

# Excess Maternal Deaths Associated With Coronavirus Disease 2019 (COVID-19) in Mexico

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## INTRODUCTION

Almost 20 million people worldwide have been infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as of August 10, 2020.<sup>1</sup> Although the burden of maternal mortality related to coronavirus disease 2019 (COVID-19) in high-income countries appears limited, low- and middle-income countries may be affected differently.<sup>2</sup> The Mexican Ministry of Health publishes weekly epidemiologic reports describing the count of total maternal deaths, their causes, and the maternal mortality ratio.<sup>3</sup> Using this open source, we aimed to estimate the weekly number, weekly percentage, and total number of excess deaths from all causes that could be directly or indirectly attributed to COVID-19 based on preliminary weekly counts of deaths from 2011 through the 32nd week of 2020 (August 3–9). In addition, we describe the maternal mortality ratio over time and causes of mortality since 2011.

## METHODS

Weekly maternal death counts for 2020 were compared with documented trends from prior years to determine whether the number of deaths was higher than expected. Namely, Farrington surveillance algorithms<sup>4</sup> based on Poisson generalized linear models with overdispersion were used to estimate the upper bound (ie, upper limit of the 95% prediction interval) for the predicted number of deaths per week of 2020. This was based on weekly death counts from 2011, when the Mexican Ministry of Health epidemiologic reports first became available, through 2019. The number of excess deaths was estimated as the difference between the observed count and the predicted upper bound by week. The percent excess was calculated as the number of excess deaths divided by the upper bound by week. The total number of excess deaths reflected a summation of the number of excess deaths between the 1st and 32nd week of 2020. Statistical analysis was performed using R 4.0.0.

## RESULTS

According to predictions from the Mexican Ministry of Health, the anticipated maternal mortality ratio in Mexico for 2020 was 29.5 per 100,000 live births, a stark contrast to the actual maternal mortality ratio of 42.4 that has been calculated thus far for 2020.<sup>3</sup> Maternal mortality stratified by cause in Mexico from 2011 to 2020 is shown in Table 1. From the 1st through the 32nd week of 2020 (August 3–9), 523 maternal deaths have been reported. Importantly, COVID-19 is now the leading cause of maternal mortality in Mexico.<sup>3</sup> Compared with previous years, the proportion of deaths from respiratory causes (32%) is higher in 2020 compared with any other timepoint in this analysis. The weekly number and weekly percentage of excess maternal deaths from all causes for 2020

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### Financial Disclosure

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**Table 1. Maternal Mortality in Mexico From 2011 to 2020 Stratified by Cause and Excess Maternal Deaths for 2020**

Year	Cause of Death					Maternal Mortality Ratio (95% CI)*	No. of Excess Maternal Deaths <sup>†</sup>
	Respiratory Diseases	Hypertensive Disorders of Pregnancy	Postpartum Hemorrhage	Venous Thromboembolism	Other Causes		
2011	42/955 (4.4) <sup>‡</sup>	229/955 (24.0)	213/955 (22.3)	40/955 (4.2)	431/955 (45.1)	49.9 (47.3–52.7)	—
2012	42/949 (4.4) <sup>§</sup>	210/949 (22.1)	201/949 (21.2)	40/949 (4.2)	456/949 (48.1)	49.9 (47.2–52.7)	—
2013	14/867 (1.6) <sup>  </sup>	201/867 (23.2)	150/867 (17.3)	41/867 (4.7)	461/867 (53.2)	38.0 (35.7–40.5)	—
2014	93/902 (10.3)	171/902 (19.0)	177/902 (19.6)	44/902 (4.9)	417/902 (46.2)	38.6 (36.2–41.1)	—
2015	38/712 (5.3)	147/712 (20.7)	159/712 (22.3)	49/712 (6.9)	319/712 (44.8)	31.7 (29.5–34.1)	—
2016	36/760 (4.7)	202/760 (26.6)	172/760 (22.6)	43/760 (5.7)	307/760 (40.4)	34.4 (32.1–36.9)	—
2017	28/722 (3.9)	158/722 (21.8)	173/722 (24.0)	38/722 (5.3)	325/722 (45.0)	32.0 (29.7–34.4)	—
2018	30/667 (4.5)	145/667 (21.7)	155/667 (23.3)	34/667 (5.1)	303/667 (45.4)	30.2 (28.0–32.6)	—
2019	38/690 (5.6)	142/690 (20.6)	141/690 (20.4)	23/690 (3.3)	346/690 (50.1)	31.1 (28.8–33.5)	—
2020 <sup>¶</sup>	168/523 (32) <sup>‡</sup>	83/523 (16)	90/523 (17)	4/523 (1)	178/523 (34)	42.4 (39.0–46.1)	86

Data are n/N (%) unless otherwise specified.

\* Maternal deaths per 100,000 live births.

<sup>†</sup> Maternal death counts from 2011 through 2019 were used to calculate excess maternal deaths for 2020.

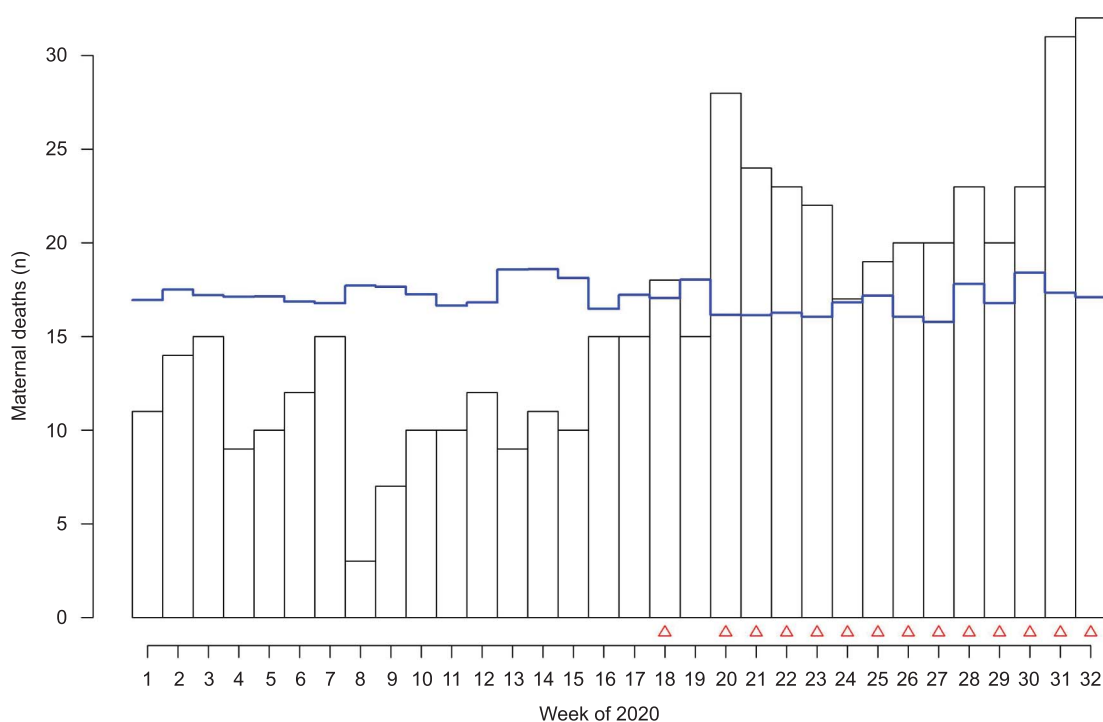
<sup>‡</sup> The count is distributed as follows: 29 deaths due to pneumonia and 13 deaths due to other respiratory diseases.

<sup>§</sup> The count is distributed as follows: 24 deaths due to pneumonia and 18 deaths due to other respiratory diseases.

<sup>||</sup> The count is distributed as follows: eight deaths due to pneumonia and six deaths due to other respiratory diseases.

<sup>¶</sup> Up to the 32nd epidemiologic week of 2020.

<sup>‡</sup> The count is distributed as follows: 109 deaths due to confirmed coronavirus disease 2019 (COVID-19), 34 deaths for which COVID-19 needs to be confirmed, and 25 deaths due to other respiratory diseases.



**Fig. 1.** Excess maternal deaths in Mexico for 2020 up to the 32nd epidemiologic week. Each bar represents 1 week. The blue line represents the upper bound for the predicted number of maternal deaths per week of 2020, based on weekly maternal death counts from 2011 through 2019. The observations above this line represent the number of excess deaths, and those weeks are highlighted with a triangle. Mexico entered the most serious and widespread phase 3 transmission of coronavirus disease 2019 (COVID-19) in week 17. Thus far, there have been 86 excess maternal deaths from all causes in 2020, distributed as follows: 1, 12, 8, 7, 6, 2, 4, 4, 5, 3, 5, 14, and 15 for the 18th, 20th, 21st, 22nd, 23rd, 25th, 26th, 27th, 28th, 29th, 30th, 31st, and 32nd weeks, respectively. The percent excess for the weeks listed above was 6%, 75%, 50%, 44%, 38%, 12%, 25%, 25%, 28%, 18%, 28%, 82%, and 88%, respectively.

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are presented in Table 1 and Figure 1. Overall, there were 86 excess maternal deaths reported from all causes thus far (weeks 1–32) in 2020.

## DISCUSSION

In contrast with maternal outcomes in economically advanced countries,<sup>2</sup> our results suggest higher mortality among pregnant women in Mexico during the COVID-19 pandemic. Of note, similar consequences were observed during the H1N1 pandemic in 2009, where an excess of 211 maternal deaths in Mexico were reported for that year.<sup>5</sup>

We acknowledge the limitations of our study. The data reported by the Mexican Ministry of Health are provisional, and there is evidence of continued increasing rates of SARS-CoV-2 infection. Therefore, our results should be interpreted with caution, because an underestimation of maternal deaths cannot be ruled out. In addition, our analysis of excess deaths is limited to the evaluation of death from all causes.

Similar to our findings in Mexico, it is possible that other low- and middle-income countries have experienced a disproportionate burden of maternal mortality related to COVID-19. Renewed focus on improving the structural competency of health care systems<sup>6</sup> in Mexico and other underresourced countries is urgently needed to mitigate the adverse effects of COVID-19 on maternal health.

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