
Epidemics and Pandemics: Covid-19 and the “Drop of Honey Effect”

Submitted 20/03/20, 1st revision 28/03/20, accepted 15/04/20

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Abstract:

Purpose: The aim of this paper is the use of the “drop of honey effect” to explain the spread of Covid-19.

Approach/Methodology/Design: After Covid-19 appearance in Wuhan, in the Chinese province of Hubei, by December, 2019, it spread all over the world. The World Health Organization declared it as pandemic in March 11, 2020. The infection is highly contagious and made thousands of deaths around the world. Timely decisions are key for the control of the dissemination. The “drop of honey effect” results as an important framework to explain the Covid-19 spread.

Findings: An opportune decision in a very initial moment could have made all the difference in the virus spread.

Practical Implications: The study will contribute positively for the understanding of the importance of well-timed decisions for governments, world organizations, academia, companies and people, each one on a different dimension's level.

Originality/Value: This study presents the “drop of honey effect” as an original and very suitable framework to explain the way how the virus spread all over the world after the virus in Wuhan began to infect people.

Keywords: Drop of Honey Effect, Chaos Theory, Covid-19, SARS-CoV-2, Virus, Coronavirus, Human Behavior, China.

JEL code: I12, I100.

Paper Type: Commentary note.

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1. Introduction

The “*drop of honey effect*” metaphor is applied to Covid-19 disease². In the context of chaos theory, it performs a powerful capacity and usefulness for the explanation and understanding of this disease spread. A very single fact in the very initial conditions may have caused the total disruption in the health care systems in several countries around the world; and have had a tremendous impact on the world finance and on the world economy itself, in general. Well timed and correct decisions may have a huge positive effect, and in this case this would have been a very probable setting. The uncertainty around the expected effects made the decision-making process fail.

In this case of Covid-19, caused by the SARS-CoV-2 coronavirus, that appeared in Wuhan (the capital of the Hubei Chinese province) by the end of 2019, Chinese authorities waited for trying to measure the effects of the virus itself and the evolution of the virus spread. This delay made that the response to the disease spread had become too tardy, as many epidemiologists say.

Let’s refer for example the scientific journal *Nature* that stated that epidemiologists assumed that the one flaw of the Chinese response was that quarantines and lockdowns began too late (Dawson, March 17, 2020).

As approached by Dawson (March 17, 2020), after the cases appeared by the end of 2019, Chinese authorities did not take any steady action until the mid-January, 2020. For instance, Dawson cited Howard Markel, a public health researcher at University of Michigan, who said: “*the delay of China to act is probably responsible for this world event*”. In the mid-January, 2020 the severity of the disease was assumed and the first “*proper*” measures were adopted. This shows the importance of opportune decisions and how a small difference in the very initial moment could have made all the difference, what makes evidence of the capacity of the “*drop of honey effect*” to explain this phenomenon.

Correct decisions in the very initial moment – the most critical moment for the disease dissemination control - would have been crucial for the management of this coronavirus (SARS-CoV-2) spread.

The virus circulated first in Wuhan, the capital of the Hubei Chinese province, spreading to the rest of China and then to the rest of the world. Consequences in the public health, and in the social, economic and financial dimensions were tremendous worldwide.

²*Applications of the “drop of honey effect” to several social phenomena were presented previously; it was applied to social and political events for example in Filipe and Ferreira (2013, 2014), Ferreira, Filipe, Coelho and Pedro (2014).*

2. Epidemics and Pandemics

Epidemics and pandemics have affected humanity since distant times. Etymologically speaking, epidemic (from the Greek *epi* and *demos*) means “upon/above people”. Although the term epidemic is variously defined, it corresponds to a rapid spread of a disease to a large number of people in a given population within a short period of time. An epidemic disease is one “affecting many persons at the same time, and spreading from person to person in a locality where the disease is not permanently prevalent”. The World Health Organization (WHO) further specifies epidemic as occurring at the level of a region or community (Kelly, 2020).

Pandemic (from the Greek *pan* and *demos*) means “all people”, it reaches “all” people. A pandemic (the pandemic disease) spreads across a large region, in different continents or worldwide. Any debate around the exact definition for pandemic (what is a pandemic? or an epidemic?) may agree on the extensive manifestation of the disease, in excess of what might normally be expected for a geographical region.

According to the WHO definition “a pandemic is the worldwide spread of a new disease”. WHO also refers the case of the influenza pandemic that “occurs when a new influenza virus emerges and spreads around the world, and most people do not have immunity”. By its turn, the United States Centers for Disease Control, U.S. Department of Health and Human Services (U.S. CDC) approaches the pandemic as referring “to an epidemic that has spread over several countries or continents, usually affecting a large number of people”. It represents a geographic spread; the severity of the disease is not mentioned – see Surico and Galeotti (2020), citing WHO and Washington Post.

On 11 March, 2020, WHO declared a pandemic this coronavirus disease Covid-19. WHO Director-General, in his March 11, 2020 speech said: “we have therefore made the assessment that COVID-19 can be characterized as a pandemic”; and added: “we have never before seen a pandemic sparked by a coronavirus. This is the first pandemic caused by a coronavirus”. He still said that “WHO has been assessing this outbreak around the clock and we are deeply concerned both by the alarming levels of spread and severity, and by the alarming levels of inaction” (WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020).

In the human history, tuberculosis, cholera, bubonic plague, smallpox, or influenza are some of the most severe diseases. These world spread diseases were properly defined as pandemic; they killed millions of people throughout the human history. For example, smallpox may have killed hundreds of million people along its thousands of years' existence; bubonic plague in the 14th century killed an estimated number of 75-200 million people; or the 1918 influenza pandemic (“Spanish flu”)

which may have killed between 17 and 50 million people. Let's refer also the most recent strain of H1N1 influenza virus pandemic (January 2009 - August 2009), after the first one of 1918; and the pandemics of HIV/AIDS and Covid-19. Medical advances made possible new approaches to improve the fight to the diseases. The current pandemic, Covid-19, with a very high rate of infections, demanded a worldwide response by the scientific community, who currently searches for solutions, either vaccines or treatments. Meanwhile, previous medicines that have showed to have some benefic effects on sick people began to be experimented.

3. The Tale

In previous works we introduced the tale (a 1909's poem) - created by the Armenian poet Hovhannes Tumanyan - in the context of chaos theory (see footnote 2). It is reproduced in this note for presenting the approach to the Covid-19 spread, applied also to this situation as a metaphor to show the effects in the chaos theory context.

In the story, a very big problem or a quarrel starts from basically nothing (from a little drop of honey). The way events spread is interesting. The tale shows clearly the phenomenon and this is why it is reproduced in the present paper. The similarities to the present situation of Covid-19 are evident.

The tale is as follows:

“On a warm afternoon, on the second floor of a splendid palace that overlooked the market place of the city, sat a king and his minister. While the king was eating some puffed rice on honey, he looked over his land with satisfaction. What a prosperous city he ruled. What a magnificent city. As he was daydreaming, a little drop of honey dripped from his puffed rice onto the window ledge. The minister was about to call a servant to wipe up the honey, when the king waved a hand to stop him. *“Don't bother, it's only a little drop of honey, it's not our problem.”*”

The minister watched the drop of honey slowly trickle down the window ledge and land on the street below. Soon, a buzzing fly landed on the sweet drop of honey. A nearby lizard shot out its long tongue and caught the fly. The lizard was taken by surprise when a cat leapt on it. The cat was pounced on by its worst enemy, the dog, that had broken free from its chain. Meowing and barking erupted from the street below the King and his minister.

The minister was about to call a servant to go and deal with the brawling cat and dog when the king said: *“Relax, the cat and dog belong to the market people. We should not interfere. It's not our problem.”*

The cat's owner was horrified to see her cat being attacked by the big bully of a dog and started whacking the dog with her broom. The dog's owner was horrified to see her dog being attacked by the big bully of a cat and started whacking the cat with her

broom. Soon, people started coming out from their stalls and houses to see what all the screaming and shouting was about. Seeing their friend’s cat being attacked, they joined in berating the dog and its owner. Others, seeing their friend’s dog being attacked by the cat, also joined in. Very quickly, the shouting became violent and a fight broke out in the street. The worried minister turned to the King but his only comment was, *“Not our problem. Here, have some more puffed rice and honey.”*

The king and his adviser ate as they watched the fray below. Soon the police were called in to break up the fight, but the people were so angry, each side convinced that they were right (right about what, they couldn’t remember). They started attacking the policemen. The fight rapidly broke out into a full-scale riot. The king eyed the minister and said: *“I know what you are thinking, but the army will handle it. Besides, this is not our problem.”*

The riot swiftly escalated into a civil war with looting and destruction all over the city. Buildings were set alight and by nightfall, the magnificent city was reduced to a pile of smoking ashes. The king and his minister stood spellbound rooted to the spot where they had been watching all day. Their mouths were hanging open in horror. *“Oh...”* said the king quietly, *“maybe the little drop of honey was our problem.”* (freely adapted from the tale of Hovhannes Tumanyan).

4. Facts and Particularities

As the proper measures were not taken or were taken lately, the infection spread and became first epidemic and then pandemic, reaching all the world in several weeks with hundreds of thousands of infected people and thousands of deaths. Only after the pandemic is possible to have a very complete study.

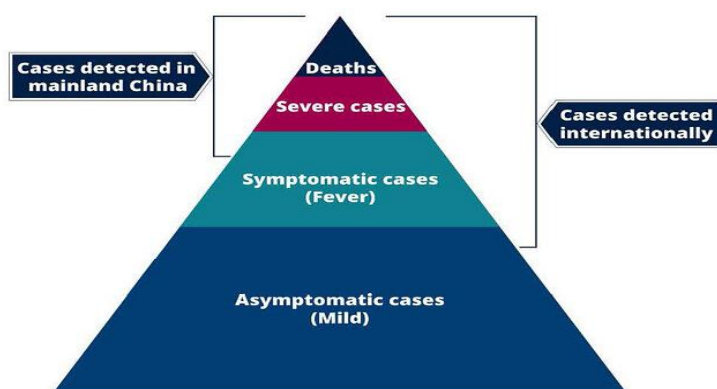
Although Covid-19 has a very short history, since it appeared in Wuhan by the end of 2019, a tragic end for thousands people has already happened around the world. This situation allows to understand the way the virus SARS-CoV-2 spread from Wuhan, China to the rest of the world. After the virus circulated initially within Wuhan, the capital of the Hubei Chinese province, then it spread to the rest of the province and also China and to the rest of the world. Up to March 23, 2020, *“it took 67 days from the first reported of Covid-19 to reach 100,000 cases, 11 days for the second 100,000, and just four days for the third 100,000”* as reported by BBC (BBC News March 23, 2020). In the Coronavirus disease (COVID-19) outbreak situation update of March 31, 2020, 15:51 WEST (WHO Latest updates - Live press conference (Geneva)) there were 719,785 infected confirmed people, 33,673 deaths, in 203 countries, areas or territories with cases (World Health Organization³).

The following triangle graph (Figure 1) presented by Reynolds – CATO Institute (March 2, 2020) relates to a study from the Imperial College London (February 10,

³ <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>).

2020). It shows that most people infected by COVID-19 are never counted as being infected. As the Imperial College explains, that is because “*the bottom of the pyramid represents the likely largest population of those infected with either mild, non-specific symptoms or who are asymptomatic*”. Tedros Adhanom, Director General of the World Health Organization (WHO), explained in his February 28 briefing, “*most people will have mild disease and get better without needing any special care*”. Several studies have found that about 80% of all the COVID-19 cases have relatively minor symptoms which end without severe illness and therefore remain unreported.

Figure 1. Stages of COVID-19 disease



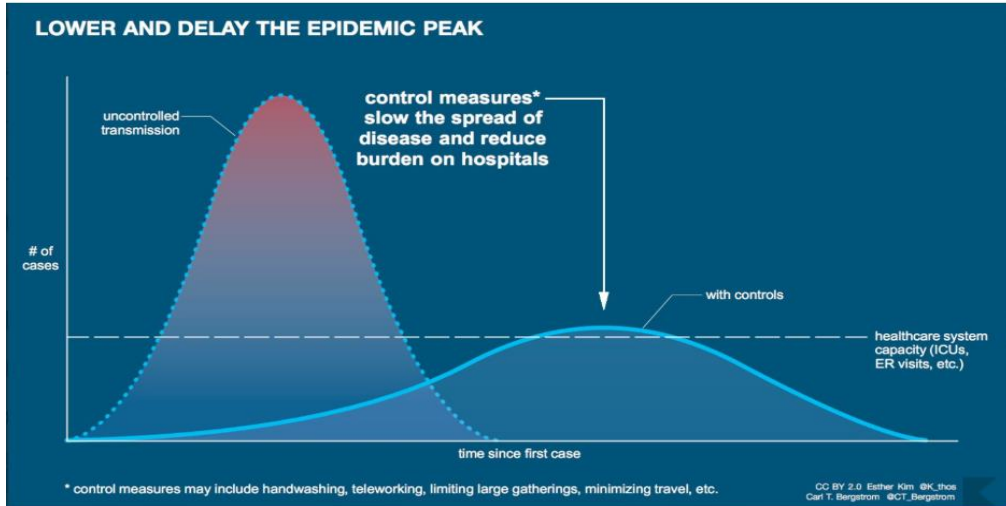
Source: Reynolds - CATO Institute (March 2, 2020).

This means that there will be much more infected people than the ones reported. The following Figure 2, by its turn, shows the importance of fast action. A flattened curve shows how a reduced rate of coronavirus infection can reduce the impact on the healthcare system. The chart shows two curves with two very different virus reproduction rates. In the steepest curve, the virus reproduces quickly in a short period of time. In this scenario, the health care system is overwhelmed, on which mortality rates can be high and infected people may not get the treatment they need. In the second, a flatter curve, controls help reduce the dissemination of the coronavirus. Infections occur, but over a longer period of time. Since health care workers and facilities are not overwhelmed, infected people receive better treatment and fewer deaths happen (Lacina - World Economic Forum, March 8, 2020).

Krstić (2015) defended that there is no reason a priori to believe that all social phenomena can ultimately be explained as the product of deliberative or intentional efforts of individuals to maximize their utility. In this process, this can be viewed for two situations over this phenomenon. First, as soon as Chinese authorities could not attain the phenomenon controlled in the initial moment and it spread. And then when countries governments appealed for people “staying at home” and some people did not comply with these recommendations, although they should know the risks

for them and for others, often devaluating these risks. As the uncertainty was very high the risks should have been enough understood by everyone, acting according to their government’s policies.

Figure 2. Lower and delay of epidemic peak



Source: Lacina - World Economic Forum (March 8, 2020).

5. The Covid-19 Disease’s Grabinski and Klinkova (2020) Approach

Grabinski and Klinkova (2020) uses the following mathematical situation for explaining the spreading of Covid-19. Grabinski and Klinkova (2020) present an equation that shows a population $n(t)$ growing proportionally to n :

$$\dot{n}(t) = \frac{1}{\tau} \cdot n(t) \tag{1}$$

Equation (1) will lead to unlimited growth and the speed is given by the constant τ . If τ is small a rapid growth will happen and a big one slows the growth. If a disease is spreading, τ can be estimated by a reproduction number. Different values for τ for different parts of the population can be supposed. For Covid-19, experts estimate that about two thirds of the population will get infected eventually without vaccination. In such a context, Grabinski and Klinkova (2020) assume a limit for Equation (1) considering the logistic equation:

$$\dot{n}(t) = \frac{1}{\tau} \cdot n(t) \cdot (1 - n(t)) \tag{2}$$

Equation (2) is not untypical for growth’ limitations. When $n(t)$ approaches its maximum 1, growth becomes slower and slower. The solution for Equation (2) can be given in a closed form by Equation (3):

$$n(t) = \frac{n_0 \cdot e^{t/\tau}}{1 - (1 - n_0) \cdot e^{t/\tau}} \quad (3)$$

By calculating the derivative with respect to time of Equation (3), Grabinski and Klinkova (2020) study the specific curves for the way the infection spread in the societies according to their populations' particular behaviors. They bring up that the very good behavior of one half of the society's population cannot compensate the bad behavior of the other half, for reaching the goal of spreading cases of a disease over a long period. The authors also register the need of the very broad majority of people taking the appropriate measures for making them effective. In this case, health care services will be better able to receive Covid-19 patients.

Being τ in Equation (2) a function of time it modifies the solution in Equation (3). τ can also change discontinuously when, e.g. a curfew is introduced. Considering the exponential behavior, by introducing a change in τ slightly earlier or later it may also lead to a very big change. And the change in τ is identical to the drop of honey effect. In fact, this illustration by Grabinski and Klinkova (2020) demonstrates that this pandemic disease resulted in a suitable situation on which the "drop of honey effect" works.

6. Discussion

We have been applying this framework since several years ago to a set of social phenomena situations. In this case, we reproduced once again the Tumanyan poem, once it fits perfectly in the events of the coronavirus Covid-19 spreading. The "drop of honey effect" metaphor shows to be clearly adequate to present the way the virus spread from Wuhan to the world, already reaching the generality of the world's countries and territories.

The impact on world's health care systems has been tremendous. Also there were huge repercussions on the economic and financial dimensions. Many stock exchanges declined significantly, some of the most important of them declining around 30%, in a period of several weeks. COVID-19 abruptly interrupted a more than a decade of bull market and shot the markets for the muddle.

In the first moments, Chinese authorities tried to confine the disease. After failing, the disease spread and, even so, official entities in the reached countries considered that they should avoid the alarmism. After the disease got largely installed, the panic generalized and hard measures got evidently necessary and were adopted. Once more, this example shows the way we have presented the "drop of honey effect" on the chaos theory context for social phenomena.

This paper highlights the effects of the "drop of honey". The effect in this case is caused by something very small and "invisible", and very malicious in its essence.

The tale is reproduced and shows clearly the importance of controlling a situation in the very beginning, demanding for a good management of causes and effects. The governments' policies and the social, economic and financial impacts of the disease in the short term were tremendous.

Suitable decisions and appropriate measures would have contributed in such a situation of this pandemic for making these Covid-19 disease effects much softer. As generally recognized, in the very beginning measures were delayed. Even the very first approaches undertaken all over the world by some international organizations and national governments were often soft and the taken measures inappropriate for the moment.

Dawson (March 17, 2020), in a press article, exposed that the initial measures carried out by the Chinese government were delayed; and also demonstrated the importance of acting timely: “models [...] show [that] if the country had taken steps to contain the virus one week earlier, it could've prevented 67% of all cases [...]. If the Chinese government had acted three weeks prior, at the beginning of January, [...] it would've slashed the number of cases to 5% of the total”.

These sentences show the relevance of the “drop of honey effect” for explaining this phenomenon. As in the poem of Tumanyan, it was an authorities' “problem”. In the Covid-19 case, it was first a Chinese authorities problem; Chinese authorities incorrect approach to Covid-19 in the beginning was the “pull the trigger” for the disease spread.

References:

- Ferreira, M.A.M., Filipe, J.A., Coelho, M., Pedro, I. 2014. Chaos in World Politics: A Reflection. The ‘Drop of Honey Effect’, in Banerjee, Santo; Erçetin, Sefica Sule; Tekin, Ali (Eds.), *Chaos Theory in Politics*. 1, 89-104. Springer Netherlands.
- Filipe, J.A., Ferreira, M.A.M., Coelho, M., Pedro, M.I. 2010. Chaos, anti-chaos and resources: Dealing with complexity, *Aplimat-Journal of Applied Mathematics*, 3(2), 83-90.
- Filipe, J.A., Ferreira, M.A.M. 2013. Social and political events and chaos theory - the "drop of honey effect". *Emerging Issues in the Natural and Applied Sciences*, 3(1), 126-137.
- Filipe, J.A., Ferreira, M.A.M. 2014. Chaos in Social and Political Phenomena - The “Drop of Honey Effect”. *Aplimat – Journal of Applied Mathematics and Engineering*, (6), 83-90.
- Grabinski, G., Klinkova, K. 2020. Why individual behavior is key to the spread of viruses such as Covid-19. *Theoretical Economics Letters*, 10(2). Scientific Research Publishing Inc.
- Krstić, M. 2015. Rational Choice Theory and Explanation of Social Phenomena. *Godišnjak Fakulteta Političkih Nauka*, 9(13), 165-184.

Press:

- BBC News March 23, 2020. Coronavirus: Pandemic is 'accelerating', WHO warns as cases pass 300,000. Available at <https://www.bbc.com/news/world-52010304>. Accessed on March 24, 2020.
- Dawson, J. March 17, 2020. Caller Blasts Idaho Gov. Brad Little's Response to Coronavirus During Town Hall. Available at <https://www.boisestatepublicradio.org/post/caller-blasts-idaho-gov-brad-littles-response-coronavirus-during-town-hall#stream/0>. Accessed on March 24, 2020.
- Kelly, J. 2020. "Epidemic" vs. "Pandemic": What Do These Terms Mean? Available at <https://www.dictionary.com/e/epidemic-vs-pandemic/>. Accessed on March 30, 2020.
- Lacina, L. - World Economic Forum (March 8, 2020). Minimizing Coronavirus' impact is a race against time - this chart explains why. Available at <https://www.weforum.org/agenda/2020/03/this-one-chart-shows-why-minimizing-coronavirus-impact-is-a-race-against-time/>. Accessed on March 30, 2020.
- Reynolds, A. - CATO Institute. March 2, 2020. The Misleading Arithmetic of COVID-19 Death Rates. Available at <https://www.cato.org/blog/misleading-arithmetic-covid-19-death-rates>. Accessed on March 31, 2020.
- Surico, P., Galeotti, A. March, 23, 2020. The economics of a pandemic: the case of Covid-19. London Business School. Available at <https://icsb.org/theeconomicsofapandemic/>. Accessed on March 30, 2020.
- WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. Available at <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020>. Published on March 11, 2020. Accessed on March 24, 2020.
- World Health Organization. Coronavirus disease (COVID-19) Pandemic, Latest updates – Live press conference (Geneva). Available at <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>. Accessed on March 31, 2020.