Factors associated with delays in the search for care in under-5 deaths in Yucatán, Mexico

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Abstract

Objective. We examined delays during the search for care and associations with mother, child, or health services characteristics, and with symptoms reported prior to death. **Materials and methods.** Cross-sectional study comprising household interviews with 252 caregivers of children under-5 who died in the state of Yucatán, Mexico, during 2015-2016. We evaluated the three main delays: 1) time to identify symptoms and start search for care, 2) transport time to health facility, and 3) wait time at health facility. **Results.** Children faced important delays including a mean time to start the search for care of 4.1 days. The mean transport time to the first facility was longer for children enrolled in *Seguro Popular* and there were longer wait times at public facilities, especially among children who also experienced longer travel time. **Conclusions.** Providing resources to enable caregivers to access health services in a timely manner may reduce delays in seeking care.

Keyword: child mortality; neonatal mortality; autopsy

Resumen

Objetivo. Analizar las demoras en la búsqueda de atención y su asociación con características de la madre, del niño y los servicios de salud, así como con los síntomas reportados antes de la defunción. **Material y métodos.** Diseño transversal con entrevistas a 252 cuidadores que se encargaron de niños menores de cinco años que fallecieron en el estado de Yucatán, México, durante 2015-2016. Se evaluaron tres demoras: 1) tiempo en identificar la complicación e iniciar el proceso de búsqueda; 2) tiempo de transporte; y 3) tiempo de espera en la unidad de salud. **Resultados.** Los niños enfrentaron demoras importantes en la búsqueda de atención. La media de tiempo para iniciar la búsqueda de atención fue de 4.1 días. La media de tiempo de transporte a la primera unidad de atención fue mayor para niños inscritos en el Seguro Popular y hubo tiempos de espera más largos en unidades de salud del sector público, especialmente entre niños que tuvieron tiempos de transporte largos. **Conclusión.** Proporcionar recursos que permitan a los cuidadores acceder a los servicios de salud de manera oportuna puede reducir las demoras en la búsqueda de atención.

Palabras clave: mortalidad del niño; mortalidad neonatal; autopsia

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Reducing child mortality is a top priority in global health and is included in the Sustainable Development Goals.[1] In 2017, Mexico had an estimated child mortality rate of 15.7 per 1 000 live births, a reduction from 41.2 in 1990.[2] The government has taken actions to address under-5 mortality, including a national strategy to achieve universal health care coverage, national programs on immunization and care for diarrheal and respiratory diseases,[3] and targeted actions to attend neonatal emergencies.[4]

The state of Yucatán, located in southeast Mexico, had a population of 2 102 259 in 2015,[5] with an estimated under-5 mortality rate in 2017 of 13.6 per 1 000 live births.[6] Despite having a lower under-5 mortality rate than the national average, the concentration of health services in two major cities[7] and the high proportion of indigenous language speakers (25.6%)[5] suggests that child mortality may be related to health care access, especially in under-5 emergency situations.

While child mortality can be reduced through implementing specific interventions,[8] the success of those interventions, and universal health coverage (defined as the possibility of the population to obtain the health services they need and benefit from financial risk protection, while access refers to the opportunity to do both), relies on the access of the population to quality health services in a timely manner.[9] Health-care-seeking behavior has been identified as a factor related to health care utilization in children under-5.[10,11] In this study, we used the three delay model to analyze the process of health-care-seeking in children under-5. This model was proposed initially for the analysis of maternal mortality;[12,13] however, it has been applied to the analysis of other types of deaths, including emergency situations.[14] This model identifies three periods in the search for care where delays can occur: 1) identifying a health problem and deciding to seek care; 2) transportation time to reach a health facility; and 3) the wait time at a health facility to receive adequate and appropriate treatment. These three delays can be affected by socioeconomic factors, accessibility of facilities, and quality of care.[12] In this study we analyzed the delays in seeking care for children under-5 who died in Yucatán, Mexico, in 2015-2016 to identify bottlenecks and areas susceptible to intervention. Therefore, the objective of this study is twofold: 1) to assess the magnitude of the three delays in the search for care for children under-5 and to identify characteristics of the caregiver and the health services related to them; and 2) to identify how the identification of some symptoms can be related to the presence of delays.

Materials and methods

The population under study includes all children under-5 whose death occurred in Yucatán, Mexico, during 2015-2016. Individuals under 28 days old were classified as neonates, and individuals aged 28 days to four years were classified as children. We identified deaths through the vital registry and subsequently searched for the families' households using the addresses in mortality records. For deaths that occurred in units of the Secretary of Health of Yucatán, we additionally searched for information on the location of residence of the families in medical records.

The only exclusion criterion was that the family lived outside of the state of Yucatán either at the time of the death or during data collection. We eliminated cases of neonatal deaths in which the child did not leave the health facility after birth because the complication was detected in the facility immediately following delivery.

This is a cross-sectional study exploring the process of seeking care. The outcome variables are each delay in the process, as defined in the three delays model. The first delay is dichotomized using a one-hour cutoff point since 56.7% of cases reported seeking care within one hour of noticing the first alarm signs. For the second delay, we collected information regarding travel time, distance traveled, and cost of transportation for each facility visited. Since these indicators were correlated, we used travel time as the main indicator for this delay and incorporated a one-hour cutoff point for analysis because 40% of cases had travel times of less than one hour. For the third delay, we examined the wait time associated with each visit to a facility for the event that caused the death. Half of cases were attended immediately upon arriving at the health facility; therefore, we dichotomized this variable as immediate versus any further waiting time.

We analyzed variables that may be related to the occurrence of each delay. The cause of death for each case was obtained from vital registration records, which assign causes based on the International Classification of Diseases-10th revision (ICD-10).[15] We classified cases according to their underlying cause of death into six categories: perinatal, congenital, infectious (excluding respiratory infections and perinatal sepsis), respiratory infections (excluding perinatal respiratory failure), nervous system diseases (excluding congenital), and other causes of death.

To estimate socioeconomic status, we constructed a wealth index considering household characteristics,

assets, and employment, following the methodology proposed in the evaluation of the Mesoamerican Health Initiative.[16] We also considered mothers' characteristics, including education, age, and enrollment in social security. Social security included the Mexican Institute of Social Security (*Instituto Mexicano del Seguro Social*, IMSS), which serves employees with a formal job; the Institute of Social Security and Services for State workers (*Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado*, ISSSTE), which serves government employees; and *Seguro Popular*, the nationwide medical care program designed as a safety net to cover citizens who are not enrolled or covered through another form of insurance, which is no longer in place. The type of facility visited by the caregiver and child was classified as private or public. Municipality of residence was classified into urban or rural using a cutoff of 15 000 inhabitants. Finally, we used a verbal autopsy interview with the caregiver of the deceased child.

Procedure

We conducted interviews with caregivers of children under-5 who died in 2015-2016. Interviews were conducted in the caregiver's house and native language, with 19 interviews (7.5%) partially or completely conducted in Mayan. All data from the verbal autopsies were collected electronically using tablets between March and November 2017. The period between the death and the interview ranged from three to 18 months.

The interview consisted of a standardized verbal autopsy using neonatal and child modules of the Population Health Metrics Research Consortium (PHMRC) Shortened Questionnaire[17] and a section with questions about health-care-seeking behavior during the final illness and household characteristics. The questionnaire includes questions about the symptoms experienced by the child and any condition that was previously diagnosed along with an open question, in which the informant is asked to describe in her/his own words the events that led to the child's death. All interviewees provided signed informed consent to participate, and ethical approval for the study was granted by the Internal Review Boards of the two participating institutions.

Analysis

We calculated descriptive statistics and explored the association between the three delays and different covariates using logistic regression, fitting four models for each delay: 1) bivariable models, exploring the crude association between the outcome variables and each covariate; 2) multivariable models, adjusted by enrollment in medical insurance, type of facility visited, and neonatal versus child death; 3) another multivariable model, adding the cause of death; and 4) a final multivariable model adding the diagnosis or symptoms experienced by the child as reported in the verbal autopsy and adding the previous delays. We assessed collinearity among covariates, although due to the small number of observations it was not possible to explore possible interactions among them. Goodness of fit was assessed using the Hosmer and Lemeshow Chi-square test. We conducted the analysis using all observations, and using only the subset of data for which we had complete socioeconomic information in which the wealth index could be estimated as a sensitivity analysis.

Results

We collected information on 298 deaths of children who sought care during the illness that led to death, with 252 cases providing complete information.

Characteristics of the sample are presented in table I. The most common causes of death for neonates were perinatal and congenital, while the most common causes of death for children were congenital, infectious and parasitic diseases, and respiratory diseases.

Delays in the search for care stratified by public or private facilities are presented in table II. Results indicate that a substantial proportion of children visited more than one facility and children who first visited a private facility visited a significantly higher number of facilities to seek care than children who first visited a public facility. Over half of all cases, 143 (56.7%), reported a first delay of under one hour, and 190 (75.4%) reported seeking care within 24 hours. A lower proportion of children who first sought care at a public facility experienced a first delay (38.7%) compared to those who first sought care at a private facility (60.4%). Similarly, 45.2% of children who first sought care at a public facility experienced a second delay, compared to 58.5% of children who first sought care at a private facility. Once they reached the facility, more children reported a third delay if they first sought care at a public facility (42.7%) compared to those who first sought care at a private facility (37.7%).

Table III presents the odds ratios (OR) of experiencing the first delay. Children who sought care first in public facilities had lower odds of experiencing a first delay. Children whose caregiver reported coughing, lethargy, or rash as a symptom were more likely to delay the search compared to children whose caregiver did not report these symptoms. By contrast, children whose caregivers reported grunting as a symptom were less likely to delay the search than those whose caregiver did not report this symptom.

Table I
Characteristics of sample (n=252). Yucatán, Mexico, 2015-2016

Measure	Neonates* (n=95)		Children (n=157)		Total (n=252)	
	N	Percent	N	Percent	N	Percent
Care sought	95	100	157	100	252	100
Mother is respondent	66	69	115	73	181	72
Male deceased	65	68	86	55	151	60
Urban	46	48	80	51	126	50
Location of death						
Hospital deaths	88	93	127	81	215	85
In route deaths	2	2	6	4	8	3
Home deaths	3	3	20	13	23	9
Other health facility deaths	1	1	2	1	3	1
Cause of death						
Perinatal	56	59	6	4	62	25
Congenital	17	18	31	20	48	19
Infectious	1	1	27	17	28	11
Nervous system	0	0	12	8	12	5
Respiratory	0	0	25	16	25	10
Other‡	21	22	56	36	77	31
Signs and symptoms§						
Bulging fontanelle	0	0	11	7	11	4
Cough	0	0	47	30	47	19
Cough severe	0	0	18	11	18	7
Lasting cough	0	0	27	17	27	11
Diarrhea	0	0	42	27	42	17
Die suddenly	55	58	10	6	65	26
Fever	0	0	79	50	79	31
Fever severe	0	0	24	15	24	10
Lasting fever	0	0	14	9	14	6
Grunt	0	0	45	29	45	18
Lethargic	37	39	7	4	44	17
Rash	0	0	31	20	31	12
Lasting rash	0	0	9	6	9	4
Skin (flaking, red, or black)	9	9	34	22	43	17

* Neonates are classified as under 28 days old, and children are classified as 28 days to 5 years
‡ Other causes of death include neoplasms, endocrine, circulatory, and external causes
§ Some informants reported several symptoms, so the report of symptoms adds up to more than 100%

Table IV presents factors associated with the second delay. Children entitled to *Seguro Popular* had almost twice the odds of experiencing a second delay compared to children with other forms of medical insurance. Children whose caregiver reported cough as a symptom were over six times more likely to have long travel times, while children whose caregiver reported lasting cough as a symptom had lower odds of presenting this delay as compared to those who did not report those symptoms. When stratifying for cost of transportation (n= 114), cases with transportation costs above the median had significantly higher odds of experiencing a second delay (adjusted OR= 4.30, 95%CI: 1.19-17.71).

Analysis of the third delay, presented in table V, indicate that children who first sought care in a public facility had higher odds of having a long wait time relative to children who first sought care at a private facility. Additionally, children who presented the first delay and visited two or more facilities also had higher odds of presenting the third delay.

After controlling for socioeconomic characteristics, results of the subset (n= 69) were consistent with the analysis of the complete sample, except that cases with *Seguro Popular* were less likely to present the first delay compared to cases using other forms of insurance (adjusted OR= 0.66, 95%CI: 0.46-0.94). All variables in

Table II
Descriptive statistics of delays experienced by deceased children in the search for care. Yucatán, Mexico, 2015-2016

Delay*	Public first (n=199)		Private first (n=53)		Total (n=252)	
	Mean (SD)	Median	Mean (SD)	Median	Mean (SD)	Median
Delay 1: Time to start seeking care (hours)	82.46 (24.25)	1	159.19 (61.04)	3	98.6 (23.08)	1
Number of facilities visited‡	1.7 (0.06)	2	2.58 (0.13)	2	1.88 (0.06)	2
Travel distance to first facility (km)	84.42 (62.73)	6.5	14.73 (10.6)	3	68.78 (48.74)	6
Travel time to first facility (hours)	1.67 (0.46)	0.5	0.45 (0.06)	0.33	1.41 (0.36)	0.5
Travel cost to first facility§	195.33 (34.26)	70	134.74 (31.46)	70	176.73 (25.69)	70
Total distance traveled for all visits (km)	95.95 (62.61)	17	37.27 (32.3)	4	82.78 (49.04)	12
Delay 2: Total travel time for all visits (hours)	3.17 (0.61)	1	1.88 (0.27)	1.17	2.9 (0.48)	1
Total travel cost to all facilities§	301.42 (52.03)	100	445.66 (104.99)	150	345.7 (48.5)	120
Cost of care at first facility§	1 283.33 (302.99)	1 000	4 139.14 (2 340.66)	700	3 555 (1 865.54)	700
Total cost for all visits§	1 350 (328.93)	1 000	8 137.71 (3 637.41)	750	6 749.32 (2 915.49)	800
Delay 3: Wait time at first facility (hours)	1.58 (0.36)	0	0.29 (0.08)	0	1.32 (0.29)	0

Delay*	Public		Private		Total	
	Median	IQR	Median	IQR	Median	IQR
Delay 1: Time to start seeking care (hours)	1	10	3	47	1	17.25
Number of facilities visited‡	2	1	2	1	2	1
Travel distance to first facility (km)	6.5	49.75	3	7	6	24
Travel time to first facility (hours)	0.5	0.77	0.33	0.75	0.5	0.33
Travel cost to first facility§	70	175	70	172	70	117.5
Total distance traveled for all visits (km)	17	54.75	4	8.5	12	57
Delay 2: Total travel time for all visits (hours)	1	1.79	1.17	1.33	1	1.75
Total travel cost to all facilities§	100	267.5	150	551	120	447.5
Cost of care at first facility§	1 000	1500	700	825	700	1 087.5
Total cost for all visits§	1 000	1500	750	1 265	800	1 485
Delay 3: Wait time at first facility (hours)	0	1	0	0.25	0	0.71

* *p*-value indicates the comparison between means of visiting a public or private facility first
‡ *p*<0.01
§ Mexican peso
IQR: Interquartile range

Table III

**FACTORS ASSOCIATED WITH BEGINNING SEARCH FOR CARE AMONG DECEASED CHILDREN UNDER-5.
YUCATÁN, MEXICO, 2015–2016**

	First delay (n=252)	
	Crude OR (95%CI)	Adjusted OR (95%CI)*
Enrollment in medical insurance		
Social security (IMSS or ISSSTE)	1.0 (Ref)	1.0 (Ref)
No insurance	2.84 (0.57-20.93)	3.12 (0.47-27.15)
Seguro Popular	0.79 (0.44-1.41)	0.88 (0.44-1.76)
Place of death		
Private facility	1.0 (Ref)	1.0 (Ref)
Private hospital	2.35 (0.60-11.75)	1.22 (0.24-7.44)
Public facility	0.78 (0.35-1.74)	0.58 (0.23-1.46)
Public hospital	0.40‡ (0.20-0.82)	0.41 (0.18-0.95)
Age group		
Neonate‡	1.0 (Ref)	1.0 (Ref)
Child	2.19 (1.30-3.78)	1.64 (0.61-4.52)
Cause of death		
Other	1.0 (Ref)	1.0 (Ref)
Congenital	0.53 (0.25-1.09)	0.65 (0.26-1.61)
Infectious	0.76 (0.32-1.81)	0.70 (0.24-1.95)
Nervous	0.63 (0.17-2.13)	0.47 (0.08-2.38)
Perinatal	0.42 (0.21-0.83)	0.69 (0.28-1.70)
Respiratory	0.81 (0.32-2.01)	0.90 (0.29-2.79)
Symptoms reported in verbal autopsy		
Bulging fontanelle	1.61 (0.47-5.72)	0.69 (0.13-3.51)
Cough	2.81 (1.47-5.53)	4.49 (1.15-18.91)
Cough severe	1.70 (0.65-4.61)	0.52 (0.12-2.25)
Lasting cough	3.56 (1.54-8.96)	1.42 (0.31-6.58)
Diarrhea	2.49 (1.27-5.00)	1.82 (0.74-4.60)
Die suddenly	0.64 (0.35-1.14)	1.27 (0.57-2.86)
Fever	2.43 (1.42-4.22)	1.61 (0.66-3.94)
Fever severe	1.35 (0.58-3.16)	0.61 (0.18-1.98)
Lasting fever	1.81 (0.61-5.65)	1.06 (0.23-5.04)
Grunt	0.85 (0.43-1.63)	0.23 (0.08-0.59)
Lethargic	1.25 (0.65-2.39)	2.64 (1.17-6.08)
Rash	4.51 (2.01-11.18)	5.54 (1.71-21.38)
Lasting rash	2.72 (0.70-13.12)	0.51 (0.08-3.57)
Skin (flaking, red, or black)	1.47 (0.75-2.89)	1.60 (0.69-3.75)

* Adjusted by variables in the table
‡ Neonates are classified as under 28 days old, and children are classified as 28 days to 5 years
IMSS: *Instituto Mexicano del Seguro Social*
ISSSTE: *Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado*
OR: Odds ratios

Table IV
Factors associated with delays in transportation among deceased children under-5.
Yucatán, Mexico, 2015–2016

	Second delay (n=252)	
	Crude OR (95%CI)	Adjusted OR (95%CI)*
Enrollment in medical insurance		
Social security (IMSS or ISSSTE)	1.0 (Ref)	1.0 (Ref)
No insurance	1.27 (0.23-6.27)	0.62 (0.09-3.82)
Seguro Popular	1.83 (1.02-3.34)	1.87 (0.97-3.67)
Place of death		
Private facility	1.0 (Ref)	1.0 (Ref)
Private hospital	0.41 (0.10-1.51)	0.59 (0.12-2.68)
Public facility	0.58 (0.25-1.30)	0.68 (0.27-1.69)
Public hospital	0.44 (0.21-0.89)	0.47 (0.20-1.08)
Age group		
Neonate‡	1.0 (Ref)	1.0 (Ref)
Child	1.04 (0.63-1.74)	0.55 (0.21-1.44)
Cause of death		
Other	1.0 (Ref)	1.0 (Ref)
Congenital	1.68 (0.81-3.51)	1.75 (0.73-4.21)
Infectious	0.90 (0.37-2.15)	0.85 (0.31-2.30)
Nervous	0.86 (0.24-2.92)	0.43 (0.08-1.98)
Perinatal	1.20 (0.61-2.35)	1.76 (0.74-4.23)
Respiratory	0.80 (0.31-1.99)	0.93 (0.31-2.68)
Delay		
First delay	1.35 (0.82-2.24)	1.33 (0.73, 2.45)
Number of places visited		
One facility	1.0 (Ref)	1.0 (Ref)
Two or more facilities	8.16 (4.55-15.22)	15.62 (6.98-37.82)
Symptoms reported in verbal autopsy		
Bulging fontanelle	1.31 (0.39-4.67)	0.84 (0.17-3.91)
Cough	1.77 (0.94-3.42)	6.36 (1.47-35.06)
Cough severe	1.39 (0.53-3.75)	0.52 (0.12-2.23)
Lasting cough	0.85 (0.37-1.90)	0.17 (0.03-0.75)
Diarrhea	1.38 (0.71-2.71)	1.21 (0.50-2.95)
Die suddenly	0.59 (0.33-1.05)	0.55 (0.25-1.17)
Fever	1.35 (0.79-2.31)	1.07 (0.45-2.54)
Fever severe	1.31 (0.56-3.11)	1.16 (0.38-3.56)
Lasting fever	2.02 (0.68-6.76)	2.06 (0.52-8.93)
Grunt	2.27 (1.17-4.51)	2.00 (0.82-5.04)
Lethargic	0.99 (0.51-1.89)	1.08 (0.49-2.37)
Rash	1.37 (0.64-2.95)	1.66 (0.56-5.08)
Lasting rash	0.53 (0.11-2.06)	0.32 (0.05-1.83)
Skin (flaking, red, or black)	1.87 (0.95-3.77)	1.97 (0.87-4.59)

* Adjusted by variables in the table
‡ Neonates are classified as under 28 days old and children are classified as 28 days to 5 years
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	Third delay (n=252)	
	Crude OR (95%CI)	*Adjusted OR (95%CI)**
Enrollment in medical insurance		
Social security (IMSS or ISSSTE)	1.0 (Ref)	1.0 (Ref)
No insurance	0.43 (0.06-2.15)	0.20 (0.01-1.76)
Seguro Popular	0.71 (0.40-1.27)	0.56 (0.27-1.13)
Place of death		
Private facility	1.0 (Ref)	1.0 (Ref)
Private hospital	3.02 (0.81-11.98)	2.34 (0.43-12.99)
Public facility	2.15 (0.95-5.07)	4.72 (1.72-13.92)
Public hospital	1.42 (0.69-3.05)	3.93 (1.46-11.48)
Age group		
Neonate‡	1.0 (Ref)	1.0 (Ref)
Child	2.30 (1.35-4.00)	0.75 (0.24-2.26)
Cause of death		
Other	1.0 (Ref)	1.0 (Ref)
Congenital	0.66 (0.31-1.37)	0.59 (0.22-1.50)
Infectious	0.90 (0.37-2.15)	0.97 (0.33-2.79)
Nervous	3.60 (0.99-17.17)	5.40 (0.97-40.84)
Perinatal	0.57 (0.28-1.14)	1.16 (0.43-3.20)
Respiratory	1.11 (0.44-2.75)	0.75 (0.24-2.26)
Delays		
First delay	2.03 (1.22-3.39)	2.43 (1.24-4.83)
Second delay	1.35 (0.82-2.24)	0.92 (0.46-1.84)
Number of places visited		
One facility	1.0 (Ref)	1.0 (Ref)
Two or more facilities	2.32 (1.37-4.00)	2.89 (1.32-6.46)
Symptoms		
Bulging fontanelle	15.37 (2.87-284.34)	19.66 (2.75-419.75)
Cough	2.20 (1.16-4.23)	1.37 (0.34-5.59)
Cough severe	1.44 (0.54-3.81)	0.40 (0.09-1.69)
Lasting cough	2.65 (1.18-6.25)	0.68 (0.15-3.08)
Diarrhea	2.39 (1.22-4.77)	1.48 (0.57-3.83)
Die suddenly	0.32 (0.17-0.60)	0.46 (0.19-1.10)
Fever	3.15 (1.83-5.52)	2.35 (0.96-5.88)
Fever severe	3.12 (1.32-7.99)	2.41 (0.76-8.15)
Lasting fever	3.76 (1.22-14.04)	1.65 (0.35-8.47)
Grunt	2.22 (1.16-4.32)	1.86 (0.71-4.87)
Lethargic	0.60 (0.29-1.18)	0.88 (0.35-2.17)
Rash	1.36 (0.64-2.91)	0.20 (0.06-0.67)
Lasting rash	1.12 (0.27-4.35)	1.37 (0.19-10.11)
Skin (flaking, red, or black)	0.99 (0.50-1.94)	0.46 (0.17-1.17)

* Adjusted by variables in the table
‡ Neonates are classified as under 28 days old and children are classified as 28 days to 5 years
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ISSSTE: *Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado*
OR: *Odds ratios*

the second delay model had estimates in the same direction but became non-significant, and in the third delay model, cases that experienced a second delay had higher odds of experiencing a wait time at the health facility (adjusted OR= 1.44, 95%CI: 1.06-1.95). Additionally, children who showed symptoms of diarrhea and severe fever had higher odds of experiencing a wait time at the health facility (adjusted OR= 1.63, 95%CI: 1.05-2.54, adjusted OR= 2.11, 95%CI: 1.23-3.62, respectively).

Discussion

This study uncovered important delays in seeking care among children under-5 who died in Yucatán, Mexico, during 2015-2016. To the best of our knowledge, this is the first study documenting delays in the search for care for this age group in Mexico. Our findings indicate that a substantial proportion of children visited more than one facility and had long times to start seeking care.

We used the three delay framework to identify barriers in the care-seeking process. The first delay was shorter when caregivers sought care initially at a public hospital. Hospitals may be perceived as better equipped and staffed, and therefore caregivers who were able to go to a public hospital started the search for care faster. Several studies have analyzed factors that can affect health-care-seeking behavior with the number of symptoms identified, as well as their perceived severity, increasing the likelihood of seeking care for children under-5.[18-23] Although our models control for cause of death, we have no way to control for the perceived severity of the health condition. It is possible that cases attending public hospitals were more complicated (or perceived as more complicated), and therefore the caregivers sought care in a timelier manner.

Compared to other global health settings, caregivers in this study reported shorter first delays, with 75% of caregivers seeking care within 24 hours after identifying symptoms, compared to 53% in Malawi,[10] and 38.5% in Rwanda seeking care within 48 hours.[11] Even when these three countries claim to have universal health coverage, Mexico has a much higher service coverage percentage and is higher on the universal health coverage index.[24] The public health network is widespread in Yucatán, including first-level facilities from the Secretary of Health (free or low-cost for people enrolled in *Seguro Popular*) and a set of facilities from the IMSS, which is also considered public. Caregivers in the state of Yucatán, Mexico, may have higher socioeconomic status and be located closer to care facilities than caregivers in more rural settings such as Rwanda and Malawi, possibly encouraging caregivers to start the search for care more promptly.

Other studies have found that the likelihood of seeking care increases in the presence of certain symptoms, like diarrhea and fever, and with the duration of illness.[11] In this study, we aimed to explore in greater detail which symptoms could trigger an early or late search for care through administering verbal autopsies to the caregivers of children under-5 who had died. When symptoms like coughing, lethargy, or rash were detected in the child, the first delay was longer. These symptoms may not have been perceived as serious, which is consistent with previous research in Mexico finding that the presence of some symptoms can be considered "normal" and does not trigger care-seeking in a timely manner.[25] In concordance with other studies,[26] our results indicate that it is important to conduct health promotion activities among the population to assist in identifying alarm signs that indicate serious conditions.

The second delay was longer for children enrolled in *Seguro Popular* relative to children covered by other forms of social security. This finding may suggest that *Seguro Popular* was serving populations with longer travel times and less access to services. The Mexican government eliminated *Seguro Popular* from the Mexican health system and replaced it with the Institute for Health and Wellness (*Instituto de Salud para el Bienestar*, INSABI), which began in 2020. It will be important to monitor the impact of this policy change in terms of access to care and health-care-seeking behavior.

The analysis of the search for care process indicates that one in four cases visited at least two facilities, likely because families seek care at nearby facilities that may not have the capacity to treat life-threatening illnesses. These results are consistent with a study in Bangladesh that found that 22% of dying children under-5 visited more than one provider in their search for care.[26] Even when some of these cases may have then been referred to appropriate facilities, the number of places visited suggests that the process of searching for care may have been more complicated for them. We cannot differentiate from our data whether the first referral was medically inappropriate or whether the child's condition changed while traveling to the second facility. However, it is concerning that children who faced long waiting times at health facilities were the same children who had higher odds of a delayed search for care and visiting more than one health facility. It is important to empower the population with health promotion campaigns to provide them with resources not only to identify alarm symptoms, but also to have in place strategies to seek care for children in an effective and timely manner in case of a medical emergency, as it is done with the "birth plans" for pregnant women. However, it is also important to reinforce referral systems to facilitate prompt care in cases that

have visited multiple health facilities searching for care and have longer travel times.

Another interesting finding was that travel times were shorter for children attended in private facilities, although they had a much longer delay in initiating their search for care. This may reflect the fact that small private facilities can be available in communities in the study areas, and therefore caregivers sought care for their children there as a first option, but they may have delayed seeking care due to higher costs or other factors.

This study has some limitations that should be considered in the interpretation of results. First, our analysis is limited to children who died and therefore may have experienced a more complicated process than those who survived after facing a comparable medical condition. We recognize the process may have been more effective in cases in which the child survived. However, the problems faced by this population are also relevant in the planning of health systems. In a future phase of this project, we hope to capture information about the process of children who had complications but survived.

Another limitation is that we capture information about the symptoms experienced by the child through the verbal autopsy report of the child's caregiver. Limitations in the quality of information from verbal autopsies have been documented.[27] However, we have focused this study on how the recognition of symptoms by the caregiver can affect the search for care, rather than on the actual accuracy of the reporting. This self-report limitation could also have a social desirability bias in delay reporting.

Linked to the previous limitation, the verbal autopsy questionnaire used in this study only captures keywords useful for the ascertainment of cause of death in the open question, but not any additional information on the process of search for care and events related to the death. This is an important limitation, and an area that should be analyzed in further studies.

Finally, although receiving appropriate care once the facility is reached is important,[28] in this study we were not able to analyze in detail factors related to quality of care. This can affect the final outcome of the care of a child, and in turn could influence the inclusion of a case in the study.

Conclusion

Despite the claim that Mexico reached universal health coverage in 2012,[29] the results of this study show that caregivers of children under-5 experience significant delays in seeking care, suggesting that this population still faces barriers to accessing health care. The delays identified in this study may be relevant to other settings with similar or more limited health systems.

Findings show that health promotion activities are required among caregivers for early recognition of alarm signs and symptoms in children under-5, and a prompt start to searching for care. Given the relative importance of the first delay, special efforts to reduce it should be implemented**.** In addition, concrete strategies should be elaborated with the participation of women to face medical emergencies in children and make possible a quick response. Innovative approaches using mass media have been successful in other countries to promote early care-seeking in the prevention of child mortality[30] and could be implemented in settings like this. On the health systems side, it is important to improve referral systems and care for emergencies to facilitate access to care.

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