Impacts of the SARS-CoV-2 pandemic on the seasonal incidence of hospitalizations for acute respiratory diseases among children in Alberta, Canada

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Background & Objectives

- Pediatric hospitalizations for acute respiratory diseases (ARD) generally have a biennial pattern – peak incidence is highest every other winter season.

- ARD includes bronchiolitis, pneumonia, influenza like illness, and croup.

- Objectives: To describe (i) the seasonal pattern of ARD and (ii) the impacts of the SARS-CoV-2 pandemic on hospitalizations, clinical severity, and the affected population.

Methods

- Design: Population based retrospective observational study among children < 18 years-old in Alberta.

- Data Source: Discharge Abstract Database from Apr 2003 to Dec 2023.

- ARD was defined with most responsible diagnosis at discharge using *ICD-10* codes.

- Modeling: Seasonal autoregressive integrated moving average (SARIMA) models fitted time series data to predict the expected outcomes from Apr 2020 to Dec 2023.

- Outcome 1: Weekly hospital discharges for ARD (per 100,000 children).

- Outcome 2: Weekly percent PICU discharges of all hospitalization for ARD (13-week moving average [MA] and standard deviation [SD]).

- Outcome 3: Weekly average age in months at time of discharge (13-week MA and SD).

- Impact was measured with ratios and percent change in observed versus expected outcomes during winter seasons after the SARS-CoV-2 pandemic.
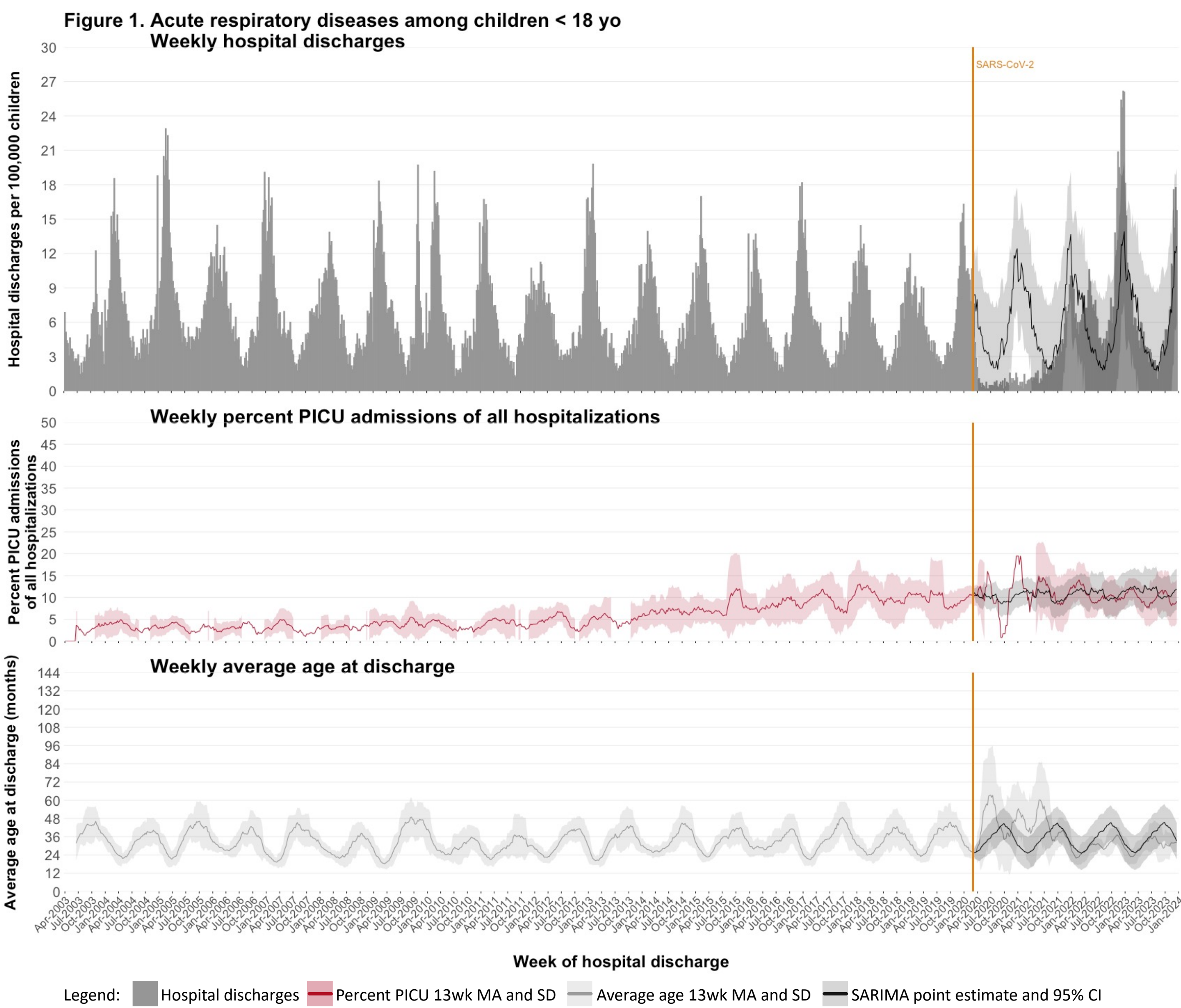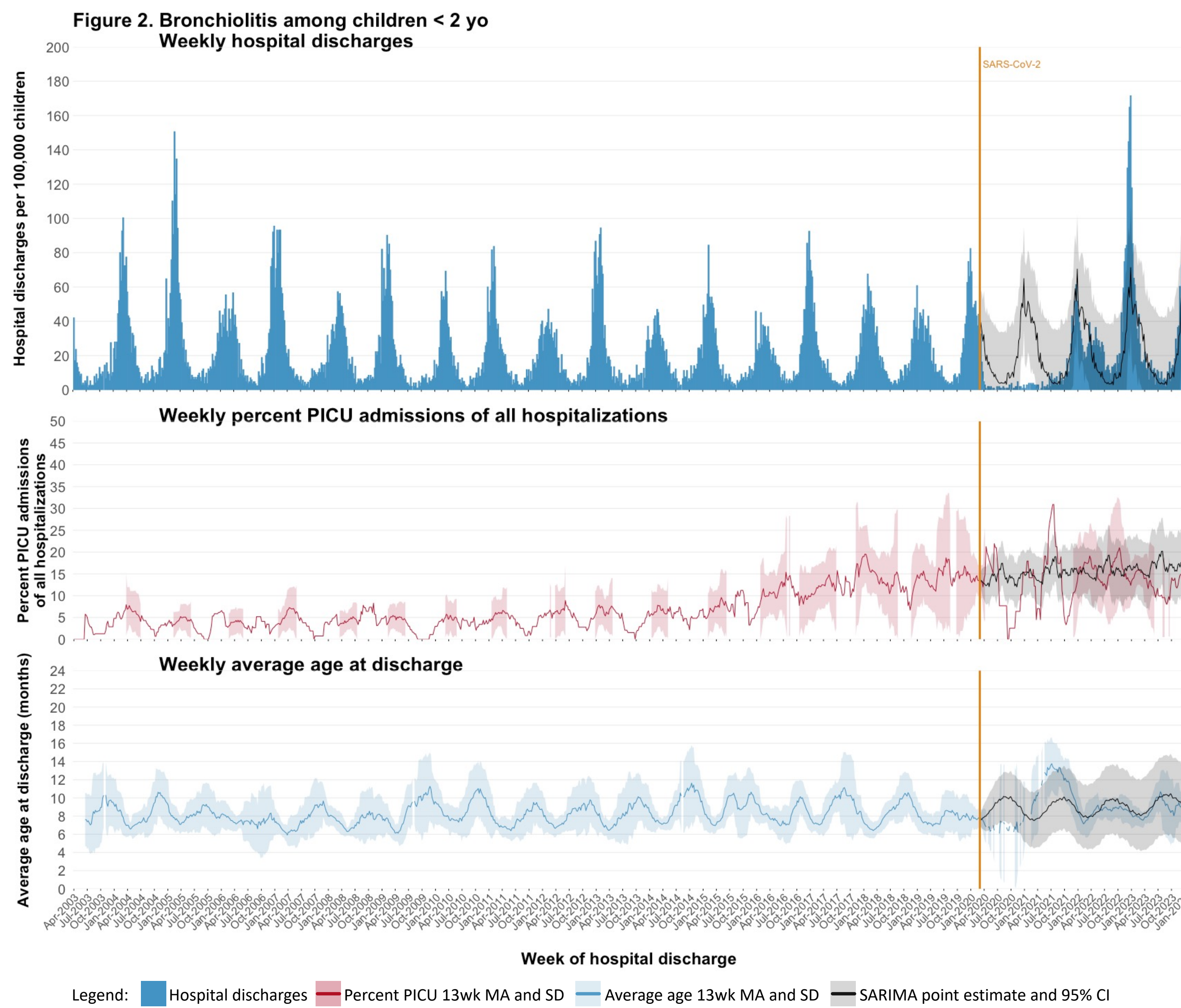
Figure 1. Acute respiratory diseases among children < 18 yo

Table 1. Acute respiratory diseases among children < 18 yo

	Reference SARIMA - Expected			Observed	Impact	
	Avg	Low 95%	High 95%	Avg	Ratio	Percent change (%)
Incidence of hospital discharges per 100,000 children						
Dec 2020 - Feb 2021	10.42	5.11	15.73	0.82	0.08	-92.09
Dec 2021 - Feb 2022	10.41	4.89	15.93	7.53	0.72	-27.72
Dec 2022 - Feb 2023	10.77	4.71	16.83	16.28	1.51	51.23
Average percent PICU admissions (%)						
Dec 2020 - Feb 2021	10.88	7.83	13.93	12.03	1.11	10.56
Dec 2021 - Feb 2022	11.07	7.59	14.55	14.02	1.27	26.65
Dec 2022 - Feb 2023	11.68	7.49	15.87	11.86	1.02	1.53
Average age at discharge (months)						
Dec 2020 - Feb 2021	30.26	21.43	39.10	42.71	1.41	41.14
Dec 2021 - Feb 2022	30.29	20.98	39.61	22.85	0.75	-24.58
Dec 2022 - Feb 2023	30.56	20.54	40.58	23.02	0.75	-24.66

Table 2. Bronchiolitis among children < 2 yo

	Reference SARIMA - Expected			Observed	Impact	
	Avg	Low 95%	High 95%	Avg	Ratio	Percent change (%)
Incidence of hospital discharges per 100,000 children						
Dec 2020 - Feb 2021	46.27	16.45	76.09	1.70	0.04	-96.33
Dec 2021 - Feb 2022	47.94	16.45	79.44	36.29	0.76	-24.30
Dec 2022 - Feb 2023	49.14	14.22	84.06	91.20	1.86	85.58
Average percent PICU admissions (%)						
Dec 2020 - Feb 2021	12.99	-1.26	27.24	14.10	1.09	8.58
Dec 2021 - Feb 2022	12.48	-13.83	38.79	17.55	1.41	40.59
Dec 2022 - Feb 2023	11.69	-30.65	54.03	15.78	1.35	35.00
Average age at discharge (months)						
Dec 2020 - Feb 2021	7.98	6.00	9.96	9.21	1.15	15.48
Dec 2021 - Feb 2022	7.90	5.64	10.16	7.45	0.94	-5.68
Dec 2022 - Feb 2023	7.94	5.20	10.68	7.93	1.00	-0.07

Figure 2. Bronchiolitis among children < 2 yo

Legend: Hospital discharges — Percent PICU 13wk MA and SD — Average age 13wk MA and SD — SARIMA point estimate and 95% CI

Results

- There were 63,776 hospitalizations for ARD, of which 4,167 (6.53%) included a PICU admission.

- Of the hospitalizations for ARD:
  22,963 (36.01%) were for bronchiolitis
  23,977 (37.44%) were for pneumonia
  10,833 (16.97%) were for influenza-like-illness
  4,984 (7.81%) were for croup

  Please see all Figures & Tables

- During the winter, the average incidence of hospitalization (per 100,000 children) for ARD decreased 12.71-fold in Dec 2020 - Feb 2021, and increased 1.51-fold in Dec 2022 - Feb 2023 (Figure & Table 1).

- Similar results were observed for each ARD (Figures & Tables 2-5). In particular, the incidence of bronchiolitis decreases 27.22-fold in Dec 2020 - Feb 2021, and increased 1.86-fold in Dec 2022 - Feb 2023 (Figure & Table 2).

- There was no significant change in the percent PICU admissions, nor average age at discharge (Figures & Tables 1-5).

Conclusion

- The SARS-CoV-2 pandemic had significant impacts on the pattern of pediatric hospitalizations for ARD.

- Initially hospitalizations decreased in Dec 2020 - Feb 2021, followed by a surge in Dec 2022 - Feb 2023.

- During the surge, we did not observe a difference in clinical severity based on percent PICU admissions nor affected population based on average age at discharge in Alberta.

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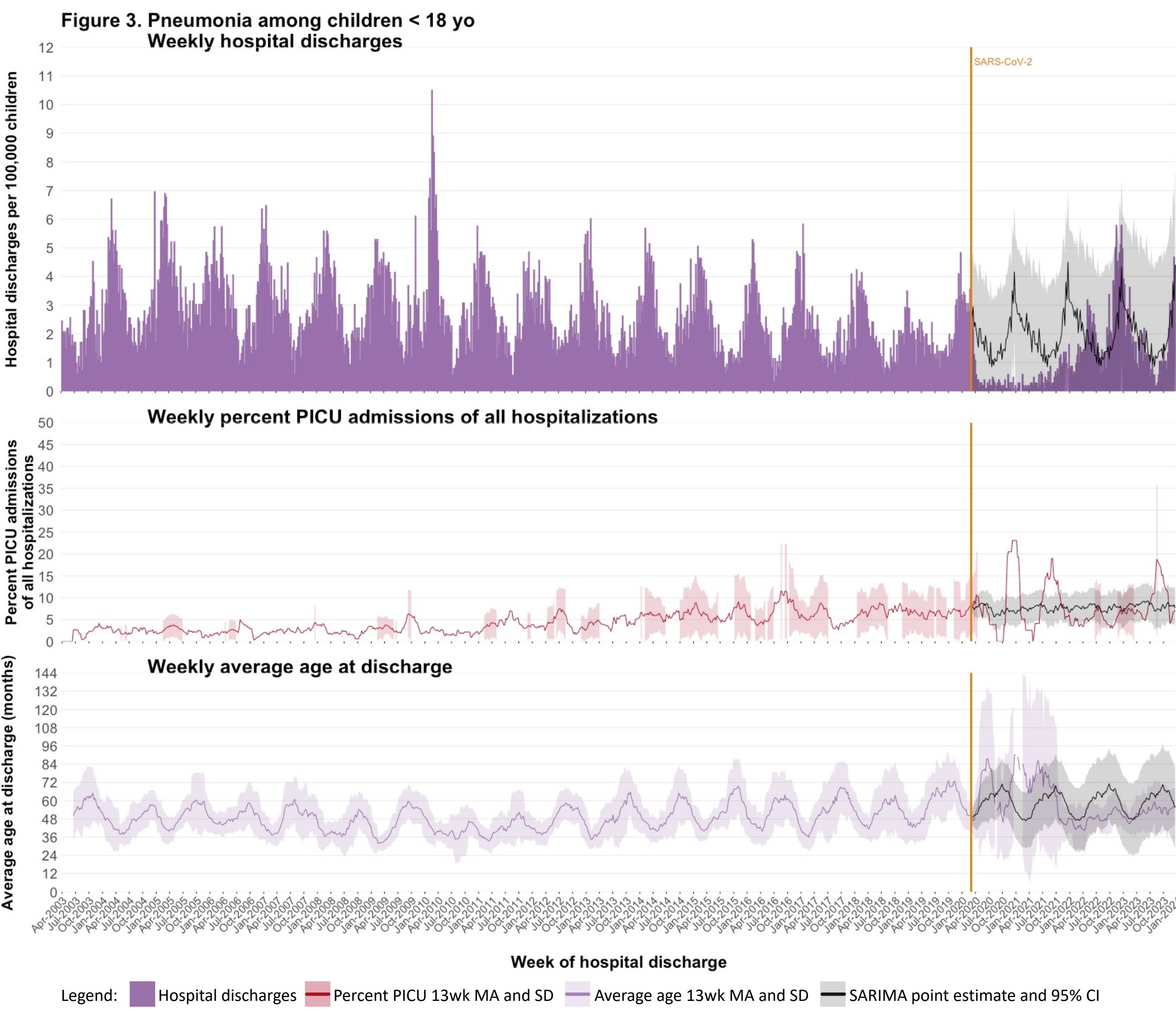Figure 3. Pneumonia among children < 18 yo

Figure 4. Influenza like illness among children < 18 yo

Figure 5. Croup among children < 6 yo

Table 3. Pneumonia among children < 18 yo

	Reference SARIMA - Expected			Observed	Impact	
	Avg	Low 95%	High 95%	Avg	Ratio	Percent change (%)
Incidence of hospital discharges per 100,000 children						
Dec 2020 - Feb 2021	2.81	0.56	5.05	0.22	0.08	-92.17
Dec 2021 - Feb 2022	3.07	0.57	5.58	0.96	0.31	-68.68
Dec 2022 - Feb 2023	2.94	-0.08	5.95	3.68	1.25	25.10
Average percent PICU admissions (%)						
Dec 2020 - Feb 2021	7.13	3.86	10.39	5.13	0.72	-28.06
Dec 2021 - Feb 2022	7.55	4.14	10.97	5.26	0.70	-30.38
Dec 2022 - Feb 2023	7.78	4.06	11.50	6.96	0.89	-10.53
Average age at discharge (months)						
Dec 2020 - Feb 2021	55.21	32.74	77.68	72.40	1.31	31.14
Dec 2021 - Feb 2022	60.32	19.02	101.63	41.96	0.70	-30.44
Dec 2022 - Feb 2023	62.38	-4.09	128.84	46.28	0.74	-25.81

Table 4. Influenza like illness among children < 18 yo

	Reference SARIMA - Expected			Observed	Impact	
	Avg	Low 95%	High 95%	Avg	Ratio	Percent change (%)
Incidence of hospital discharges per 100,000 children						
Dec 2020 - Feb 2021	1.97	0.16	3.78	0.14	0.07	-92.70
Dec 2021 - Feb 2022	2.04	0.03	4.05	0.77	0.38	-62.40
Dec 2022 - Feb 2023	2.01	-0.42	4.43	2.36	1.18	17.88
Average percent PICU admissions (%)						
Dec 2020 - Feb 2021	9.50	2.69	16.31	0.00	0.00	-100.00
Dec 2021 - Feb 2022	9.00	1.70	16.30	7.60	0.84	-15.54
Dec 2022 - Feb 2023	9.08	1.14	17.01	5.21	0.57	-42.57
Average age at discharge (months)						
Dec 2020 - Feb 2021	41.84	27.76	55.92	35.22	0.84	-15.82
Dec 2021 - Feb 2022	41.71	26.28	57.13	29.80	0.71	-28.54
Dec 2022 - Feb 2023	41.45	24.66	58.23	41.34	1.00	-0.25
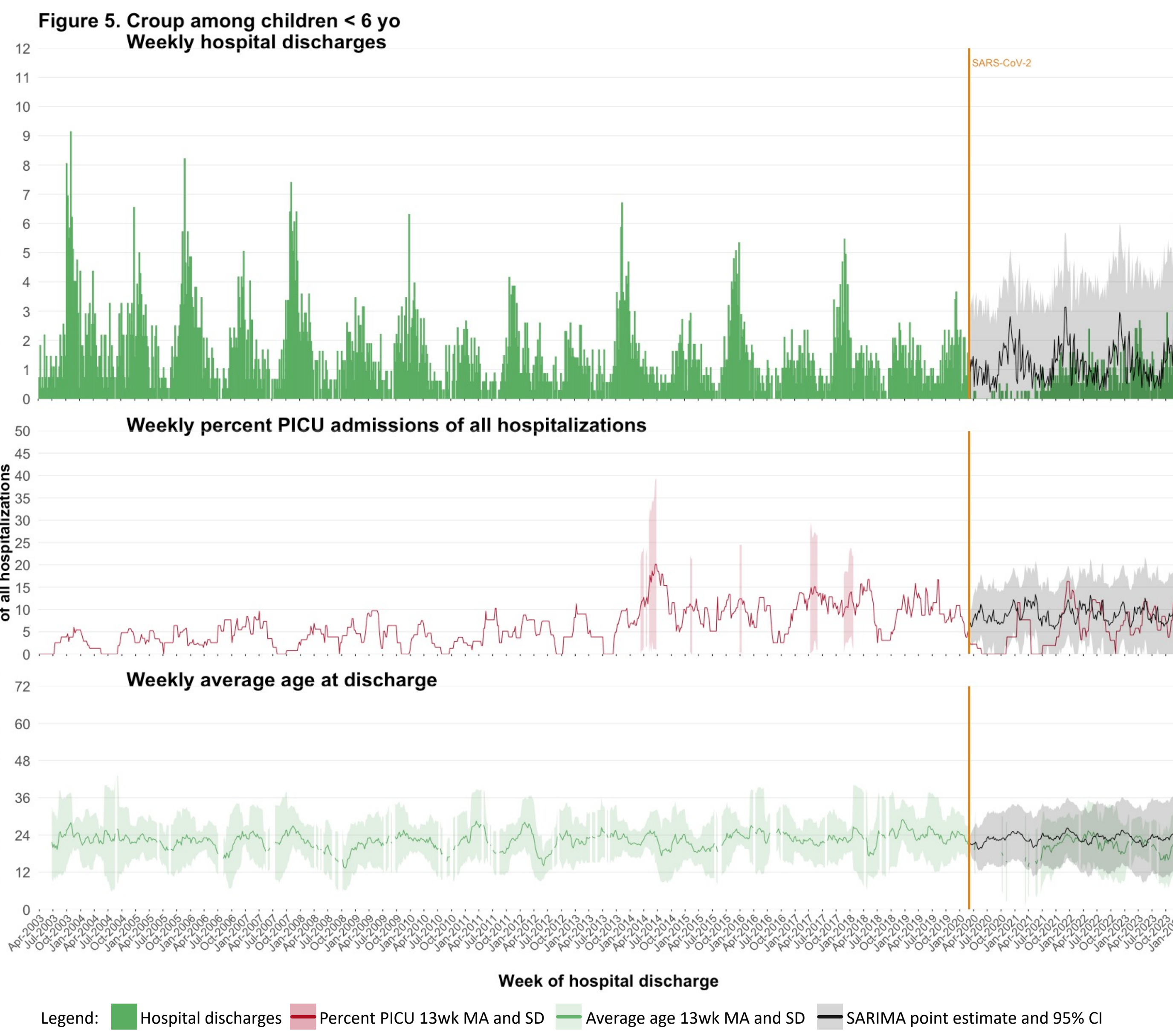
Table 5. Croup among children < 6 yo

	Reference SARIMA - Expected			Observed	Impact	
	Avg	Low 95%	High 95%	Avg	Ratio	Percent change (%)
Incidence of hospital discharges per 100,000 children						
Dec 2020 - Feb 2021	1.70	-0.61	4.00	0.06	0.04	-96.46
Dec 2021 - Feb 2022	1.77	-0.75	4.30	0.98	0.55	-44.79
Dec 2022 - Feb 2023	1.73	-1.33	4.79	0.84	0.49	-51.27
Average percent PICU admissions (%)						
Dec 2020 - Feb 2021	9.75	2.52	16.98	7.69	0.79	-21.11
Dec 2021 - Feb 2022	9.43	1.77	17.09	10.26	1.09	8.74
Dec 2022 - Feb 2023	8.98	0.70	17.27	4.30	0.48	-52.08
Average age at discharge (months)						
Dec 2020 - Feb 2021	25.15	19.20	31.09	21.00	0.84	-16.48
Dec 2021 - Feb 2022	24.32	17.67	30.97	23.23	0.96	-4.49
Dec 2022 - Feb 2023	24.74	16.72	32.75	22.46	0.91	-9.21

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