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How fever is defined in COVID-19 publications: a disturbing lack of precision

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Abstract

Objectives: Fever is the single most frequently reported manifestation of COVID-19 and is a critical element of screening persons for COVID-19. The meaning of "fever" varies depending on the cutoff temperature used, the type of thermometer, the time of the day, the site of measurements, and the person's gender and race. The absence of a universally accepted definition for fever has been especially problematic during the current COVID-19 pandemic.
Methods: This investigation determined the extent to which fever is defined in COVID-19 publications, with special attention to those associated with pregnancy.
Results: Of 53 publications identified in which "fever" is reported as a manifestation of COVID-19 illness, none described the method used to measure patient's temperatures. Only 10 (19%) publications specified the minimum temperature used to define a fever with values that varied from a 37.3 °C (99.1 °F) to 38.1 °C (100.6 °F).
Conclusions: There is a disturbing lack of precision in defining fever in COVID-19 publications. Given the many factors influencing temperature measurements in humans, there can never be a single, universally accepted temperature cut-off defining a fever. This clinical reality should not prevent precision in reporting fever. To achieve the precision and improve scientific and clinical communication, when fever is reported in clinical investigations, at a minimum the cut-off temperature used in determining the presence of fever, the anatomical site at which temperatures are taken, and the instrument used to measure temperatures should each be described. In the absence of such information, what is meant by the term "fever" is uncertain.

Keywords: covid-19; fever; pregnancy; temperature; thermometer.

Introduction

Physicians since antiquity have regarded fever as an entity worthy of unremitting attention, and for nearly two centuries have had instruments with which to verify its existence. Given the medical profession's intense interest in fever since time immemorial, one would expect there to be a universally accepted definition of the entity. In physiological terms, there is such a definition: "a state of elevated core temperature, which is often, but not necessarily, part of the defensive response of multicellular organisms to invasion by live microorganisms or inanimate matter recognized as pathogenic or alien by the host" [1, 2]. Unfortunately, this particular definition is clinically useless, because lack of agreement as to the meaning of "a state of elevated core temperature." Despite millennia of clinical attention devoted to elevated body temperatures, no universally accepted thermal definition of fever exists to this day.

The absence of such a universally accepted definition has been especially problematic during the current COVID-19 pandemic. "Fever" is the single most frequently reported manifestation of the illness and, as such, its detection is a critical element of programs screening persons for the infection. In one of the earliest published series of COVID-19 cases, Huang [3], detected fever in 40 of 41 (98%) of cases, cough in 31 (76%), and myalgia or fatigue in 18 of 41 (44%). In another report by Guan [4], 43.8% of COVID-19 cases were febrile on admission to hospital, whereas 88.7% were febrile at some time during the hospitalization. In pregnant women infected with COVID-19 fever has been equally common. In a review of 13 publications concerned with the infection in pregnant women,

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fever, along with cough and chest pain were the most common manifestations of the illness [5, 6].

While universally accepted normal ranges have been established for other vital signs, temperature continues to be a notable exception. There is no agreement as to the upper limit of the normal temperature range in humans (i.e., the temperature that defines the lower limit of the febrile range). Moreover, publications involving "febrile" patients rarely include a definition of fever or the method and anatomic location employed in measuring patients' temperatures. These oversights are critical, given the fact that patients' temperatures vary according to the location at which measurements are taken (e.g., oral, tympanic, axillary, rectal, skin), the type of thermometer used (e.g., contact, non-contact, handheld thermal scanner), time of day, and patients' gender and race [7, 8].

A reliable means of detecting the presence of fever is especially important during pregnancy, because of its relevance not just to the health of the mother, but also that of the fetus and in turn, that of the newborn baby. Pregnant women's temperatures are routinely taken on admission to the labor and delivery suite [9]. However, given the complexities surrounding patients' temperatures described above and the absence of a universal definition of what constitutes a "fever," interpretation of such measurements with regard to the febrile state is far from straight forward.

In undertaking this investigation, we sought to determine the extent to which fever is defined and the methods used to measure patients' temperatures are described in published reports of COVID-19-infected patients in general and pregnant women in particular. Given that detection of fever is the principal method used to screen persons for COVID-19 (and for that matter infections in general), and that fever is the most common symptom reported in COVID-19 patients, we believe that such information should be included in every publication concerned with the clinical characteristics of the infection.

Methods

We conducted a literature search using PubMed and Google Scholar, covering the period January 2020 to June 2020. We focused on pregnancy during the COVID-19 pandemic because of its growing clinical significance world-wide and also to limit our search to a manageable size. Publications considered for analysis were identified by the presence of the following search terms in the title or abstract: COVID **OR** coronavirus **OR** SARS-CoV-2 **AND** pregnancy. We also reviewed other online coronavirus/COVID-19 publications cited frequently in the COVID-19 pregnancy literature. Publications mentioning an elevated temperature or fever as a manifestation of COVID-19 were examined for their definition of fever (i.e., a specific temperature defining the lower limit of the febrile range) and a description of the method used in measuring patients' temperatures (i.e., instrument used and anatomic site examined).

Table 1: Fever cut-off for COVID-19 pregnant patients.

Temperature cut-off defining a fever	Measurement site[a]	Source
≥37.3 C (≥99.2 °F)	NG	Yang H et al. [10]; Chen Y, et al. [11]
>37.5 °C (>99.5 °F)	NG	Mao et al. [12]; Chen S, et al. [48]; González R, et al. [14]
>37.5 °C (>99.5 °F)	NG	Chen et al. J [11]
≥37.6 °C (≥99.7 °F)	NG	Liu, Y et al. [13]; Liu D, et al.· [15]
≥37.8 °C (≥100 °F)	NG	Breslin N et al. [16]
≥38.0 °C (≥100.4 °F)	NG	Acog·org accessed 7/6/ 2020; Ellington S, et al. MMWR Morb Mortal Wkly Rep 2020 [18]
>38.0 °C (>100.4 °F)	NG	Richardson et al. JAMA 2020 [17];

[a]NG, not given.

Results

Three hundred thirty-four publications with COVID **OR** coronavirus **OR** SARS-CoV-2 **AND** pregnancy in the abstract or title were identified. Of these, 53 included the term "fever" [10–35] [36–62] as a manifestation of COVID-19. None of these 53 publications (0/53) described the method used in measuring patients' temperatures. Only 10/53

Table 2: Fever cuf-off for COVID-19, non-pregnant patients.

Temperature cutoff defining a fever	Measurement site[a]	Reference
≥37.0 °C (≥98.6 °F)	Axilla	Zhuang SF, et al. [63]
≥37.2 °C (≥99 °F)	NG	Liu Y, et al. [64]
≥37.3 °C (≥99.2 °F)	NG	Na Du, et al. [65]
>37.3 °C (>99.2 °F)	NG	Lauxmann MA [66]
≥37.5 °C (≥99.5 °F)	Axilla	Guan W, et al. [4], González R, et al. [14]; Ciceri F, et al. Clin Immunol 2020 [67]
>37.5 °C (>99.5 °F)	NG	Mao B, et al. [12]
>37.8 °C (>100 °F)	NG	Brill SE, et al. BMC Med 2020 [68]; Chen/Guo [55]
≥38.0 °C (≥100.4 °F)	NG	Mitra B, et al. Emerg Med Australas 2020 [69]
≥38.0 °C (≥100.4 °F)	Oral	Alsofayan YM, et al. J Infect Public Health 2020 [70]
>38.0 °C (>100.4 °F)	NG	Hashmi HAS, Asif HM [71] Pongpirul WA, et al. [72]; Okoh AK, et al. [73]
>38.5 °C (>101.3 °F)	NG	Li TZ, et al. [74]

[a]NG, not given.

Table 3: Fever cut-off for non-COVID-19, pregnant patients.

Fever definition	Measurement site	Measurement site reference
Morning:>37.2 °C (98.9 °F) or >37.7 °C (>99.9 °F)	Oral	https://www·uptodate·com/contents/pathophysiology-and-treatment-of-fever-in-adults [75]
>37.8 °C (>100.0 °F)	NG	Romero et al. [76]; Yoon [77]
≥38 °C	NG	Towers et al. [79]
>38 °C (>100.4 °F)	NG	Hospital-based Triage of obstetric patients ACOG Committee Opinion number 667; July 2016 [80]

Table 4: Fever cut-off for non COVID-19, non-pregnant patients.

Fever definition	Measurement site	Measurement site reference
37.7 °C (99.9 °F) upper limit normal	Oral	Mackowiak [81]
38.0 °C (100.4 °F) upper limit normal	Axilla	Wunderlich [82, 83][a]
≥38.3 °C (101 °F),	NG	Laupland [84]
A·M >37.2 °C (>98.9 °F) or P·M >37.7 °C (>99.9 °F)	Oral	Dinarello [85]
There is not a single agreed-upon upper limit for normal temperature with sources using values between 37.2 and 38.3 °C (99.0 and 100.9 °F) in humans	NG	Wikipedia [86]
≥38.0 °C (≥100.4 °F)	NG	CDC [78]

[a]Wunderlich's thermometers were calibrated 1.6–1.8 °C (2.9–3.2 °F) higher than current thermometers (7).

(19%) specified a minimum temperature used to define fever. Of those COVID-19/Pregnancy publications giving a minimum temperature used to define fever, values varied from a low of 37.3 °C (99.1 °F) to a high of 38.1 °C (100.6 °F) (Table 1). Similarly varied minimum temperatures used to define fever appeared in publications dealing with COVID-19-related fevers in non-pregnant patients (Table 2), in publications dealing with non-COVID-19-induced fevers in pregnant patients (Table 3), and in non-COVID-19/no pregnancy publications (Table 4).

Discussion

Our investigation revealed that, whereas most COVID-19 publications identify fever as a cardinal manifestation of the illnesses, a distinct minority of such publications gives the minimum temperature used to define fever. Almost none, including those containing a definition of fever, describes the method used to measure patients' temperatures. In effect, the authors of these publications, including a recent review of the pathophysiology of COVID-19 [86] almost universally ignore the clinical reality that patients' temperatures vary according to the site at which measurements are made, by the type of thermometer used, by time of day, by the patient's age, and whether the patient is pregnant.

The failure to describe the anatomic site at which measurements are taken is especially problematic, given the variation in temperature existing at various sites throughout the human body. Singh, for example, found temperatures measured with an electronic thermometer to differ between the right and left axilla [87]. The extent of such variation is illustrated further in a recent review by Geneva [88] that identified the following average temperatures for sites most often used in measuring patients' temperatures: rectal, 37.04 °C (98.7 °F), tympanic, 36.64 °C (98.0 °F), urine, 36.61 °C (97.9 °F), oral 36.57 °C (97.80 °F) and axillary, 35.97 °C (96.7 °F).

Temperature readings can also vary according to the type of instrument used. Traditionally, contact thermometers that are placed on the forehead or in the mouth, ear, axilla, or rectum have been used to monitor patients' temperatures. Non-contact thermometers, which have become the preferred instruments from an infection control standpoint when screening patients for COVID-19, allow temperatures to be taken with minimal (tympanic) or no (non-contact infrared thermal scanners) physical contact with the person being examined. There is no consensus as to the optimal cut-off temperature for determining the existence of a fever for each device.

Even among the few publications reviewed that do state clearly a minimum cut-off temperature for fever, considerable variation exists both as to what cut-off temperatures were chosen and the anatomic site at which temperature measurements were obtained. In a publication cited over 5,000 times in other works, Guan [4] identified fever (defined by them as an axillary temperature ≥37.5 °C [≥99.5 °F]) as the most common manifestation of COVID-19-induced illness, without specifying the type of thermometer used or the method by which axillary temperatures were obtained. In a study of COVID-19-infected, pregnant women, Breslin [16] defined fever as a temperature of "at least 37.8 °C (100.0 °F) without specifying either the type of thermometer used or the site at which measurements were taken. In a review of 108 pregnant women with COVID-19, Zaigham and Anderson [43] identified fever in 68% of cases

without defining the term. Moreover, only 5 of the 14 references they reviewed defined a cutoff for fever and none indicated how temperatures were measured. Reviews of COVID-19 during pregnancy by Dashraath [52], Rasmussen and Jamieson [38], Galang [89] and Della Gatta [90] also identified fever as a prominent manifestation of the illness without defining temperature cutoffs for fever or describing the methodology involved in measuring patients' temperatures.

Carl Reinhold Wunderlich (1815–1910) is credited with offering one of the earliest evidence-based definitions of fever derived from the results of an analysis of a vast number of axillary temperatures taken from patients in his clinic in the latter part of the 19th century [81, 82]. Based on these observations, he defined a *slight fe*ver as 38–38.4 °C (100.4–101.1 °F), a *moderate fever* as 38.5–39 °C (101.3–102.2 °F) and *considerable fever* as 39.5–40.5 °C (103.1–104.9 °F), with cutoffs lower in the morning than in the evening. Currently, according to *Harrison's Principles of Internal Medicine* [91], fever is defined as a core temperature (rectal) of 37.5–38.3 °C (99.5–100.9 °F), a skin temperature (axillary) >37.2 °C (>99 °F), a morning oral temperature >37.2 °C (>99 °F), or late afternoon oral temperature >37.7 °C (>99.9 °F), with lower thresholds applicable to frail elderly persons. The Merck Manual defines fever as an elevated body temperature (>37.8 °C (100.0 °F) orally or >38.2 °C (100.8 °F) rectally) or an elevation above a person's known normal daily value [92].

How fever is defined in pregnant women also varies. Based, in part, on a study of temperatures of normal parturients, which ranged from 34.6–37.6 °C (94.3–99.7 °F) upon admission to the labor unit, Acker [93] defined intrapartum fever as a maternal temperature ≥38 °C (100.4 °F) orally. Herbst [94] defined fever in pregnancy as "… at least one recorded temperature of ≥38.3 °C (≥101 °F)," whereas an expert panel [95] recommended defining fever during pregnancy as a single oral temperature of ≥39 °C (≥102.2 °F) or two readings of ≥38 °C (100.4 °F) taken 30 min apart.

Given the many factors influencing the results of temperature measurements in humans, there can never be a single, universally accepted temperature cut-off defining a fever. This clinical reality, however, should not prevent precision in reporting fever. To achieve the needed precision and thereby improve scientific and clinical communication, when fever is reported in clinical investigations, the cut-off temperature used in determining the presence of fever, the anatomical site at which temperatures are taken, and the instrument used to measure temperatures should each be described. In the absence of such information, what is meant by the term "fever" will remain uncertain.

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References

1. IUPS Thermal Commission. Glossary of terms for thermal physiology: second edition. Pflügers Archiv 1987;410:567–87.
2. Mackowiak PA. Concepts of fever. Arch Intern Med 1998;158:1870–81.
3. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497–506.
4. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020;382:1708–20.
5. Panahi L, Amiri M, Pouy S. Risks of novel coronavirus disease (COVID-19) in pregnancy; a narrative review. Arch Acad Emerg Med 2020;8:e34. PMID: 32232217; PMCID: PMC7092922.
6. Breslin N, Baptiste C, Miller R, Fyuchs K, Goffman D, Gyamfi-Bannerman C, et al. Coronavirus disease 2019 in pregnancy: early lessons. Am J Obstet Gynecol 2020;2:100111.
7. Mackowiak PA, Wasserman SS, Levine MM. A critical appraisal of 98.6°F: the upper limit of the normal body temperature, and other legacies of Carl Reinhold August Wunderlich. J Am Med Assoc 1992;268:1578–80.
8. Mackowiak PA, Wasserman SS. Physicians' perceptions regarding body temperature in health and disease. South Med J 1995;88:934–8.
9. American College of Obstetricians and Gynecologists' Committee on Obstetric Practice. Committee opinion no. 667: hospital-based triage of obstetric patients. Obstet Gynecol 2016;128:e16–9.
10. Yang H, Sun G, Tang F, Peng M, Gao Y, Peng J, et al. Clinical features and outcomes of pregnant women suspected of coronavirus disease 2019. J Infect 2020;81:e40–4.
11. Chen Y, Li Z, Zhang YY, Zhao WH, Yu ZY. Maternal health care management during the outbreak of coronavirus disease 2019. J Med Virol 2020;92:731–9.
12. Mao B, Liu Y, Chai YH, Yin XY, Lu HW, Yang JW, et al. Assessing risk factors for SARS-CoV-2 infection in patients presenting with symptoms in Shanghai, China: a multicentre, observational cohort study. Lancet Digit Health 2020;2:e323–30.
13. Liu Y, Chen H, Tang K, Guo Y. Clinical manifestations and outcome of SARS-CoV-2 infection during pregnancy. J Infect 2020;S0163–4453:30109–2.
14. González R, García-Otero L, Pons-Duran C, Marban-Castro E, Gonce A, Llurba E, et al. Hydroxychloroquine efficacy and safety in preventing SARS-CoV-2 infection and COVID-19 disease severity during pregnancy (COVID-Preg): a structured summary of a study protocol for a randomised placebo controlled trial. Trials 2020;21:607.
15. Liu D, Li L, Wu X, Liu S, Wang X. Pregnancy and perinatal outcomes of women with coronavirus disease (COVID-19) pneumonia: a preliminary analysis. AJR Am J Roentgenol 2020;215:127–32.

16. Breslin N, Baptiste C, Gyamfi-Bannerman C, Miller R, Martinez R, Bernstein K, et al. Coronavirus disease 2019 among asymptomatic and symptomatic pregnant women: two weeks of confirmed presentations to an affiliated pair of New York City hospitals. Am J Obstet Gynecol 2020;2:100118.
17. Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson K, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York city area. J Am Med Assoc 2020;323:2052–9.
18. Ellington S, Strid P, Tong VT, Woodworth K, Galang RR, Zambrano LD, et al. Characteristics of women of reproductive age with laboratory-confirmed SARS-CoV-2 infection by pregnancy status - United States, January 22–June 7, 2020. MMWR Morb Mortal Wkly Rep 2020;69:769–75.
19. Juan J, Gil MM, Rong Z, Zhang Y, Yang H, Poon LC. Effect of coronavirus disease 2019 (COVID-19) on maternal, perinatal and neonatal outcome: systematic review. Ultrasound Obstet Gynecol 2020;56:15–27.
20. Naqvi M, Zakowski P, Glucksman L, Smithson S, Burwick RM. Tocilizumab and Remdesivir in a pregnant patient with coronavirus disease 2019 (COVID-19). Obstet Gynecol 2020 Jun 30. https://doi.org/10.1097/AOG.0000000000004050 [Epub ahead of print].
21. Grimminck K, Santegoets LAM, Siemens FC, Fraaij PLA, Reiss IKM, Schoenmakers S. No evidence of vertical transmission of SARS-CoV-2 after induction of labour in an immune-suppressed SARS-CoV-2-positive patient. BMJ Case Rep 2020;13:e235581.
22. Rajewska A, Mikolajeck-Bedner W, Lebdowicz-Knul J, Sokolowska M, Kwiatkowski S, Torbe A. COVID-19 and pregnancy - where are we now? A review. J Perinat Med 2020;48:428–34.
23. Matar R, Alrahmani L, Monzer N, Debiane LG, Berbari E, Fares J, et al. Clinical presentation and outcomes of pregnant women with COVID-19: a systematic review and meta-analysis. Clin Infect Dis 2020 Jun 23:ciaa828. https://doi.org/10.1093/cid/ciaa828 [Epub ahead of print].
24. Pereira A, Cruz-Melguizo S, Adrien M, Fuentes L, Marin E, Perez-Medina T. Clinical course of coronavirus disease-2019 in pregnancy. Acta Obstet Gynecol Scand 2020;99:839–47.
25. Chaccour C, Ruiz-Castillo P, Richardson MA, Moncunil G, Casellas A, Carmona-Torre F, et al. The SARS-CoV-2 Ivermectin Navarra-IS Global Trial (SAINT) to evaluate the potential of ivermectin to reduce COVID-19 transmission in low risk, non-severe COVID-19 patients in the first 48 hours after symptoms onset: a structured summary of a study protocol for a randomized control pilot trial. Version 2. Trials 2020;21:498.
26. Ryan GA, Purandare NC, McAuliffe FM, Hod M, Purandare CN. Clinical update on COVID-19 in pregnancy: a review article. J Obstet Gynaecol Res 2020. https://doi.org/10.1111/jog.14321 [Epub ahead of print].
27. Marim F, Karadogan D, Eyuboglu TS, Emiralioglu N, Gurkan CG, Toreyin ZN, et al. Lessons learned so far from the pandemic: a review on pregnants and neonates with COVID-19. Eurasian J Med 2020;52:202–10.
28. Dana PM, Kolahdooz F, Sadoughi F, Moazzami B, Chaichian S, Asemi Z. COVID-19 and pregnancy: a review of current knowledge. Infez Med 2020;28(1 Suppl):46–51.
29. Zimmermann P, Curtis N. COVID-19 in children, pregnancy and neonates: a review of epidemiologic and clinical features. Pediatr Infect Dis J 2020;39:469–77.
30. Rabice SR, Altshuler PC, Bovet C, Sullivan C, Gagnon AJ. COVID-19 infection presenting as pancreatitis in a pregnant woman: a case report. Version 2. Case Rep Womens Health 2020 May 29;27: e00228. [Epub ahead of print].
31. Chen X, Li Y, Wang J, Cai H, Cao H, Sheng J. Pregnant women complicated with COVID-19: a clinical analysis of 3 cases. Zhejiang Da Xue Xue Bao Yi Xue Ban 2020;49:240–4.
32. Ovali F. SARS-CoV-2 infection and the newborn. Front Pediatr 2020;8:294.
33. Savasi VM, Parisi F, Patane L, Ferrazzi E, Frigerio L, Pellegrino A, et al. Clinical findings and disease severity in hospitalized pregnant women with coronavirus disease 2019 (COVID-19). Obstet Gynecol 2020;136:252–8.
34. Kasraeian M, Zare M, Vafaei H, Asadi N, Faraji A, Bazrafshan K, et al. COVID-19 pneumonia and pregnancy; a systematic review and meta-analysis. J Matern Fetal Neonatal Med 2020:1–8. https://doi.org/10.1080/14767058.2020.1763952 [Epub ahead of print].
35. Findeklee S, Morinello E. Clinical implications and economic effects of the corona virus pandemic on gynaecology, obstetrics and reproductive medicine in Germany-learning from Italy. Minerva Ginecol 2020 May 13. https://doi.org/10.23736/S0026-4784.20.04558-X [Epub ahead of print].
36. Penfield CA, Brubaker SG, Limaye MA, Lighter J, Ratner AJ, Thomas KM, et al. Detection of SARS-COV-2 in placental and fetal membrane samples. Am J Obstet Gynecol 2020;2:100133.
37. Chen S, Huang B, Luo DJ, Li X, Yang F, Zhao Y, et al. Pregnancy with new coronavirus infection: clinical characteristics and placental pathological analysis of three cases. Zhonghua Bing Li Xue Za Zhi 2020;49:418–23.
38. Rasmussen SA, Jamieson DJ. Coronavirus disease 2019 (COVID-19) and pregnancy: responding to a rapidly evolving situation. Obstet Gynecol 2020;135:999–1002.
39. Yang Z, Wang M, Zhu Z, Liu Y. Coronavirus disease 2019 (COVID-19) and pregnancy: a systematic review. J Matern Fetal Neonatal Med 2020:1–4. https://doi.org/10.1080/14767058.2020.1759541 [Epub ahead of print].
40. Irani M, Pakfetrat A, Mask MK. Novel coronavirus disease 2019 and perinatal outcomes. J Educ Health Promot 2020;9:78.
41. Martins-Filho PR, Santos VS, Santos HP Jr. To breastfeed or not to breastfeed? Lack of evidence on the presence of SARS-CoV-2 in breastmilk of pregnant women with COVID-19. Rev Panam Salud Públic 2020;44:e59.
42. Yan J, Guo J, Fan C, Juan J, Yu X, Li J, et al. Coronavirus disease 2019 in pregnant women: a report based on 116 cases. Am J Obstet Gynecol 2020;223:111.e1–e14.
43. Zaigham M, Andersson O. Maternal and perinatal outcomes with COVID-19: a systematic review of 108 pregnancies. Acta Obstet Gynecol Scand 2020;99:823–9.
44. Alzamora MC, Paredes T, Caceres D, Webb CM, Valdez LM, La Rosa M. Severe COVID-19 during pregnancy and possible vertical transmission. Am J Perinatol 2020;37:861–5.
45. Muhidin S, Behboodi Moghadam Z, Vizheh M. Analysis of maternal coronavirus infections and neonates born to mothers with 2019-nCoV; a systematic review. Arch Acad Emerg Med 2020;8:e49. eCollection 2020.
46. Ashokka B, Loh MH, Tan CH, Su LL, Young BE, Lye DC, et al. Care of the pregnant woman with coronavirus disease 2019 in labor and delivery: anesthesia, emergency cesarean delivery, differential diagnosis in the acutely ill parturient, care of the newborn, and protection of the healthcare personnel. Am J Obstet Gynecol 2020;223:66–74.

47. Li N, Han L, Peng M, Lv Y, Ouyang Y, Liu K, et al. Maternal and neonatal outcomes of pregnant women with COVID-19 pneumonia: a case-control study. Clin Infect Dis 2020:ciaa352. https://doi.org/10.1093/cid/ciaa352 [Epub ahead of print].
48. Chen S, Liao E, Cao D, Gao Y, Sun G, Shao Y. Clinical analysis of pregnant women with 2019 novel coronavirus pneumonia. J Med Virol 2020. https://doi.org/10.1002/jmv.25789 [Epub ahead of print].
49. Wang SS, Zhou X, Lin XG, Liu YY, Wu JL, Sharifu LM, et al. Experience of clinical management for pregnant women and newborns with novel coronavirus pneumonia in Tongji Hospital, China. Curr Med Sci 2020;40:285–9.
50. Di Mascio D, Khalil A, Saccone G, Rizzo G, Buca D, Liberati M, et al. Outcome of coronavirus spectrum infections (SARS, MERS, COVID 1 -19) during pregnancy: a systematic review and meta-analysis. Am J Obstet Gynecol 2020 Mar 25;2:100107. [Epub ahead of print].
51. Yu N, Li W, Kang Q, Xiong Z, Wang S, Lin X, et al. Clinical features and obstetric and neonatal outcomes of pregnant patients with COVID-19 in Wuhan, China: a retrospective, single-centre, descriptive study. Lancet Infect Dis 2020;20:559–64.
52. Dashraath P, Wong JLJ, Lim MXK, Lim LM, Li S, Biswas A, et al. Coronavirus disease 2019 (COVID-19) pandemic and pregnancy. Am J Obstet Gynecol 2020;222:521–31.
53. Peyronnet V, Sibiude J, Deruelle P, Huissoud C, Lescure X, Lucet JC, et al. SARS-CoV-2 infection during pregnancy. Information and proposal of management care. CNGOF. Gynecol Obstet Fertil Senol 2020;48:436–43.
54. Rasmussen SA, Smulian JC, Lednicky JA, Wen TS, Jamieson DJ. Coronavirus disease 2019 (COVID-19) and pregnancy: what obstetricians need to know. Am J Obstet Gynecol 2020;222: 415–26.
55. Chen H, Guo J, Wang C, Luo F, Yu X, Zhang W, et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. Lancet 2020;395:809–15.
56. Alfaraj SH, Al-Tawfiq JA, Altuwaijri TA, Memish ZA. Middle East respiratory syndrome coronavirus in pediatrics: a report of seven cases from Saudi Arabia. Front Med 2019;13:126–30.
57. Maxwell C, McGeer A, Tai KFY, Sermer M, Maternal Fetal Medicine Committee; Infectious Disease Committee. Management guidelines for obstetric patients and neonates born to mothers with suspected or probable severe acute respiratory syndrome (SARS). J Obstet Gynaecol Can 2009;31:358–64.
58. Ksiezakowska K, Laszczyk M, Wilczynski J, Nowakowska D. SARS-CoV infection and pregnancy. Ginekol Pol 2008;79:47–50.
59. Yudin MH, Steele DM, Sgro MD, Read SE, Kopplin P, Gough KA. Severe acute respiratory syndrome in pregnancy. Obstet Gynecol 2005;105:124–7.
60. Zhang JP, Wang YH, Chen LN, Zhang R, Xie YF. Clinical analysis of pregnancy in second and third trimesters complicated severe acute respiratory syndrome. Zhonghua Fu Chan Ke Za Zhi 2003; 38:516–20.
61. Madec F, Kaiser C, Gourreau JM, Martinat-Botte F. Pathologic consequences of a severe influenza outbreak (swine virus A/H1N1) under natural conditions in the non-immune sow at the beginning of pregnancy. Comp Immunol Microbiol Infect Dis 1989;12:17–27.
62. San-Juan R, Barbero P, Fernández-Ruiz M, Lopez-Medrano F, Lizasoain M, Hernandez-Jimenez P, et al. Incidence and clinical profiles of COVID-19 pneumonia in pregnant women: a single-centre cohort study from Spain. EClinicalMedicine 2020;23:100407.
63. Zhuang SF, Hu J, Qiao N, Lan ZH, Lai JY, Wu JG, et al. Low-grade fever during COVID-19 convalescence: a report of 3 cases. World J Clin Case 2020;8:2655–61.
64. Liu Y, Wang Z, Ren J, Tian Y, Zhou M, Zhou T, et al. A COVID-19 risk assessment decision support system for general practitioners: design and development study. J Med Internet Res 2020;22:e19786.
65. Du N, Chen H, Zhang Q, Che L, Lou L, Li X, et al. A case series describing the epidemiology and clinical characteristics of COVID-19 infection in Jilin Province. Virulence;11:482–5. https://doi.org/10.1080/21505594.2020.1767357.
66. Lauxmann MA, Santucci NE, Autrán-Gómez AM. The SARS-CoV-2 coronavirus and the COVID-19 outbreak. Int Braz J Urol 2020;46: 6–18.
67. Ciceri F, Castagna A, Rovere-Querini P, Cobelkli FD, Ruggeri A, Galli L, et al. Early predictors of clinical outcomes of COVID-19 outbreak in Milan, Italy. Clin Immunol 2020;217:108509.
68. Brill SE, Jarvis HC, Ozcan E, Burns TLP, Warraich RA, Amani LJ, et al. COVID-19: a retrospective cohort study with focus on the over-80s and hospital-onset disease. BMC Med 2020;18:194.
69. Mitra B, Luckhoff C, Mitchell RD, O'Reilly GM, Smit V, Cameron PA. Temperature screening has negligible value for control of COVID-19. Emerg Med Australas 2020;32:867–9.
70. Alsofayan YM, Althunayyan SM, Khan AA, Hakawi AM, Assiri AM. Clinical characteristics of COVID-19 in Saudi Arabia: a national retrospective study. J Infect Public Health 2020;13:920–5.
71. Hashmi HAS, Asif HM. Early detection and assessment of covid-19. Front Med 2020;7:311.
72. Pongpirul WA, Mott JA, Woodring JV, Uyeki TM, MacArthur JR, Vachiraphan A, et al. Clinical characteristics of patients hospitalized with coronavirus disease, Thailand. Emerg Infect Dis 2020;26:1580–5.
73. Okoh AK, Sossou C, Dangayach NS, Meledathu S, Phillips O, Raczek C, et al. Coronavirus disease 19 in minority populations of Newark, New Jersey. Int J Equity Health 2020;19:93.
74. Li TZ, Cao ZH, Chen Y, Cai MT, Zhang LY, Xu H, et al. Duration of SARS-CoV-2 RNA shedding and factors associated with prolonged viral shedding in patients with COVID-19. J Med Virol 2020:1–7. https://doi.org/10.1002/jmv.26280 [Epub ahead of print].
75. Available from: https://www.uptodate.com/contents/pathophysiology-and-treatment-of-fever-in-adults [Accessed 17 Aug 2020].
76. Romero R, Chaemsaithong P, Korzeniewski SJ, Kusanovic JP, Docheva N, Martinez-Varea A, et al. Clinical chorioamnionitis at term III: how well do clinical criteria perform in the identification of proven intra-amniotic infection? J Perinat Med 2016;44: 23–32.
77. Yoon BH, Romero R, Park JY, Oh KJ, Lee J, Conde-Agudelo A, et al. Antibiotic administration can eradicate intra-amniotic infection or intra-amniotic inflammation in a subset of patients with preterm labor and intact membranes. Am J Obstet Gynecol 2019; 221:142. e1–22.
78. Available from: https://www.cdc.gov/quarantine/air/reporting-deaths-illness/definitions-symptoms-reportable-illnesses.html [Accessed 17 Aug 2020].
79. Towers CV, Yates A, Zite N, Smith C, Chernicky L, Howard B. Incidence of fever in labor and risk of neonatal sepsis. Am J Obstet Gynecol 2017;216:596 e1–5.

80. American College of Obstetricians and Gynecologists' Committee on Obstetric Practice. Committee opinion no. 667: hospital-based triage of obstetric patients. Obstet Gynecol 2016;128: e16–9.
81. Wunderlich CR. Das Verhalten der Eigenwärme in Krankheiten. Leipzig, Germany: Otto Wigard; 1868.
82. Wunderlich CR, Wunderlich CA, Seguin E. On the temperature in diseases: a manual of medical thermometry. New York: William Wood & Co; 1871.
83. Laupland KB. Fever in the critically ill medical patient. Crit Care Med 2009;37(7 Suppl):S273–8.
84. Dinarell CA, Porat R. Harrison's principles of medicine; 2020. Available from: https://accessmedicine.mhmedical.com/content.aspx?sectionid=192011177&bookid=2129&jumpsectionid=192011177 [Accessed 17 Aug 2020].
85. Available from: https://en.wikipedia.org/wiki/Fever [Accessed 17 Aug 2020].
86. Wiersinga WJ, Rhodes A, Cheng C, Peacock SJ, Prescott HC. Pathophysiology, transmission, diagnosis, and treatment of coronavirus disease 2019 (COVID-19) A review. J Am Med Assoc 2020;324:782–93.
87. Singh V, Sharma A, Khandelwal R, Kothari K. Variation of axillary temperature and its correlation with oral temperature. J Assoc Phys India 2000;48:898–900.
88. Geneva II, Cuzzo B, Fazili T, Javaid W. Normal body temperature: a systematic review. Open Forum Infect Dis 2019;6. ofz032. Available from: https://doi.org/10.1093/ofid/ofz032 [Accessed 9 Apr 2020].
89. Galang RR, Chang K, Strid P, Snead MC, Woodworth KR, House LD, et al. Severe coronavirus infections in pregnancy. Obstet Gynecol 2020;136:262–72.
90. Della Gatta AN, Rizzo R, Pilu G, Simonazzi G. Coronavirus disease 2019 during pregnancy: a systematic review of reported cases. Am J Obstet Gynecol 2020;223:36–41.
91. Dinarello CA, Porat R. 23: Fever. Harrison's Principles of Internal Medicine, 19e. Available from: https://accessmedicine.mhmedical.com/content.aspx?bookid=1130&sectionid=79724479.
92. Available from: https://www.merckmanuals.com/professional/infectious-diseases/biology-of-infectious-disease/fever [Accessed 5 Aug 2020].
93. Acker DB, Schulman EB, Ransil BJ, Sachs BP, Friedman EA. The normal parturient's admission temperature. Am J Obstet Gynecol 1987;157:308.
94. Herbst A, Wolner-Hanssen P, Ingemarsson I. Risk factors for fever in labor. Obstet Gynecol 1995;86:790–4.
95. Higgins RD, Saade G, Polin RA, Grobman WA, Buhimschi IA, Watterberg K, et al. Evaluation and management of women and newborns with a maternal diagnosis of chorioamnionitis: summary of a workshop. Obstet Gynecol 2016;127:426–36.