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Effectiveness of measuring body temperature in combating COVID-19: a literature review

Eficácia da aferição de temperatura corporal no combate a COVID-19: uma revisão bibliográfica

Giovana Muniz Beni[1], Isabela Pontarolo Gomes[1], João Eduardo Carvalho[1], Julia Naomi Koga[1], Lucas Gabriel Pereto Silva[1], Gustavo Lenci Marques[2], Bernardo Machado Montesanti de Almeida[3]

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ABSTRACT: Introduction: In December 2019, the first case of COVID-19 emerged, which in the following months became a pandemic disease. Among the main symptoms associated, fever, cough and vomiting are the most recurrent. For this reason, in the search to reduce contamination in public environments, several establishments started to perform screenings by measuring the temperature at the entrances and / or exits, in order to identify possible contaminated individuals. This review aims to evaluate the effectiveness of this screening method for the diagnosis of COVID-19. Methodology/Results: This review was developed from the search for articles in the electronic database Pubmed, using the descriptors "Fever", "Body Temperature", "Mass screening", "Diagnosis" and "COVID-19". The selection of articles was carried out in blind pairs and resulted in the collection of 8 articles. The exposure and discussion of the results concerns viral transmission in the oligosymptomatic phase, use of thermometers and epidemiological impact. Discussion and Conclusion: The current literature does not present sufficient evidence favorable to the use of temperature screening and several studies are against its use, given low specificity and sensitivity. On the other hand, there are positive secondary gains, such as awareness of the pandemic and warning about the necessary care at this moment.

Keywords: Fever; Body temperature; Mass screening; Diagnosis; COVID-19.

RESUMO: Introdução: Em dezembro de 2019 surgiu o primeiro caso de COVID-19, a qual nos meses seguintes se tornou uma doença de caráter pandêmico. Dentre os principais sintomas associados a tal, febre, tosse e vômito são os mais recorrentes. Por esta razão, na busca por reduzir a contaminação em ambientes públicos, diversos estabelecimentos passaram a realizar triagens por aferição de temperatura nas entradas e/ou saídas, visando identificar possíveis indivíduos contaminados. Esta revisão visa avaliar a eficácia deste método de triagem para diagnóstico de COVID-19. Metodologia/Resultados: Esta revisão foi desenvolvida a partir da busca de artigos na base eletrônica de dados Pubmed, utilizando os descritores "Fever", "Body Temperature", "Mass screening", "Diagnosis" e "COVID-19". A seleção dos artigos foi realizada em pares às cegas e resultou na coleta de 8 artigos. A exposição e discussão dos resultados se diz respeito à transmissão na fase oligossintomática, uso dos termômetros e impacto epidemiológico. Discussão e Conclusão: A atual literatura não apresenta evidência suficiente favorável ao uso da triagem por temperatura e diversos estudos são contrários ao seu uso, dado baixa especificidade e sensibilidade. Em contrapartida, há ganhos secundários positivos, tais como a conscientização sobre a pandemia e o alerta sobre os cuidados necessários neste momento.

Descritores: Febre; Temperatura corporal; Triagem em massa; Diagnóstico; COVID-19.

1. Pontifícia Universidade Católica do Paraná, Faculdade de Medicina – Curitiba – PR. Discente do curso de medicina. ORCID: Beni GM: https://orcid.org/0000-0002-1024-141X; Gomes IP: https://orcid.org/0000-0002-5947-8442; Carvalho JE: https://orcid.org/0000-0002-1672-1967; Koga JN: https://orcid.org/0000-0002-7856-2279; Silva LGP: https://orcid.org/0000-0003-1220-2251. E-mail: giovanabeni@hotmail.com, isa-pontarolo@hotmail.com, naomi.juliak@gmail.com, joaoec95@gmail.com, lucaspereto@hotmail.com.
2. Pontifícia Universidade Católica do Paraná. Universidade Federal do Paraná, Faculdade de Medicina – Curitiba – PR. Docente do curso de medicina. ORCID: https://orcid.org/0000-0002-6057-0350. E-mail: gustavo.lenci@pucpr.br.
3. Universidade Federal do Paraná, Faculdade de Medicina – Curitiba – PR. Infectologista. ORCID: https://orcid.org/0000-0001-5293-3652. E-mail: machado_de_almeida@hotmail.com.
Mailing address: Gustavo Lenci Marques. Rua Imaculada Conceição, 1155 - Prado Velho, Curitiba – PR. CEP: 80215-901

INTRODUCTION

In December 2019, the disease we now call COVID-19, caused by the viral pathogen SARS- CoV-2, had its first case in Wuhan province. In the following months, COVID-19 became a pandemic and its rate of infection is increasing, as well as morbidity and mortality. Among the symptoms of COVID-19, fever, cough and vomiting are the most recurrent[1,2].

Because fever is a common clinical manifestation in most infectious diseases, the measurement of body temperature is considered a way to assess the health of potentially infected people[3]. According to the World Health Organization (WHO), rectal temperature ≥38◦C or axillary ≥37.5◦C are indicative of fever, meanwhile for oral measurement, most authors agree that the threshold is >37.7 °C[4]. Thus, the process of body temperature monitoring is present in the current pandemic in several environments, with emphasis on air and road transport, public spaces and hospitals, acting as an attempt to minimize contagion by Sars-CoV-2.

Likewise, the measurement of body temperature was also present in other pandemics of infectious diseases such as Sars-cov 1, Influenza and Ebola[5]. In all cases, the main devices used for real-time body screening were non-contact infrared thermometers (NCITs) and infrared thermographs (IRTs)[6].

However, the shortcomings of this method must be considered[7]. Data obtained after its application during outbreaks of the viruses cited above suggest that screening by body temperature is not effective for detection of infected individuals[5], which may have its insufficiency punctuated: disease transmission during the oligosymptomatic phase - individuals do not have fever or cough - and inappropriate use of thermometers due to interference from external factors such as ambient temperature, air flow, non-standard calibration and even the absence of a consensus on the definition of fever through the IRTs and NCITs, making it difficult to effective screening.

Therefore, the objective of this research is to evaluate, through the literature review, whether the screening from the measuring body temperature is effective for detecting possible COVID-19 infected and whether it has an impact from an epidemiological point of view.

METHODOLOGY

The development of this study was carried out from a literature review on the effectiveness of measurement of body temperature during the COVID-19 pandemic.

Data collection was performed by searching for articles in the electronic database, Pubmed. In order to perform the selection, the MeSH platform was used to form the following search descriptors: Fever, Body temperature, Mass screening, Diagnosis, COVID-19. The inclusion criteria was: articles selected for their relevance, published in 2020. In addition, the review was executed working in pairs, independent reviewers included studies based on title, abstract and full manuscript reading and disagreements were solved with a third reviewer.

The exposition and discussion of the obtained results concerns the following three analytical conceptions: transmission in the oligosymptomatic phase; use of thermometers and epidemiological impact

RESULTS

Performing the initial search, with the descriptors and inclusion criteria in the Pubmed platform, the result obtained was 7824 articles; then 108 articles were selected by title; of these, 16 were then filtered by abstract; finally, there were 8 left after the complete reading. The following flowchart demonstrates this process.

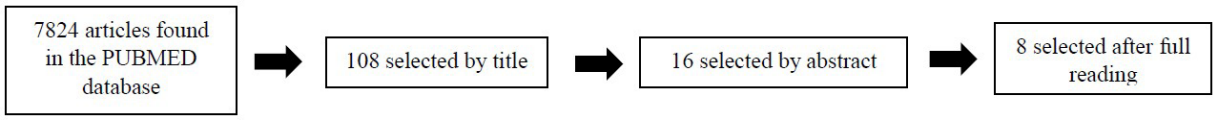

Figure 1 – Selection of the articles

Table 1 – Title and general characteristics of the articles target of this study

Title of the articles	Country/Year	Resume
Evaluation of a telethermographic system for temperature screening at a large tertiary-care referral hospital during the coronavirus disease 2019 (COVID-19) pandemic	United States 2020	This study showed that the telethermogrsphic system improves screening performance and report similar temperatures to those recorded by temporal scanners, having na acceptable payback time
Temperature screening has negligible value for control of COVID-19	Australia 2020	In this australian study, the fever screening showed up with low sensitivity for detecting individuals with COVID-19, seeing as this was na unusual sympton among hospital patients tested positive for SARS-Cov-2

Table 1 – Title and general characteristics of the articles target of this study

Title of the articles	Country/Year	Resume
Clinical evaluation for fever-screening thermography: impact of consensus guidelines and facial measurement location	United States 2020	Clinical Study with 596 showed that temperatures IRT-based and reference (oral) temperatures varies greatly depending on the facial measurement location.
Clinical features of patients with covid-19: is temperature screening useful?	United States 2020	Most patients with positive test for covid-19 didn't present fever of 38°C at the measurement. Using only temperature to track COVID-19 will be ineffective and will no longer identify most patients with active disease.
Measurement of body temperature to prevent pandemic COVID-19 in hospitals in Taiwan: repeated measurement is necessary	Taiwan 2020	This letter points out that in order to measure the temperature more accurately, it is necessary for individuals to be acclimatized to the environment in which the screening will be performed, since this method can be influenced by environmental factors such as external temperature, wind, rain and the use of antithermal medications by the patient.
Covid-19 screening: are forehead temperature measurements during cold outdoor temperatures really helpful?	Austria 2020	Study that evaluated the infrared temperature of the face of 101 hospital employees and proved to be inappropriate for the screening of infectious diseases
Estimated effectiveness of symptom and risk screening to prevent the spread of COVID-19	United States 2020	Traveller screening is being used as a strategy to limit the spread of COVID-19 worldwide, however, it's estimated that more than half of the infected people won't be detected because they don't have symptoms yet and for transmitting the disease before they appear. In addition to screening, some countries have adopted another measure to prevent the contagion: the quarantine of travelers coming from locations with a high transmission rate. A screening process model was proposed, comprising a questionnaire on exposure and risk of individual contagion and the presence or absence of symptoms, in order to obtain a larger screening area and block the horizontal transmission.
Body temperature screening to identify SARS-CoV-2 infected young adult travellers is ineffective	Switzerland 2020	The use of temperature measurement as a transmission barrier proved to be insufficient to detect cases of COVID-19 in the age group presented by the survey, from 18 to 25, since fever is not sensitive enough to diagnose the disease. The WHO recommendation was reinforced by the research that shows that PCR test is the only efficient way to monitor and control the infection.

DISCUSSION

Initial studies have shown that the accuracy of temperature measurement can be effective for detecting COVID-19 cases. This can be proven through Zhou et al.[7], who measured the temperature of 17 regions of the face using thermal imaging in 596 participants comparing with oral thermometry of each individual and used the Receiver Operating Characteristic (ROC) and area under the curve (AUC) curves for statistical analysis. Following the guidelines and recommendations of the International Commission on Electrotechnics (IEC) and the ISO/TR 13154, the measurement of temperature using infrared thermographs (IRTs) presented an improvement in measurement accuracy and detection of febrile individuals as it presented good results with high values of AUC. However, even with these positive results, about 73% of cases have a state febrile, causing approximately ¼ of individuals not to be tracked by temperature, which may be epidemiologically worrisome. In addition, the Centers for Disease Control and Prevention (CDC) establishes 38°C as the cutoff value to assess the presence of fever, however, the study showed that 60% of individuals with fever values above 37.5º did not exceed the diagnostic limit recommended by the CDC. Finally, IRT-based screening is not feasible for screening individuals infected with diseases. However, it can be useful if done in conjunction with an assessment of a range of symptoms.

Continuing the search for trying to make the temperature measurement more accurate and efficient to diagnose infected individuals, Leach et al.[8] pointed out that the use of telethermographs is preferable in comparison with temporal artery thermometers. The reason for this is the need to employ several individuals to perform it, while telethermographs are able to measure the temperature of a greater number of people at the same time without needing direct intervention and, therefore, reducing the requirement of human resources for such a task. Another point to be highlighted is the temperature measurement as a discouraging factor for symptomatic individuals not to

enter public places for fear of being identified. However, whether by the use of telethermographs or employees, the budget needed to implement both strategies should be considered as a limiting factor.

In contrast to the use of screening by temperature, Mitra et al.[9] demonstrated that the measurement of temperature was not an effective method for detecting patients with COVID-19, as fever was an unusual symptom in the initial stages of the disease, which in addition to not being effective in screening, can lead to a false sense of security, as it would not impede the circulation of infected individuals and the spread of the disease. Therefore, social distancing and self-isolation when infected are possibly more effective than wide temperature screening.

The low frequency of fever as a negative factor to the use of temperature screening was also observed by Vilke et al.[10] at the Department of Medical Emergency at the University of California at San Diego. In this research, 6894 individuals were tested for diagnosis of COVID-19, which also were submitted to a questionnaire and screened by temperature. Of this group, only ⅕ of those diagnosed with disease developed fever above 38ºC, reinforcing the ineffectiveness of this screening method.

Another problem with this method is the existence of a large number of variables related to the environmental factors that can affect the measurement such as outdoor temperature, wind, rain and even the use of antipyretic medications by the patient. We still know that to measure the temperature more accurately it is necessary for individuals to be acclimatized long enough to the environment in which the screening will be carried out, which is not always consistent with daily life[11].

Corroborating this idea, Dzien et al.[12] measured, through an infrared thermometer, 92 participants who were wearing winter clothing. The external temperature was determined between 0 to -5.5 °C, and after arrival, patients remained seated at the entrance of the establishment, where many measurements were made. Measurements took place between 7 and 8 AM upon arrival and then within minutes 1, 3, 5 and 60. In the moments after entry, the temperature varied significantly until reaching a stationary state after 1 hour, the values found were an increase of about 0.8 °C within the ranges marked, reaching a difference of 3.4 °C between the first and the last measurement. Thus, despite being a fast and economical process, testing the forehead temperature is not effective for detection of infectious diseases, mainly during winter and early spring due to low temperatures external and by being influenced by the environment.

In addition, there is a mathematical model that evaluated the parameters for an efficient global response against the spread of COVID-19. Gostic et al.[13] estimated that, taking into account the natural history and epidemiological factors of COVID-19, screening (performed by measuring temperature and questionnaire) will not identify the majority of infected travelers and that the effectiveness of tracking is inversely proportional to the growth of the epidemic. This is because this type of tracking has difficulty to detect individuals during or shortly after the incubation period or shortly after the onset of symptoms; that problem is aggravated the longer the incubation period is. This way, screening is also influenced by exposure risk factors that contribute to the detection of specific cases and have reasonable sensitivity to the questionnaire. However, questionnaire-based screening has limited effectiveness because it depends on the honesty of the passenger when reporting their exposure. So, even with the joining of these two, many infected were not identified in this screening model, since most of the failures are due to these cases (asymptomatic or those who are not aware of their exposure). Furthermore, some measures can potentially reinvigorate the screening model presented, such as improving the efficiency of technologies related to symptom detection (thermal scanners), refinement of questionnaires as risk factors become better known and rapid CRP tests available for detection of those infected already at the entrance of the sites (however, if this measure is carried out in high proportion, may be costly).

Finally, Bielecki et al.[5] conducted a study in the Swedish armed forces that reinforces points covered. In this, 94 military men who tested positive for COVID-19 had their temperatures measured twice a day for 14 days. The results showed that only 18% of these patients were detected with fever at the threshold of 38°C and, when used 37.1°C as a parameter, 63% were identified. Despite the low sensitivity, the specificity was adequate. In addition, after 5 days only 1 individual had fever, while the others, even being in the contagious period, no longer had fever. Thus, the work itself reinforces that the temperature measurement is not enough to track the most cases of COVID-19

Therefore, the review demonstrates that there is no favorable evidence to perform the screening through the body temperature in infectious disease outbreaks due to the influence of external factors, fever being a unusual symptom in infected individuals, difficulty in implementing the appropriate standards for measuring large scale, difficulty in identifying symptoms during the incubation period and the formation of queues for screening that can compromise social distance depending on the environment. Also, hiring a person to carry out the screening is a waste of money and effort, as they could act by encouraging the social distancing measures, proper use of masks and encouragement of hand hygiene. In short, this screening strategy has minimal benefits and should be considered cost and benefit at the application site, in addition to its effectiveness in relation to other prevention strategies.

CONCLUSION

There is not enough evidence to support the use of temperature screening. At the same time, several literatures are against the use of this method, given its low accuracy. However, there are secondary positive gains, such as raising awareness about the existence of the pandemic and warning about the necessary care during this time

Thus, it is necessary to reconsider this tracking strategy and seek new non-invasive approaches for this. Still, we must reiterate that above all social distancing and proper use of masks are still the most effective measure to prevent contagion.

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