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Commentary

Body temperature screening to identify SARS-CoV-2 infected young adult travellers is ineffective

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Dear Editor,

We are writing this letter to the editor of "*Travel medicine and Infectious Diseases*" to alert readers of the futility of body temperature screenings at airports and border entry points.

Body temperature screening (fever) is the primary test performed at the borders of some countries and concerns have been raised about its efficacy [1]. A recent study suggests low efficiency of such screening procedures among hospitalized patients [2]; however, data are lacking for young adults who often present with mild or asymptomatic disease. Crucially, this is the part of the population considered to be highly contagious [3]. This is also the population segment most likely to travel and encounter body temperature screening which has been implemented at airports around the world.

Data from previous outbreaks of other viruses (Ebola, Influenza H1N1) suggest that the number of cases detected by screening for body temperature is minimal or non-existent. SARS-CoV-1 screening procedures in Canada, Singapore, and Australia seem to have detected zero cases overall. Simulations performed modelling COVID-19 suggest that, at best, 44% of cases could be detected during exit screenings using body temperature measurements [4,5].

We evaluated the body temperature of 84 COVID-19 patients twice daily for fourteen days after diagnosis by PCR. These patients were part of a cohort of young (median age 21), predominantly male recruits in military basic training of the Swiss Armed Forces. The outbreak of COVID-19 as well as the demographic characteristics of this cohort is described elsewhere [3].

The tympanic temperature of symptomatic patients with PCR confirmed COVID-19 was significantly higher than the temperature of unaffected controls (Fig. 1A), but the distribution density curves of temperatures overlap considerably between both groups. Sensitivity and specificity were calculated by comparing the two groups (Fig. 1B, receiver-operator-characteristics ROC curve): While a traditional fever cut-off value of 38.0 °C detected only 18% of COVID-19 cases (although with 100% specificity in our cohort), a much lower cut-off value of 37.1 °C allowed us to detect 63% of the cases with a reduced specificity of 95%. Since the control data was recorded in a group of almost exclusively men and during wintertime in the Swiss alps, such a low cut-off temperature is likely to result in many false-positives if women are included, if climatic conditions are warmer, or if other respiratory infections (such as rhinovirus, parainfluenza virus, respiratory syncytial virus) which cause slightly elevated body temperatures, are co-circulating.

The temperature data started was collected on the day recruits presented with symptoms, and not at random, thus, the sensitivity is probably overestimated, since body temperature is highest at the day of presentation: Shortly after presentation, body temperature normalized

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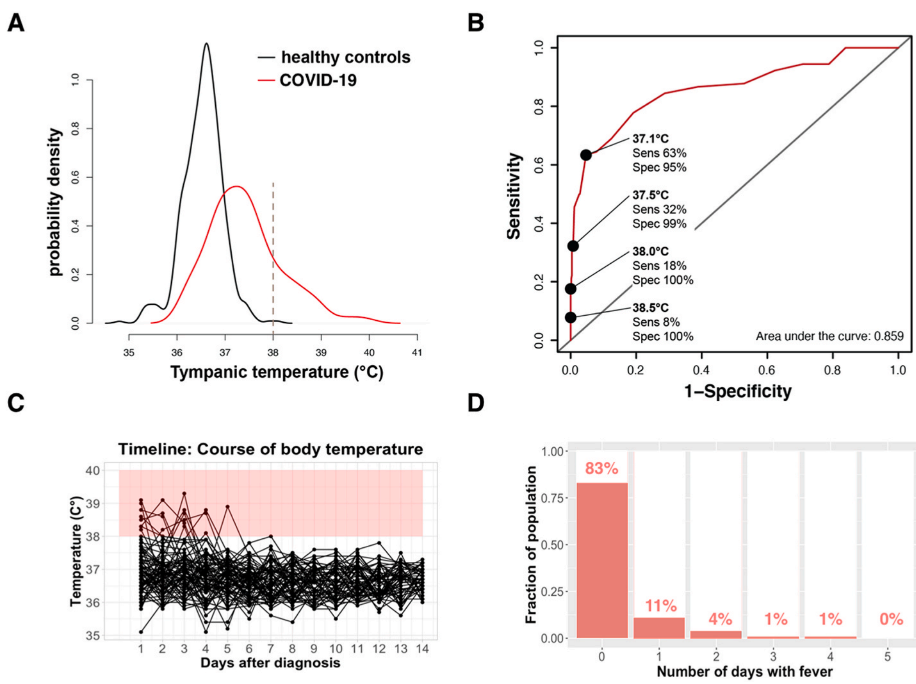

Fig. 1. (A) Probability density of temperature of healthy controls (black, n = 703 measurements of 132 individuals) and of patients presenting symptomatically and testing positive for SARS-CoV-2 by nasopharyngeal swab at the time of presentation (red, n = 81). While the temperature of patients with COVID-19 was significantly higher than of healthy controls, the curves overlap considerably. (B) Sensitivity and specificity of temperature as a screening tool. While a temperature cut-off value of 37.1% does allow identification of 63% of the cases, the specificity is only 95% and probably over-estimated. A fever cut-off of 38 °C only allows identification of the minority of cases, while an even higher cut-off value of 38.5 °C misses 92% of all COVID-19 patients at the time of presentation. (C) Longitudinal change of temperature in 84 patients with COVID-19. Temperature curves of individual patients. Fever (>= 38 °C is shown in red). No patient had a fever after day 4. (D) Histogram of the number fever-days with at least one measurement >38 °C of 84 patients. 83% of our cohort never exhibited fever (0 days > 38°).

(Fig. 1C), and after five days, no patient had fever anymore, while infectivity is reported to last up to 10 days post-infection. 83% of our patients never developed a fever and, with one exception, no one suffered from fever for longer than three days (Fig. 1D). In our evaluation of young army recruits, a temperature cut-off of 38 °C only allows for the identification of the minority of cases, while an even higher cut-off value of 38.5 °C misses 92% of all COVID-19 patients at the time of presentation in this age category.

Screening for fever is not sensitive enough to detect the vast majority of COVID-19 cases in the age group between 18 and 25 years. Even a low-temperature cut-off value of 37.1 °C will miss more than a third of symptomatic cases of COVID-19 on the day of diagnosis and will cause a large number of false-positives.

The CDC considers screening employees for temperature as a possible strategy to combat the further spread of COVID-19 [6]. This raises the need to develop new clinical criteria to detect cases of COVID-19 as temperature-based random screening proves to be virtually useless for young adults as shown here in our evaluation.

We reinforce the WHO's recommendation that widespread testing for SARS-CoV-2 is currently the only available efficient way to monitor the trajectory of the infection and control the spread of COVID-19. Screening temperature at borders is a strategy that has been pursued in the past and has proved to be both expensive and ineffective. We advocate the evaluation of, novel non-invasive screening approaches, such as testing saliva samples for SARS-CoV-2 with rapid follow-up on positives. This may prove to be a fast and more sensitive alternative to body temperature screening at borders.

CRediT authorship contribution statement

Michel Bielecki: Conceptualization, Investigation, Formal analysis, Writing - original draft. **Giovanni Andrea Gerardo Crameri:** Investigation, Writing - review & editing. **Patricia Schlagenhauf:** Conceptualization, Writing - review & editing. **Thomas Werner Buehrer:** Project administration, Writing - review & editing, Funding acquisition. **Jeremy Werner Deuel:** Conceptualization, Investigation, Formal analysis, Supervision.

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