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The Importance of Being Tested

by **Giulia Giordano**[1] | Assistant Professor

[1]: Department of Industrial Engineering, University of Trento, Trento, Italy

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ABSTRACT
As COVID-19 is raging worldwide, mathematical models tailored to the pandemic suggest the most effective interventions to contain the contagion. Physical distancing and lockdown, indispensable at an early stage, can be combined with testing and contact tracing, crucial to relieve lockdown measures safely and possibly end the epidemic faster.

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Imagine the global threat of a potentially lethal virus, showing up in mainland China and rapidly spreading worldwide, for which no effective treatments or vaccines are available.

A few months ago, this would have been nothing more than a book or a movie plot. Unfortunately, it is now a dramatic reality that is affecting the daily life of us all: as we are writing, the new coronavirus SARS-Cov-2, originating the COVID-19 pandemic, has caused more than ten million infected and a death toll of above half a million.

In the absence of suitable pharmaceutical interventions, all we can do is prevent the virus from spreading with hygiene measures and face masks and enforcing physical distancing and lockdown. Also, we can test, promptly isolate infected people, and trace their contacts to identify and break the contagion chain.

For now, our most potent weapon against the virus is mathematics. Mathematical models can explain how the epidemic spreads, forecast its future trend and allow us to plan effective interventions.

The SIDARTHE model is one of the earliest attempts to capture the peculiar features of COVID-19 and its clinical evolution. It describes and predicts the pandemic's course by partitioning the population into different stages: susceptible uninfected, infected that can be either detected or undetected, and whose symptoms can be either absent, mild, or life-threatening, recovered, and dead. Individuals can transition from one stage to another due to contagion, diagnosis, symptom development, worsening, recovery, or death.

Considering the severity of illness is fundamental because COVID-19 can have a very different clinical evolution in different individuals. Taking this aspect into account, the model can predict the peak of the total number of infected and the peak of the number of needed intensive care beds, thus forecasting the medical resources and infrastructures needed.

Distinguishing between detected and undetected infected people is very relevant in the COVID-19 outbreak because many infected people are asymptomatic, but we cannot test the whole population. Hence, the infected people counted in the data are just a fraction. The model helps quantify this underestimation and predict its effects. When many cases, typically resolving in recovery, are never diagnosed, the mortality is overestimated; conversely, the contagion rate is underestimated. Also, infected people who are not diagnosed, especially when asymptomatic, can spread the infection much more, without even knowing, because they are not quarantined.

Since it is tailored to COVID-19, the SIDARTHE model can be used to assess the consequences of possible policies, and plan the most effective interventions to mitigate, contain, and suppress the contagion.
To compare different scenarios when countermeasures (such as distancing and lockdown, as well as testing and contact tracing) are enforced and combined, the Italian outbreak has been considered as a case study. However, our model can be used to study the epidemic evolution in any geographical area, once its parameters are appropriately chosen.

Thanks to the model, we have learned many valuable lessons.

Staying at home saves many lives: distancing measures and lockdowns are fundamental and effective to contain the contagion.
Since you do it, do it well: the lockdown should be promptly enforced at the earliest stage, and be strict; if it is enforced later, it is less effective and needs to last for longer.
In fact, no restrictions lead to an early but massive peak of infected, which overwhelms any healthcare system. Mild restrictions "flatten the curve" but delay the peak and prolong the emergency's duration, without reducing the number of infected that much. Substantial restrictions anticipate and drastically reduce the peak, ending the epidemic rapidly with small involvement of the population.
Weakening the lockdown too early leads to a soon resurging outbreak. Therefore, no haste: take all the time that is needed.

Yet, can we lock ourselves at home until a vaccine is found? What about our social life, our mental health, our jobs, and the economy?

Lockdown is not the only strategy at our disposal, and here comes the importance of being tested. The model results show that widespread testing and contact tracing help end the epidemic faster, combined with physical distancing and the use of personal protective equipment. Testing is the only way to relieve lockdown measures safely without tragic outcomes.

Therefore, the SIDARTHE model for the COVID-19 pandemic suggests that a milder physical distancing can be safely allowed if combined with massive testing and contact tracing. Led by mathematics, we can withstand the outbreak in the besieged castle, waiting for reinforcements from the pharmaceutical research.