

International testing policies for COVID-19 - An overview and an economic-statistical perspective¹

(this text has been prepared by the Cerge-Ei policy think-tank with the aim to advise Czech health authorities)

The way in which medical testing decisions are made plays a central role in the world's fight against the COVID-19 epidemic. Good testing policies need to adapt to the epidemic's progress, to the technology by which we can trace it, and to our understanding of the disease itself. Developing and adjusting such an algorithm requires input from epidemiologists, biochemists and others. As economists, we believe we may have relevant knowledge, since allocating COVID-19 tests is a classical problem of allocating scarce resource. Acknowledging our lack of epidemiology, biochemistry or medicine, we have prepared the following annotated overview of testing guidelines and practices around the world as an invitation to interdisciplinary debate.

The usage of tests varies with a country's infection rate and the availability of tests:

- Countries with a severe lack of PCR tests mainly test patients in a critical condition to benefit the patient, and largely refrain from epidemiological considerations in making testing decisions.
- Multiple countries without a well-developed system for contact tracing mainly test those with a high a priori probability of being infected, especially symptomatic patients.
- Countries with a high number of tests available and a well-developed system for tracing contacts also test asymptomatic individuals according to their carrier potential², and they aim at collecting representative data.
- Countries with a lack of PCR tests often use pre-tests for influenza and bacterial infections before applying a PCR test.

In the following, we identify and discuss basic dilemmas in developing testing policies. For each practice we consider, we present advantages and disadvantages and give some brief examples of international practices and recommendations. We are not in a position to make recommendations. Feedback from other relevant disciplines is highly welcome.

1. Should asymptomatic contacts of infected people receive PCR testing if their carrier potential is high?

- **Advantages:**
 - The importance and prospects of testing asymptomatic suspected cases increase with the quality of contact tracing, which is getting better in the Czech Republic. The contacts of everyone with a positive PCR test are investigated; their close contacts are quarantined. The

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² By "carrier potential" we mean a person's potential to spread the disease if they are themselves infected. The carrier potential is high for a nurse, prisoner or shop assistant but low for a lumberjack.

epidemiological benefit of contact tracing increases if it is begun immediately at the onset of a person's illness.

- The carrier potential of healthcare professionals, salespeople, food industry workers etc is high compared to the general population. Targeting PCR tests according to carrier potential increases the yield and thus the effectiveness of contact tracing.
- Testing asymptomatic people reduces some selection bias in the test population and may thus provide a better statistical picture of the epidemic.
- **Disadvantages:**
 - Lower a priori probability of detecting an infection compared to testing only symptomatic people with contacts to confirmed infections.
 - Possibly higher expected damage through testing, as there is a risk of infection during or in connection with getting tested. (Symptomatic are already more likely to be infected.)
 - Symptoms are at present not critical for quarantine decisions, which are made based on contact history.
 - The time window between becoming infectious and testing positive in a PCR can be large. This means there can be a higher probability of false negative tests in asymptomatic people.
- **International practice** (*collected by L. Matysková*): *The practice is not widespread yet, as tests remain scarce. Symptoms are a prerequisite for testing, among others, in the US [1, 8, 16], Canada [3], Norway [19], Germany [20], Denmark [21], Sweden [22] and Australia [28]. Countries with more across-the-board testing are, for example, South Korea [18] and Singapore [29], i.e. those with higher testing capacity. The ECDC recommends that tests be performed primarily on symptomatic patients [23]. The WHO guidelines consider carrier potential in the following sense: they recommend to prioritize testing symptomatic individuals from vulnerable groups, health professionals and and the first symptomatic person from enclosed premises [30]. Taiwan tests asymptomatic people who have been in contact an infection cluster [unverified]. See article in The Lancet for estimates of the impacts of tracing [36].*

2. Use pre-tests for other diseases to determine whether a symptomatic person should receive a PCR test?

- **Advantages:** In symptomatic populations, using pre-tests for influenza and bacterial diseases before administering a PCR test may increase the rate of detecting COVID-19 infections by a double-digit percentage for a fixed number of PCR tests. This practice is especially effective when other diagnoses are more frequent than COVID-19³ and if there is a severe lack of PCR tests.
- **Disadvantages:**
 - The effectiveness of this practice decreases with the relative frequency of COVID-19 compared to other diseases, either through a higher number of COVID-19 infections or the end of the flu season.
 - Not useful for asymptomatic people.
 - Increases elapsed time before a positive COVID-19 diagnosis.
 - The effectiveness of the practice is hard to evaluate since patients may have several infections (including COVID-19) at the same time.

3 Pre-tests for other diseases can help detect COVID-19 in the population of symptomatic patients. Even if COVID-19 and other diseases are a priori statistically independent phenomena, there would still be a negative correlation between COVID-19 and other diseases in the symptomatic population.

- **International practice** (collected by V. Novák): Using influenza tests as pre-tests is common practice in many countries (USA [1, 7], Canada [3], China [4]). The WHO recommends that testing for other respiratory illnesses should not delay testing for COVID-19 [13].

3. Use rapid antibody tests as pre-test to determine whether a person is suitable for a PCR test?

- **Advantages:**
 - In principle, using an inaccurate but easily available rapid test for COVID-19 antibodies before deciding whether to administer a more precise PCR test may increase the rate of detecting COVID-19 infections by a double-digit percentage for a fixed number of PCR tests.
 - The use of rapid tests could help manage the flow of people with mild cold symptoms seeking PCR tests (e.g. by exaggerating their symptoms or their contact history).
- **Disadvantages:** Antibody tests only become reliable at a later stage of the disease than PCR tests. A rapid pre-test for antibodies would hence make it less likely that early-stage infections are detected by PCR tests.
- **International practice** (collected by L. Matysková): Recommended by the National Institute of Public Health (CZ) [2]. We have not found recommendations of this practice in other countries. According to the WHO, rapid tests can help with real-time and retrospective assessment of the spread of the disease in the general population [13].

4. Broaden the use of body temperature measurements in public places?

- **Advantages:**
 - Identifying people with elevated body temperatures can improve the allocation of PCR tests.
 - Available on a large scale.
 - Can help rapidly isolate people with mild symptoms but large carrier potential.
 - Isolating people with fever due to other diseases prevents the spread of these other diseases and thus lowers the overall strain on health care resources
 - Very simple to implement.
- **Disadvantages:**
 - Does not help detect asymptomatic carriers.
 - Usefulness decreases with the quality of contact tracing and the availability of PCR tests.
 - Quarantining people with elevated temperature but no COVID-19 has costs.
 - Imposes restrictions on freedom of movement.
 - Staff-intensive (but needs no qualified medical staff).
 - Correlation between body temperature and COVID-19 is small and measurement errors are large.
 - Body temperature can be suppressed by over-the-counter medications. Quarantining people with elevated body temperature motivates them to suppress their body temperature. (In China, temperature measurement was supplemented by a ban on the sale of antipyretics.)
- **International practice** (collected by P. Kocourek): Temperature measurement is widespread in Singapore, Hong Kong, China (in public buildings, shopping centers, restaurants etc) and other Asian countries [25, 26, 17]. The WHO and the ECDC comment on this practice in the context of international flights [27].

5. Isolate suspected infections and those with mild symptoms in facilities instead of at home?

- **Advantages:** The spread of COVID-19 within households plays a significant role in its overall spread.
- **Disadvantages:**
 - Major interference with personal freedoms.
 - Infections may spread in isolation centers.
- **International practice** (collected by V. Novák): Implemented in China [4, 17, 37, 39], South Korea [4], Israel [37]. In Slovakia [38], Singapore [26, 39] and Taiwan [40], quarantine centers are mainly used for those who return from abroad or for those who cannot remain at home. The WHO recommends the isolation of light cases at home, in health facilities (if resources allow) or in public facilities (stadiums, gyms) [41].

6. Administer tests on a random population sample?

- **Advantages:**
 - Random (representative) data is necessary for a better understanding of the disease as well as the effectiveness of countermeasures.
 - This research cannot be completely imported from abroad, since many epidemiological facts are country-specific.
 - The testing could be done using rapid tests as accuracy is not of paramount importance for this purpose.
- **Disadvantages:** Lack of tests; infection danger for those who get tested.
- **International practice** (collected by V. Novák): Rarely done at the beginning of an epidemic. In imperfect form, it is carried out in Iceland [6], India [9], Florida, USA [33] and Hawaii, USA [34]. See [35] for arguments for collecting representative data.

7. Test healthy (or recovered) people without a COVID-19 diagnosis for antibodies? Keep a database of those who are cured?

- **Advantages:** People with (probable) immunity have significant value in the health sector, food supply etc.
- **Disadvantages:** It is not yet known what kind of immunity is acquired.
- **International practice:** (collected by J Steiner) Not used so far as there are few cured patients and little is known about acquired immunity. The idea is discussed in a scholarly article on serological testing [24].

8. Provide financial compensation for quarantine and private testing?

- **Advantages:** Provide the right incentives for citizens to report symptoms and contact with infected people.
- **Disadvantages:** If set incorrectly, could set perverse incentives (especially among the poor).
- **International practice** (collected by P. Kocourek): Quarantined people are compensated in South Korea, Taiwan and Israel [31, 32, 18]. Medium-sized businesses in the US must pay sickness benefits to quarantined employees [46]. South Korea pays commercial tests if they are positive [18].

9. What is the role of the poor and socially excluded?

- Socially excluded people are the achilles heel of social distancing strategies. They will violate social distancing rules and quarantine more often than others for existential reasons (e.g. laborers, beggars, prostitutes). Combined with the reality of their living conditions, a fast spread of COVID-19 in this population segment seems likely.
- **International practice:** (collected by O. Jann) Several countries accommodate the homeless in empty hotels and offer special testing [42, 43]. The US CDC recommends not clearing encampment sites so their residents do not disperse widely [44]. Spain distributes food and clothing to poor and homeless, as well as offers mobile testing [45].

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