Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Journal of Infection and Public Health 14 (2021) 757–758

Contents lists available at ScienceDirect

Journal of Infection and Public Health

journal homepage: http://www.elsevier.com/locate/jiph

Letter to the Editor

The use of double border-screening strategy in the surveillance and prevention of COVID-19

Keywords:
COVID-19
Travel
Border screening
Double testing
Effectiveness
Prevention

Dear editor,

As a global health problem, COVID-19 has led to a worldwide effort and an immense response aimed at tackling the pandemic. Effective control measures including non-pharmaceutical interventions such as temporary lockdowns, social distancing and enhanced personal hygiene were implemented to limit the spread of the disease. As hyperconnectivity in the modern world has been considered to facilitate the exponential global spread of COVID-19 [1], reduced travel both domestically and internationally was an additional control measure universally adopted. In a recent study, early and sustained implementation of containment through internal and external border controls was identified as a key strategy in curbing the spread of the disease [2]. Accordingly, distinct travel restrictions in addition to entry/exit screening and isolation methods have been applied at international land borders in different countries.

Secondary cases of COVID-19, transmitted from imported cases, pose a significant risk of community spread in a country [3]. The requirement of a negative reverse transcriptase polymerase chain reaction (RT-PCR) test result performed within 72 h of boarding for air and sea travel, in addition to a second RT-PCR screening upon arrival at the country border, was among the measures imposed by the local government in Northern Cyprus. This was later followed by the implementation of a one-week quarantine procedure for all passengers arriving from high risk countries [4]. In this study, we aimed to evaluate the effectiveness of a double RT-PCR screening procedure for border surveillance. In order to determine the effectiveness of double RT-PCR testing, the results of two independently administered tests were evaluated in terms of chances of obtaining two false-negative or -positive results, two accurate results or either a false-negative or -positive result in one of the administered tests [5]. The conditional probability has been defined as the probability of event A, when it is known that an event such as B has occurred either by assumption or evidence [6] and has been denoted by P (A|B) or P (A/B). In order to determine the effect of the COVID-19 RT-PCR test on the probability of giving correct results, all scenarios, applied with a second RT-PCR test are discussed with conditional probabilities (Table 1). If the first test has a false-negative or -positive rate of 40%, the chances of obtaining two false-negative or two false-positive results declines to 16%. On the contrary, if the first test has a false-negative or -positive result, the chances of obtaining a second accurate test result would be 24%. These results indicate that the implementation of a second RT-PCR test at international borders allows for a 24% increase in the RT-PCR test confidence level.

Table 1
The conditional probabilities of the second PCR test result.

The conditional probabilities	Calculations
$P\left(T/T\right)$	$P(T) * P(T) = 0.60 \times 0.60 = 0.36$
$P\left(F/T\right)$	$P(F) * P(T) = 0.40 \times 0.60 = 0.24$
$P\left(T/F\right)$	$P(T) * P(F) = 0.60 \times 0.40 = 0.24$
$P\left(F/F\right)$	$P(F) * P(F) = 0.40 \times 0.40 = 0.16$

T = true test, F = false test where probability of true test $P(T) = 60\%$.

The results show that the probability of deriving at least one true test is

$$1 - P\left(\frac{F}{F}\right) = 1 - 0.16 = 0.84$$

The second test increased the probability of reaching at least one true test by 24%, indicating that the second test had a significant effect on reaching the correct test.

Double border-screening measures have also been implemented by Iceland during the pandemic. The use of a first test upon arrival and a second test after 5–6 days in a quarantine facility in Iceland was shown to minimize the risk of a false negative result which may lead to the spread of infection [7]. Several countries have established temporary travel arrangements between neighboring countries with similar COVID-19 incidence termed as 'travel bubbles' or 'travel corridors' and allow travel within their respective borders without on-arrival quarantine. Travel bubbles require strict surveillance and control measures to limit the importation of COVID-19 [8]. As an additonal international border surveillance measure against COVID-19, the use of trained biodetection dogs has been suggested as a preliminary screening method at country borders. Biodetection dogs may aid in the early identification and isolation of potential asymptomatic SARS-CoV-2-infected passengers, however this strategy has an average sensitivity of 82.63% and should be confirmed by RT-PCR testing [9,10].

The results of our study indicates that the implementation of a double testing procedure as a border-control measure represents a powerful strategy to increase the effectiveness of RT-PCR screening and to lift confinement restrictions during the COVID-19 pandemic.

Authors' contributions

BB and TS conceived the study. BB, DUO, BU and TS wrote the manuscript. All authors collaborated on content development,

https://doi.org/10.1016/j.jiph.2021.03.012

revised the manuscript and approved the final version of the manuscript.

Funding

No funding sources.

Competing interests

None declared.

Ethical approval

Not required.

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9 February 2021