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RESEARCH ARTICLE

FACIAL FLUSHING IN COVID-19: SUBCLINICAL CHARACTERISTIC UNRECOGNIZED AND INVISIBLE TO THE NAKED EYE

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ABSTRACT

Early diagnosis of coronavirus disease 2019 (COVID-19) is crucial for disease treatment and control. The clinical characteristics in patients infected with COVID-19 most commonly manifest fever, cough and fatigue, which in some patients can be accompanied by runny nose, headache and other symptoms. Additional symptoms such as diarrhea are less common. All research about the clinical characteristics of COVID-19, none of COVID-19 research mentioned that facial flushing was a clinical feature that could be found. The invisible facial flushing, unrecognized clinical sign with the naked eye could be detected by the smartphone application in the COVID-19 patients. This novel screening tool for COVID-19 patients will be potential for early diagnosis and may be used in conjunction with thermoscan camera as front line screening and diagnostic capacity. It will help all medical service providers the effective screening tool for the recognition and early diagnosis before performing CT scans and real-time RT-PCR (rRT-PCR) assays, especially in some health care facilities where could not be performed due to lack of laboratory support. Furthermore, application in active case finding for COVID-19, the key actions to stop transmission is challenging in countries with community transmission.

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INTRODUCTION

Early diagnosis of coronavirus disease 2019 (COVID-19) is crucial for disease treatment and control. The clinical characteristics in patients infected with COVID-19 most commonly manifest fever, cough and fatigue, which in some patients can be accompanied by runny nose, headache and other symptoms. Additional symptoms such as diarrhea are less common (Huang *et al.*, 2020). All research about the clinical characteristics of COVID-19, none of COVID-19 research mentioned that facial flushing was a clinical feature that could be found (Huang, 2020; Guan *et al.*, 2020; Chen *et al.*, 2020; Wang *et al.*, 2020). Generally, if we look for facial flushing in patients with COVID-19 with the naked eye, it will be difficult to see easily, as the skin color on the faces of different patients is obscured for us to be clearly observed and it will be dependent on multiple factors such as races, skin color, skin pigmentation, anemia status, and observer bias. We reported invisible facial flushing in two cases of dengue infection and influenza detected by PC

program and smartphone app: decorrelation stretching and K-means clustering (Arpornsuwan, 2020). The decorrelation stretch is a process that is used to enhance (stretch) the color differences found in a color image. It has been used in remote sensing to enhance multispectral images. The National Aeronautics and Space Administration (NASA) has developed a decorrelation stretching method and successfully applied it to enhance the color information of the images and to show up very faint color changes that are almost invisible to the eye. Decorrelation stretching is used to enhance color differences in images with high interchannel correlation. Therefore, it allows us to see details that are otherwise not so obvious or invisible to the human eye (Alley, 1996; Harman, 2005). With this process, we could detect invisible facial flushing about 94.7% of dengue patients in comparison with seeing with the naked eye found in only half of the dengue patients (Arpornsuwan, 2020; Sirivichayakul, 2012). We could apply this innovative method to the COVID-19 patient too, because the clinical signs and symptoms, including the immunopathogenesis of dengue infection are also similar to COVID-19 (Tisoncik *et al.*, 2012; Ye *et al.*, 2020). We demonstrated the invisible facial flushing in COVID-19 patient rapidly detected by smartphone application (Arpornsuwan, 2020). This subclinical discovery with a novel method using the Rock Art Enhancer app (only

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for Android smartphone) in three step technique uses a combination of decorrelation stretching for enhancing the colors in photos to make faint features more visible and with color thresholding for image segmentation (Dunk, 2019). This is the first case of the COVID-19 patient with the appearance of invisible facial flushing detected by the smartphone application. The process and interpret the finding are rapidly within 1 minute for three step technique. So the enhanced face photos using the smartphone application may be useful as a rapid screening tool for diagnosis of COVID-19 patients. In conclusion, if the invisible facial flushing, unrecognized clinical sign with the naked eye could be detected by the smartphone application is the most common clinical features of Coronavirus disease 2019, this novel screening tool for COVID-19 patients will be potential for early diagnosis and may be used in conjunction with thermoscan camera as front line screening and diagnostic capacity. It will help all medical service providers the effective screening tool for the recognition and early diagnosis before performing CT scans and real-time RT-PCR (rRT-PCR) assays, especially in some health care facilities where could not be performed due to lack of laboratory support. Furthermore, application in active case finding for COVID-19, the key actions to stop transmission is challenging in countries with community transmission.

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