for public primary healthcare monitoring, providing an auxiliary tool to control Covid-19. The Covid-19 required many continuous tests, which were not feasible. This research minimizes these numbers by monitoring specific vital signals (e.g. temperature, blood oxygen and pressure and heartbeat rate) through digital data captured from off-the-shelf smart bands and provided to public primary healthcare professionals.

The present research comprises two main phases. In the first phase (completed) a computational architecture is presented, based on a Fog and Internet of Things (IoT) approach,

to support public primary healthcare with monitoring of vital signs of volunteer individuals through smart bands and software for this purpose. This phase was financed by a public agency[75].

The second phase of the research (in progress) corresponds to the use of the architecture proposed in the previous stage, its hardware devices, software and experimental results in the current pandemic context of COVID-19. In order to expand the results of the research in the context of health care in times of a pandemic, this phase

was submitted to a federal government agency with a total project cost of US$ 70.000. Part of that amount will be used for the acquisition of 100 smart bands for monitoring patients from the public primary health care network in the regional public hospital of the city of Juiz de Fora, included patients diagnosed with COVID-19 and others patients. The results obtained in the regional hospital and in the health public network of Juiz de Fora can be expanded and replicated to the entire primary public healthcare. In other words, representing a monitoring approach could save lives and bring more security information inside environments to those who are required to work during the COVID-19 pandemic.

The paper is organized as follows. In section II, we present some aspects related to digital transformation, big data, artificial intelligence and data analytics in e-health. Section III shows related work and describes the proposed architecture to support a public primary healthcare approach. Section IV shows preliminary experimental results. Section VI presents conclusions and future work.

2 Digital Transformation, Big Data, Artificial Intelligence and Data Analytics

In this section, we present some concepts related to digital transformation, big data, artificial intelligence and data analytics related to e-health. Because of the large variety of areas and environments inside e-health, we selected some segments potentially relevant to the present challenge of the Covid-19 pandemic.

2.1 Digital Transformation

While the concept of “digital transformation” and its practical management is a concern in parts of the business environment, including large companies like Google, Amazon, Apple, NetFlix, among others, the use of technologies that promote digital transformation still is done reluctantly in the field of public health in Brazil and in many countries, including those considered “developed” or first world.

[75] The Fog-IoT approach partially funded by TBE and EDP under supervision of ANEEL – The Brazilian Regulatory Agency of Electricity Project number PD-02651-0013/2017.

As is discussed in Tardieu et al (2020), health care is facing the challenge of affordability in a growing and aging population. The authors argue that progress in data-enabled precision medicine is beginning to transform traditional linear models to an environment of multi-sided market variants. In this scenario, healthcare *providers* (such as hospitals, pharmaceutical companies, doctors), on the one side, and healthcare *payers* (governments, insurance companies, patients) on the other require a balance between the best possible health outcomes and cost. Tardieu et al also observe that future healthcare affordability, patient experience, treatment efficacy, healthcare capacity and system efficiency will depend on the success of health information exchange platforms and leveraging of electronic health records.

In the health area, technologies related to Telemedicine contribute to digital transformation. Technologies used for telemedicine have been available for decades (ROCHA et al., 2016; KESSARA, JONAS and SCHULMAN 2020); however, high costs combined with the impossibility of high-speed internet access limited its possibilities for expansion until a few decades ago. Currently, the evolution of hardware and software components and network capabilities have made the application of telemedicine extremely viable. Even so, its use comes up against many obstacles in the scope of health, such as: i) heavy regulation and lack of consistent investments (FLANNERY and JARRIN, 2018); ii) strict data protection and privacy regulations (PRICE WATERHOUSE HEALTH RESEARCH INSTITUTE, 2020); iii) restricted use of telemedicine services in rural or remote areas (KESSARA, JONAS and SCHULMAN, 2020); and iv) the legacy of healthcare models historically structured in personal interactions between doctors and patients (KESSARA, JONAS and SCHULMAN, 2020).

These same obstacles are some of the reasons that currently prevent further advances in the adoption of technologies for digital transformation in the health field. However, this situation has begun to change, given the urgency of measures and transformative actions to combat the pandemic of the new coronavirus. A good example of this occurred in the United States with the approval of Public Law no. 116-123, which now allows the use of telemedicine services for all beneficiaries of the Medicare health insurance system with a service fee (KESSARA, JONAS and SCHULMAN, 2020). A similar measure was adopted in Brazil, through Law no. 13.989. which authorizes the use of telemedicine, on an emergency basis, for the duration of the crisis caused by the coronavirus (SARS-CoV-2), with public authorities paying for the telemedicine services offered by SUS (BRASIL, 2020).

The work presented in Ricciardi et al (2019) provides an interesting view on how to govern the digital transformation of health services. The authors mention that, similar to other innovations and (new) technologies, such promises could or could not materialize and provide potential

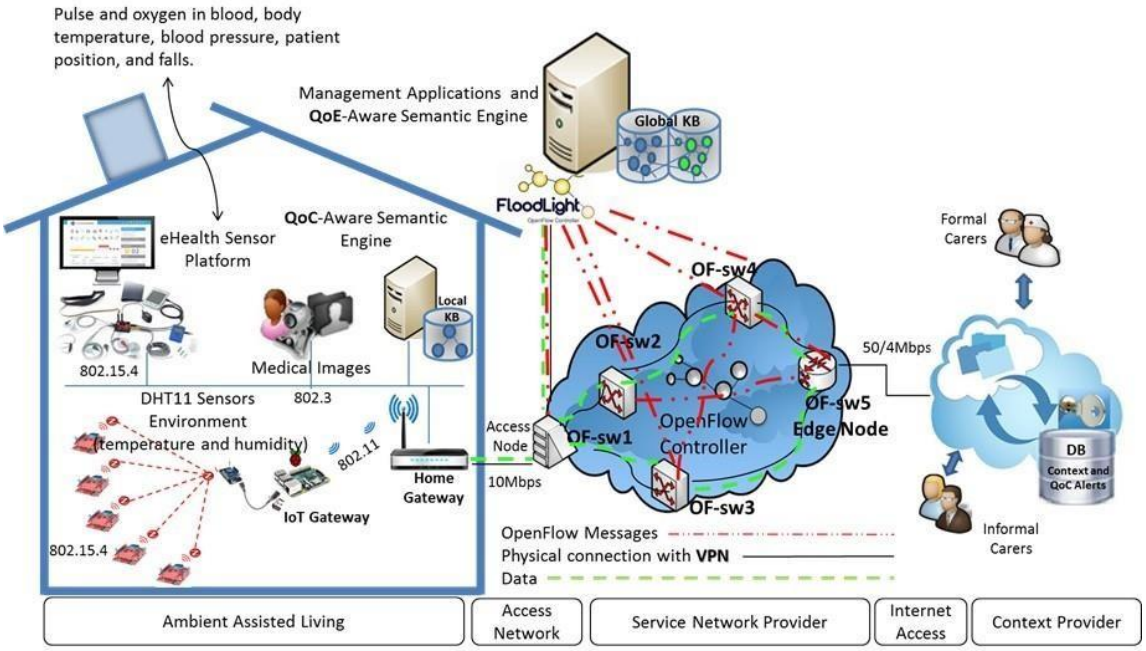
benefits. In addition, it also highlights that some technologies may also be accompanied by unintended and/or negative (side) effects in the short or long term. As a result, observed by the authors, the introduction, implementation, utilization and funding of digital health technologies should be carefully evaluated and monitored. Ricciardi et al (2019) draw attention to the importance of governments playing a more active role in the further optimization of both the process of decision making (both at the central and decentral level) and of the related outcomes. Authors also argue that governments need to find a balance between centralized and decentralized activity. Moreover, the health care system needs to be more broadly prepared to be able to transition to digitalization. It is mentioned that the threshold of what is important rises from education, through financial and regulatory preconditions, to implementation of monitoring systems to monitor its effects on health system performance.

2.2 Big Data

The sensing of environmental signals both the home and the people, as it shown in Figure 1 from research work presented in Silva, Gonçalves and Dantas (2019). This figure provides an example, which we developed for an e-health proposal, which results in a large amount of useful data from the home and mainly from the people inside.

Audio/video uploads and file transfers are used, respectively, to simulate the teleconsulting service and send medical images. In the application that we developed previously (SILVA, GONÇALVES and DANTAS, 2019), called QoCManApp, the sensed data are collected, quantified and evaluated, ensuring that only qualified context objects are distributed. Whenever a new data entry is detected in the KB, the inference engine interprets the rules to check for QoE (Quality of Experience) degradation (in this step, the QoC – Quality of Context - parameters associated with the context are analyzed); if there is degradation, the sensed data are discarded. Semantic processing ensures that only accurate, current, valid, complete and significant data are sent to the remote service center.

Figure 1. Ambient Assisted Living example (SILVA, GONÇALVES and DANTAS, 2019)



Source: Elaborated by the authors

This research work example was chosen because it is an objectively interesting effort which generates a large amount of e-health big data, without exposing people and health professionals. Libelium Cooking Hacks (2014) presented as an interesting e-health sensor environment that could help those planning on to building an environment to data collect in similar scenario. On the other hand, an approach for analysis of QoS requirements for e-health services and mapping to evolved packet system QoS classes is presented in Skorin-Kapov and Matijasevic (2020).

2.3 Artificial Intelligence

As Impedovo and Pirlo (2019) mention, artificial intelligence is changing the healthcare industry from many perspectives, including diagnosis, treatment and follow-up. A wide range of techniques has been proposed in the literature, such as applications of AI in health care; knowledge; data mining and knowledge discovery in medicine; medical expert systems; personal medical feature data; medical device technologies; diagnoses and therapy support systems; machine learning-based medical systems; and pattern recognition in medicine.

In addition, Cremer and Loebbeck (2019) state that in an era of accelerating digitization and advanced big data analytics, harnessing quality data and insights will enable innovative research methods and management approaches. Among others, artificial intelligence imagery

analysis has recently emerged as a new method for analyzing the content of large amounts of pictorial data. Their research work contribution provides background information and outlines the application of artificial intelligence imagery analysis for analyzing the content of large amounts of pictorial data.

Both references (IMPEDOVO and PIRLO, 2019; CREMER and LOEBBECK, 2019) provide clear ideas about the AI tools and proposals that require appropriated data. In other words, there is an assumption that the data is clean and sanitized. The research work presented in Tae el al (2019) mention that the wide use of machine learning is fundamentally changing the software development paradigm (coined as Software 2.0) where data becomes a first-class citizen. However, it is time to extend the notion of data cleaning for modern machine learning requirements.

2.4 Data Analytics

Raghupathi and Raghupathi (2014) reaffirm that big data analytics has the potential to transform the way healthcare providers use sophisticated technologies. The authors mention that it is possible to have some improvements from their clinical and other data repositories and have enhancement decisions. However, they also comment that in the future, we will see the rapid, widespread implementation and use of big data analytics across the healthcare organization and the healthcare industry.

In addition, several challenges are highlighted that must be addressed. The authors also observe that big data analytics and applications in healthcare are at initial stage of development, but advances in platforms and tools may accelerate their maturing process.

3 Related Work and Proposed Architecture

The previous section clearly let us infer that in order to differentially tackle the challenge of digital healthcare transformation, the adoption of new technologies must be carefully employed. Therefore, this section represents the first step of this paper contribution, because it highlights how we can conceive a modern architecture design to support a public primary healthcare monitoring.

The research challenge from our project is to provide, through a distributed monitoring approach, digital data from individuals to those responsible for public primary healthcare. In the Covid-19 pandemic, the contribution focus is in providing vital signals monitoring to provide some indications from a person contamination (e.g. changes from temperature, oxygen level and blood

pressure). This is a differential approach, because it can avoid a continuous massive test in the present scenario of billions of people.

The approach mentioned was the ordinary idea of cloud computing facilities and infrastructure. Therefore, we present some recent efforts found in the literature (e.g. BIERZYNSKI et al, 2017; DU et al, 2018; XIAO and KRUNZ 2017) related to fog-cloud environment cooperation. This cooperation is a vital element inside an architecture to collect and gather large amounts of digital data.

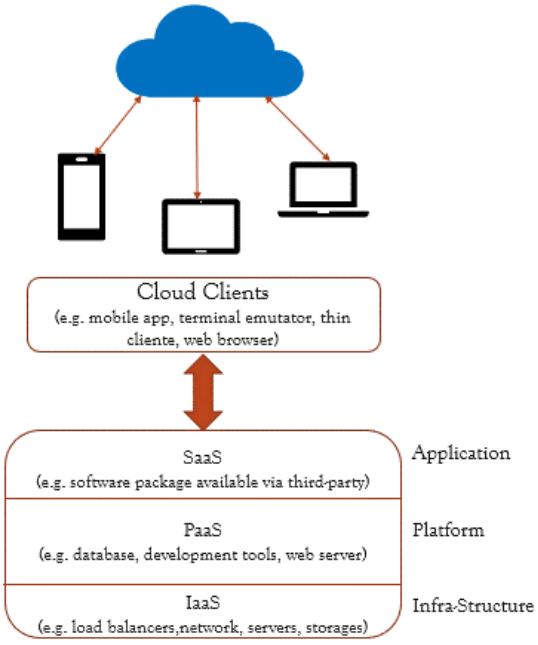
Bierzynski et al (2017) present the cooperation between the fog and the cloud in mobile cloud computing environments. The authors claim that this configuration could offer improved offloading services to smart mobile user equipment (UE) with computation intensive tasks. This paper tackles the computation offloading problem in a mixed fog-cloud system by jointly optimizing the offloading decisions and the allocation of computation resource transmit power and radio bandwidth, while guaranteeing user fairness and maximum tolerable delay.

Alternatively, a study on the workload offloading problem to fog computing networks is presented in Du et al (2018). This work suggests that a set of fog nodes can offload part (or all) of the workload originally targeted to the cloud data centers to further improve the quality-of-experience (QoE) of users. Authors also investigate two performance metrics for fog computing networks: users' QoE and fog nodes' power efficiency.

Research presented in Xiao and Krunz (2017) mentioned that traditional cloud-based infrastructures are not enough for the current demands of Internet of Things (IoT) applications. The authors claim that two major issues are the limitations of latency and network bandwidth. In addition, the authors call to attention that in recent years, the concepts of fog computing and edge computing were proposed to alleviate these limitations by moving data processing capabilities closer to the network edge. They also mention that considering IoT growth and development forecasts for the full potential of IoT can, in many cases, only be achieved by combining cloud, fog and edge computing. The authors also highlight developments and possibilities as well as consider challenges for implementation in the areas of hardware, machine learning, security, privacy and communication.

One important aspect to be observed is changing from classical cloud architecture to present research proposals, as illustrated by Figure 2. In a new fashion cloud configuration, applications represented in Figure 2 may not be supported. Reasons for this obsolescence include the high volume of data and latencies related to the communications links. On the other hand, the figure demonstrates the conventional services at cloud infrastructures (IaaS, PaaS, SaaS), where clients are only passive elements.

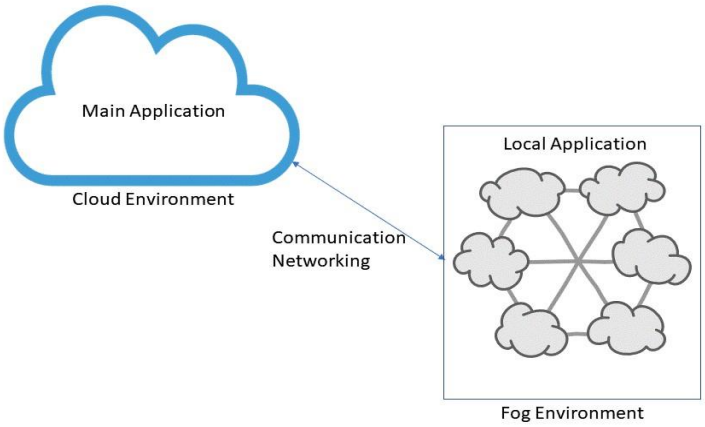
Figure 2. An ordinary view of a cloud connection



Source: Elaborated by the authors

Figure 3 illustrates a successfully adopted new paradigm (from our previous research) to connect local devices through a fog environment and then to a cloud infrastructure (DANTAS, BOGONI and FILHO, 2020). Advantages of this approach include capture of personal distributed data health, potential for local storage, potential for use in local AI applications, local data cleaning and ability to gather several data sources and then submit to the cloud. These attributes enhance the quality of data that will be uploaded to the cloud, therefore providing a more accurate information about the edge points in the fog environment.

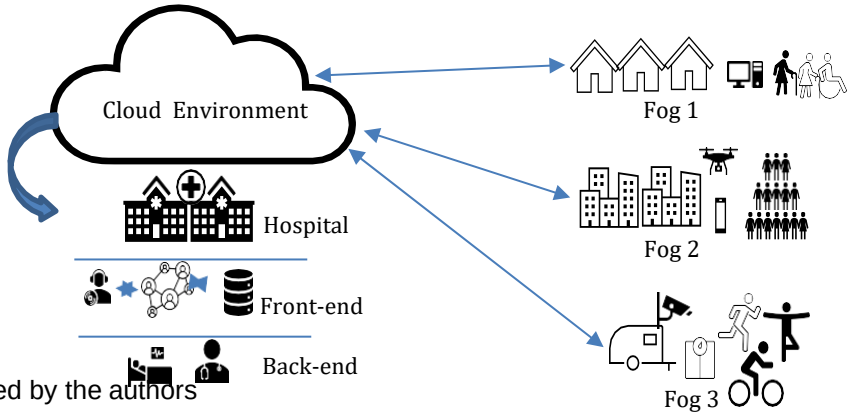
Figure 3. Proposed fog-cloud infrastructure



Source: Elaborated by the authors

After choosing which type of communication network paradigm was the most appropriate infrastructure, the public primary health care architecture conceived is presented in figure 4. It is relevant to mention that our case study efforts started because of a Federal Brazilian Government proposal call targeting public services polices. Therefore, our proposal is oriented to public services.

Figure 4. The public primary health care architecture



Source: Elaborated by the authors

In the architecture, we have three different type of fog environments:

- Fog 1: in this group we considered elderly people and people with disabilities. In addition, local computer and mobile facilities were considered.
- Fog 2: this second group was a group from poor communities (or slums). This group included people with different age, sex and health conditions.

- Fog 3: this group focused on persons with a history of regular exercise and sport practice.

One of the main reasons for these different groups of fog classification is based scientific observation from previous research works, such as those presented in Nazario et al (2017). When an appropriated environment is designed with the peer actors, the effort to evaluate quality of context is minimized. In other words, we effectuated an important preprocessing action for an assistant's front-end inside the hospital.

The next stage was to design how the data gathered from the fogs would be received and treated inside the hospital structure. Therefore, understanding the local procedure from a public hospital we called one stage front-end and another back-end. Similar to computer science jargon, the first element receives and preprocess the received data. The second level, coined as back-end, is the location for a doctor responsible for central monitoring.

As was mentioned in literature previously presented (TARDIEU et al, 2020; RICCIARDI et al, 2019), the conceived public primary healthcare environment could, for example, provide the following attributes:

- A balance between the best possible health provisions and cost. Due to fact that gathering digital data could enhance the initial process by facilitating the best choices of assignments and avoiding unnecessary costs with medical care professionals and facilities.
- The fresh digital data gathered from users would represent an up-to-date figure of the outside scenarios, from the fogs.
- This innovation with new technologies could materialize potential benefits of data storage for future differential data analytics, utilizing new AI software packages.

4 Experimental Results

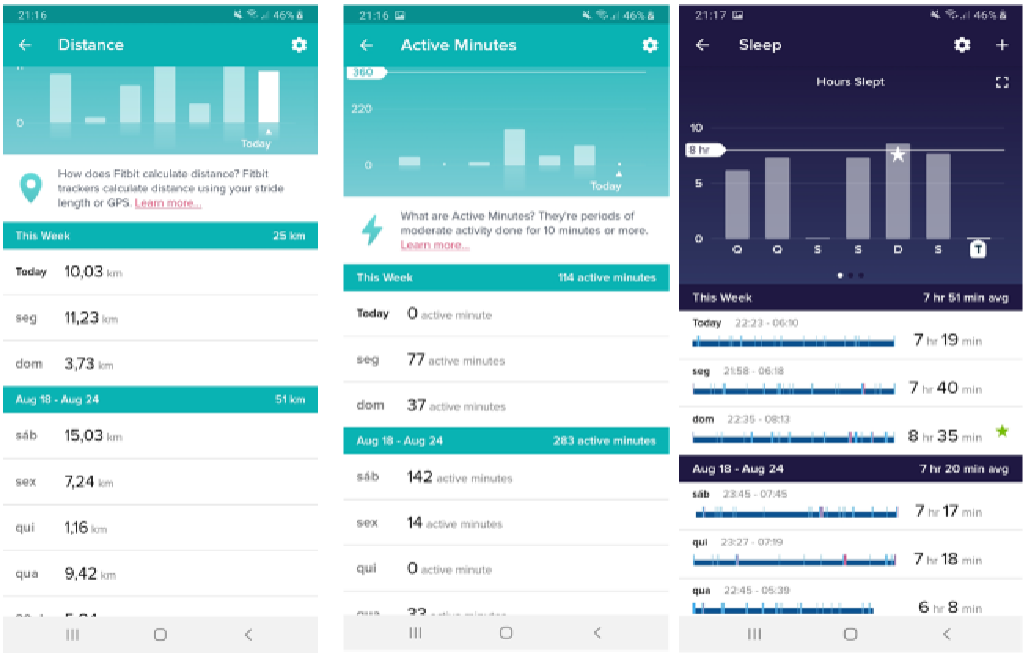
In this section, initial experimental results from our ongoing project are presented. Therefore, we are going to present four pieces of the architecture. Fog environments are the first three, followed by the fourth scenario representing the real public hospital. This choice was based upon the level of technology familiarity from persons involved in the experiments.

4.1 Scenario Fog 3

In this space people that exercise regularly and athletes were the population of the fog. They commonly utilized commercial devices to monitor their physical activities. Therefore, we considered their own smart bands as a device to collect their data. Figure 5 illustrates, from a smart band Fitbit Alta, some snapshots with parameters such as distance, active minutes and sleep.

We have noticed during the experiments that some of those devices do not allow for open data access. These devices have several facilities, however, gathering data from an outside application is not easy and sometimes could not be realized. Another point observed was the complexity of using some functions, due to the large amount of options or required knowledge of the device.

Figure 5. Some snapshots from an ordinary smart band in Fog 3.



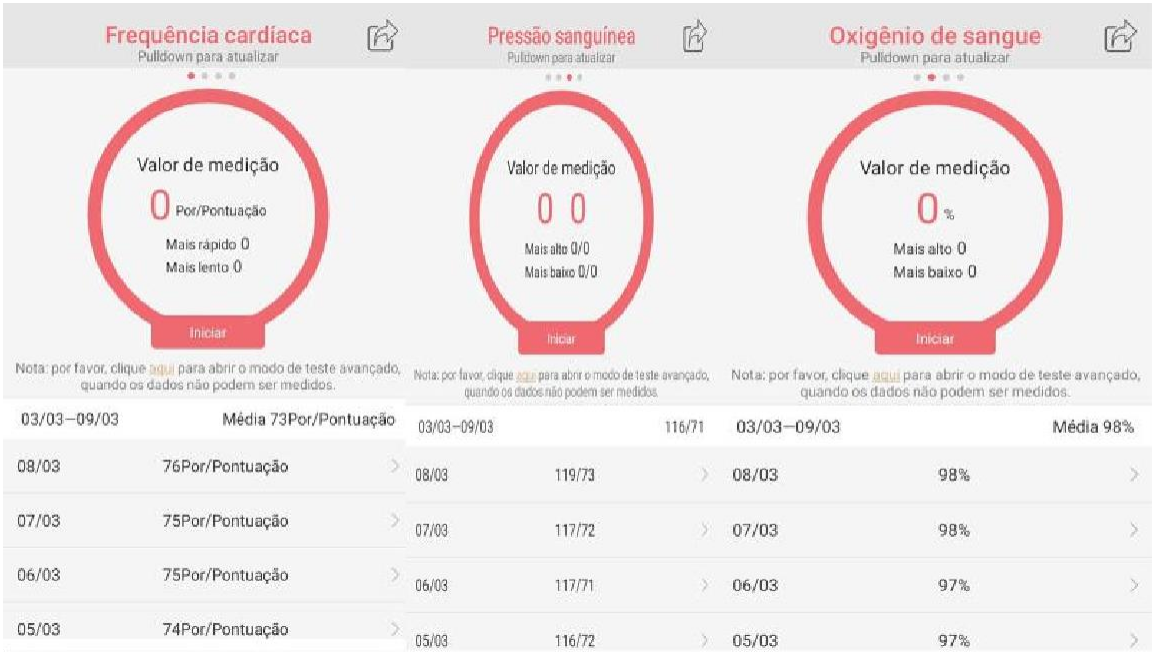
Source: Elaborated by the authors

4.2 Scenario Fog 2

In the Fog 2 we considered a population from a slum, where devices that are complex to setup and expensive are not realistic to use. Therefore, we performed a search for the cheapest smart band which could fulfill our requirements for simplicity and open digital data. The devices bought for the experiments were Kaihai IP68, which each cost US$ 25. This device presented

some similarities to the first set of devices, from Fog 3, as Figure 6 shows. On the other hand, they could provide an easier way to gather the personal data as an open data source for public effort.

Figure 6. Heartbeat, blood pressure and blood oxygen from Kaihai IP68



Source: Elaborated by the authors

4.3 Scenario Fog 1

Due to the characteristics from the people inside this fog group, we decided to develop an app, called the IoT App. The goal was to have the IoT App in the mobile phone which could help in the capture of vital signal data and to execute their synchronizations. Vital signals (e.g. temperature, heartbeat, oxygen and blood pressure) are essential to monitoring people and indicating some indications of Covid-19 signals. Figure 7 illustrated an example from a screenshot of the application. Important to mention is that monitoring vital signals in the Covid-19 pandemic could represent a differentiated support tool, avoiding a large number of unnecessary tests. This application are in the stage of testing, because challenges were discovered during the tests with some smart band devices and we are still developing it.

Figure 7. Mobile phone IoT APP facilities

Source: Elaborated by the authors

4.4 Scenario Hospital

The final scenario was the public hospital, which will be the healthcare providers (TARDIEU et al, 2020). The partner for the research was a public hospital in the city of Juiz de Fora, in Brazil, which clearly understood the goal and benefits from e-health digital data. This public hospital is a regional reference for the care of patients in the mesoregion of the Zona da Mata of the state of Minas Gerais with a current capacity of 50 ICU beds and 129 infirmary beds, with both able to receive patients diagnosed with Covid-19.

The experimental development of a front-end and a back-end in parallel with the hospital software application is presented in the following figures. Important to mention is that this is an ongoing project with a highly-coupled cooperation between the two parts (the federal university and the public hospital).

Figures 8 and 9 show interfaces of the monitoring web system for data collected from patients, which functions as a monitoring center composed of a coordinator doctor and a team of nurses and health agents. Figure 8 shows how the coordinator doctor usually acts in the hospital software package. The collaboration allows for the gathering of the experimental digital data from our fogs. In Figure 9, it is possible to visualize a screen shot with the temperature and heartbeat from a patient, who could be a hundred kilometers from the hospital. Through this system, it is possible to consult patient data, including data from the electronic medical record (for example, history of consultations and administered drugs), parameters collected from the devices (for example, body temperature and heart rate) and patient historical series. From the analysis of the

collected data, this system allows intervention actions by the monitoring center, which range from an online assessment with the patient to the dispatch of a medical team to the patient's residence for emergency care.

Figure 8. An interface for the coordinator doctor

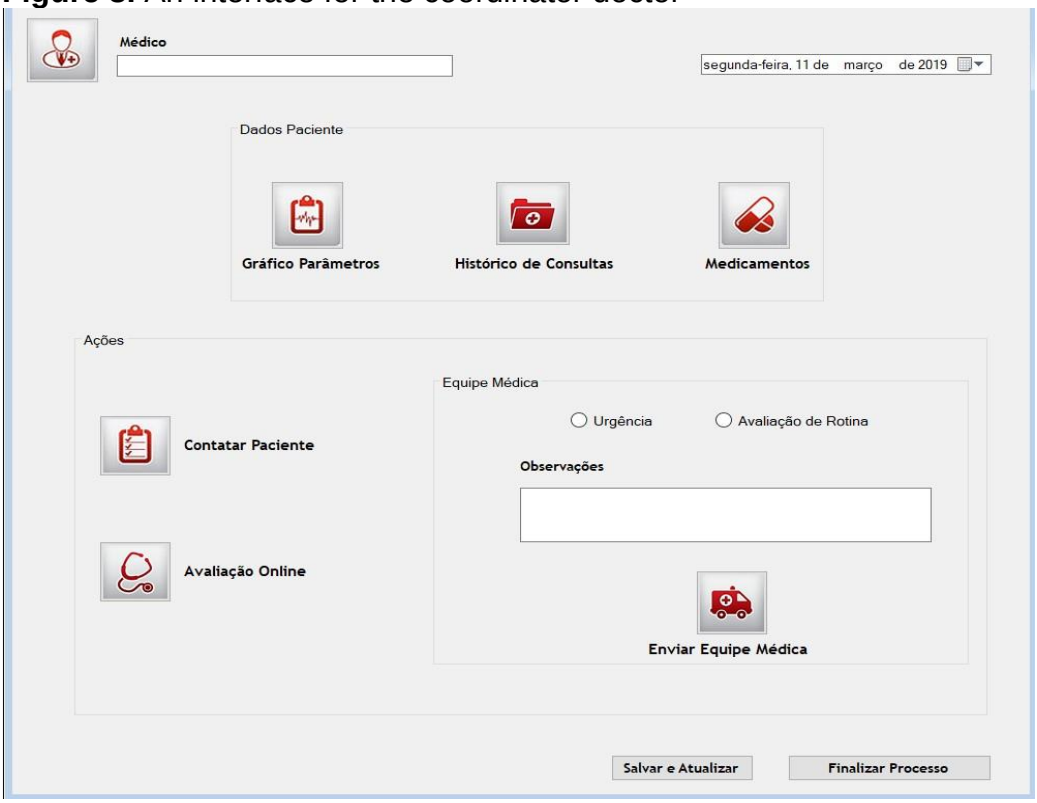
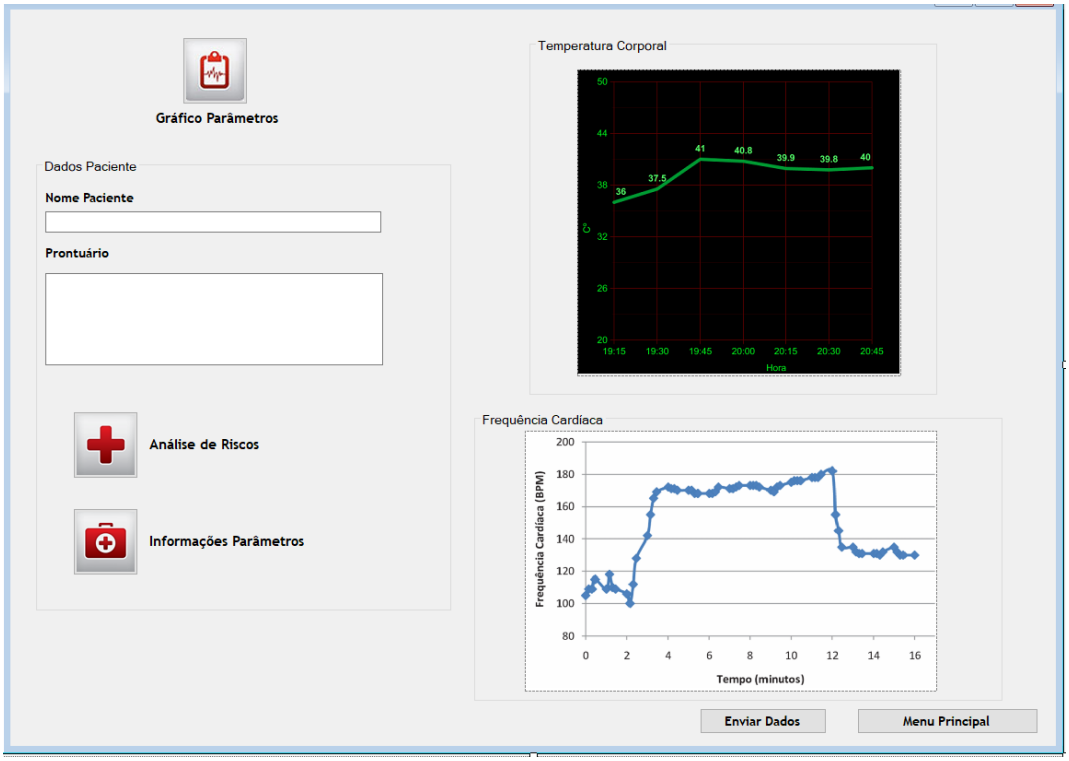
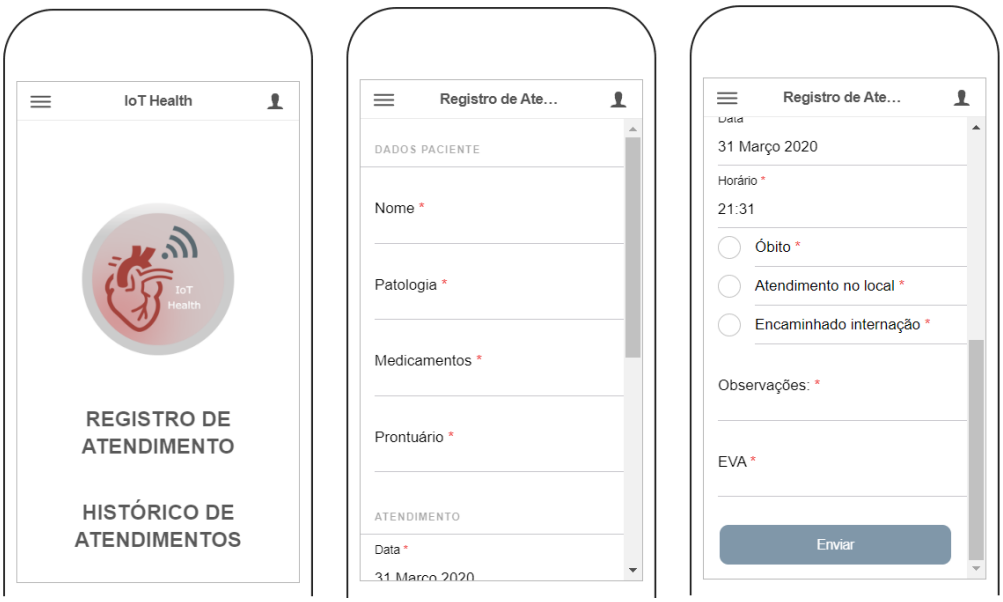


Figure 9. An interface example of patient temperature and heartbeat



After a medical intervention action is triggered by the monitoring center, the next step in the care workflow is performed by the health agent at the patient's home. Using a mobile application developed (see Figure 10), the health agent records the information from the service (medications, medical records, observation and the patient's pain scale – Visual Analogue Scale - VAS) and also ends the service, registering one of the 3 (three) possible states: death, on-site care or referral for hospitalization.

Figure 10. An interface for the health agent at the patient's home



Source: Elaborated by the authors

It is important to mention that all those experiments utilized the digital data from the researchers involved in this effort. The hospital side is a replication of your real environment. The feedback from hospital personnel has been incredibly positive. However, the regulatory preconditions - as mentioned in Ricciardi et al (2019) - exist and are barriers to be surmounted.

5 Conclusion and Future Works

The actual Covid-19 pandemic scenario reinforces the necessary efforts, similar to the present research work, targeting the better use in the future of the digital transformation, big data, artificial intelligence and data analytics for healthcare. These technologies could accomplish the difference between poor digital data of today and information around the world about people's vital signals in the Covid-19 pandemic.

In this paper, we present an ongoing project, which targets the collection of vital signals digital data for public primary healthcare monitoring. Three fog environments were established with different types of people. The main goal of these classifications was to understand how difficult the procedures to get vital signals from these groups and storage in a public hospital are. The empirical experiments provide important lessons, because to have an expensive smart band does not represent the guarantee to access to the digital data by a third-party application. On one hand, low cost devices could provide access to personal data, but does not present the same features, such as level of battery life. These aspects are compatible with what we saw in the

literature, which stated that innovations and new technologies could or could not materialize potential benefits. In addition, a personal education for all types of people is also required in this new digital transformation scenario.

Some future research actions (which are underway) are: (i) teaching the importance to gather digital data from vital signals to all groups involved in this research; (ii) a large effort to search for more appropriate smart bands in terms of cost-benefit; (iii) enhancements on the IoT App to connect a set of mobile devices to the selected smart bands; (iv) implementing some procedures inside the fogs to data cleaning utilizing AI applications; and (v) allowing some data analytics inside the fogs with the digital data collected.

Finally, it is important to highlight that the next steps of this research can provide a great contribution to minimizing the COVID-19 tests of the Brazilian population, which involves high costs, due to the size of the country. Tests can be minimized by monitoring individuals' specific vital signs, which include temperature, heart rate, oxygenation and blood pressure. More than costs, monitoring the individual health of each person, monitored by the smart bands of this proposal, allows faster actions by health professionals in patients with COVID-19 and others monitored due to their condition of comorbidities (for example, patients with cardiovascular, diabetic and hypertensive diseases). In other words, representing a monitoring approach could save lives and bring more security information inside environments to those who are required to work during the COVID-19 pandemic.

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Gobernanza de la pandemia del covid-19 y modelos de gestión: ¿Hacia un nuevo tipo de vínculo sociedad-Estado?

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La pandemia causada por el Covid-19 ha impulsado, de manera urgente y no planificada, diferentes orientaciones o modelos de gobernanza de la pandemia. Los gobiernos han propuesto diferentes modelos u orientaciones de combate a la pandemia, con resultados no concluyentes. Estos modelos y las premisas que los subyacen no son solo respuestas rápidas a una situación contingente e hipercompleja en la situación sanitaria, sino que corresponden a la existencia de racionalidades, decisiones y planificación de modelos de administración y gestión y su vínculo con el Estado. A partir de un contexto de hipercomplejidad, describimos una aproximación a los modelos de gestión de la pandemia de Suecia, Alemania y España, principalmente. Con base en las reflexiones sobre su gestión, abrimos un análisis sobre las orientaciones en la reconfiguración futura del Estado y su relación con la sociedad y la administración y gestión pública y los impactos políticos ya visibles.

Palabras clave: administración y gestión pública, pandemia covid-19, Unión Europea

Governança dos modelos de pandemia e gestão da covid-19: Rumo a um novo tipo de vínculo sociedade-estado?

A pandemia causada pela covid-19 gerou, de maneira urgente e não planejada, diferentes orientações ou modelos de governança da pandemia. Os governos propuseram diferentes modelos ou diretrizes para combater a pandemia, com resultados inconclusivos. Esses modelos e as premissas subjacentes a eles não são apenas respostas rápidas a uma situação contingente e hipercomplexa para responder à situação de saúde, mas correspondem à existência de racionalidades, decisões e planejamento dos modelos de administração e gestão e sua ligação com o Estado. De um contexto de hipercontingência, descrevemos uma abordagem para os modelos de gerenciamento de pandemia da Suécia, Alemanha e Espanha, principalmente. A partir das reflexões sobre sua gestão, abrimos uma análise sobre as orientações para a futura reconfiguração do Estado e sua relação com a sociedade, a administração e a administração pública e os impactos políticos já visíveis.

Palavras-Chave: administração e gestão pública, pandemia covid-19, União Europeia

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Governance of the Covid-19 pandemic and management models: towards a new type of society-state link?

The pandemic caused by the Covid-19 has prompted, in an urgent and unplanned manner, different orientations or governance models of the pandemic. Governments have proposed different models or guidelines to combat the pandemic, with inconclusive results. These models and the premises that underlie them, are not only quick responses to a contingent and hyper-complex situation to respond to the health situation, but correspond to the existence of rationalities, decisions and planning of Administration and management models and their link with the state. From a context of hyper contingency, we describe an approach to the pandemic management models of Sweden, Germany and Spain mainly. Based on the reflections on its management, we open an analysis on the orientations in the future reconfiguration of the State and its relationship with society and the Administration and public management, and the already visible political impacts.

Key words: public administration and management, covid-19 pandemic, European Union

Introducción y contextualización

La pandemia causada por el Covid-19 ha impulsado, de manera urgente y no planificada, diferentes orientaciones o modelos de gobernanza de la pandemia. Estos modelos y las premisas que los subyacen no son solo respuestas rápidas a una situación contingente e hipercompleja para dar respuesta a la situación sanitaria creada, sino que corresponden a la previa existencia de racionalidades, planificación, inversiones y, en el caso de este artículo, a diferentes modelos de administración y gestión y a su vínculo con el Estado. En un contexto contingente, exponemos una aproximación a los modelos de gestión de la pandemia de tres países: Suecia, Alemania y España, principalmente. En base a las reflexiones sobre su gestión, abrimos un análisis sobre los impactos en la reconfiguración y orientación del Estado y su relación entre la sociedad y la administración y gestión pública.

En la situación creada por la pandemia, las administraciones públicas han tenido que adaptarse a unas condiciones muy inestables en un espacio de tiempo muy limitado: toma de decisiones constantes y rápidas, reformulación rápida de métodos y aplicación de tecnologías todavía insuficientemente expandidas y aplicadas, nuevos tipos de atención masiva de los ciudadanos, elevado absentismo por cuestiones de enfermedad y contagio de muchos funcionarios públicos, etc. A esta nueva situación dinámica, hay que añadir las medidas que los gobiernos de todo el mundo tuvieron que tomar referentes a las restricciones de las libertades constitucionales: confinamiento obligatorio de la población, restricción de movimientos, vigilancia y control masivos por medio de las posibilidades de *Big-data*, medidas coactivas, etc.

Cada gobierno ha reaccionado frente a esta contingencia inesperada de diferentes maneras y estrategias. Ante la gravedad de la situación, algunos gobiernos se han prácticamente adelantado a los impactos, otros han tardado unos días o semanas con consecuencias catastróficas para el sistema de salud (Italia y España, por ejemplo), mientras otros han optado por estrategias de combate y control diferentes como el confinamiento voluntario (Suecia). Las decisiones que han motivado estas estrategias no se deben a situaciones improvisadas, sino que corresponden a modelos de gestión ya existentes en cada gobierno, modelos de selección meritocráticos para los cargos de responsabilidad y dirección, y en definitiva el tipo de relación entre la administración pública y el Estado.

Partimos de la suposición de que el éxito en la gestión y control de la pandemia, o solo la gestión reactiva e improvisada de los impactos ha sido consecuencia de diferentes

causas vinculadas con los tipos de relación del trípode administración-sociedad-Estado: planificación e inversiones en el sistema de salud nacional, capacidad profesional y expertise de los responsables políticos de salud y control de enfermedades, extensión de la coproducción de servicios, incremento de la cooperación público-privada, aunque relegando "lo público" (en la versión conservadora) y en la extensión y reducción de las responsabilidades del Estado. Estas tendencias no son nuevas, sino que corresponden a acciones y estrategias ya iniciadas en los últimos años. Este proceso ha tenido lugar en un contexto de hipercomplejidad, es decir, con la emergencia de incontables variables que requieren una selección por parte del observador, y en la que ya se insertan unas nuevas y cambiantes relaciones entre la sociedad y el Estado. Así pues, se está configurando definitivamente una nueva relación entre la sociedad y el Estado y, en consecuencia, una nueva relación entre la política y la administración pública. ¿Cómo afecta y cómo se manifiesta esta nueva relación?

El artículo tiene el objetivo de intentar responder de forma inicial a dos cuestiones fundamentales: primera, qué modelos de gestión se han implementado en países de la Unión Europea; y segunda, a qué modelos de relación o vínculo entre la administración y el Estado corresponde. Hemos limitado y organizado este escrito en tres apartados. En el primer apartado abordamos el vínculo de la gobernanza con la contingencia y el riesgo, cuyos impactos en la administración pública han sido escasamente analizados. En el segundo exponemos modelos de gestión en diversos países de la Unión Europea. En el tercer apartado, describimos los cambios y las tendencias subyacentes que corresponden de alguna forma con el papel del Estado y sus impactos en las administraciones públicas. Toda reforma no es casual, sino que responde a unos intereses, modelos y actuaciones por parte del poder político. Esbozamos los modelos en que se deslumbra la relación entre Estado y sociedad y, en consecuencia, entre Estado y administración. No es el objetivo de este artículo, hacer un análisis sobre las decisiones tomadas por los respectivos gobiernos. Tampoco se tiene la pretensión de responder las cuestiones planteadas de forma conclusiva dadas las incertidumbres existentes. En el plano metodológico se ha recurrido a informaciones publicadas en periódicos, ministerios de salud nacionales y agencias de salud internacionales, limitando temporalmente entre los meses de febrero y mediados de junio de 2020.

1. Hipercomplejidad, contingencia y riesgo

Algunas de las decisiones que toman los gobiernos o el poder político, pueden no ser

necesarias, pero al mismo tiempo, sus consecuencias tampoco son previsibles. La causa de los fenómenos no puede ser demostrada ni negada de manera definitiva. Las probabilidades estadísticas demuestran esta hipótesis. Así, contingentes son las proposiciones que no son necesariamente verdaderas ni necesariamente falsas, aunque surja una posibilidad real de que sucedan. La incerteza caracteriza estas situaciones que se manifiestan en actuaciones frente a desastres naturales o de origen humano. En el caso de la pandemia causada por el Covid-19 y de la preparación y prevención sanitaria de las sociedades, es evidente que la situación encontró a todos los países desprevenidos, aunque disponer de un sistema de sanidad más extenso y preparado no era una tarea imposible, su existencia ha dependido siempre de decisiones políticas y administrativas previas o durante la pandemia. En el caso de las sociedades modernas actuales, que son en general hipercomplejas y formadas por una extensa y densa organización político-administrativa y jurídica en múltiples niveles, es necesario abordarlas en la perspectiva de la contingencia y del riesgo.

Estas sociedades se orientan cada vez más a un tipo de articulaciones, convenciones y mediaciones hacia sistemas e interacciones altamente sofisticadas En el caso de la pandemia, son las comunicaciones emitidas entre el ámbito sanitario, el científico y el económico, han resultado asimétricamente contrapuestas o no aceptadas mutuamente. En estas sociedades la articulación entre los diferentes niveles de gobierno y de las instituciones, su funcionamiento, la gestión de las demandas y emergencia de conflictos, son cada vez más caracterizados por largos procesos hipercomplejos en muchas ocasiones con intereses diametralmente opuestos, como se ha demostrado en España en la gestión de la pandemia entre los diferentes niveles de gobierno central y autonómico de Cataluña y el País Vasco.

La pandemia del Covid-19 ha puesto de manifiesto la hipercomplejidad en todas sus dimensiones: paradojas entre la economía, la salud y la ciencia, y en las decisiones en diferentes niveles de gobierno en todos los países (ya sean federales o descentralizados), diversas lógicas de combate y confinamiento (y sus irracionalidades). También se han evidenciado las disfunciones en las estrategias de combate a la pandemia entre las decisiones gubernamentales, la articulación multinivel y entre los gobiernos y la Organización Mundial de la Salud, y entre los estados de la Unión Europea, en las primeras semanas de abril de 2020.

1.2. Hipercomplejidad, Administración y gestión pública

Todavía es reciente la idea de que los procesos de toma de decisiones, la gestión en las políticas públicas, los procesos administrativos y burocráticos de la administración pública son procesos intrincados. A diferencia de otras ciencias sociales, como es la economía, es todavía reciente la utilización de las ideas de las teorías sobre la complejidad y su utilización en las observaciones de la administración y gestión pública. Los enfoques vinculados con la complejidad (o hipercomplejidad) y los enfoques evolutivos y sistémicos en la perspectiva autorreferencial han recibido poca atención analítica y empírica (VIDAL, 2019). Consideramos en el escenario descrito de la pandemia de Covid-19 como de hipercompejidad, en que podemos caracterizar la emergencia de multiplicidad de variables (cualitativas y cuantitativas) sobre las cuales es necesario seleccionar y que han tenido sus impactos en los modelos de gobernanza multinivel aplicados por los gobiernos[11]. El concepto ha sido utilizado y analizado por diversos estudiosos de la teoría sistémica (KNODT, 1995, p. XVIII; LA COUR; PHILIPPOULOS, 2013; ANGELL; DE METRIS, 2010, p. 187) y en el contexto del tema de este escrito se refiere a los factores contingentes y las múltiples variables que intervinieron durante la pandemia del Covid-19.

¿Cómo puede contribuir la teoría sistémica o el punto de partida de la complejidad para aumentar la compresión de este abrupto fenómeno y sus inherentes peligros, con las propuestas de resolución de problemas en la administración y la gestión pública respecto a la gestión de la pandemia del Covid-19? En ámbitos económicos específicos (gestión hospitalaria, empresarial etc.), las publicaciones han hecho hincapié en el potencial de la teoría de la complejidad para abordar el desarrollo de políticas (TAIT; RICHARDSON, 2009), se cuestiona el papel de los expertos de políticas y su pretendida expertise, "autoridad" y "experiencia" de los modelos económicos tradicionales, al tratarse de un simple reduccionismo, al ignorar el *complex thinking.*

La teoría de sistemas y de los procesos de adaptación mutua entre ellos, es una posibilidad de observación y análisis. Se parte del presupuesto de los principios de la *good governance* y de la capacidad dinámica de autoorganización como una característica permanente en evolución en los procesos emergentes. Aunque no se asuma la lógica de la capacidad operativa autónoma de un sistema, y por lo tanto de crear sus propias estructuras, estos procesos se forman a partir de eventos, fenómenos de acción e interacción colectiva, los cuales contribuyen a formar una estructura institucional.

[11] Niklas Luhmann en sus escritos se refiere indistintamente a "complejidad" y "hipercomplejidad", y define esta última como la ausencia de un padrón moral en la sociedad. Véase aquí: N. Luhmann, [1984] 2016; 2006.

En los sistemas de salud y de funcionamiento hospitalario la auto organización, o capacidad de auto gestionarse en todos los niveles (elección de compras de material, elección de modelos de gestión privados etc.), surge de la capacidad de libre elección y acción de las personas participantes y las organizaciones en el sistema político, económico o sanitario. No obstante, la interacción, como veremos en el sistema sanitario (con opciones asimétricas de compras de material en España, entre el gobierno central y los autónomos) también puede obstruir estos procesos, por lo que es necesario un tipo de comprensión de la coordinación (multinivel), ya que la integración difiere de las ideas convencionales sobre la simple adaptación mutua. La sincronización entre los participantes o las organizaciones (entre los niveles municipal, regional y central) presupone que una estructura es insuficiente para estimular la integración, aunque exista un contexto de diversidad institucional (político y/o jurídico) dentro del cual los límites cambian constantemente, lo que requiere que sean establecidas nuevas interconexiones entre ellos.

1.3. Contingencia y riesgo en el contexto de la pandemia Covid-19

La Organización Mundial de la Salud (OMS) ya había publicado en el año 2019 (OMS-GPMB, septiembre 2019) un informe en el que advertía la posibilidad de una pandemia mundial causada por un virus desconocido y la necesidad de que los gobiernos se prepararan para esta situación. El riesgo de la eclosión de una pandemia de tal magnitud y profundidad, con efectos tan devastadores, no fue asumida por ningún país occidental. Ya con la eclosión del Covid-19 en Wuhan el mes de enero del 2020, la OMS minimizó la posibilidad de una pandemia de alcance mundial. En un primer momento, la OMS admitió el 27 de enero, un error en la divulgación del riesgo global del nuevo coronavirus**.** Inicialmente esta organización calificó el riesgo de “moderado”, siendo rectificado más tarde por “alto”, y, posteriormente, que el riesgo era “muy alto en China, alto regionalmente y alto globalmente”. La imperceptibilidad de los peligros, su supranacionalidad, la “expropiación ecológica” y el paso de la normalidad a la absurdidad fueron diagnosticados por Beck ([1986]1998), en la ocasión del accidente nuclear de Chernóbil en 1986. La contingencia estuvo presente en las decisiones iniciales de la OMS: ¿Por qué no fue informada por el gobierno chino del elevado riesgo? ¿Era imposible un riesgo “moderado”, o “alto”? ¿Sería posible que su expansión e infección fuera tan rápida?

Como la contingencia, el riesgo y el peligro constituyen una secuencia dinámica y continua, algo que ha quedado claro en la gestión del coronavirus. Contingencia, en la perspectiva que presentamos aquí, o sea, aquello que no es necesario ni imposible, pero

que puede existir siempre, comporta necesariamente riesgo, y el riesgo comporta a su vez peligro. Además de los predicados ontológicos “ser” y “no ser”, la contingencia también implica un tercer valor, a saber, la “imposibilidad de determinación”. La “era de incertidumbre”, como se ha demostrado durante la pandemia, es una versión particular de la sociedad moderna, cuyo atributo determinante es la contingencia. En las condiciones modernas, las necesidades y las imposibilidades ya no proporcionan el marco ordenado del mundo. Ya no existen formas socialmente necesarias para la limitación recíproca de los diversos componentes de la sociedad o incluso para la coherencia social del conjunto. Se acepta que todo lo que se supone puede ser diferente, y que cualquier cosa, aunque no todo de una vez, se puede redefinir y cambiar a través de la comunicación. La sociedad moderna es una sociedad que abarca las contingencias como ninguna otra antes. Si bien las necesidades e imposibilidades se aceptan por razones de tiempo, en este tipo de sociedad, en consonancia con su aceptación de las contingencias, se caracteriza sobre todo por atributos débiles requeridos (seguridad, planificación, control de laboratorios biológicos entre otros factores) en el sentido de propiedades emergentes inicialmente indeterminables, altamente improbables y frágiles.

Debería ser obvio que, en las condiciones de las sociedades contemporáneas, tanto la ciencia como la política, y su relación entre sí, ya no pueden concebirse en términos de necesidad, sino que deben analizarse en términos de estas propiedades improbables y frágiles emergentes de sociedad. Al mismo tiempo, sin embargo, debe recordarse que, en estas condiciones, nada se considera tampoco imposible: ¿Qué gobierno podría afirmar en enero del 2020, que se avecinaba una revolución mundial que abarcaría todos los ámbitos, tecnológica, económica, social, de consumo, de tiempo libre, académica, solo cuatro semanas más tarde? ¿Qué consultoría podría anticipar que esta revolución haría caer gobiernos y ministros en pocas semanas? ¿Qué estudio podría anticipar que el concepto de viajes de larga distancia cambiaría radicalmente? ¿Quién podría afirmar empíricamente la efectividad del “efecto mariposa”, que un simple movimiento pudo afectar a una sociedad a 10.000 kilómetros de distancia?

El riesgo está presente en todos los ámbitos de la vida cotidiana organizacional y en las organizaciones sanitarias en particular: en su gestión, planificación, toma de decisiones, inversiones, etc. Surge la pregunta: ¿Qué es el riesgo? Las diferentes corrientes en la filosofía y en las ciencias sociales le han atribuido diversos significados. En la tradición racionalista ha sido considerado como producto de una decisión que según sus impactos posteriores (negativos) se hubieran podido prever o evitar. Aquí se trata de un cálculo temporal con el horizonte de un futuro incierto y cuyos impactos podrían ser evitados.

Pueden ser aceptadas situaciones de riesgo que lo contemplen, siempre y cuando esté justificada la posibilidad de que ocurra (construcción de grandes represas, empresas contaminantes, experimentación con nuevos virus, etc.). Esta ha sido la argumentación imperante. Niklas Luhmann ([1984]2016) ha cuestionado el concepto tradicional de contingencia por ser limitada, puesto que sólo puede describir riesgos en sus aspectos cuantitativos y probabilísticos y los analiza básicamente en el sistema económico y científico.

El análisis y observación del riesgo en la diferenciación funcional posibilita utilizar simultáneamente la observación elemental (basada de datos estadísticos) y la observación de segundo grado (basada en las selecciones del observador). La observación de primer grado es el mundo real y, por lo tanto, es limitada al poder solamente identificar cuantitativamente los posibles riesgos. Con la utilización del concepto binario riesgo-seguridad, se tratan de observaciones sólo para garantizar la seguridad, para la cual es necesario más y mejor tipo de información. Por esto propone que la teoría debe ser orientada a la observación de segundo orden. Se trata de un fenómeno de "contingencia múltiple" (LUHMANN, 2016), o sea, permite y ofrece abordarlo desde diferentes perspectivas por diferentes observadores. Aquí el problema reside en que el riesgo es algo que es descrito como similar por diferentes observadores. La consecuencia es que genera informaciones muy diversas entre ellos. En este punto, propone la diferenciación entre riesgo y peligro. Mientras que el riesgo se refiere al caso en que el desafío es consecuencia de la decisión, con el peligro los posibles daños son provocados externamente, es decir atribuido al entorno del sistema. La observación de segundo grado permite establecer la distinción entre quienes deciden qué son los riesgos y quienes son los afectados.

2. La gestión de la pandemia en los países de la Unión Europea

La pandemia del covid-19 ha cogido a los países de la Unión Europea, como todas las sociedades y gobiernos del mundo por sorpresa. Las reticencias iniciales a una mayor cooperación no se han solucionado definitivamente. Las propuestas de hacer mutuos los costos de la pandemia o de "eurobonos" sugeridas por los presidentes de España y de Italia para superar la crisis económica han encontrado con fuertes resistencias entre los países nórdicos, en especial Dinamarca, Holanda y Austria[12].

Ha sido común entre los países de la UE que durante la pandemia el foco de

[12] *CAIXABANK,* Álvaro Leandro y Adriá Morron**,** Políticas económicas frente a la COVID-19: ¿se romperán las fronteras de lo imposible? Disponible en: https://www.caixabankresearch.com/politicas-economicas-frente-la-covid-19-se-romperan-las-fronteras-de-lo-imposible

contagio más frecuente haya sido encontrado en las residencias de ancianos. Este trágico fenómeno se ha registrado en prácticamente todos los países. Solo en Suecia, la Agencia de Salud Pública logró demostrar por medio de las estadísticas que al menos el 40% de las muertes en la región urbana de Estocolmo, el epicentro de la epidemia en este país, se produjeron en instituciones para ancianos y en asilos para tercera edad. El mismo fenómeno se ha reproducido en Francia, Italia, Gran Bretaña, España, y en menor medida en los países nórdicos y Alemania. En las Comunidades de Madrid y Cataluña (14.900 en total, aproximadamente el 40 % de fallecimientos se produjo en estos centros)[13].

De manera similar a la Gran Recesión que azotó los países de la EU entre los años 2008-2010, aunque sus impactos no han sido superados, en especial en los países de la cuenca mediterránea, la crisis del coronavirus ha demostrado que la UE no tiene un mecanismo de gobernanza que pueda garantizar la solidaridad entre sus miembros. La pandemia del Covid-19 y la solidaridad entre sus estados es una cuestión que será mantenida en el futuro. No se ha dispuesto de mecanismos que impulsen a los países miembros a responder de forma conjunta, o al menos coordinada.

2.1 Suecia

A diferencia de los demás países nórdicos (Dinamarca y Noruega) que adoptaron la estrategia de semi-confinamiento, el gobierno de Suecia descartó la posibilidad de aislar a su población por considerar que las medidas drásticas no eran lo suficientemente eficaces como para justificar su impacto en la sociedad. Desde el inicio de la pandemia, Suecia ha intentado en las primeras semanas una estrategia diferenciada respecto al resto de países de la Unión Europea y, con pocas excepciones en el mundo. Se ha informado a la población sobre los peligros, el gobierno ha realizado y recomendado el distanciamiento social, aunque no ha impuesto el confinamiento total de la población, sino una especie de semi confinamiento, pues el gobierno consideró que las medidas drásticas no eran eficaces para frenar los impactos de todo tipo en la sociedad. Las universidades y colegios han continuado normalmente, al igual que la vida en las terrazas, parques, bares y cafés. Se ha partido de la premisa cultural de este país y de la responsabilidad individual, en un país con una población de alrededor de diez millones de habitantes. En Suecia la ciencia ha mantenido un diálogo entre el ámbito económico y el cultural, en el que la ciencia vinculó la constatación

[13] *RTVE,* Radiografía del coronavirus en residencias de ancianos: más de 19.400 muertos con Covid-19 o síntomas compatibles, 15 junio 2020. Disponible en: https://www.rtve.es/noticias/20200615/radiografia-del-coronavirus-residencias-ancianos-espana/2011609.shtml

histórica y empírica del país con epidemias pasadas para abordar las medidas de lucha contra la pandemia de Covid-19.

En un informe de HSBC[14], se destacan tres características demográficas del país que han permitido también amortiguar el impacto social y económico del coronavirus: 1) Más de la mitad de los hogares suecos se componen únicamente de una persona, lo que facilita el distanciamiento social; 2) Más personas trabajan desde la modalidad domiciliaria que cualquier otro lugar en Europa; 3) Todos los hogares cuentan con acceso a internet para el desarrollo de sus actividades laborales.

En Suecia, la gestión de las situaciones de crisis se confía a las agencias especializadas, (Junta Nacional de Salud y Bienestar, Agencia Sueca de Contingencia Civiles, MSB) no siendo el gobierno quien ha tomado las decisiones. La Agencia Nacional de Salud (*Folkhälsomyndigheten* tiene la responsabilidad del desarrollo y la actualización de la expertise, así como busca difundir el conocimiento sobre la medicina de desastres y la preparación para emergencias con el fin de proporcionar asistencia al Sistema de Salud y servicios sociales en tiempos de emergencia y gestión de desastres. El gobierno ha encargado a la Junta que coordine y prepare la disponibilidad de medicamentos y suministros médicos según sea necesario en un estado de alerta reforzado. La estrategia por la que se optó para la contención del virus no fue tanto frenarlo en seco o permitir una "inmunidad de rebaño" (o pasaporte inmunológico, como inicialmente propuso el Primer ministro Boris Johnson en Gran Bretaña), cuando la mayoría de la población adquiere anticuerpos. La Agencia Nacional de Salud ha partido de la hipótesis de una cultura de distancia social "natural" entre la población. El consultor de la Agencia de Nacional Salud, Johan Giesecke expone el principal argumento[15]:

> Nosotros, o el gobierno sueco, decidimos en inicio de enero que las medidas que debemos tomar contra la pandemia deben ser basadas en evidencias. Cuando se empieza a analizar las medidas que están siendo tomadas ahora por diferentes países, se percibe que muy pocas de ellas tienen un sustento de evidencia (...) Pero sabemos de una que es conocida desde hace 150 años o más, que consiste en lavar sus manos, esto es bueno para uno mismo y para los otros cuando se está en una epidemia. Pero el resto, el cierre de fronteras,

[14] HSBC Global Research, 2020. Disponible en: https://www.research.hsbc.com/C/1/1/320/gjvcpRH
[15] *Pfarma.com.br*, Fabio Reis, 14 mayo 2020, *Estudo de caso: Suécia e o novo coronavírus*, disponible en: https://pfarma.com.br/coronavirus/5612-suecia-covid19.html

> cierre de escuelas, distanciamiento social... casi no existe ciencia por detrás de esto (REIS, 2020).

No obstante, esta estrategia ha comportado un elevado número de fallecimientos y el colapso de la sanidad, aunque el sistema no ha llegado en ningún momento al colapso. Las únicas medidas importantes fueron prohibir las reuniones o grupos de más de 50 personas, y las visitas a los asilos de ancianos. Por lo demás, el gobierno hizo un llamamiento a la "conciencia cívica", pidiendo a todos que "asumieran sus responsabilidades" y que siguieran las recomendaciones en materia de salud. Ante un aumento de casos, no fue hasta el 16 de abril, que el Parlamento ha concedido poderes especiales al gobierno para que decretara medidas más restrictivas. Con estos poderes el gobierno posee la autonomía de poder actuar rápidamente en caso necesario con medidas como cierres de puertos, escuelas o centros deportivos o recreativos[16].

Sin embargo, la estrategia del gobierno no ha sido libre de críticas por parte del sistema científico. Para Bo Lundbäck, profesor de epidemiología de la Universidad de Gotemburgo (oeste): "las autoridades y el gobierno creyeron estúpidamente que la epidemia no llegaría a Suecia en absoluto"[17]. Por otro lado, el mismo primer ministro Stefan Löfven, tuvo que reconocer en la primera semana de mayo que: "La preparación no fue lo suficientemente buena"[18]. No obstante, el día 7 de mayo, el país ya había superado las 3.000 muertes. A pesar de la perplejidad de estas medidas, el gobierno ha mantenido las recomendaciones del Organismo de Salud Pública del país. En esta paradójica situación, 21 científicos e investigadores publicaron una columna exigiendo "medidas rápidas y radicales", incluyendo el cierre de escuelas y restaurantes[19]. El debate se ha iniciado entre el gobierno y las autoridades sanitarias que han seguido presionando para que se adopte una estrategia a largo plazo, remarcando que la contención sólo funciona durante períodos cortos. Critican contundentemente a la Agencia de Salud Pública y advierten que Suecia sigue una curva de enfermos similar a la de Italia, y exigen que el poder político actúe en consecuencia.

Entre el 7 al 9 de abril, murieron en Suecia 10,2 personas por millón de habitantes al día, por covid-19. Esta cifra superaba a la de otros países europeos: en Italia la cifra fue de

[16] Government Office of Sweden.
[17] *Euronew*s, Rafael Cereceda. ¿El modelo sueco frente al coronavirus empieza a hacer aguas ante el aumento de fallecidos?, 6 de mayo de 2020. Disponible en: https://es.euronews.com/2020/04/16/el-modelo-sueco-frente-al-coronavirus-empieza-a-hacer-aguas-ante-el-aumento-de-fallecidos
[18] Ibid.
[19] Diario *Dagens Nyheter.*

9,7; en Dinamarca fue de 2,9; en Noruega 2,0; y en Finlandia 0,9, respectivamente[20]. De estas cifras es posible deducir que en Suecia han muerto más de diez veces más personas a causa del coronavirus que en Finlandia. En Finlandia todos los cafés y restaurantes están cerrados, al igual que las escuelas están cerradas, y las reuniones de más de diez personas están prohibidas. Por otro lado, Noruega, con muertes por millón de habitantes cinco veces más bajas que Suecia, no ha tenido reglamentaciones de conducta tan estrictas como Finlandia, pero de todas formas mucho más estrictas que la de Suecia. Para Camilla Stoltenberg, directora del Instituto Noruego de Salud Pública*:*

> Noruega ha sido absolutamente crucial tener más control en esta fase, el implementar numerosas medidas en una etapa temprana (…) Ha sido importante para ganar tiempo y prepararse para lo que esté por venir y tener buenas condiciones para enfrentar la epidemia en el futuro*[21]* (STOLTENBERG, 2020).

Tegnell, de manera similar a Johan Giesecke, poseen una post formación en la London School de Higiene y Medicina Tropical, en cuyos departamentos se inspiró la política adoptada en un principio por Boris Johnson, a saber, la mitigación de la epidemia para evitar el desbordamiento de los hospitales, mientras se expande entre la población hasta que alcanza inmunidad grupal o "inmunidad de rebaño"[22]. Giesecke no aprobó el cambio de actitud del gobierno británico[23], al defender los efectos negativos para la salud y para la sociedad debido a las medidas autoritarias y restrictivas tomadas por los gobiernos, con el argumento de que el confinamiento no soluciona el problema. Por otro lado, considera que la cifra final de fallecidos en cada país al final será similar, puesto que el virus se expandirá hasta que la mayoría de la población desarrolle inmunidad, o en unos meses, que sea posible disponer de una vacuna. Mark Handley, profesor de Sistemas en red en University College London, ha publicado unas series de gráficos que exponen la evolución de la pandemia en los países nórdicos y el aumento de infecciones por millón de habitantes y confirma la hipótesis de que en Suecia el descenso de las infecciones se produjo de forma

[20] *Worldometer.* Disponible en: https://www.worldometers.info/coronavirus/

[21] *Aktuellt,* Norska folkhälsodirektören: "För tidigt säga att vi lyckats" 9 april*, 2020.* Disponible en*:* https://www.svt.se/nyheter/utrikes/norska-folkhalsodirektoren-for-tidigt-saga-att-man-lyckats

[22] *The Conversation,* ¿Qué es la inmunidad de rebaño y por qué Reino Unido confía en ella frente al coronavirus?, 20 march, 2020. Disponible en: https://theconversation.com/que-es-la-inmunidad-de-rebano-y-por-que-reino-unido-confia-en-ella-frente-al-coronavirus-134175

[23] Entrevista en *Unherd*. Which epidemiologist do you believe? The debate about lockdown is not a contest between good and evil, 27 abril 2020. Disponible en: https://unherd.com/2020/04/which-epidemiologist-do-you-believe/

similar a otros países con el confinamiento[24].

En este contexto, ¿El modelo sueco ha aportado alguna ventaja? ¿Es todavía temprano para evaluarlo? Como todo el proceso que envuelve el covid-19 todavía no se dispone de suficientes informaciones comparadas empíricamente. Suecia se ha fundamentado en dos pilares: autodisciplina y estructura de trabajo. La ministra de asuntos exteriores, Ann Linde, ha confiado en la responsabilidad cívica de sus ciudadanos para prevenir la propagación del virus. Sin embargo, esta responsabilidad no se encuentra sólo en la cultura y la forma de vida de la población, sino que el gobierno en sus acciones ha dado ejemplo a toda la sociedad. En el ámbito empresarial, se ha confiado en las empresas y los trabajadores para que asuman su responsabilidad. A partir de estas constataciones diversos gobiernos se han preguntado sobre la posibilidad de implementar el modelo en sus respectivos países. Goldman Sachs, ha declarado expresamente: "la experiencia sueca no se puede extrapolar"[25], por causa de las características culturales específicas de este país. Las medidas del Gobierno han reflejado la tradición sueca democrática y las estructuras de la sociedad, en las que el Gobierno no tiene la potestad para decretar toque de queda, a no ser que estalle una guerra.

Para el Anders Tegnell[26] (epidemiólogo y jefe de la Agencia de Salud Pública de Suecia) el objetivo principal ha sido mantener las tasas de transmisión en un nivel tal que el sistema de salud no colapse. Para este epidemiólogo no es posible seguir manteniendo una estrategia de aislamiento social (cierre de fronteras y establecimientos públicos) ya que ni es sostenible ni viable en el tiempo. Considera que la "inmunidad colectiva" permite afrontar esta pandemia en el largo plazo, aunque esta inmunidad no es el foco de su estrategia, sino una condición que puede derivarse a partir de ella. Sin embargo, diversos estudios han constatado que la inmunidad colectiva como una condición, se logra cuando menos el 70% de la población, se vuelve inmune a la enfermedad, ya sea por recuperación o mediante la vacuna. Esta situación genera que en el corto plazo las muertes sean mayores que en relación a otros países, aunque hace menos probable la propagación del virus dado que no hay suficientes portadores infecciosos para contagiar.

En suma, es difícil valorar la efectividad de la estrategia del gobierno, que en el día 15 de mayo contabilizó 29.677 casos confirmados, 4.971 recuperados y 3.674

[24] *Leonoticias.* Suecia envidia el rigor de sus vecinos, 25 de abril 2020. Disponible en: https://www.leonoticias.com/internacional/union-europea/envidia-sueca-rigor-20200424183308-ntrc.html?ref=https%3A%2F%2Fwww.google.com.br%2F

[25] Ibid.

[26] *La Tercera.* Anders Tegnell, el epidemiólogo detrás de la polémica estrategia de Suecia contra el coronavirus, 13 de abril de 2020. Disponible en: https://www.latercera.com/la-tercera-pm/noticia/anders-tegnell-el-epidemiologo-detras-de-la-polemica-estrategia-de-suecia-contra-el-coronavirus/wdyjfuk4pzgafiq5vc7ocluyr4/

fallecimientos. En el mes de abril, el FMI publicó que Suecia sufriría una contracción anual estimada del PIB -6.5% (mientras que en la zona euro la caída sería de un -7.5 por ciento) y una ligera contracción del 0.3% del primer trimestre[27]. A mediados de mayo, la ministra de economía, Magdalena Andersson, ya se refería a una caída del 10 % del PIB[28].

2.2. Alemania

Alemania, se ha mostrado como la nación más efectiva, por ser el país europeo con una gran población y con menos fallecimientos. En este país el sistema científico, el político y el económico han logrado un cierto equilibrio. El hecho que el sistema de salud no haya colapsado fue debido a la preparación y efectividad de este sistema. Desde los inicios de los casos, el gobierno mantuvo una estrategia clave ante la "urgencia" del problema al poner en marcha una campaña masiva de pruebas entre la población. Con ello fue posible establecer una red pública, mutualista y privada de laboratorios con el objetivo de lograr el control de la pandemia. Alemania ha partido de un modelo de sistema sanitario que ha evidenciado la fortaleza y eficiencia de su sistema de salud y ha combinado importantes recursos e inversiones previas a una gestión eficaz. El modelo de colaboración público-privada e institucional que ha sido un factor que impulsó el alcance de la eficiencia con el mejor resultado al menor coste posible. Por otro lado, la agilidad de la gestión ha caracterizado a los elementos del sistema sanitario (centros de salud, clínicas especializadas, laboratorios y grandes hospitales), que ha funcionado de forma óptima. Alrededor del 70% de los centros sanitarios de Alemania están gestionados por compañías privadas, fundaciones, organizaciones mutuales benéficas o grupos religiosos, siendo que el 30% restante tiene una gestión pública directa. Esta estructura incorpora un alto grado de elementos de gestión empresarial al manejo de los centros sanitarios, con lo que se combinan un pensamiento de flexibilidad para adaptarse a las circunstancias. Como consecuencia los hospitales del país disponen de más facilidad para utilizar economías de escala en el uso de sus recursos y más capacidad de negociación con proveedores, liberándose de las trabas burocráticas y optimizando costes en las compras de material.

Sin embargo, pese a su potente estado social (y sistema sanitario) han aparecido problemas con la pandemia relativos a la transferencia de responsabilidades y coordinación[29] en el ámbito de la salud entre los *Länder* y los municipios. La pandemia

[27] *La vanguardia*, La arriesgada normalidad sueca, 31 marzo 2010.
[28] *El país*, 21 mayo 2020.
[29] *Deutschlandfunk Kultur.* Forderung nach mehr Kompetenzen für den Bund, 12 de marzo de 2020. En: https://www.deutschlandfunkkultur.de/corona-pandemie-forderung-nach-mehr-kompetenzen-fuer-

comenzó en Alemania el 27 de enero del 2020 con la identificación del primer caso en Múnich. En las primeras semanas la mayoría de los casos fueron identificados en una fábrica de componentes de automóvil. A partir del 26 de febrero ya se registran casos en Baden-Württemberg y otros por viajes procedentes de Italia, China e Irán. El centro de epidemiología y control de enfermedades es asesorado por el Instituto Robert Koch (RKI) y juntos gestionaron el plan nacional de pandemias. En la primera fase, los casos fueron gestionados en el "estadio de contención" con el objetivo de minimizar su expansión. En 11 de marzo, la canciller Angela Merkel afirmó que el país estaba bien preparado y que inicialmente las medidas de cuarentena y distanciamiento social no serían necesarias[30]. Ante el aumento rápido de contagiados de caso el 13 de marzo pasó al nivel "de protección" en el que fueron cerradas escuelas, universidades, jardines de infancia y residencia para personas mayores. El 22 de marzo se anunció un toque nacional de cuarentena. Desde un principio el coordinador de Emergencias Infecciosas del Instituto de Virología del Charité en Berlín Christian Drosten apostó por la aplicación masiva de pruebas entre la población, focalizando los núcleos de infección con el objetivo de identificar los contactos y de esta forma controlar la expansión de la pandemia[31]. Al bajo número de fallecidos corresponde también un sistema hospitalario y un sistema de unidades de cuidados intensivos muy extenso y superior al de otros países europeos.

2.3. España

En España la opinión mayoritaria es que se ha reaccionado demasiado tarde[32], ya que la recomendación de permanecer en casa tuvo lugar cuando ya había más de 1.000 contagios en Madrid[33]. El 7 de febrero de 2020, el Foro Económico Mundial otorgaba a España el título de mejor sanidad del mundo, siendo además el tercer país en esperanza de vida[34].

La OMS declaró que el brote de virus era una pandemia el 11 de marzo. Tres días

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den.1008.de.html?dram:article_id=472312

[30] Declaraciones recogidas en: EURACTIV.de

[31] *Der Tagesspiegel*. Neue statistiche Auswertung bestätig alten Verdacht, 03 de junio de 2020. En: https://www.tagesspiegel.de/wissen/drosten-studie-ueberarbeitet-neue-statistische-auswertung-bestaetigt-alten-verdacht/25882680.html

[32] *Financial Times,* 2 marzo 2020, Political divisions depeen Spain battles coronavirus.

[33] *El Pais*, Espanha e Coreia do Sul, exemplos opostos de controle epidemiológico do coronavírus, 16 marzo 2020. Disponible en: https://brasil.elpais.com/sociedade/2020-03-16/coreia-e-espanha-exemplos-opostos-de-controle-epidemiologico-do-coronavirus.html

[34] *Redacción Médica*. El foro Económico Mundial da a España el título de mejor sanidad del mundo, 7 febrero 2020. Disponible en: https://www.redaccionmedica.com/secciones/sanidad-hoy/espana-cuenta-con-la-mejor-sanidad-el-mundo-segun-el-foro-economico-mundial-8476. Consultado el 7 de febrero de 2020.

más tarde ya se producían una fuerte extensión de los contagios en las ciudades de Madrid, Barcelona y otros puntos del país. El Consejo de Ministros declaraba el estado de alarma. Antes la convocatoria de la manifestación multitudinaria prevista para el Día Internacional de la Mujer para el 8 de marzo, a pesar de ello, el director del Centro de Coordinación de Alertas y Emergencias Sanitarias Fernando Simón mantuvo una posición ambigua cuando fue preguntado sobre esta manifestación: “Si mi hijo me pregunta si puede ir le diré que haga lo que él quiera”, y que no recomendaba a “nada a nadie ”, y aseguró que cada persona debía considerar asistir o no a las manifestaciones feministas en Madrid.[35]

No nos detendremos aquí a analizar los problemas heredados de las administraciones públicas, ya abordadas por diversos estudios crónicos (Jiménez Asensio, 2020; Ramio 2015) en los que se identifican sus problemas estructurales (“visión cortoplacista de la política”, “marco normativo obsoleto”, envejecimiento de las plantillas, etc.).

Durante la pandemia, ya fueron puestos a prueba mecanismos y técnicas de comunicación información (TICs) y prestación de servicios de la administración y gestión pública, algunos ya existentes y utilizados (administracion.gob.es), otros infrautilizados (videoconferencias) y otros novedosos (Asistente Virtual de la Seguridad Social, *sites* de municipios). La pandemia ha obligado a agilizar en carácter de urgencia las formas de trabajo de las administraciones y adaptarlas a unas circunstancias excepcionales. Su organización se ha tenido que extender medidas incipientes antes de la pandemia (flexibilización, reorganización de turnos, teletrabajo, *homework*).

3. Modelos de gestión

El modelo de previsión de Alemania hizo que el país obtuviera la capacidad logística de realizar, ya en el 20 de marzo, 160.000 exámenes diagnósticos por semana, mientras que Italia, Gran Bretaña y España sólo habían podido realizar 150.000, 50.000 y 30.000 exámenes diagnósticos, respectivamente. Esta estrategia de diagnósticos (pruebas rápidas focalizadas) incide en estos países muchas en personas con el virus que no fueron diagnosticados por tener síntomas o por la falta de material del examen para la detección de la enfermedad con lo que la pandemia se extendió de manera descontrolada. En Alemania convergieron de manera más aproximada el número de casos detectados, respecto al número de infectados[36].

[35] Declaraciones en *La Vanguardia*, 7 marzo 2020.

[36] *BBC News*. Alejandro Millán Valencia. ¿Por qué Alemania tiene un número tan bajo de muertos por covid-19 en comparación con otros países?, 21 marzo 2020. Disponible en: https://www.bbc.com/mundo/noticias-internacional-51980118

Algo diferente ha pasado en España en que en ningún momento se ha dispuesto de estimaciones creíbles acerca de la expansión de la pandemia, con muy pocas pruebas de detección. El resultado ha sido una política a ciegas y muy lenta hacia la normalización. Si bien la libertad operativa para comprar equipos médicos ha sido "excepcional", el resultado fue "extremadamente ineficiente"[37]**.** En España, el Sistema Nacional de Salud tiene como modelo el concurso, el cual comporta varios problemas. Por un lado, no tiene capacidad de gestión de la contratación directa, por otro, inunda la contratación de opacidades y costes periféricos. Ese modelo de operaciones de compra, que va más allá de convocar concursos de suministro, es el habitual en los centros sanitarios alemanes, con lo que disponen de la capacidad de conocer "perfectamente" los mercados exportadores de productos sanitarios. En esta perspectiva de gestión privada, se ha actuado en un "medio habitual y lo han hecho no solo con eficacia y eficiencia, sino también con transparencia". El informe también considera que la organización de los centros sanitarios alemanes sigue los criterios y los modelos de la gestión corporativa: "sin ataduras estatutarias contrarias a los valores de eficacia y transparencia", y cree que eso facilita la reorganización de los servicios o la disponibilidad de persona[38].

En suma, en Alemania el sistema de sanidad evolucionó de un modelo de gestión sanitario amenazado por la falta de inversiones y de recursos públicos durante las dos últimas décadas (en especial desde la Gran Crisis del año 2008) hacia un modelo de previsión, financiado mediante el complemento de seguros públicos y privados con el objetivo de asegurar que sea sostenible a largo plazo. En España todavía se está lejos de lograr este tipo de cooperación, salvo alguna comunidad autónoma como es el caso de Cataluña. Para poder asumir con éxito una estrategia similar a la de Alemania es necesaria una "una infraestructura que la sostenga", siendo que Alemania ha dispuesto de este sistema sanitario "vital para controlar esta pandemia y permitir la subsistencia de la economía y de un modelo de sociedad libremente elegido"[39]. No obstante, aparece aquí una paradoja en la afirmación que en España esa "eficacia" de coordinación y cooperación entre lo público y lo privado "solo" ha tenido lugar en la Comunidad de Madrid, puesto que la Comunidad se "ha dotado de sólidas infraestructuras y un modelo de gestión flexible que,

[37] Instituto Coordenadas*,* 2 mayo 2020.

[38] *Libre mercado.* Instituto Coordenadas atribuye el "éxito" en la gestión de Alemania a la "eficiencia de su sistema sanitario, 5 abril 2020. Disponible en: https://www.libremercado.com/2020-05-04/coronavirus-instituto-coordenadas-atribuye-la-gestion-de-alemania-a-su-sistema-sanitario-1276657011/

[39] Declaraciones del vicepresidente ejecutivo del Instituto Coordenadas. De gobernanza y economía aplicada, Jesús Sánchez. Disponible en: https://www.institutocoordenadas.com/es/analisis/estrategia-alemania-gestion-covid-19-sistema-sanitario-eficiencia_20063_102.html

con todo y a pesar de todo, ha dispuesto de un sistema de salud que ha hecho frente a una de las más devastadoras situaciones imaginables"[40]. Sin embargo, no ha tenido en cuenta que en la Comunidad de Madrid es donde se han producido más casos (66.005) y fallecimientos (8.809), muy por encima de Cataluña (con 55.464 casos y 5.882 fallecidos), o el País Vasco (con 13.257 casos y 1.454 fallecidos), lugares con sistema de cooperación público-privada muy avanzados (Tabla 1).

La prensa alemana se ha hecho eco de la dramática situación en España[41]:

> aparentemente, se han producido fallos muy graves, y no desde hace poco tiempo. Alguien será responsable de estos errores que han tenido muchas muertes como consecuencia. Y seguramente no será el personal de cuidados, sobrepasado de trabajo, motivo por el que viene quejándose desde hace tiempo (FRANKENBERGER, 2020).

En muchas de ellas el ejército descubrió cadáveres de fallecidos desde hacía algunos días. El gobierno español intervino inmediatamente en las residencias de ancianos poniéndolas bajo control especial con la aprobación de medidas drásticas. Sin embargo, será necesario formular la pregunta a quienes han sido los responsables de la gestión: ¿Cómo pudo ocurrir algo así?

[40] Ibid.

[41] Klaus-Dieter Frankenberger, *Frankfurter Rundschau,* 22 de abril de 2020. *Frankfurter Allgemeniner Zeitung*, 25 abril 2020. "Tödliche Missstände im System".

Tabla 1 – Estrategia de los gobiernos y éxito en la lucha contra la pandemia (17 mayo – 15 junio 2020)

	Estrategia del gobierno	Casos por 1.000.000 Habitantes (2) (4)	Muertes por 1.000.000 habitantes (2)	Test realizados x 1.000 habitantes (1) totales (2)	Número total de casos confirmados 17 mayo (2) 15 junio (3)
Suecia	Restricciones voluntarias	2.546 (2) 5.110.67 (4)	312	32.18 (1) 177.500 (2)	30.143 (2) 37.542 (3)
Noruega	Confinamiento total	1.509 (2) 1.587.46 (4)	41	51.14 (1) 216.350 (2)	8.244 (2) 8.411 (3)
Dinamarca	Confinamiento total	1.791 (2) 2.105.07 (4)	91	130.28 (1) 455.613 (2)	10.927 (2) 11.699 (3)
Alemania	Confinamiento parcial	2.063 (2) 2.225.5 (4)	91	56.03 (1) 3.147.771 (2)	176.450 (2) 179.364(3)
España	Confinamiento total	4.764 (2) 5.217.18 (4)	565	60.38 (1) 3.037.840 (2)	277.719 (2) 239.932(3) 25 mayo cambio de metodología
Italia	Confinamiento total	3.623(2) 3.919.65 (4)	505	46.58 (1) 2.944.859 (2)	224.760 (2) 232.248 (3)

Fuentes:
(2) https://www.worldometers.info/coronavirus/#countries.
Coronavirus COVID-19 Global Cases by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU).
ArcGIS. Johns Hopkins CSSE, fecha: 17 de mayo de 2020.
European Centre for Disease Prevention and Control (ECDC)
(1) *Our World in Data*, Oxford, fecha: 13 de junio de 2020, https://ourworldindata.org/grapher/total-confirmed-deaths-of-covid-19-per-million-people-vs-gdp-per-capita?xScale=linear&country=DNK~DEU~NOR
(3) *Our world in data*, Oxford, fecha: 15 de junio de 2020 https://ourworldindata.org/grapher/total-cases-covid-19?country=owid_wrl~dnk~deu~ita~nor~esp~swe
(4) *Our world in data*, Oxford, fecha: 15 de junio de 2020 https://ourworldindata.org/grapher/total-confirmed-cases-of-covid-19-per-million-people?region=Europe

3.1. Administración pública y reconfiguración sociedad-Estado

La mayoría de las predicciones y prospecciones realizadas en los últimos años sobre la Administración pública, la extensión y las responsabilidades del Estado, han quedado en su mayoría obsoletas, mientras que otras se verán reforzadas por la rapidez e impactos de los acontecimientos, ganando en actualidad. La reconfiguración del vínculo sociedad-Estado, comprende diversos niveles y ámbitos de análisis: política y formas de gobierno, sociedad, gestión, administración pública, seguridad, etc. Los postulados de la Nueva Gestión Pública han correspondido a un delineamiento de la relación administración-Estado, siendo el impulso para la renovación de las administraciones públicas durante el último cuarto de siglo. El escenario post virus es, en algunos aspectos, todavía inseguro, al configurarse dos modelos contrapuestos.

3.2. Escenario post virus: modelos autoexcluyentes

Expertos coinciden en que el escenario post virus abre inseguridades y contingencias y, por lo tanto, nuevas posibilidades. Es evidente que habrá que explorar los posibles cambios del Estado y de la administración pública desde la perspectiva de la hipercomplejidad que caracteriza las sociedades modernas. Complejidad en el sentido sistémico significa contingencia, y contingencia significa riesgo y peligro. Viene a ser que algo no es ni imposible ni necesario pero que puede ser. Esta doble negación se presta a ambigüedades y por lo tanto a interpretaciones diversas. Para la idea que presentamos en este texto, posee el valor de que cualquier propuesta de cambio es posible y, por lo tanto, podría ser efectiva. La cuestión para nosotros es: ¿En qué dirección se producirá este cambio? Aquí aparece el gran desafío para las democracias liberales, el Estado y la administración pública.

Es posible identificar dos modelos: 1) Estado reducido y continuidad económica; 2) Estado extenso, vinculado con la presentación de un Estado-céntrico. Los dos modelos ya son objeto de identificación en diversos países, y seguirán en ampliación en el futuro próximo. No obstante, en la perspectiva de la complejidad, aparecen paradojas en los dos modelos. La autonomía del sistema administrativo respecto a la política puede suponer dos fenómenos diferentes. Por un lado, no estar sometido al control interesado del sistema político, y por lo tanto favorecer su función elemental de administrar. Por otro, puede adquirir una preponderancia respecto al sistema político por lo que puede quedarse sin ningún tipo de control político.

Con la gobernanza de la pandemia se han evidenciado los modelos de gestión de la sociedad, las funciones del Estado, sus paradojas, y en consecuencia el perfilamiento y profundización de las tendencias ya iniciadas y en curso, referentes al vínculo sociedad-Estado y al futuro modelo de Estado. Ha sido repetido que la intención por parte de los gobiernos de confinamiento de la población (horizontal, vertical, “inmunidad del rebaño” etc.), obedece a la lógica de evitar el colapso del sistema de salud de cada país. Cada uno de estos sistemas nacionales tiene una capacidad máxima de atención de los infectados por la pandemia y una cantidad limitada de camas con respiradores automáticos y el personal médico especializado para su manejo. Para evitar el colapso, o sea, la posibilidad de no poder atender a todos los casos necesarios en una fecha clave, es necesario que el número de contaminados no sobrepase en ningún momento un máximo que el sistema sanitario pueda gestionar y atender, por lo que ha sido necesario que la curva de pacientes

necesitados de atención médica se mantenga lo más plana posible, durante el espacio de tiempo más extenso, en lugar de una curva de rápida ascensión y durante poco tiempo, hasta alcanzarse el pico de los casos atendidos. Por otro lado, también ha proporcionado al sistema científico más tiempo para el desarrollo de un tratamiento o del desarrollo de una vacuna.

El confinamiento vertical ha correspondido a la lógica de evitarse al máximo la paralización económica de los países afectados, con el argumento de que, en el ámbito económico, los impactos de la pandemia serán peores, por destruirse la base de la riqueza y el número de empleos en el país. Este tipo de confinamiento está direccionado a la población de riesgo (más de 60 años y/o con enfermedades crónicas). En la fase inicial de la pandemia esta medida fue recomendada por Gran Bretaña, Norteamérica y Brasil. Por otro lado, el confinamiento horizontal implica la mayor parte de la población. Puede tratarse de un confinamiento irregular, cuando para ser efectivo se recomienda un 70% de la población (según recomendación de la OMS) y debe ir acompañado de una prueba preventiva, focalizando los puntos catalizadores y las personas en los que se inició la pandemia. Fue utilizado masivamente en Alemania y se ha mostrado como el más efectivo, al ser el país europeo con menos fallecimientos. ¿A qué lógicas político-administrativas y de entendimiento del estado corresponde cada modelo? Hemos realizado un esbozo de delineamiento que corresponde a dos lógicas: Estado reducido y Estado extensivo (en su presentación sistémica Estado-céntrico). Ambos modelos no están libres de paradojas (VIDAL, 2019).

3.3 Estado reducido jerárquico

La propuesta de reducir el tamaño y reformular las funciones del Estado no es nueva, manifestándose en el plano político recientemente en un contexto de crisis de la democracia liberal, la emergencia de partidos y movimientos populistas radicales, y la sustitución por regímenes alocráticos. Puede adquirir dos formas diferentes: una organización del Estado centralizador y una organización policéntrica. En el contexto de crisis económica (impactos de la Gran Recesión del año 2008), se pretende reducir niveles decisorios en el plano multinivel, eliminando estructuras que puedan molestar la toma de decisiones rápidas. Desde hace unos años ya se viene implementando en Norteamérica, con la priorización de la responsabilidad individual en todos los ámbitos (educación, sanidad, empleo, jubilación etc.), lo que significa que en situaciones de riesgo y peligro social el Estado no será responsable. El sistema económico debe ser dejado a la iniciativa privada con la mínima intervención del Estado. La gestión de la pandemia de coronavirus ha mostrado la contingencia de este modelo. Se podría haber declarado el confinamiento vertical si hubiera

existido un sistema sanitario con capacidad para atender a toda la población con calidad para una situación excepcional como es en esta pandemia. El asumir un confinamiento vertical viene a significar que el país debería disponer de un sistema de salud exponencialmente más extenso y amplio para la población (en principio, pero sin exclusión para situaciones de emergencia como la actual) en los niveles cuantitativo y cualitativo. Pero con esta pandemia también han emergido sus paradojas al reivindicar movimientos ciudadanos sobre la libertad civil (a menudo en gobiernos de extrema derecha) frente a los métodos de control, vigilancia y confinamiento impuestos.

3.4. Estado extensivo (Estado-céntrico)

La pandemia ha servido también para que diversas publicaciones puedan predecir el esperado colapso del sistema de libre mercado o capitalista. Sus propuestas abarcan desde visiones apocalípticas del futuro (exclusivamente imaginativas) con hasta predicciones realistas. Para sectores políticos autodenominados de izquierda, el confinamiento ha poseído una virtud y predicción: con la ampliación temporal de la crisis del coronavirus, también cambiará enormemente el orden económico tal y como lo hemos conocido. La perspectiva es que la economía de mercado tal como se conoce probablemente se abolirá parcialmente, en la que la propiedad privada y la competencia serán menos importantes, y la influencia del Estado aumentará masivamente. Se retoma así la teoría Estado-céntrica, en la que el Estado es el principal productor de bienestar social, que también puede significar paradójicamente mayor control burocrático y centralización administrativa.

En ambos modelos aparecen también paradojas, puesto que un Estado reducido puede favorecer formas de gobierno como autogobierno, autoorganización, autorregulación, o *glocalización*, mientras que un estado extenso tendería a la absorción de iniciativas de este tipo, en pro de políticas estatales centralizadas y homogeneizadoras en un contexto económico *globalizador*. Esta disyuntiva aparecería en estados de orden federal o descentralizados.

Unas reflexiones provisionales

Las administraciones públicas, como un sistema autónomo, se verán afectadas por los cambios procedentes de su entorno, acelerados de manera rápida por la pandemia del covid-19. Muchas de las posibilidades que se han puesto en marcha ya estaban presentes, aunque de forma incipiente en la administración (teletrabajo, *homework*, flexibilización de horarios, etc.). Estas posibilidades serán habituales en las organizaciones y en la

administración pública de los próximos años. Con la crisis del covid-19, los fallos digitales de la administración y gestión pública se han vuelto más claras y con consecuencias dolorosas. Las posibles soluciones propuestas tienen brechas de seguridad importantes y faltan los requisitos elementales para la identificación electrónica.

La administración pública tendrá que dejar su aparente área de confort (jurídico y económico) para entrar definitivamente en la contingencia. Esto significará un amplio abanico de posibilidades, aunque no necesarios, exigirán de los funcionarios, de la estructura y de sus funciones una constante adaptación a las comunicaciones (en forma ya no solo de demandas sino en maneras de coproducción de servicios) procedentes de la política (y del modelo de gobernanza) del estado y de la sociedad. El riesgo será constante con los intentos de "colonización" de la política que pueden dirigirse hacia una orientación progresista o conservadora. Esta colonización ha sido denunciada frecuentemente, aunque con pocos resultados prácticos como se ha hecho evidente durante la pandemia. Esta situación se ha producido por los cuatro vicios de los sistemas políticos: *meritocracia política* (será necesario repensar problemas estructurales que han lastrado la administración pública); *partitocrazia* (control de los partidos de los puestos públicos); *lotizzazione* (reparto de cuotas); y *tangentopoli* (polis de los sobornos) extensible en particular en los países mediterráneos (España, y sus Comunidades Autónomas, e Italia)[42]. Estos vicios no han sido inhabituales en España y en las Comunidades Autónomas, en las que ministros o secretarios responsables de las residencias de ancianos o del área de salud poseían formación o experiencia en áreas no afines a la salud (formación en educadores/as psicopedagógicos/as, maestro/as, filósofos/as o licenciados/as en ciencias físicas), entre otras formaciones ajenas a su responsabilidad. Los impactos han sido manifiestos.

La administración asume los límites y prioridades de la política. La administración deberá mantener su autonomía basada en criterios técnicos (y meritocráticos) en todos sus niveles, en especial en los superiores de dirección. En el delineamiento de la relación administración pública y Estado, el sistema político dependerá de varios factores: el modelo de gobernanza, la fuerza política en el poder, la necesaria revolución político-técnica, los modelos y prácticas de audiencias públicas que se apliquen, el tipo de cooperación público-privada, y, en definitiva, la capacidad de autonomía (y auto referencialidad) de la administración pública frente al colonialismo de la política, sin criterios técnicos.

En el plano político ya se ha dado el inicio de una sucesión de dimisiones, renuncias

[42] Instituto di Reserce Sulla Publica Administrazione, 2014.

y retiros de responsables políticos e institucionales en prácticamente todos los países afectados. Elecciones generales legislativas planeadas para los años 2021 y 2022, medirán la confianza que la ciudadanía ha depositado en sus respectivos gobiernos durante la gestión de la pandemia, y pasarán factura a la forma en que se repartió el financiamiento del pago de los gastos de la emergencia sanitaria, en las ayudas y políticas públicas de emergencia implementadas.

En el contexto de la post pandemia y ante la grave crisis económica, laboral[43] y social que están viviendo los países y en el contexto de la reformulación de las responsabilidades y extensión del Estado, se perfilan y presentan diferentes desafíos para la administración pública en el futuro. Es posible perfilar dos modelos principales:

Primero, en un contexto de transformación de las responsabilidades del Estado – ya iniciado unos años antes – y de su relación con la sociedad, significa que según el modelo de actuación del Estado que se imponga, que varía entre un Estado más amplio u otro más reducido, aunque ambos vinculados con procesos de re-descentralización, la administración y gestión pública se verá afectada en su autonomía, capacidad y ámbito de acción, y en sus formas tradicionales de planificar el trabajo.

Segundo, según el modelo de Estado que se imponga, también se abrirán posibilidades de introducir, o de acelerar cambios estructurales y la generalización de las posibilidades de las tecnologías de información y comunicación ya iniciadas unos años antes, (*e-government*, *e-administration, e-democracy*) y en las que se resaltan los aspectos positivos. Ello puede conducir a nuevas formas de “gobernanza inteligente”, “gobierno electrónico”, pero también pueden representar la implementación de nuevas posibilidades de vigilancia y control, siendo vistas con desconfianza (ATTOUR; CHAUPAIN-GUILLOT, 2020).

Cada una de estas tendencias presentadas aquí de forma esquemática corresponde a diferentes presupuestos conceptuales, políticos y de gobernanza sobre la manera de entender la regulación de la sociedad en su totalidad. La Nueva Gobernanza Pública ha reemplazado gradualmente a las organizaciones de servicios dispersos (asociaciones, fundaciones, Tercer sector, cooperativas de servicios) por un entramado de redes de sistemas de prestación de servicios públicos, cuyo funcionamiento se basa en la interacción de una multiplicidad de actores para lograr los objetivos sociales y la prestación de servicios públicos con énfasis en la asociación y la colaboración. Se trata de una adaptación del

[43] *El País*, Economía, 5 de mayo de 2020.

modelo institucional jerárquico (*top down*) tradicional, hacia un modelo de inspiración compleja para permitir abordar las necesidades sociales y también como instrumento para la inclusión social. La coproducción de servicios adquiere una nueva dimensión y adquiere una importancia central de la producción de servicios públicos.

En los países de la Unión Europea ya se identifica un vertiginoso aumento de la pobreza, similar (o incluso superior) a la existente en el año 2008, debido al desempleo masivo que ha causado la pandemia, y a la falta de ahorro de muchas familias. Se discute la introducción definitiva del Ingreso Mínimo Vital o Renta Básica Universal, aunque sin consenso en el ámbito político. También se vislumbra un futuro de demandas judiciales impuestas por la ciudadanía contra la equivocada gestión de los gobiernos y de las residencias de ancianos y centros de tercera edad. Los problemas y fenómenos han sido identificados transversalmente en los países de la UE:

1) La hipótesis sobre la falta de centralización nacional del sistema de salud ha sido un factor de mayor propagación nacional de la enfermedad (Suecia). Este problema se ha detectado en especial en los países de organización descentralizada, como España en que el Ministerio de Sanidad se encontró, al inicio de la pandemia, con sus competencias totalmente vacías en favor de las Comunidades autónomas, hecho que dificultó la compra de material sanitario en el extranjero.

2) La gestión de las instituciones para ancianos. En la mayoría de los países estos centros son gestionados por empresas privadas bajo gestión pública, consorcios público-privados, gestión pública (dependientes de los municipios o de los gobiernos autónomos), o gestión privada. Un problema reincidente han sido las condiciones de trabajo del personal sanitario. En Suecia, en estas instituciones para ancianos, que son en parte de propiedad privada o dependientes de las municipalidades, “el personal suele ser pagado por hora, menos remunerado, menos educado y más joven” ha declarado Ingmar Skoog, director del Centro de Ancianos y Salud de la Universidad de Gotemburgo[44]. En Finlandia, estos profesionales están protegidos por convenios colectivos, mientras que, en Suecia, afirman “los que cobran por hora no reciben su salario si se quedan en casa con síntomas leves”, como se indica en las instrucciones. En Noruega no se ha apreciado ninguna representación excesiva entre los extranjeros[45].

3) Propagación en los barrios y áreas económicamente más desfavorecidos. En el caso de

[44] *Gestión*, Suecia y la estrategia "outsider" contra el coronavirus, 11 mayo 2020. 11de mayo de 2020, https://gestion.pe/blog/te-lo-cuento-facil/2020/05/suecia-y-la-estrategia-outsider-del-coronavirus.html/
[45] Ibid.

Suecia, en Estocolmo, es estos barrios es donde reside la mayoría de las personas de origen inmigrante, están hasta tres veces más afectados por la epidemia que el resto de la capital. Respecto a los inmigrantes y refugiados que viven en las periferias de Estocolmo, el gobierno ha mostrado "una preocupante falta de conocimiento o de interés" por parte de las autoridades sanitarias hacia estas poblaciones, cuyo comportamiento social es a veces diferente[46].

4) Los impactos sociopolíticos en todos los países europeos están por ver, aunque serán profundos. Durante la crisis sanitaria ya han tenido lugar numerosas protestas en Berlín y otras ciudades alemanas, tanto por grupos de extrema derecha como de extrema izquierda. Desde intelectuales de la izquierda extraparlamentaria, ultraderecha y neofascistas, hasta defensores de las teorías de la conspiración, están llevando a cabo una atípica crítica contra la gestión de la pandemia en Alemania, donde cada sábado se convocan concentraciones en contra del poder político, ya que consideran que se están aprovechando de la crisis para poner en jaque la democracia. En España o Italia grupos conservadores se han manifestado al cuestionar la eficacia del gobierno.

Es todavía temprano e incierto hasta dónde y en qué extensión se producirán los cambios en las administraciones públicas y en su relación con la gobernanza del modelo u orientación del Estado. Tan solo futuras observaciones empíricas podrán descifrar esta incógnita.

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[46]*France 24*. Frente a un balance alarmante por el coronavirus, el modelo sueco de tambalea, 16 abril 2020 Declaraciones de Gina Gustavsson. France 24. https://www.france24.com/es/20200416-frente-a-un-balance-alarmante-por-el-coronavirus-el-modelo-sueco-se-tambalea

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