COVID-19 in Mexico (I): Has the contagion curve been flattened and the speed of propagation slow down? An exercise of behavioral and mathematical integration (COVID-19 in Mexico)

Julio Alfonso Piña López, Martín Gildardo García Alvarado, Mario Rojas Russell

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Abstract

Background: In Mexico, in more than 150 days after the beginning of the epidemic, until August 09 a total of 480,278 cases of COVID-19 have been confirmed by the health authorities.

Objective: To assess the scientific evidence that supported the verbal behaviors that the contagion curve has already flattened or that the speed of propagation has become slower down in Mexico, as the person responsible for combating the epidemic has repeatedly stated from April to the beginning of August, 2020.

Methods: This retrospective study analyzed the verbal behavior of the person responsible for combating the epidemic, as well the official data of confirmed COVID-19 cases. Logistic model was applied to assess if the contagion curve has been flattened and the speed of propagation slowing down.

Results: According to the data, the verbal behavior of the person responsible for combating the epidemic in Mexico cannot find any scientific support, considering that in this exercise the logistic model it is projecting that by the end of December more than 630 thousand cases of the disease could be reached in our country; also, the results shows that the speed of spread of infections of the disease has been up, despite the notorious under-registration of epidemiological indicators, among which the confirmed cases and deaths stand out.

Conclusions: In Mexico, the practice of different verbal behaviors (e.g. We tamed the pandemic, We already flattened the curve or The speed of propagation in Mexico is slowing down) do not contribute to transmitting messages that are clear, concise and credible, which translates into a potential negative impact on the practice of preventive behaviors to avoid the contagion of the SARS-CoV-2 in large segments of the population. Clinical Trial: No trial registration

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Kew Words: Mexico, COVID-19, Verbal Behavior, Logistic Model, Flattened the Curve, Speed of Propagation.

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The COVID-19 outbreak challenges public health systems and their ability to effectively communicate with their populations. Failed to communicate well lead to a lost of trust and reputation, economic impacts, and –in the worst case- loss of lives [1].

Introduction

In Mexico, the first COVID-19 confirmed case, a disease caused by the novel Coronavirus (SARS-CoV-2), was reported on February 28, 2020 in a 35-year-old man who days before had traveled to Europe [2]. In more than 150 days after the beginning of the epidemic, on August 09 a total of 480,278 COVID-19 cases have been confirmed by the health authorities [3], occupying until that day the sixth world place in the heading (just behind US, Brazil, India, Russia and South Africa) as well as the third place in officially registered deaths (just behind US and Brazil) [4,5]. Despite the sustained increase that the principal epidemiological indicators (e.g. confirmed cases, suspicious cases and deaths) showed since mid-April, the person responsible for combating the epidemic in Mexico began with the practice of different verbal behaviors in which, relying on phrases or short sentences, he made statements such as "*We tamed the pandemic*", "*Contagion was reduced, it has already become horizontal*", "*We flattened the curve*", and more recently, "*The speed of propagation in Mexico is slowing down*" or "*The growth rate of the epidemic has been slowing*". Some of those behaviors would be unremarkable, except for the fact that its practice has been recurring since April 29, just eight days after the start in April 21 of Phase 3 of Preventive Social Isolation, where special emphasis was placed on non-pharmacological measures to mitigate the effects of the epidemic, to reduce the number of daily infections and to flatten the contagion curve [6].

If it is assumed that in Mexico in Phase 3 of Preventive Social Isolation and with its main action, the *National Healthy Distance Day*, non-pharmacological measures began to be implemented on April 21, in principle there are some questions that require clear answers: what scientific evidence was available eight days later to take for granted the statement that in our country contagions were beginning to decrease? Or that thanks to massive interventions contagions were reduced between 60 and 75%? Even more, that the contagion curve had flattened? Likewise, what scientific evidence support the assumption that the speed of propagation has become slower? Finally, why from April 29 those verbal behavior continues to be practiced on a recurring basis, considering the little more than 480 thousand of COVID-19 cases officially confirmed until August 09? It is possible that in Mexico we find ourselves in a scenario in which, paraphrasing Cohen and Corey [7], uncertainty and doubt are becoming true, to the extent in that verbal behaviors are repeated as many times as necessary?

To answer these questions, the present work was exercise of behavioral and mathematical integration, aimed to assess the scientific evidence that supported the verbal behaviors that the contagion curve has already flattened or that the speed of propagation has become slower down in Mexico, as the person responsible for combating the epidemic has repeatedly stated from April to the beginning of August, 2020. Although we agree with the indications by the World Health Organization (WHO) quoted at the beginning of this section, analyzing a verbal behavior pattern maintained during more than three months is not a minor issue regarding the loss of trust and reputation; even more important, it has to do with

how clear, concise and credible the messages become or not [8], and how they can affect people's behavior to prevent the spread of COVID-19 [9,10].

Methods

Retrospectively, the study compared the evolution of information on the pandemic from two sources of public information. First, the Twitter text and video posts were recovered from the official account of who heads the strategy against the pandemic in Mexico (@HLGatell). In accordance with the behavior analysis methodology [11,12], the publications from February 28 to August 9, 2020 were exhaustively reviewed. The frequency of verbal behaviors (written or spoken) related to topics such as the flattening of the contagion curve, the use of the Sentinel model as support for decision-making, the use of masks, the usefulness of mass testing for the diagnosis of the disease, as well as the supposed reduction in speed spread of confirmed cases was counted. Twenty-three categories of written or spoken verbal behaviors were transcribed verbatim (Table 1). To avoid bias, all records of verbal behaviors were independently reviewed by two of the researchers with the aim of comparing the selected content.

Insert Table 1 here

Second, to compare the verbal behaviors we use the official data on the confirmed cases between April 21 and August 09 (see Table 2), information which was retrieved from the Federal Government database website (www.coronavirus.gob.mx/). According to the recommendations of the Johns Hopkins University (through the Coronavirus Recourse Center), the analysis considered the 5-days moving average of confirmed cases, approach who prevent mayor events (e.g., changes in reporting methods) from skewing the data [13].

Insert Table 2 here

Statistical analysis

The numerical data was initially analyzed and organized with the Microsoft Excel Spreadsheet 19.0 (Microsoft 365 for Windows). After observing that the graphic behavior has a sigmoidal appearance, we decided that an appropriate model for the analytical description of the number of infections is a logistic function. This is, in addition, consistent with the basic assumption in the study of the behavior of population variables, in the sense that the instantaneous rate of growth of a population (number of people infected, in our case) is proportional, at a given moment, both the value of the variable and the limit capacity available at that time. This principle, written as a dynamic system, is formulated as the first order

nonlinear differential equation $\dfrac{dC}{dt} = bC(L-C)$, whose general solution is of the form:

$$C(t) = \frac{L}{1 + K\,e^{-bt}},$$

Where:

$C(t)$ is the number of people infected at time $t \geq 0$,

b is a constant and positive coefficient that is characteristic of the variable being studied and of the biological and ecological regime in which it develops,

L is the possible limiting capacity, which is determined by the vital environment of the variable, and

K is a constant (of integration) and that, numerically, depends on the value of the variable now it is taken as the initial

instant (*t* = 0). In fact, $K = \dfrac{L}{C(0)} - 1.$

These parameters were estimated using the least squares technique; however, two aspects must be taken into account: one is that the logistic model is deterministic, that is, it does not take into account stochastic factors; and another, is that the model depends on the available data, which implies that, by increasing the data will change the model [14,15]. Finally, based on the available information (Table 2) and as complementary analysis, we estimated the speed of spread of the average disease per day for periods of 5-days, to confirm whether or not the speed of propagation is decreasing, as the responsible of combating the epidemic has recently stated. This analysis was carried out from considering the increase in confirmed daily average cases, that is, the increases were divided by 5, according to the basic definition of average speed.

Results

How COVID-19 confirmed cases have increased from April 21 to August 09 in Mexico?

From *t*-0 to *t*-110, the increase in confirmed cases has been constant, both in absolute terms (in a total of 339,895 cases) and, of course, in percentage terms (in a total of 3,677.4%). Using the information on confirmed cases as shown in Table 2 (including the increments observed between *t*'s and the average velocity of infections between *t*'s), we have applied the least squares method to determine the logistic curve that best approximates the data. By a change of variables, the logistic function can be transformed into a linear equation. Applying the procedure to determine the parameters b, L and K of the logistic curve of least squares adjustment to the data corresponding to the number of infected people shown in Table 2 [16], we obtain that the resulting model is given by the following equation:

$$C(t) = 638,567.36/(1+32.91e^{-0.04t}), \; t \geq 0.$$

Logistic function of confirmed cases

As seen in Figure 1, the polygonal in orange color correspond to the data of confirmed cases between *t*-0 and *t*-110, meanwhile the polygonal in blue color correspond to the function resulting from a least square fit of the logistic model to the available data. It can be clearly seen in the polygonal in orange color that the speed and extent of infections has remained constant and frankly growing over time. On the other hand, according to this model, corresponding to April 21 as the starting observation date, the number of infections will stabilize in more than half a 600 thousand cases. The peak, that is, the value of *t* at which the graph of function C has an inflection point, occurs when *t* = 87, corresponding to July 17. It is important to clarify that by "peak" we mean the inflection point of the logistic curve, and that, by the symmetry

of the curve, it is determined by that instant T at which $C(T)=\frac{1}{2}L$.

Insert here Figure 1

Projections of potential cases of COVID-19 from August 09 to December 27, 2020

By other side, as shown in Table 3, according to the predictions based on the logistic model, we can say that from the first days of August to the end of October the number of confirmed cases will show a consistently growth, starting with the stabilization process at the first days of November, from which would expected less than 1,000 cases and decreasing for each 5-days subsequent periods, which would culminate on December 27 of the year in progress.

Insert here Table 3

Has been reduced the speed of infections in Mexico?

In relation to the statement that there is a slowdown in infections and therefore that the speed of spread of the epidemic has become slow, Figure 2 shows that the speed of spread of infections of the disease has been up. In this Figure there are five periods, one from June 05 to June 10 (from t-45 to t-50), another from June 25 to June 30 (from t-65 to t-70), the third one, from July 10 to July 15 (from t-80 to t-85), the fourth from July 25 to July 30 (from t-95 to t-100) and the last one from August 04 to August 09 (from t-105 to t-110), in which the increase does not follow the trend to rise.

Insert here Figure 2

Discussion

Public health and epidemiology specialists have agreed that flattening the curve means that the number of confirmed cases *per day* reaches a maximum point (what is known as the *turning point* or the *peak of the epidemic*), to give way, later, to a period in which the tangent line to the curve starts becoming horizontal, due to the decrease in the speed of propagation of infections [17-20]. The basic criterion is the number of confirmed cases, which as they decrease in quantity in the time continuum, for obvious reasons, are expected to positively impact the low rates of hospitalization and deaths [21,22]. In line with the previously mentioned by both public health and epidemiology specialists, the Coronavirus Resource Center of the Johns Hopkins University proposes that the phenomenon of flattening the curve implies reducing the number of cases of COVID-19 from one day to the next, a reduction that, in effect, if and only if it is hold constant over time will result in the curve becoming "flat" (*sic*). In the punctual follow-up of these daily reports, making comparisons of the new cases reported in 10 countries up to August 10, between July and so far in August it was confirmed that countries such as the United Kingdom and Canada, mainly, had managed to reduce consistently the number of cases per day (taking as a parameter the average of cases every 5-days) and consequently flattened the epidemiological contagion curve; other countries, including Mexico, has been showing in the last 15 days an erratic pattern in which ones point out that the contagion curve was flattened and in others not; for example, between August 06 and 07 it was reported that the curve had been flattened, for day 08 not, while for the 09 that yes, considering the same

average of every 5-days, so technically in our country had flattened the epidemiological contagion curve [23].

Despite the later, it is necessary to take this with due caution, as it relates to the phenomenon of the reduction in the rate of contagion, which as shown in Figure 2 than in five time series from June and despite the sustained increase in the number of daily cases confirmed, there is also erratic behavior in the flow of the rate of contagion, because the analysis of the average of the five days reported by the Coronavirus Resource Center coincides with the phenomenon of reporting fewer confirmed cases (and also another indicators, such as negative cases or deaths) between Saturdays and Mondays in our country. Let us give as an example that in a review that was made of the three indicators in series of days from Friday to Sunday: on Friday, July 3, 13,810 data were registered, on Saturday the 4th a total of 13,890 and on Sunday the 5th a total of 9,560; a similar pattern was found for Friday 10 with 15,436 data, Saturday 11 with 11,907 and Sunday 12 with 8,922; this pattern is highly consistent in the month of July and so far in August.

In the middle of Phase 3 of Preventive Social Isolation and when the indicator of confirmed cases began to show a sustained increase, should it be stated that the contagion curve was flattening? Likewise, should the same verbal behavior continue to be insisted once Mexico was among the ten countries around the world with the most cases of COVID-19 during June and July, as the Johns Hopkins University concluded for most days between both months? When there is no scientific certainty, the recurrent practice of verbal behaviors around "*The contagion curve has already flattened*", for example, can only lead to optimistic discourses, marked with a high dose of ambiguity and uncertainty, that does not contribute to people adopting the recommended prevention measures [17,24-26]. If in Mexico, in Cohen and Corey words[7], uncertainty and doubt have become true, it becomes so difficult for that true to change as the research progresses and better and complete data become available, as L. Garret has recently suggested [27]; this one, basically because there are three problems that have not been satisfactorily resolved in our country:

1. Just what is lacking in Mexico is research that allow us to fulfill this huge task, considering, as has been suggested in recent studies conducted around the world [28-30]: a) there is not a single epidemiological o behavioral published study that has addressed crucial issues such as which are the immunity levels of population according to seroepidemiological surveys or what are the effects of non-pharmacological measures on the different segments of the population; b) in what percentage has mobility occurred between Phase 3 and their extension known as the *New Normality*, and what speed and magnitude have been reproduced the COVID-19 confirmed cases; and c) what are the effective impact of messages from the federal government on social and psychological factors underlying preventive or risky behaviors.

2. Notorious under registries have been demonstrated in several indicators [31-33], e.g. confirmed cases or deaths, in part determined by the delay in notification (a phenomenon that has even been recently recognized by the health authorities themselves), but also because the federal government does not recognize the positive results of tests carried out by private laboratories or hospitals in various states, particularly in Nuevo León and Jalisco, reporting about 12 thousand confirmed cases that are not recognized by health authorities in federal government [34]. But, if we take into account a somewhat more extensive and current review and together with both states, until August 10 (with data from the 9th), including Sonora, between those three states they accumulate 96,825 confirmed cases, while the federal government only recognizes 55,161 on its official page, which represents an important difference of -41,664 confirmed cases, an important quantity of cases.

3. And in a pointed way, in Mexico another uncertainty has become true, namely, that due to the Sentinel Model (focused on mitigation policies oriented to delay the arrival of the disease) used in Phases 2 and 3, and due to the impossibility of registering all the mild cases (asymptomatic or with minor symptoms), the person responsible for the epidemic it was concluded that massive tests for the diagnosis of the disease were not necessary, just when the call around the world has recently been for the massive use of evidence to identify cases, follow up on them and their contacts, and impose mandatory containment measures if is necessary [35,36]. It is important to mention that as of August 09 Mexico had (with the most up-to-date data until August 07) one of the lowest rates of test per confirmed cases in the world [37].

Experience in public health field teaches that when the messages and information transmitted are concise, clear and credible [8], and when they are also justified in scientific knowledge and in the best of evidence-based practice, all together contributes to people adopting the pertinent prevention measures and, consequently, for obtaining better results in the eradication, mitigation and control of the epidemic [38-40]. For this, it is necessary, however, as Dr. Harvey Fineberg recently suggested in an editorial in the *New England Journal of Medicine*, to have an ingredient that is fundamental: That in federal governments a command center must be established, with a unique leader, distinguished by its credibility with the population [17].

In Mexico, and contrary to this intelligent recommendation, it seems that it has chosen to go in an opposite direction, transmitting messages and information that found no reason to exist, as when the person responsible for combating the epidemic on February 28 said: ***"The COVID-19 did not meet the characteristics to consider it as a public health emergency"***, minimizing an international public health emergency as the World Health Organization declared it by January 2020; or when on March 17 said that: ***"The president's strength is moral; the president is not a contagion force"***, granting him a kind of invulnerability. Or include when the President of the Republic himself, affirmed on March 18 and showing several scapulars: ***"Stop enemy that the heart of Jesus is with me"***; or when most recently, on June 14 said: ***"Let's regain our freedom and act judiciously […] that it is not the health authorities that give us the recommendations"***.

None of these four verbal behaviors can be said to have been justified in scientific knowledge or in the best of evidence-based practice; rather, they have done it in an incomprehensible discourse proper to common sense or appealing to moral-religious allegories; in the same logic is the verbal behavior on the phenomenon of flattening the contagion curve, which has been shown to lack scientific evidence. In general, they are all verbal behaviors that would be part of what the World Health Organization has called the infodemic: disinformation or false information that is transmitted with the deliberate purpose of deceiving [1]. What do we have left in Mexico? An urgent call for attention, to a fact that is unequivocal: That it should not be forgotten that the political, moral and public health obligation of the federal authorities in our country must necessarily and obligatorily to seek support in both science and the best of evidence-based practice. Epidemics are not fought with politics or ideologizing science; they are justly fought with the weapons provided by science and technology. If what is intended is to go against the common sense of science and science itself, to undermine it together with the best of evidence-based practice, the path to follow is short: Just repeat as many times as necessary *something is*, or *something will be*, despite the lack of scientific support that supports certain verbal behaviors.

The present study has two limitations. First, although verbal behaviors in their written modality were easy to transcribe, the same did not happen with those in their spoken modality, basically because this involved carefully reviewing hundreds of hours of videos that have been recorded since the beginning of the epidemic, both in the conferences (which are televised throughout the country) at the morning and at the afternoon, in which the person responsible for the epidemic in Mexico has an active participation. Second, estimates of new cases should be interpreted with due caution, recognizing the underreporting of several indicators (e.g. confirmed cases, suspected cases and deaths), which is partly attributed to the delay in reporting from the states to the instance in charge of collecting information in the federal government, coupled with the fact that, in the absence of a policy for carrying out massive tests, the actual number of people infected in the past or present with Coronavirus SARS-CoV-2 is unknown, and who have not required admission to a hospital institution.

Despite these limitations, the present work contributes, in a parsimonious way, but with fundament on the methodology of behavioral analysis and the logistical analysis of data, to examine a problem that has been little studied at the present time due to the COVID-19 pandemic; the one regarding the important role of the verbal behavior of opinion leaders and local people responsible for the epidemic and its lack of correspondence with the fundamental principles of scientific knowledge and the best of evidence-based practice. It is what is technically known as the absence of a relationship between say-say and say-doing.

Contributors

JAPL designed the work and wrote the first draft.

MGGA designed the proposal and performed the mathematical analysis.

MRR Review the first draft and incorporated bibliographic references.

All authors contributed equally to the final draft.

Competing interest

The authors declare that they have no competing interest.

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Table 1. Record of verbal behaviors of the person responsible for combating the COVID-19 epidemic in Mexico.

Twitt Number:	Month/Day:	Verbal behavior (in their modality of written and spoken behavior):
1	April 21	Today we considered phase 3 of the #COVID19 epidemic started. We are in the stage of rapid ascent that involves many infections and hospitalizations. For them to be as few as possible we must maintain the National Healthy Distance Day.
2	April 29	Contagion was reduced, it has already become horizontal.
3	May 05	(Thread 2/2): We are flattening the curve, which means that if we had not made the massive interventions of the National Day of Healthy Distance, we would have had many more cases in a hasty way. We have reduced contagions between 60 and 75%.
4	May 07	(Thread 3/4): The flattening of the curve does not mean that this pattern of daily change in the number of cases disappears. It will continue to be exponential, but the number of daily cases will be less compared to what would have happened if the public health measures had not been taken.
5	May 13	To this day, we have maintained a lower epidemic curve than expected. We also overcome waves of contagion in some cities, which demonstrate that #StayInHome gave good results […]
6	May 16	(Thread 3/4): In the face of alternative interpretations regarding what the flattening of the epidemic curve means, we again clarify that this refers to new cases that occur daily […] (Thread 4/4): […] At times it begins to be slower, with less height and that can reach zero, that is, that we do not have any new cases. For that moment there are still weeks or months.
7	June 05	(Thread 3/3): We continue to see cases because the epidemic continues; it is unreal that it can be stopped or avoided. What we are achieving is having fewer cases per day; that's what the flattening of the curve refers to.
8	June 25	Our success is that few people are getting it every day, even if it means that the epidemic will be long. That is flattening the curve and that is what we have done. We have been successful.
9	June 28	The speed of change is represented by the slope of the curve […] We begin to see a rise, rise, rise, which slows down. The inclination of the curve is this (displaying a curve); This represents the fulfilled objective of the mitigation measures.
10	June 30	(Video): […] What does the long epidemic mean, which started on February 28, mathematical predictions suggest that it could last until October […] The incidence is slowing down and we discussed this on Sunday with a curve that represents the percentage of cases; the number of cases that occur daily remains very high; nobody should be confused with that, the epidemic is still active, in fact the epidemic is at its highest point […]
11	July 02	(Video): What did we achieve? We have also said it, we have shown it in figure forms, and we managed to reduce the epidemic curve, flatten it. What does mean to flatten it? That instead of being high, high, high, it is as if it were a mountain with a hill, low, low, low, but long, long, long. For what reason? Because the consequence of having slower contagions is that the risk is deferred […]
12	July 06	In an interview for @canalcatorcemx […] I spoke about the success in controlling the # COVID19 epidemic, which is due to the efforts of the people of Mexico in reducing their mobility in public spaces.
13	July 07	(Video): Yes, as I said this morning […] and we started to comment since last Sunday, we see positive changes in the course of this epidemic, specifically in Mexico City, which is the area of the country where this epidemic began, where we have had the greatest burden of disease […] We also see it in other states […]
14	July 08	(Video): […] The epidemic in the country is slowing down. Now, but obviously the epidemic is still active, the increase in the number of cases does not mean to accelerate the epidemic; It is one thing that the epidemic continues in the increasing phase in the average or in the country, and another is that the speed at which this increase occurs is increasingly slow […]

15	July 09	First, I want to insist that this flattened curve that we see in no way should be interpreted as the cancellation of the pandemic. What it means is that the rate of increase in the number of cases is considerably slower.
16	July 12	(Video): The other image that we are also interested in highlighting [...] is who the people who have active disease are. One element that has confusion, when you have a short-term illness, is to be chasing case accounts. There will be more and more cases ... tomorrow will be higher than today, the cases accumulated, but in the epidemiological, technical meaning, the sum of cases that ever existed is of little use. For what reason? Because this is a short-term illness [...]
17	July 20	(Video): The difference in cases, between today and yesterday, if we compare it between today and yesterday last week, and yesterday's week, etc., there is a smaller difference. That is, the jump, the step, between days and another is proportionally smaller, even when the number of cases is certainly greater; but the difference in cases [...]
18	July 26	(Video): [...] I comment this because, a general expectation that perhaps a substantial part of the population has, is that the epidemic curves rise and then fall, that is, that over time the number of cases that occur on a given day or in a week, are higher than the previous day until the famous peak of the epidemic is reached [...]
19	July 28	(Video in the President's press release): What the next two slides shows us is how the speed at which the epidemic is growing has been reduced, and this is a very important idea, because even when new cases are added every day, and even when the sum of cases of a day is generally greater than the one of the previous day, the speed at which they are accumulated is every day smaller.
20	July 29	(Video): [...] the flat epidemic curves, as we present here, we have explained this phenomenon, the reduction has stabilized, now it has rebounded [...] Take away this perspective that once it begins to decrease (referring to the curve), once it goes down suddenly it will flatten, suddenly it will go up again [...]
21	August 04	Although it is slowing down, the epidemic of # COVID19 continues. We call for patience, caution, and discipline. We need to limit our mobility, particularly in recreational activities.
22	August 05	The increase or decrease of #COVID19 infections depends on our actions individually and collectively. Each person's attitude determines if we are part of the solution or the problem.
23	August 07	[...] That it is slow, does not mean that the epidemic is over, every day we have more cases, and newspapers that like to get every day, or almost all on the front page, "record number of cases", which they are saying is that the cases here (pointing to a graph) were more than here, and the cases here were bigger than here; In recent days they no longer speak of record cases because we have shown that the curve is in this phase of stability, plateau, but do not confuse the flattening of the curve, which is the reduction of the maximum number of cases per day, with the fact that the epidemic is on the rise, is on a plateau or eventually declines [...]

Table 2. Confirmed cases and velocity of propagation of the epidemic in Mexico from April 21 to August 09.

Time (*t*)	date	Confirmed cases (C)	Increments between *t*'s	Average velocity (*per day*)
0	April 21	9,501	3,213 [a]	642.6
5	April 26	14,677	5,176	1,035.2
10	May 01	20,739	6,062	1,212.4
15	May 06	27,634	6,895	1,379.0
20	May 11	36,327	8,693	1,738.6
25	May 16	47,144	10,817	2,163.4
30	May 21	59,567	12,423	2,484.6
35	May 26	74,560	14,993	2,998.6
40	May 31	90,664	16,104	3,220.8
45	June 05	110,026	19,362	3,872.4
50	June 10	129,184	19,158	3,831.6
55	June 15	150,264	21,080	4,216.0
60	June 20	175,202	24,938	4,987.6
65	June 25	202,951	27,749	5,549.8
70	June 30	226,089	23,138	4,627.6
75	July 05	256,848	30,759	6,151.8
80	July 10	289,174	32,326	6,465.2
85	July 15	317,635	28,461	5,692.2
90	July 20	349,396	31,761	6,352.2
95	July 25	385,036	35,640	7128.0
100	July 30	416,179	31,143	6228.6
105	August 04	449,961	33,782	6756.4
110	August 09	480,278	30,317	6063.4

[a] According to the data for the week that started on April 16.
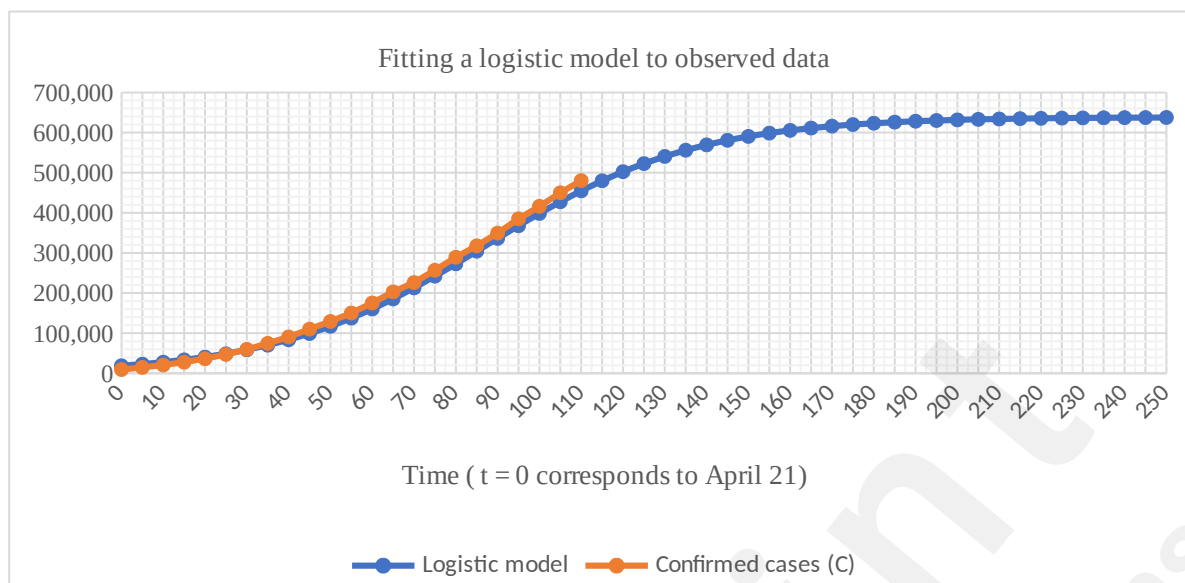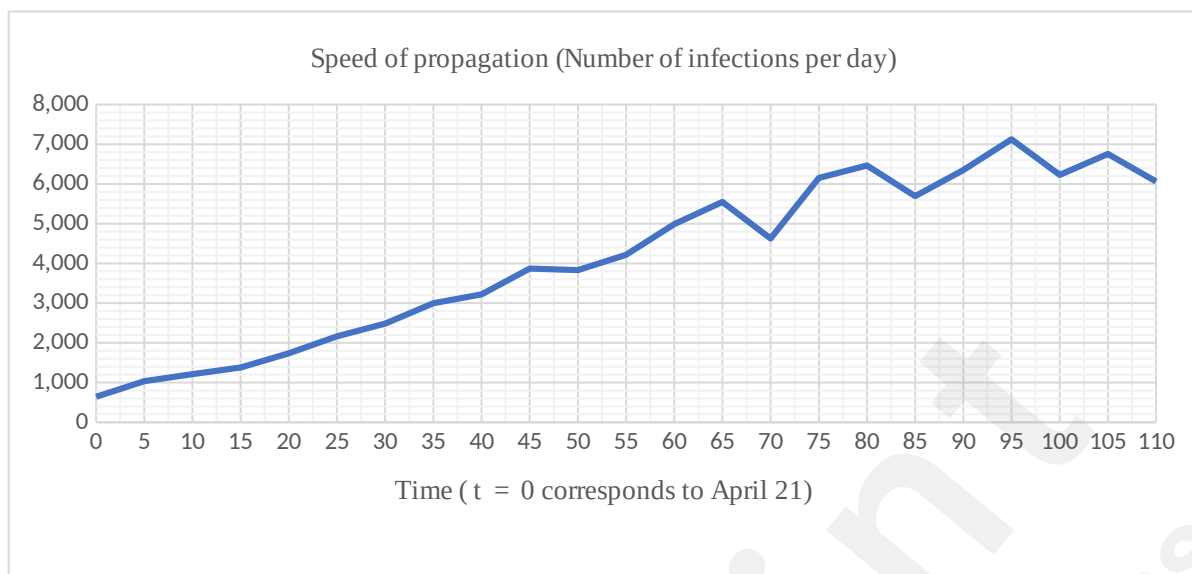
Figure 1. Logistic function of confirmed cases based on the official registry until August 09 in Mexico.

Table 3. Confirmed cases projection based on official data until August 09, according to the least squares logistics model.

Month/Day	Confirmed cases projection
August 14	479,835
August 19	502,476
August 24	522,668
August 29	540,449
September 03	555,933
September 08	569,287
September 13	580,708
September 18	590,405
September 23	598,588
September 28	605,460
October 03	611,204
October 08	615,989
October 13	619,962
October 18	623,254
October 23	625,975
October 28	628,221
November 02	630,071
November 07	631,595
November 12	632,847
November 17	633,876
November 22	634,722
November 27	635,415
December 02	635,984
December 07	636,451
December 12	636,834
December 17	637,147
December 22	637,404
December 27	637,615

Figure 2. Average speed of propagation for confirmed cases until August 09.

Supplementary Files

Untitled.

Speed of propagation (Number of infections per day)

Time ($t = 0$ corresponds to April 21)
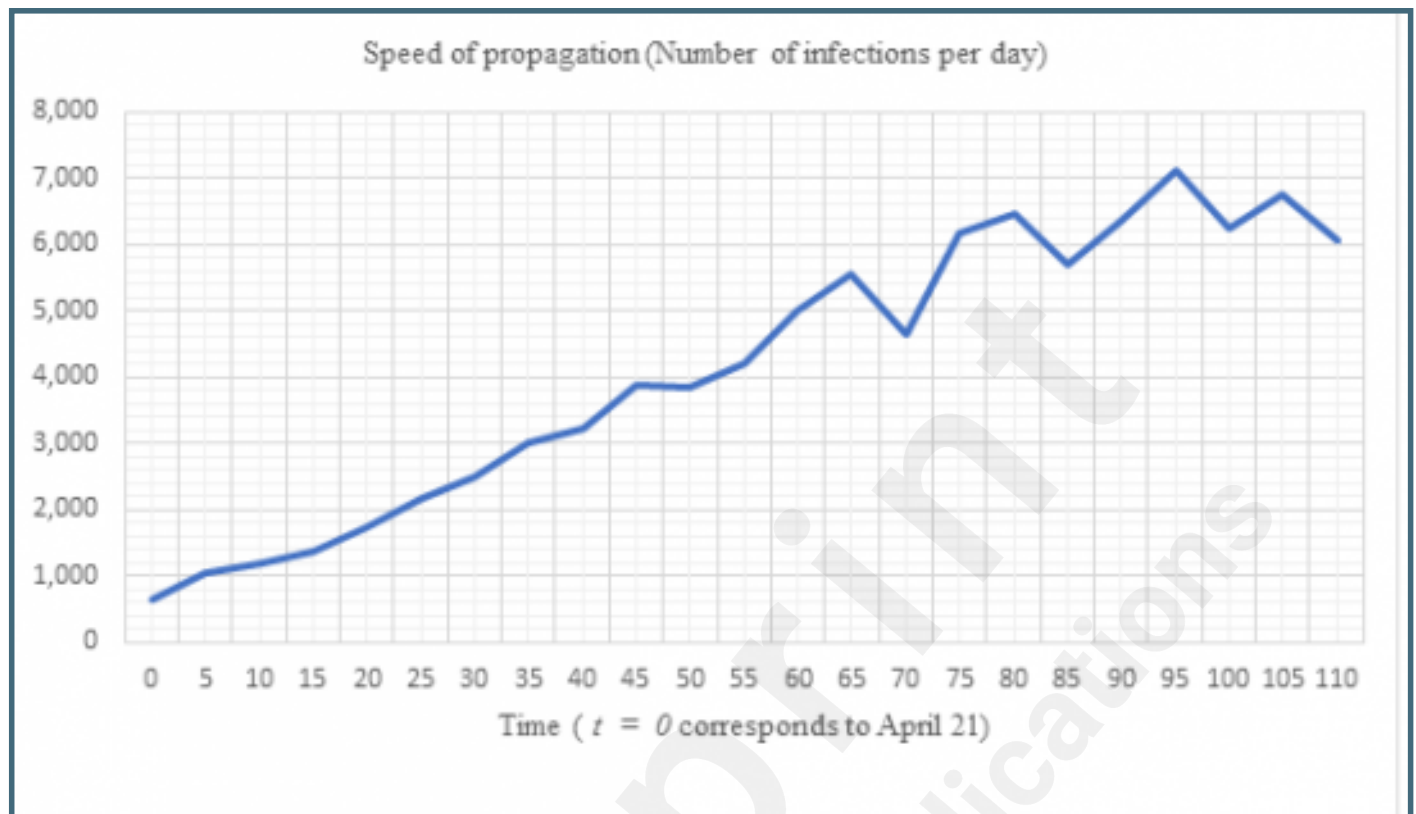
Figures

Logistic function of confirmed cases based on the official registry until August 09 in Mexico.

Fitting a logistic model to observed data