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Paediatric prehospital emergencies and restrictions during the COVID-19 pandemic: a population-based study

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Paediatric prehospital emergencies and restrictions during the COVID-19 pandemic: a population-based study

Jelena Oulasvirta, MD[1,2]

Jussi Pirneskoski, MD[2]

Heini Harve-Rytsälä, MD, PhD[2]

Mitja Lääperi, MSc[2]

Mikael Kuitunen, MD, PhD[3]

Markku Kuisma, MD, PhD[2]

Heli Salmi, MD, PhD[1,3]

[1] Division of Anaesthesiology; Department of Anaesthesiology, Intensive Care and Pain Medicine; University of Helsinki and Helsinki University Hospital, P.O. Box 340, FI-00029 HUS, Finland

[2] Department of Emergency Medicine and Services, Helsinki University and Helsinki University Hospital, P.O. Box 340, FI-00029 HUS, Finland

[3]New Children's Hospital, University of Helsinki and Helsinki University Hospital, P.O. Box 347, FI-00029 HUS, Finland

Corresponding author:

Jelena Oulasvirta

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Postal address: Töölö Hospital, University of Helsinki and Helsinki University Hospital, P.O. Box 266, FI-00029 HUS, Finland

E-mail: jelena.oulasvirta@hus.fi

Telephone: +358 50 428 7622

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What is already known on this topic

- Compared to adults, children are less affected by the COVID-19 infection but may be affected by its control measures.
- Children may experience collateral damage because of the infection control measures, mainly designed to protect adults.
- The pandemic has decreased paediatric emergency department (ED) visits, but it is not clear how or if prehospital care has also been affected.

What this study adds

- The use of prehospital emergency medical services decreased in children after declaration of the state of emergency in Finland.
- During the pandemic, ambulance calls for children were more often in the most urgent category and due to trauma. Paradoxically, almost 60% of children were not transported to the ED.
- Societal measures targeted to protect adults against the pandemic affected children and their emergency medical care.

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ABSTRACT

Background

Children are less vulnerable to serious forms of the COVID-19 disease. However, concerns have been raised about children being the second victims of the pandemic and its control measures. Therefore, we wanted to study if and how Finnish governmental restrictions aimed to constrain the local pandemic projected to paediatric prehospital emergency medical services (EMS) contacts.

Methods

We conducted a population-based cohort study concerning all children aged 0-15 years with EMS contacts in the Helsinki University Hospital (HUH) area during 1.3.-31.5.2020 (study period) and equivalent periods in 2017-2019 (control periods). We analysed the demographic characteristics, time of EMS contact, reason for EMS contact, priority of the dispatch, reason for transportation, priority of transportation, if any consultations were made, any medication or oxygen or fluids given, if intubation was performed, and whether paramedics took precautions when COVID-19 infection was suspected.

Results

The number of paediatric EMS contacts decreased by 30.4% from mean of 1794 contacts to 1369 (p=0.003). Patients were younger and there were proportionally less national language speakers: 5.3 years compared to 6.3 years (p<0.001) and -7.8% (p=0.003), respectively. The EMS contacts were more often due to trauma, (+23.7%, p<0.05), dispatched in the most urgent category (+139.9%, p=0.001), but less often resulted in ambulance transport (-21.1%, p<0.001). There were 4 deaths during the study period compared to 0-2 during the control periods.

Conclusions

In addition to a decrease in paediatric EMS contacts, the characteristics of the contacts changed substantially during the restrictions placed because of the pandemic.

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INTRODUCTION

Children seem to be less vulnerable to the serious forms of the COVID-19 disease by the new pandemic coronavirus SARS-CoV-2 than adults (1–3). Still, following the infection control measures and associated abrupt changes in healthcare delivery, children have not been spared from the health effects of the pandemic. Consequently, health professionals have expressed concern over children becoming second victims of the pandemic (4–6).

Instructions on social distancing and self-quarantine resulted in a considerable decrease in paediatric emergency department (ED) visits (4,5). Also, the emergency healthcare itself changed: In EDs and prehospital emergency medical services (EMS), infection control measures, including the use of personal protective equipment have slowed patient flows and resulted in modified treatment protocols. On the other hand, the ubiquitous presence of COVID-19 in news and media may have created a bias in clinicians, who may be prone to diagnostic errors, suspecting COVID-19 over more common conditions.

Decreasing unnecessary paediatric ED visits and ambulance calls has been a priority in paediatric emergency care already before the pandemic (7–9). Now that these contacts have substantially decreased, it is important to analyse whether this change has taken place at the cost of health risks for children.

After noticing a decrease in paediatric EMS responses in our EMS system, and alarmed by reports stating risks associated with decreases in paediatric ED visits (4,5), we wanted to study whether the decrease in paediatric EMS contacts and transports has led to patient safety hazards; and, thus, whether the public information and infection control measures targeted to children have been reasonable, and whether they would need to be adjusted in possible new waves of the COVID-19 pandemic.

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METHODS

Study area and population

The Helsinki University Hospital (HUH) area in Southern Finland has 1 263 000 inhabitants including 217 000 0-15-years-old children (2019) (10) and consists of both urban and suburban regions covering 1 216 km^2. This study covers all prehospital ambulance responses for children (aged 0-15 years) in the HUH area during the study and control periods.

Organisation of emergency medical services and healthcare system

Finland has a publicly financed universal healthcare system for all residents. The public healthcare exclusively provides all prehospital emergency medical services. All emergency calls go to the governmental emergency response centre (ERC). A professional ERC operator categorises the leading complaint to form a dispatch code and determines a priority class from A (highest risk) to D (lowest risk) according to a formal protocol (11). In HUH area, all prehospital emergencies are responded to by HUH EMS consisting of 36 ambulances and three medical supervisor units staffed by emergency medical technicians, paramedics and two physician-staffed units. An emergency physician can be consulted by phone, or, requested on scene. Not all patients encountered by EMS are transported to hospital by ambulance. After examination and treatment, the EMS personnel may conclude that patient does not need ambulance transport. In that case they must inform the patient or the caregivers on how to observe and treat the condition and on whether or when to contact healthcare services again.

There are two 24/7 paediatric ED units with in-patient care in the area. In addition, smaller units offer primary level healthcare during office hours.

Data collection

We retrieved all emergency responses concerning children (age 0-15 y) from the ambulance electronic patient record system (Merlot Medi®, CGI Suomi Oy) in HUH area between 1.3.2020 and 31.5.2020 (study period) and equivalent periods for three previous years: 1.3.2017 - 31.5.2017; 1.3.2018 - 31.5.2018;

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1.3.2019 - 31.5.2019 (control periods). The study period covered the pandemic declaration by World Health Organisation (WHO) on 11 March, the Finnish Government announcement of the state of emergency in Finland on 16 March, and the reopening of schools on 14 May. We analysed the time of contact, reason for contact, dispatch priority, reason for transportation, priority of transportation, age, sex, native language, whether the patient received medications, oxygen, fluids or was intubated, whether a physician was consulted, and whether COVD-19 was suspected. We registered mortality within 72h and eventual laboratory diagnostics for respiratory viruses (including SARS-CoV-2) from the Helsinki University Hospital in-hospital patient record system (Uranus®, CGI Suomi Oy and Apotti®, Epic Systems Corporation).

Statistical analysis

Estimates and proportions are shown using medians and interquartile ranges (IQR) and number of events are shown using counts and percentages. To compare the change in EMS contacts during the study period to that of control periods, we used the Mann-Whitney U test or Wilcoxon signed-rank test depending on whether comparisons were made between all the observations or between the weeks of 2020 and the previous years. The analyses were performed using R 3.6.3 (12) and the visualisations using ggplot2-package (13). We used 0.05 as the level of significance. As the infection control measures changed during the study period, we used line plots with date as the X-axis to evaluate the eventual changes in our parameters.

Ethical aspects and Patient and Public Involvement statement

This is a register-based study approved by the Institutional Review Board of Helsinki University Hospital (§24/2020). No public involvement was planned for this study, as the COVID-19 pandemic advanced rapidly.

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RESULTS

There were 28 680 prehospital EMS contacts during the study period, of which 1368 (4.8%) concerned children. This comprised a reduction of paediatric EMS contacts by 30.4% (p=0.003) compared to the mean of 1794 contacts in control periods (Table 1, Figure 1). Patients were younger and there were proportionally less children speaking one of the national languages (Finnish or Swedish) as native language: 5.3 years compared to 6.3 years (p<0.001) and -7.8% (p=0.003), respectively (Table 1, Figures 1 and 2). The demographic characteristics of children are described in Table 1 and Figure 1. *(Table 1 and Figures 1 and 2 here)*

Table 1. Descriptive statistics.

		Mean 2017-2019	2020	change	P-value
Age (years)		6.3 (2.1 - 12.7)	5.3 (1.8 - 12.0)		**<0,001**
Sex (male)	all n (%)	965.3 (54.0%)	753 (55.1%)		
	n per week median (IQR)	74.0 (67.7 - 77.7)	53.0 (48.0 - 70.0)	-27.6% (-35.4% - -5.4%)	**0,001**
	% per week median (IQR)	54.5% (51.5% - 55.5%)	54.3% (52.7% - 56.2%)	1.6% (-3.5 - 4.8%)	0,635
Native language (Finnish or Swedish)	all n (%)	1338.0 (79.5%)	991 (74.7%)		
	n per week median (IQR)	103.3 (99.0 - 105.0)	69.0 (66.0 - 91.0)	-32.3% (-35.2% - -10.5%)	**0,002**
	% per week median (IQR)	79.5% (78.2% - 81.8%)	72.8% (71.8% - 78.4%)	-7.8% (-8.5 - -4.8%)	**0,003**

IQR = Interquartile Range

The changes in the characteristics of EMS dispatch and transportation codes are described in Table 2 and visualised in Figure 3. The proportion of the highest priority A dispatch code rose by 139.9% (p=0.001). The absolute number of trauma patients decreased by 11.9% (p<0.02). However, their proportion increased by 23.7% (p<0.05). The proportion of non-transported patients increased by 21.1% (p<0.001). *(Table 2 and Figure 3 here)*

Four patients were dead on arrival of the EMS or died on-scene during the study period, compared to 0 - 2 during the control periods (Table 3). *(Table 3 here)*

Table 3. Mortality presented by year during equivalent periods of 1.3.-31.5.

	2017	**2018**	**2019**	**2020**	**P-value**

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All paediatric EMS contacts (n)	1722	1801	1857	1364	
Dead on arrival or on-scene (n)	2		1	4	0,060

EMS = Emergency Medical Services

Less treatments were performed in 2020 compared to the control periods: establishing an intravenous access decreased in proportion by 32.5% (p=0.008) and administering medications by 35.3% (p<0.02) (Table 4). *(Table 4 here)*

Of the 1368 children, COVID-19 infection was suspected in 103 (Figure4). Of these, 4 were previously known to be positive for SARS-CoV-2 and there were 2 new infections. However, 41 of the 1261 children not suspected as having COVID-19 by the EMS were tested for COVID-19 infection at the ED, with only 1 positive result. *(Figure 4 here)*

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DISCUSSION

During a local epidemic peak of the COVID-19 pandemic, prehospital emergency care delivered to children decreased and its characteristics changed markedly. Even though emergency calls for children were more often categorised urgent, they lead more likely to not transporting the child to hospital. Concomitantly, prehospital paediatric deaths increased. Consequently, the pandemic had unanticipated secondary effects on the emergency healthcare of children.

Finland has not experienced high COVID-19 infection rates in the population so far. The highest demand for hospital beds and intensive care was experienced mid-April (14). Thus, the changes we noticed in the emergency healthcare to children were neither due to SARS CoV-2, nor to an overwhelming of the emergency healthcare system. Instead, they represent the changes in healthcare functionality, and in the behaviour of families with children.

We expected the decrease in the number of EMS contacts for children based on international reports about substantial decreases in the number of paediatric ED visits during the pandemic (15,16). Our figures were also congruent with those from the paediatric EDs in the area, which saw a 45% decrease in the number of visits after the beginning of the infection control measures, according to the hospital statistical data. The EMS contacts with children started to decrease immediately after the declaration of state of emergency, suggesting that the decrease was more societal than medical in nature.

Successful public guidance during the state of emergency, eliminating “unnecessary” EMS contacts (9,17) may partly explain the sudden decrease in EMS contacts. In addition, infection control measures could have decreased the occurrence of acute infections in children and, hence, the occurrence of febrile seizures and dyspnoea, which are leading causes for paediatric EMS calls under normal circumstances (18). Still,

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especially the peak in the number of children who died on-scene warrants careful examination of the EMS contacts during the pandemic. Even if the increase in deaths may be due to coincidence, we cannot confidently state that the decrease in EMS contacts was a positive proceeding.

Our results suggest that paediatric low-acuity EMS contacts decreased more than contacts due to urgent or critical reasons. While the EMS contacts fell by 30.4% as compared to previous years, the proportion of dispatch with highest priority class increased, and the proportion of least urgent dispatches decreased. In addition, the proportion of non-urgent transportation and the proportion of non-transported patients increased. These are reassuring findings, as they implicate that the decrease in EMS calls did not result from caregivers not daring to contact medical care providers even when urgently in need, or from severe dysfunction of the healthcare system during the pandemic. A recent report from adult EMS contacts in the UK supports this view, stating that the pandemic did not cause reluctance to call an ambulance in case of a stroke or heart attack (19).

The increase in the proportion of EMS calls in which the patient was not transported in an ambulance ("non-transports") is interesting, as in our system, the baseline rates for non-transportation were already high (18,20). This finding is also paradoxical considering that non-urgent or non-medical complaints did not seem overexpressed during the pandemic, as previously discussed. The increased tendency not to transport by ambulance may reflect the practical difficulties imposed by the infection control measures during the pandemic, such as a time-consuming obligation to thoroughly clean the ambulance after any transport. In addition, prepared for the challenges of the pandemic, EMS personnel may have felt a need to ascertain that a maximal number of units are available at all times.

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We observed a decrease in the absolute rate of traumas, but non-traumatic emergencies decreased even more. This is interesting, as we hypothesised that the decrease in EMS dispatches during the pandemic would have been most pronounced for traumas. After all, due to social distancing, children had less school and sport activities and transports in motor vehicles. Under normal circumstances, these factors are major contributors for paediatric traumas (21). On the other hand, even if schools and activities were closed, playgrounds and other public outdoor areas remained open; thus, offering more unsupervised outside playing time. These changes from normal routines may have contributed to unpredicted new risks for traumas in children.

We found that the number of EMS calls for children speaking other language than the national languages (Finnish or Swedish) decreased similarly to other contacts but with a delay (Figure 2). In Finland, native language can be used as a proxy for recent immigrant background. Interestingly, several reports have addressed the vulnerability of ethnic minority groups to COVID-19 (22,23). Our results suggest that language and immigrant background may play a role: the information took more time to reach subpopulations with deficiencies in language skills and poor knowledge of the healthcare system. Consequently, in possible new pandemic waves, more attention should be paid to efficiently spreading accurate information in different languages and formats.

To evaluate if changes were specifically encountered by families with children, we also compared our findings to those in the total HUH population. In our area, EMS calls for adults also decreased by 11.1 % ($p = 0.004$) during the pandemic; but, in contrast to children, the absolute number of their most urgent contacts also decreased by 17.1 % ($p = 0.004$), and there was no increase in the on-scene mortality. In addition, the decrease in adult EMS contacts occurred already before the declaration of the state of emergency. The pattern for children is clearly different, which strengthens the concern raised by recent reports suggesting that children may have had to bear the burden of the restrictions of the COVID-19 pandemic differently to

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adults – even to the extent of becoming the "collateral damage" of the pandemic (6). Taken together, these findings suggest that in adults, behavioural changes (i.e., decrease in risk behaviours following social distancing, reluctance to contact medical care etc.) were responsible for most of the decrease in EMS contacts; and that, in contrast to children, the protective measures were truly protective for adults, decreasing the occurrence of severe acute illnesses and injuries. It remains to be solved how, in future pandemics, children could be protected from the negative impacts of measures designed to protect adults.

To protect the EMS and ED personnel from infections, and to optimise the use of critical resources, it would be crucial to be able to recognise children with probable or possible COVID-19. We found that calibration still needs to be done – in about half of the patients where EMS personnel suspected COVID-19, no COVID-19 tests were performed at the ED. On the other hand, only 41 of the 1261 patients in whom EMS personnel did not suspect COVID-19 infections, were tested for COVID-19 with one positive result. This implies that more explicit instructions for EMS personnel are needed (24).

Our study has several limitations. First, it is a single-centre study. Second, because of the rapid advance of the COVID-19 pandemic, this study is retrospective. We tried to address the lack of historic references by comparing the data to equivalent periods of three previous years. Finally, mortality is such a rare event that no statistical conclusions can be drawn based on our data. However, we believe that this finding needs to be disclosed.

The pandemic created exceptional circumstances with rapid changes in the behaviour of families with children and the functionality of emergency healthcare. During recent pandemics, e.g. the H1N1 influenza in 2009, school closure and social distancing measures were never extended to children in a similar way (25). In our area, the setting was particularly interesting, as the prevalence of COVID-19 in the population

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remained low throughout the epidemic (14). Thus, our results may be generalisable to other similar situations of unexpected quick changes in the healthcare.

CONCLUSIONS

The total number of contacts decreased rapidly during the COVID-19. Also, the children encountered by the EMS were more ill and we registered more deaths than in control periods. Our results highlight the need to consider secondary effects of healthcare interventions also on other populations than those originally targeted.

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Contributions:

JO, HS, MaK, HHR conceptualised and designed the study, carried out the initial analyses, drafted the initial manuscript, and reviewed and revised the manuscript. JO, HS, HHR and JP collected the data. JP and MiK participated in the design of the study, reviewed the initial data collection and initial analyses, and critically reviewed and revised the manuscript. ML designed the data analysis instruments, coordinated and supervised data analysis, and critically reviewed the manuscript. All authors approved the final manuscript as submitted and agreed to be accountable for all aspects of the work.

Any checklist and flow diagram for the appropriate reporting statement,

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Patient consent form:

Not applicable.

Data availability statement:

Data are available upon reasonable request.

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FIGURE LEGENDS:

Figure 1: Basic information on paediatric EMS contacts in 2020 compared to equivalent periods in 2017-2019.

a) Number of weekly EMS contacts

b) A timeline of the course of the first pandemic wave and number of weekly EMS contacts.

1. World Health Organization declared the pandemic, 11 March 2020
2. Public social gatherings were limited to a maximum of 500 participants, 15 March2020
3. The government announced the state of emergency, 16 March.2020
4. National restrictions and social distancing launched. Schools closed, 18 March2020
5. Launching strict national border control, 19 March 2020
6. Isolation of Southern Finland started, 28, March 2020
7. Isolation of Southern Finland ended, 15 April 2020
8. Schools reopened, 14 May 2020

c) Number and proportion of children according to age groups

d) The proportion of EMS contacts according to time of day

EMS = Emergency Medical Services

Figure 2: Proportions of EMS contacts with native language Finnish or Swedish compared to other-language-speakers

a) Presented by year during equivalent periods of 1 March to 31 May.

b) A timeline of the course of the first pandemic wave and proportion of EMS contacts with other-language-speakers.

1. World Health Organization declared pandemic, 11 March 2020
2. Public social gatherings were limited to a maximum of 500 participants, 15 March2020
3. The government announced the state of emergency, 16 March.2020
4. National restrictions and social distancing launched. Schools closed, 18 March2020

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5. Launching strict national border control, 19 March 2020
6. Isolation of Southern Finland started, 28, March 2020
7. Isolation of Southern Finland ended, 15 April 2020
8. Schools reopened, 14 May 2020

EMS = Emergency Medical Services

Figure 3: A timeline of the course of the first pandemic wave and

a) Number of trauma patients

b) Proportion of trauma patients

c) Proportion of non-transported patients

1. World Health Organization declared pandemic, 11 March 2020
2. Public social gatherings were limited to a maximum of 500 participants, 15 March2020
3. The government announced the state of emergency, 16 March.2020
4. National restrictions and social distancing launched. Schools closed, 18 March2020
5. Launching strict national border control, 19 March 2020
6. Isolation of Southern Finland started, 28, March 2020
7. Isolation of Southern Finland ended, 15 April 2020
8. Schools reopened, 14 May 2020

EMS = Emergency Medical Services

Figure 4: Flow-chart of EMS contacts in 2020 and possible suspicion of COVID-19 infection

EMS = Emergency Medical Services

ED = Emergency Department

resp infection = respiratory infection

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ORCID ID

Jelena Oulasvirta https://orcid.org/0000-0001-6750-4615

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Table 2. Change in the dispatch and transportation codes.

		Mean 2017-2019	2020	change	P-value
All EMS contacts	all n (%)	1794.3 (100.0%)	1368 (100.0%)		
	n per week median (IQR)	137.7 (130.7 - 142.0)	91.0 (86.0 - 132.0)	-30.4% (-36.6% - -12.8%)	**0,003**
Dispatch priority A*	all n (%)	55.3 (3.1%)	90 (6.6%)		
	n per week median (IQR)	3.7 (3.3 - 3.7)	8.0 (7.0 - 8.0)	90.9% (36.4% - 140.0%)	**0,031**
	% per week median (IQR)	2.7% (2.4% - 2.8%)	6.1% (5.7% - 8.4%)	139.9% (116.7 - 175.9%)	**0,001**
Dispatch priority B*	all n (%)	690.7 (38.5%)	478 (34.9%)		
	n per week median (IQR)	51.7 (50.3 - 55.7)	37.0 (30.0 - 43.0)	-29.0% (-42.3% - -20.7%)	**0,002**
	% per week median (IQR)	38.2% (36.7% - 40.5%)	36.1% (31.5% - 38.1%)	-8.7% (-15.9 - -2.3%)	**0,027**
Dispatch priority C*	all n (%)	932.7 (52.0%)	658 (48.1%)		
	n per week median (IQR)	71.3 (67.3 - 74.0)	44.0 (43.0 - 57.0)	-34.7% (-41.8% - -23.3%)	**0,001**
	% per week median (IQR)	52.1% (50.5% - 53.7%)	49.4% (45.7% - 51.4%)	-6.7% (-9.1 - -4.1%)	**0,048**
Dispatch priority D*	all n (%)	115.7 (6.4%)	143 (10.4%)		
	n per week median (IQR)	8.3 (7.3 - 11.0)	10.0 (8.0 - 12.0)	12.5% (-11.8% - 60.0%)	0,235
	% per week median (IQR)	6.5% (5.2% - 7.9%)	9.5% (8.1% - 11.4%)	65.0% (38.9 - 83.6%)	**0,001**
Transported patients	all n (%)	927.3 (51.7%)	578 (42.3%)		
	n per week median (IQR)	73.0 (67.0 - 74.7)	36.0 (34.0 - 54.0)	-49.1% (-52.0% - -27.7%)	**0,002**
	% per week median (IQR)	52.2% (51.4% - 52.9%)	41.9% (39.1% - 44.8%)	-19.5% (-27.0 - -13.4%)	**<0,001**
Transportation priority A*	all n (%)	12.3 (0.7%)	6 (0.4%)		
	n per week median (IQR)	1.0 (0.8 - 1.0)	1.0 (1.0 - 1.0)	50.0% (0.0% - 50.0%)	0,174
	% per week median (IQR)	0.7% (0.5% - 0.8%)	1.2% (0.9% - 1.2%)	107.2% (52.4 - 381.5%)	**0,031**
Transportation priority B*	all n (%)	92.3 (5.1%)	62 (4.5%)		
	n per week median (IQR)	7.0 (5.3 - 8.0)	5.0 (3.0 - 5.0)	-34.8% (-51.6% - -28.6%)	**0,004**
	% per week median (IQR)	5.4% (4.4% - 5.6%)	5.0% (3.5% - 5.7%)	-15.0% (-31.8 - 4.0%)	0,168
Transportation priority C*	all n (%)	602.0 (33.6%)	398 (29.2%)		
	n per week median (IQR)	45.3 (43.0 - 48.3)	25.0 (22.0 - 41.0)	-40.0% (-48.4% - -11.0%)	**<0,001**
	% per week median (IQR)	33.2% (31.9% - 34.5%)	29.1% (25.6% - 31.2%)	-8.8% (-24.2 - -2.0%)	**0,005**
Transportation priority D*	all n (%)	220.3 (12.3%)	113 (8.3%)		
	n per week median (IQR)	16.3 (15.0 - 18.0)	7.0 (6.0 - 9.0)	-60.9% (-63.3% - -45.0%)	**0,002**
	% per week median (IQR)	11.8% (11.6% - 13.0%)	7.4% (6.6% - 8.6%)	-37.7% (-46.2 - -27.2%)	**0,001**
Trauma patients	all n (%)	606.0 (33.8%)	504 (36.8%)		
	n per week median (IQR)	45.3 (39.0 - 51.3)	36.0 (31.0 - 41.0)	-11.9% (-24.5% - -9.6%)	**0,011**
	% per week median (IQR)	32.7% (29.6% - 37.1%)	39.0% (33.3% - 41.7%)	23.7% (-7.1 - 28.1%)	**0,048**
Non-transported patients	all n (%)	866.0 (48.3%)	786 (57.6%)		
	n per week median (IQR)	66.3 (64.0 - 68.3)	56.0 (50.0 - 68.0)	-7.8% (-26.8% - 0.0%)	**0,108**
	% per week median (IQR)	47.8% (47.1% - 48.7%)	58.1% (55.2% - 60.9%)	21.1% (15.0 - 28.4%)	**<0,001**

* the priority class from A to D refers to the urgency of the dispatch /transportation and /or to the risk of the symptom to a patient – A being the contact with highest urgency and risk and D the lowest urgency and risk

EMS = Emergency Medical Services

IQR = Interquartile Range

Table 4. Change in the interventions performed on-scene

		Mean 2017-2019	2020	change	P-value
additional help requested	all n (%)	86.7 (4.8%)	94 (6.9%)		
	n per week median (IQR)	6.3 (5.3 - 7.7)	7.0 (5.0 - 9.0)	23.5% (-29.4% - 31.3%)	0,529
	% per week median (IQR)	4.6% (4.0% - 5.6%)	6.8% (4.5% - 8.5%)	43.3% (0.7 - 117.7%)	**0,040**
MICU on-scene	all n (%)	26.0 (1.4%)	24 (1.8%)		
	n per week median (IQR)	1.7 (1.3 - 2.3)	2.0 (2.0 - 2.8)	0.0% (-13.2% - 50.0%)	0,435
	% per week median (IQR)	1.3% (0.9% - 1.7%)	2.3% (1.4% - 2.5%)	46.3% (-1.4 - 100.5%)	**0,049**
emergency physician consulted by phone	all n (%)	291.3 (16.2%)	236 (17.2%)		
	n per week median (IQR)	21.7 (21.3 - 23.0)	18.0 (15.0 - 20.0)	-28.4% (-36.3% - -1.7%)	**0,023**
	% per week median (IQR)	16.1% (15.3% - 17.1%)	17.6% (15.6% - 18.1%)	2.7% (-4.6 - 19.6%)	0,588
any measurements done on-scene	all n (%)	1693.0 (94.4%)	1280 (93.5%)		
	n per week median (IQR)	129.0 (124.0 - 134.3)	88.0 (78.0 - 124.0)	-29.0% (-37.6% - -12.3%)	**0,001**
	% per week median (IQR)	94.6% (94.0% - 94.9%)	93.9% (91.9% - 95.3%)	-0.0% (-2.2 - 1.6%)	0,455
intubation*	all n (%)	2.0 (0.1%)	3 (0.2%)		
	n per week median (IQR)	0.3 (0.3 - 0.3)	1.5 (1.2 - 1.8)		
	% per week median (IQR)	0.2% (0.1% - 0.2%)	1.3% (1.2% - 1.3%)		
supplementary oxygen given	all n (%)	41.7 (2.3%)	16 (1.2%)		
	n per week median (IQR)	3.0 (2.3 - 3.7)	2.0 (1.0 - 2.2)	-39.4% (-51.8% - 12.5%)	0,306
	% per week median (IQR)	1.9% (1.7% - 2.5%)	1.5% (1.2% - 2.4%)	-19.3% (-33.8 - 17.2%)	0,742
intravenous connection established	all n (%)	133.3 (7.4%)	65 (4.7%)		
	n per week median (IQR)	10.7 (8.3 - 12.3)	5.0 (3.0 - 7.0)	-52.6% (-70.7% - -30.8%)	**0,003**
	% per week median (IQR)	7.6% (5.9% - 9.0%)	4.4% (2.9% - 5.8%)	-32.5% (-56.8 - -24.9%)	**0,008**
any medication given	all n (%)	195.0 (10.9%)	111 (8.1%)		
	n per week median (IQR)	14.3 (12.3 - 15.3)	7.0 (6.0 - 9.0)	-44.7% (-63.6% - -37.9%)	**0,001**
	% per week median (IQR)	10.3% (8.9% - 11.9%)	7.6% (6.6% - 9.1%)	-35.3% (-44.2 - -12.9%)	**0,013**
medication given per os	all n (%)	13.0 (0.7%)	13 (0.9%)		
	n per week median (IQR)	1.0 (0.7 - 1.4)	2.0 (1.0 - 2.0)	100.0% (-20.0% - 200.0%)	0,140
	% per week median (IQR)	0.7% (0.5% - 1.1%)	1.4% (1.2% - 1.7%)	117.2% (19.4 - 220.2%)	0,109
inhalation given	all n (%)	63.3 (3.5%)	18 (1.3%)		
	n per week median (IQR)	4.0 (3.3 - 5.3)	1.0 (1.0 - 3.5)	-75.0% (-80.6% - -11.4%)	0,090
	% per week median (IQR)	3.2% (2.5% - 4.0%)	1.2% (1.1% - 2.7%)	-64.8% (-67.4 - 6.5%)	0,219
invasive** medication given	all n (%)	113.0 (6.3%)	84 (6.1%)		
	n per week median (IQR)	8.7 (6.7 - 9.0)	6.0 (5.0 - 7.0)	-33.3% (-48.3% - -8.7%)	0,050
	% per week median (IQR)	6.5% (4.7% - 7.2%)	5.8% (4.9% - 7.5%)	-22.7% (-25.8 - 31.3%)	0,635
medication given per rectum	all n (%)	10.3 (0.6%)	3 (0.2%)		
	n per week median (IQR)	1.0 (0.7 - 1.3)	1.0 (1.0 - 1.0)	-25.0% (-32.5% - 87.5%)	1,000
	% per week median (IQR)	0.7% (0.5% - 1.1%)	1.1% (0.9% - 1.1%)	7.5% (-13.2 - 171.8%)	0,750
temperature measured	all n (%)	1042.7 (58.1%)	851 (62.2%)		
	n per week median (IQR)	80.7 (74.3 - 85.0)	56.0 (52.0 - 82.0)	-28.2% (-33.5% - -15.2%)	**0,012**
	% per week median (IQR)	57.5% (56.3% - 61.4%)	63.0% (60.5% - 63.7%)	6.7% (3.4 - 11.8%)	**0,027**

* not enough data for calculating difference in intubation rates

** invasive means any intravenous or intranasal or intramuscular or intraosseal medication given

MICU = mobile intensive care unit

Supplementary Materials:

1. STROBE
2. Statistics on EMS contacts

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July 19th, 2020

Dear Editor,

Please find enclosed our manuscript entitled **"Paediatric prehospital emergencies and restrictions during the COVID-19 pandemic: a population-based study"** that we respectfully submit to *BMJ Paediatrics Open* as an original article.

Paediatricians have been concerned about the impact that infection control measures, mainly targeted to protect adults against the pandemic, could have on children. It may become difficult for acutely ill children to receive timely medical care due to social distancing measures, modified customary protocols and consequently altered patient flows in emergency departments. In order to prevent children becoming the second victims of the COVID-19 pandemic as the pandemic continues, it is crucial to study the problems that have occurred, and to adjust the infection control measures accordingly.

In a retrospective population-based approach in Helsinki, Finland, we describe the changes that occurred in paediatric prehospital emergency care from 1.3.2020 to 31.5.2020. The study period covers the pandemic declaration by World Health Organisation (WHO) on 11 March, the Finnish Government announcement of the state of emergency in Finland on 16 March, and the de-escalation of the infection control measures in mid-May. In order to better analyse the changes that happened during the pandemic and to account for possible annual variation, we compared the data to same periods in the three previous years. We noticed a significant decrease in the number of ambulance calls leading to contact with emergency medical services (EMS). However, the EMS contacts were more severe. In addition, more children died on-scene than during the same time in the control period. Only a small minority of children with infectious symptoms had COVID-19, and they were not particularly accurately identified in the prehospital setting.

Thus far, the COVID-19 pandemic has not reached high numbers of infections in Finland. Therefore, the changes we noticed in paediatric emergency medical care are not due to the coronavirus or to an overwhelming of the healthcare system. Instead, they only represent societal

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measures targeted at controlling the infection, leading to changes in the behaviour of families with children and in the healthcare offered to them.

Our results could be used to adjust information and guidance aimed at families with children in the current and new waves of the pandemic. To protect children from negative consequences of social distancing and other emergency control measures, it is crucial to advice families with children to seek emergency medical care using established criteria, and not to hesitate calling an ambulance when needed. In addition, as it does not seem easy to recognise children with COVID-19, the disease should be suspected with a low threshold in prehospital care.

We hope that our manuscript would be of interest to the readers of the *BMJ Paediatrics Open* and look forward to your response.

The data presented here have not been published previously and the manuscript is not under consideration elsewhere. All authors are responsible for the reported research, fulfil authorship requirements, and have approved the manuscript as submitted.

Yours sincerely,

Jelena Oulasvirta

Correspondence:
Jelena Oulasvirta, M.D, MSc.
Töölö Hospital
University of Helsinki and Helsinki University Hospital
P.O.Box 266
FIN-00029 HUS
Finland
E-mail: jelena.oulasvirta@hus.fi

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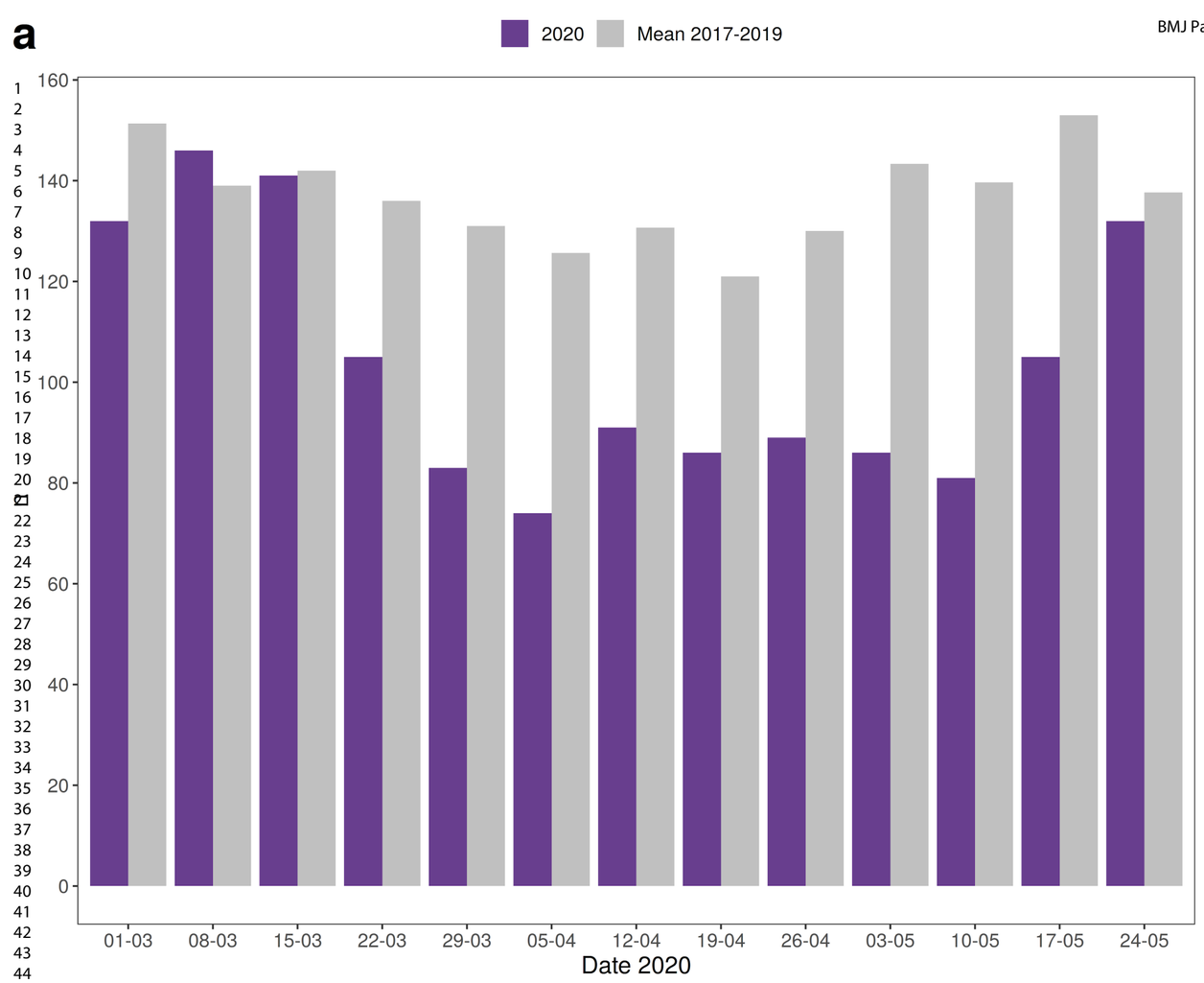

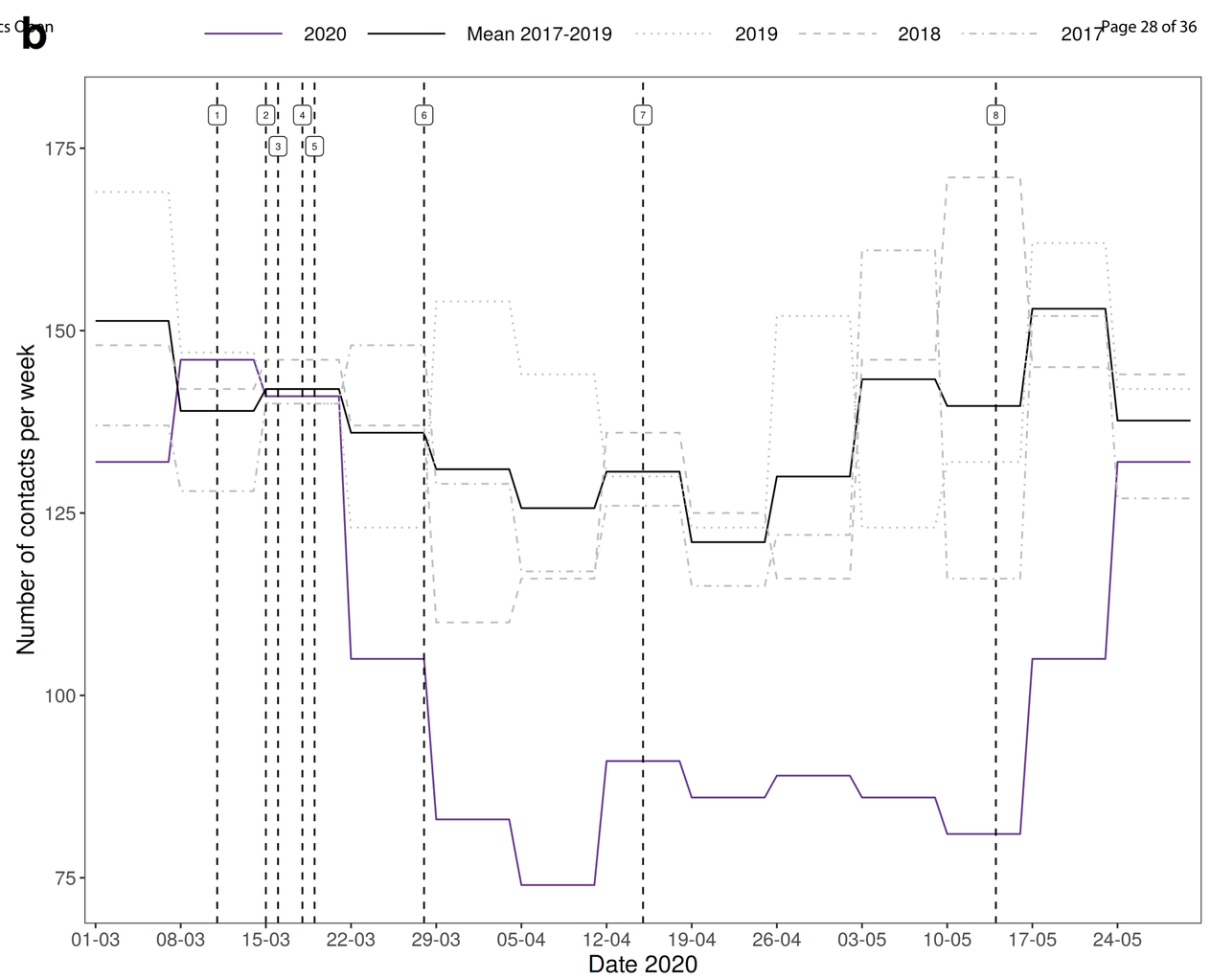

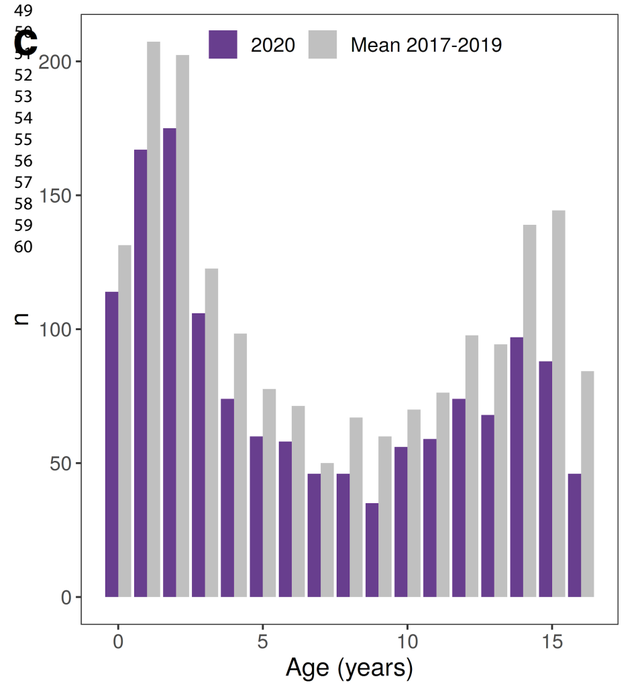

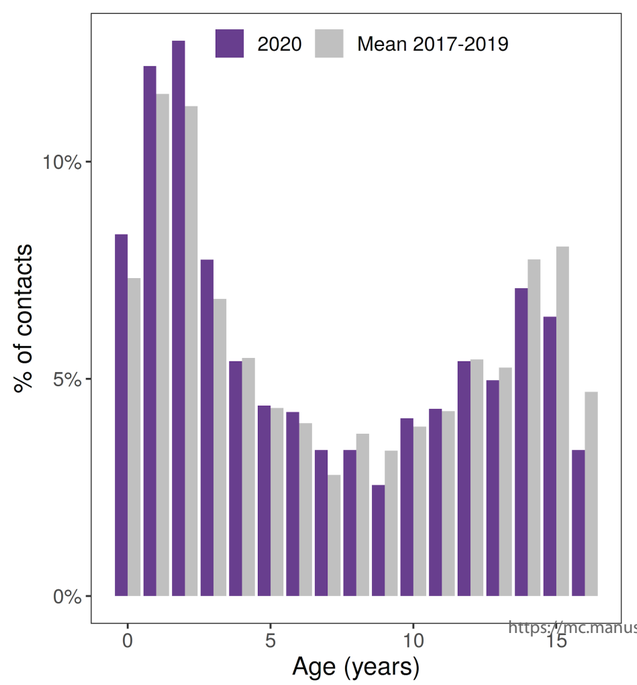

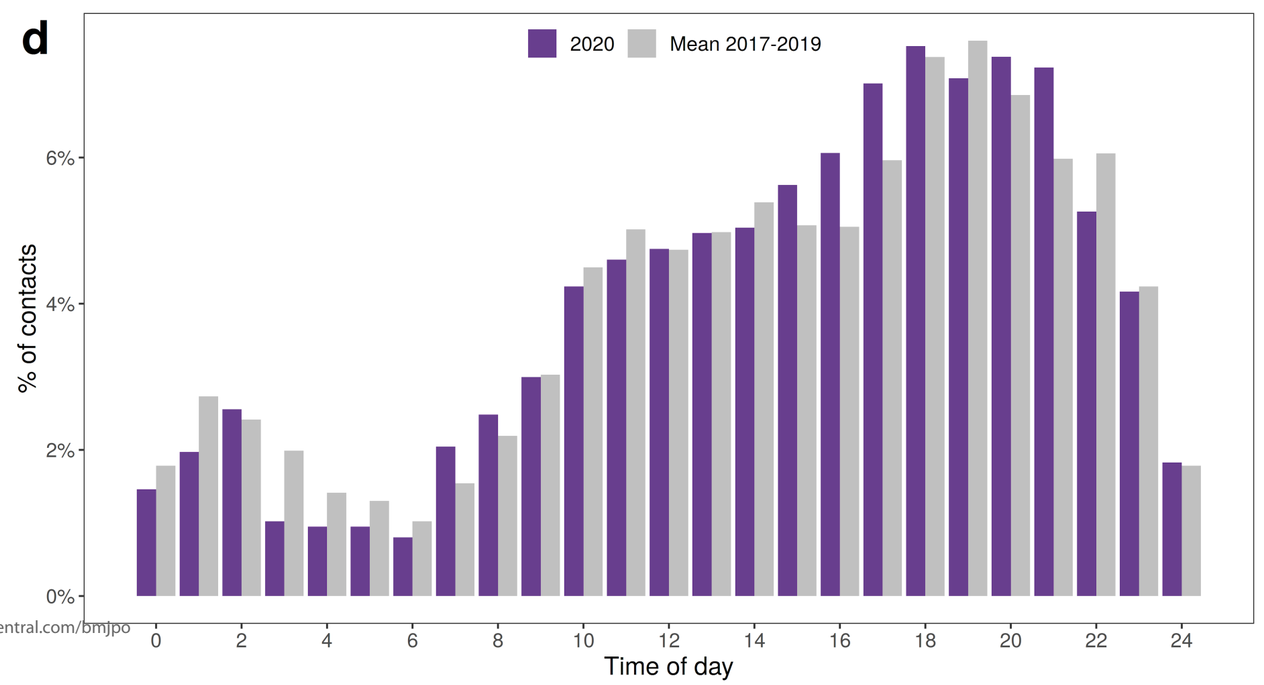

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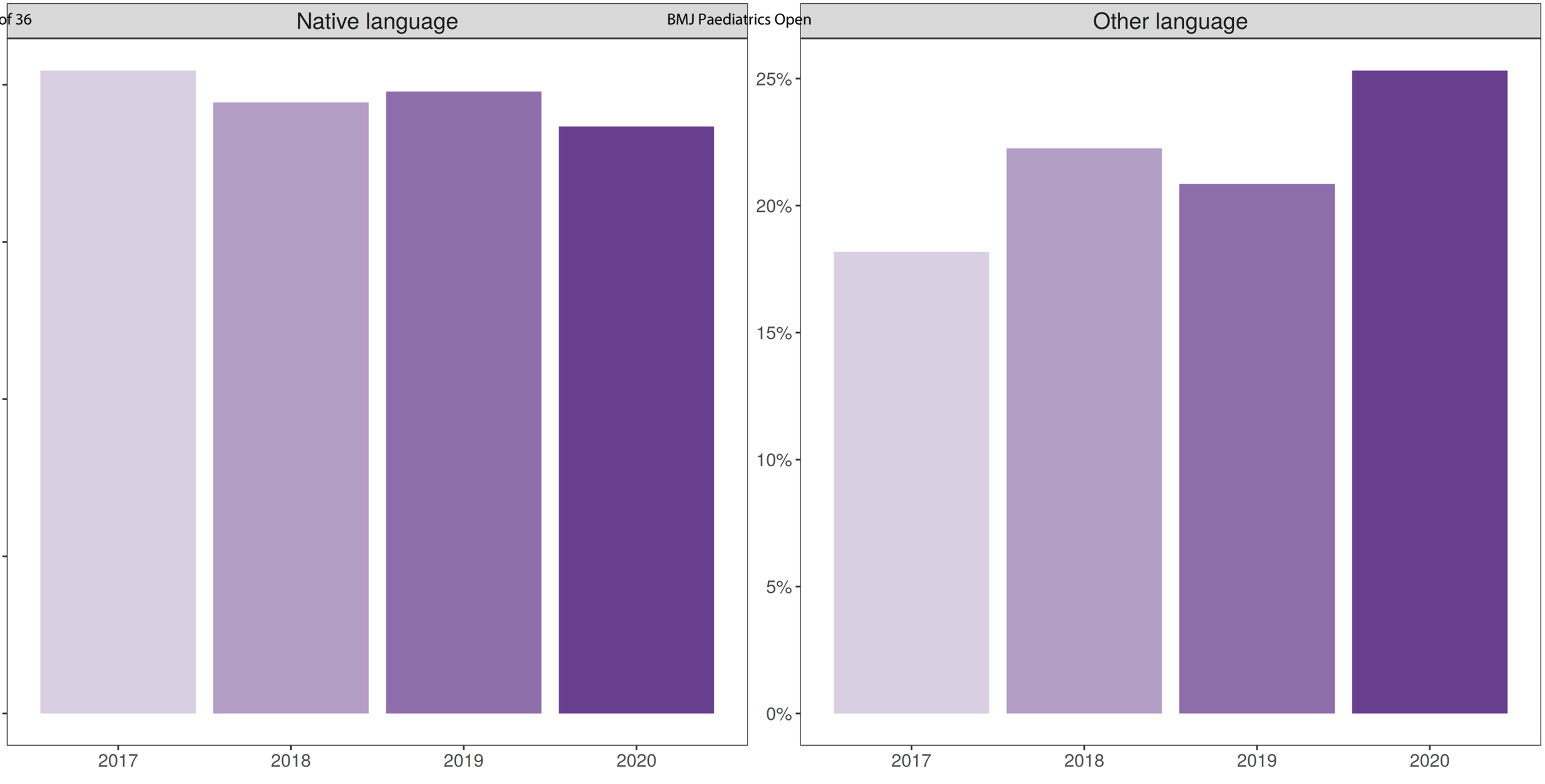

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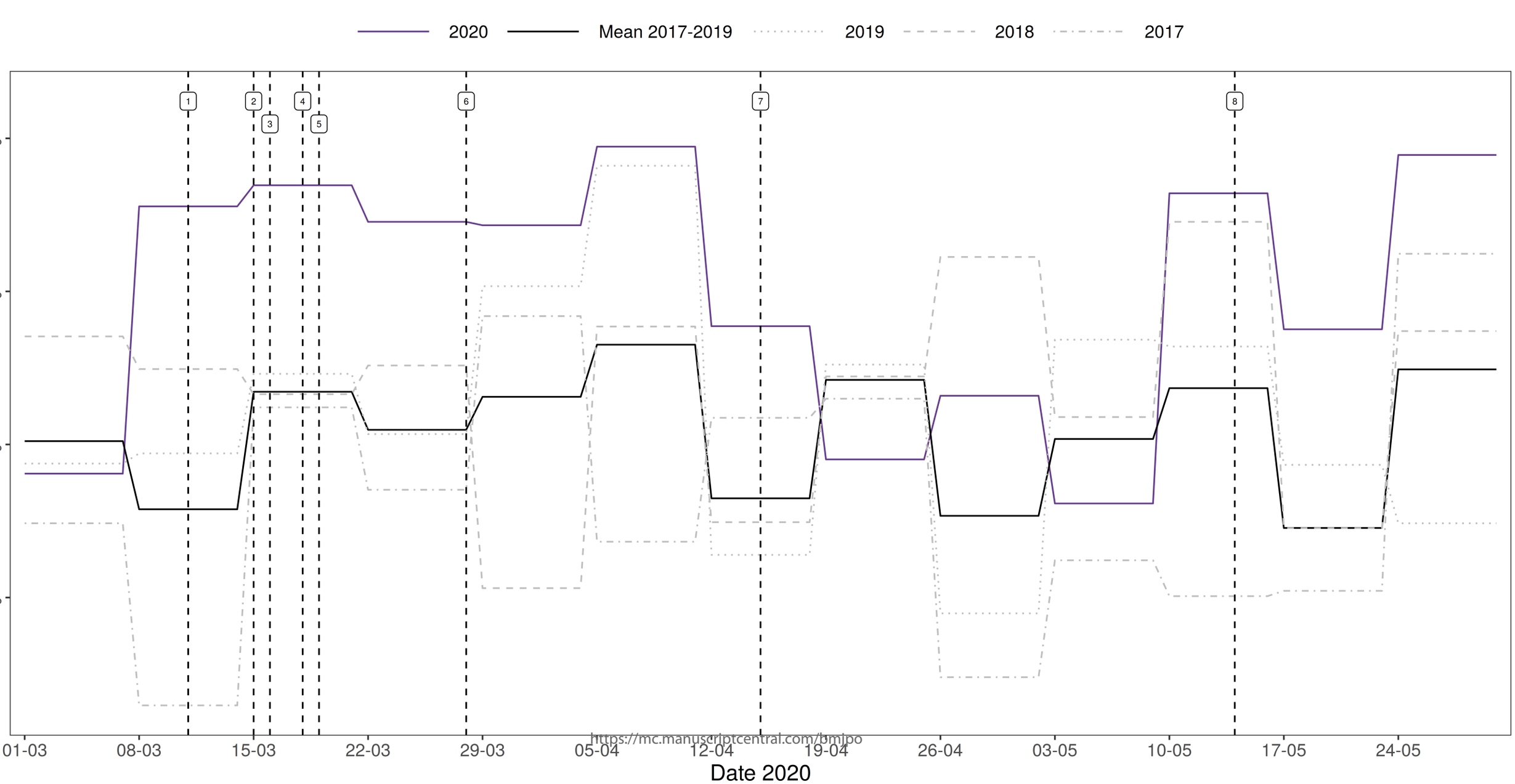

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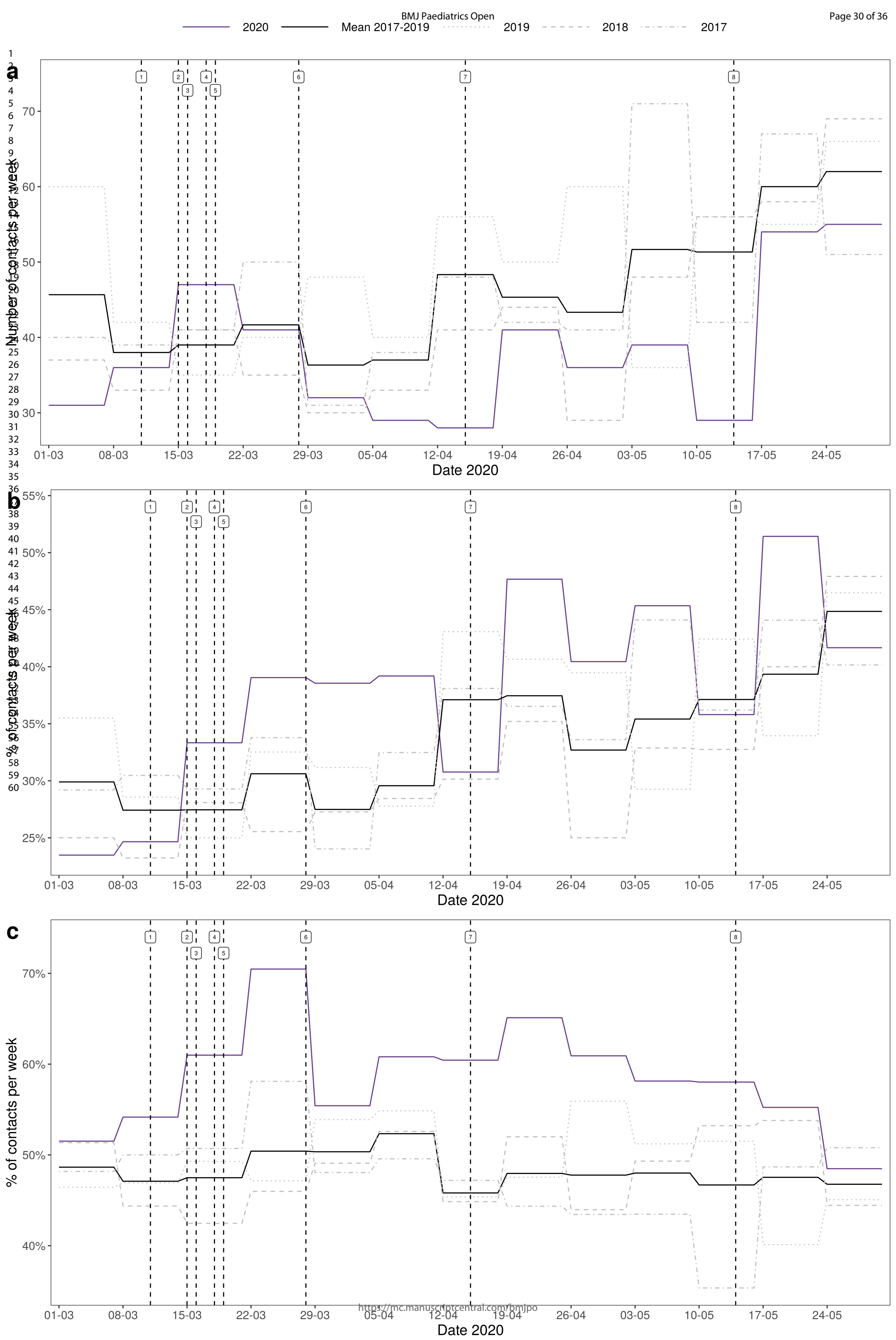

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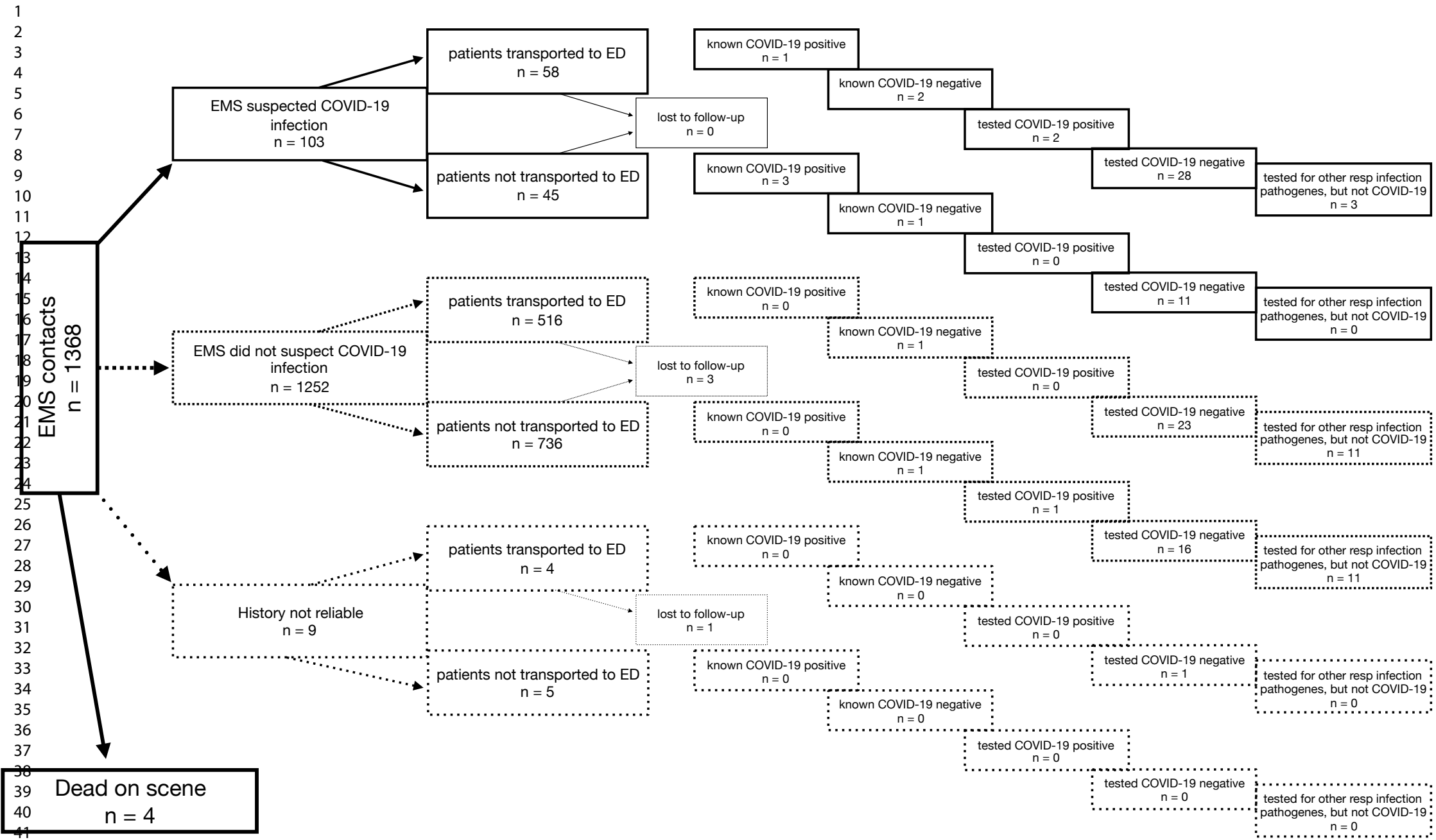
EMS contacts
n = 1368
Dead on scene
n = 4
EMS suspected COVID-19 infection
n = 103
patients transported to ED
n = 58
lost to follow-up
n = 0
patients not transported to ED
n = 45
known COVID-19 positive
n = 1
known COVID-19 negative
n = 2
tested COVID-19 positive
n = 2
tested COVID-19 negative
n = 28
tested for other resp infection pathogenes, but not COVID-19
n = 3
known COVID-19 positive
n = 3
known COVID-19 negative
n = 1
tested COVID-19 positive
n = 0
tested COVID-19 negative
n = 11
tested for other resp infection pathogenes, but not COVID-19
n = 0
EMS did not suspect COVID-19 infection
n = 1252
patients transported to ED
n = 516
lost to follow-up
n = 3
patients not transported to ED
n = 736
known COVID-19 positive
n = 0
known COVID-19 negative
n = 1
tested COVID-19 positive
n = 0
tested COVID-19 negative
n = 23
tested for other resp infection pathogenes, but not COVID-19
n = 11
known COVID-19 positive
n = 0
known COVID-19 negative
n = 1
tested COVID-19 positive
n = 1
tested COVID-19 negative
n = 16
tested for other resp infection pathogenes, but not COVID-19
n = 11
History not reliable
n = 9
patients transported to ED
n = 4
lost to follow-up
n = 1
patients not transported to ED
n = 5
known COVID-19 positive
n = 0
known COVID-19 negative
n = 0
tested COVID-19 positive
n = 0
tested COVID-19 negative
n = 1
tested for other resp infection pathogenes, but not COVID-19
n = 0
known COVID-19 positive
n = 0
known COVID-19 negative
n = 0
tested COVID-19 positive
n = 0
tested COVID-19 negative
n = 0
tested for other resp infection pathogenes, but not COVID-19
n = 0

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	#1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	#4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	#5
Objectives	3	State specific objectives, including any prespecified hypotheses	#5
Methods			
Study design	4	Present key elements of study design early in the paper	#5-#7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	#5-#7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	#5-#7
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	n/a
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	#5-#7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	#5-#7
Bias	9	Describe any efforts to address potential sources of bias	#13
Study size	10	Explain how the study size was arrived at	#5-#7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	#7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	#7
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	n/a
		(*d*) If applicable, explain how loss to follow-up was addressed	Figure 4
		(*e*) Describe any sensitivity analyses	n/a
Results			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Supplementary Material 2
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	Figure 4
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Figure 4
		(c) Summarise follow-up time (eg, average and total amount)	Table 2,4, Supplementary Material 2
Outcome data	15*	Report numbers of outcome events or summary measures over time	Table 2-4, Supplementary Material 2
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Table 2-4, Supplementary Material 2
		(*b*) Report category boundaries when continuous variables were categorized	n/a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Supplementary Material 2
Discussion			
Key results	18	Summarise key results with reference to study objectives	#10
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	#10-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	#13-14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	#15

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Supplementary Table 1. Descriptive statistics.

		2017	2018	2019	2020
Age (years)		6.4 (2.0 - 13.2)	6.5 (1.9 - 12.6)	6.3 (2.1 - 12.5)	5.3 (1.8 - 12.0)
Sex (male)	all n (%)	915 (53.2%)	980 (54.6%)	1001 (54.1%)	753 (55.1%)
	n per week median (IQR)	67.0 (61.0 - 82.0)	75.0 (65.0 - 80.0)	76.0 (71.0 - 80.0)	53.0 (48.0 - 70.0)
	% per week median (IQR)	55.3% (51.7% - 55.6%)	55.2% (53.7% - 56.1%)	52.3% (51.8% - 58.3%)	54.3% (52.7% - 56.2%)
Native language (Finnish or Swedish)	all n (%)	1327 (81.8%)	1310 (77.7%)	1377 (79.1%)	991 (74.7%)
	n per week median (IQR)	104.0 (91.0 - 109.0)	104.0 (91.0 - 106.0)	102.0 (95.0 - 110.0)	69.0 (66.0 - 91.0)
	% per week median (IQR)	82.6% (78.8% - 84.8%)	77.5% (76.3% - 79.1%)	79.7% (76.8% - 80.7%)	72.8% (71.8% - 78.4%)

IQR = Interquartile Range

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Supplementary Table 2. Change in the dispatch and transportation codes.

		2017	2018	2019	2020
All EMS contacts	all n (%)	1724 (100.0%)	1801 (100.0%)	1858 (100.0%)	1369 (100.0%)
	n per week median (IQR)	128.0 (122.0 - 140.0)	142.0 (125.0 - 146.0)	142.0 (130.0 - 152.0)	91.0 (86.0 - 132.0)
Dispatch priority A*	all n (%)	42 (2.4%)	43 (2.4%)	81 (4.4%)	90 (6.6%)
	n per week median (IQR)	3.0 (2.0 - 4.0)	3.0 (2.0 - 4.0)	5.0 (2.0 - 5.0)	8.0 (7.0 - 8.0)
	% per week median (IQR)	2.3% (1.6% - 2.6%)	2.1% (1.6% - 2.9%)	3.3% (1.6% - 4.1%)	6.1% (5.7% - 8.4%)
Dispatch priority B*	all n (%)	693 (40.2%)	677 (37.6%)	702 (37.8%)	478 (34.9%)
	n per week median (IQR)	53.0 (47.0 - 58.0)	49.0 (46.0 - 53.0)	53.0 (46.0 - 59.0)	37.0 (30.0 - 43.0)
	% per week median (IQR)	38.8% (37.3% - 42.3%)	39.0% (32.4% - 40.4%)	38.7% (34.4% - 40.7%)	36.1% (31.5% - 38.1%)
Dispatch priority C*	all n (%)	882 (51.2%)	969 (53.8%)	947 (51.0%)	658 (48.1%)
	n per week median (IQR)	65.0 (63.0 - 70.0)	74.0 (69.0 - 86.0)	72.0 (69.0 - 80.0)	44.0 (43.0 - 57.0)
	% per week median (IQR)	52.1% (50.4% - 54.3%)	54.0% (51.7% - 56.0%)	52.0% (47.3% - 56.9%)	49.4% (45.7% - 51.4%)
Dispatch priority D*	all n (%)	107 (6.2%)	112 (6.2%)	128 (6.9%)	143 (10.4%)
	n per week median (IQR)	7.0 (7.0 - 10.0)	8.0 (7.0 - 10.0)	10.0 (7.0 - 13.0)	10.0 (8.0 - 12.0)
	% per week median (IQR)	5.7% (4.8% - 7.1%)	5.8% (4.7% - 7.3%)	5.9% (5.6% - 8.8%)	9.5% (8.1% - 11.4%)
Transported patients	all n (%)	902 (52.4%)	930 (51.6%)	950 (51.2%)	578 (42.3%)
	n per week median (IQR)	67.0 (64.0 - 71.0)	74.0 (65.0 - 79.0)	71.0 (65.0 - 78.0)	36.0 (34.0 - 54.0)
	% per week median (IQR)	51.8% (50.0% - 55.7%)	50.9% (48.0% - 55.6%)	52.5% (48.5% - 53.8%)	41.9% (39.1% - 44.8%)
Transportation priority A*	all n (%)	8 (0.5%)	15 (0.8%)	14 (0.8%)	6 (0.4%)
	n per week median (IQR)	1.0 (1.0 - 1.8)	1.0 (1.0 - 2.0)	1.0 (1.0 - 2.0)	1.0 (1.0 - 1.0)
	% per week median (IQR)	0.9% (0.8% - 1.2%)	0.8% (0.7% - 1.4%)	0.8% (0.7% - 1.3%)	1.2% (0.9% - 1.2%)
Transportation priority B*	all n (%)	89 (5.2%)	84 (4.7%)	104 (5.6%)	62 (4.5%)
	n per week median (IQR)	6.0 (5.0 - 8.0)	7.0 (4.0 - 8.0)	8.0 (5.0 - 11.0)	5.0 (3.0 - 5.0)
	% per week median (IQR)	4.7% (3.9% - 5.7%)	5.1% (3.4% - 5.5%)	6.4% (3.4% - 6.6%)	5.0% (3.5% - 5.7%)
Transportation priority C*	all n (%)	587 (34.1%)	601 (33.4%)	618 (33.3%)	398 (29.2%)
	n per week median (IQR)	44.0 (40.0 - 47.0)	47.0 (42.0 - 50.0)	45.0 (41.0 - 50.0)	25.0 (22.0 - 41.0)
	% per week median (IQR)	33.3% (32.0% - 36.6%)	34.2% (30.4% - 37.1%)	33.3% (29.6% - 35.1%)	29.1% (25.6% - 31.2%)
Transportation priority D*	all n (%)	218 (12.7%)	230 (12.8%)	213 (11.5%)	113 (8.3%)
	n per week median (IQR)	15.0 (13.0 - 20.0)	17.0 (14.0 - 21.0)	15.0 (14.0 - 19.0)	7.0 (6.0 - 9.0)
	% per week median (IQR)	13.0% (10.3% - 14.6%)	12.9% (11.7% - 14.4%)	11.3% (9.9% - 13.2%)	7.4% (6.6% - 8.6%)
Trauma patients	all n (%)	605 (35.1%)	564 (31.3%)	649 (34.9%)	504 (36.8%)
	n per week median (IQR)	42.0 (40.0 - 50.0)	41.0 (33.0 - 48.0)	50.0 (40.0 - 56.0)	36.0 (31.0 - 41.0)
	% per week median (IQR)	33.8% (30.5% - 38.1%)	28.4% (25.5% - 32.9%)	34.0% (29.3% - 40.7%)	39.0% (33.3% - 41.7%)
Non-transported patients	all n (%)	820 (47.6%)	871 (48.4%)	907 (48.9%)	786 (57.6%)
	n per week median (IQR)	64.0 (58.0 - 70.0)	63.0 (61.0 - 72.0)	68.0 (63.0 - 78.0)	56.0 (50.0 - 68.0)
	% per week median (IQR)	48.2% (44.3% - 50.0%)	49.1% (44.4% - 52.0%)	47.5% (46.4% - 51.5%)	58.1% (55.2% - 60.9%)

* the priority class from A to D referres to the urgency of the dispatch /transportation and /or to the risk of the symptom to a patient – A being the contact with highest urgency and risk and D the lowest urgency and risk

EMS = Emergency Medical Services

IQR = Interquartile Range

Supplementary Table 3. Change in the interventions performed on-scene

		2017	2018	2019	2020
additional help requested	all n (%)	81 (4.7%)	74 (4.1%)	105 (5.7%)	94 (6.9%)
	n per week median (IQR)	6.0 (5.0 - 6.0)	5.0 (3.0 - 8.0)	7.0 (5.0 - 7.0)	7.0 (5.0 - 9.0)
	% per week median (IQR)	4.1% (3.9% - 4.7%)	3.4% (2.6% - 4.9%)	4.5% (4.1% - 5.4%)	6.8% (4.5% - 8.5%)
MICU on-scene	all n (%)	25 (1.5%)	23 (1.3%)	30 (1.6%)	24 (1.8%)
	n per week median (IQR)	2.0 (1.8 - 2.2)	2.0 (1.5 - 2.0)	2.0 (1.5 - 3.5)	2.0 (2.0 - 2.8)
	% per week median (IQR)	1.6% (1.2% - 1.9%)	1.4% (1.0% - 1.7%)	1.6% (1.1% - 2.6%)	2.3% (1.4% - 2.5%)
emergency physician consulted by phone	all n (%)	308 (17.9%)	261 (14.5%)	305 (16.4%)	236 (17.2%)
	n per week median (IQR)	23.0 (22.0 - 27.0)	20.0 (18.0 - 23.0)	23.0 (21.0 - 25.0)	18.0 (15.0 - 20.0)
	% per week median (IQR)	17.9% (16.8% - 20.0%)	15.4% (11.6% - 17.6%)	16.0% (14.3% - 18.5%)	17.6% (15.6% - 18.1%)
any measurements done on-scene	all n (%)	1615 (93.7%)	1695 (94.1%)	1769 (95.2%)	1280 (93.5%)
	n per week median (IQR)	120.0 (116.0 - 130.0)	131.0 (112.0 - 141.0)	135.0 (121.0 - 144.0)	88.0 (78.0 - 124.0)
	% per week median (IQR)	93.0% (92.2% - 94.9%)	94.9% (93.0% - 95.5%)	95.7% (93.8% - 96.3%)	93.9% (91.9% - 95.3%)
intubation*	all n (%)	2 (0.1%)	3 (0.2%)	1 (0.1%)	3 (0.2%)
	n per week median (IQR)	1.0 (1.0 - 1.0)	1.0 (1.0 - 1.0)	1.0 (1.0 - 1.0)	1.5 (1.2 - 1.8)
	% per week median (IQR)	0.8% (0.8% - 0.8%)	0.7% (0.7% - 0.7%)	0.6% (0.6% - 0.6%)	1.3% (1.2% - 1.3%)
supplementary oxygen given	all n (%)	38 (2.2%)	47 (2.6%)	40 (2.2%)	16 (1.2%)
	n per week median (IQR)	3.0 (2.0 - 4.0)	3.0 (2.0 - 5.0)	3.0 (2.0 - 4.5)	2.0 (1.0 - 2.2)
	% per week median (IQR)	2.4% (1.6% - 2.8%)	2.2% (1.7% - 3.6%)	2.4% (1.3% - 3.0%)	1.5% (1.2% - 2.4%)
intravenous connection established	all n (%)	128 (7.4%)	123 (6.8%)	149 (8.0%)	65 (4.7%)
	n per week median (IQR)	10.0 (8.0 - 11.0)	9.0 (7.0 - 11.0)	10.0 (10.0 - 14.0)	5.0 (3.0 - 7.0)
	% per week median (IQR)	8.5% (5.6% - 8.7%)	6.4% (5.8% - 7.5%)	8.0% (6.5% - 8.9%)	4.4% (2.9% - 5.8%)
any medication given	all n (%)	170 (9.9%)	206 (11.4%)	209 (11.2%)	111 (8.1%)
	n per week median (IQR)	14.0 (12.0 - 15.0)	14.0 (14.0 - 18.0)	15.0 (13.0 - 18.0)	7.0 (6.0 - 9.0)
	% per week median (IQR)	10.4% (8.8% - 12.1%)	10.3% (9.6% - 12.5%)	10.7% (9.0% - 13.1%)	7.6% (6.6% - 9.1%)
medication given per os	all n (%)	12 (0.7%)	16 (0.9%)	11 (0.6%)	13 (0.9%)
	n per week median (IQR)	1.5 (1.0 - 2.0)	2.0 (1.0 - 2.0)	1.0 (1.0 - 2.0)	2.0 (1.0 - 2.0)
	% per week median (IQR)	1.2% (0.8% - 1.6%)	1.4% (0.7% - 1.7%)	0.8% (0.7% - 1.3%)	1.4% (1.2% - 1.7%)
inhalation given	all n (%)	41 (2.4%)	80 (4.4%)	69 (3.7%)	18 (1.3%)
	n per week median (IQR)	3.5 (2.0 - 4.2)	4.0 (4.0 - 8.0)	5.0 (3.0 - 7.0)	1.0 (1.0 - 3.5)
	% per week median (IQR)	2.3% (1.7% - 3.2%)	3.4% (2.7% - 5.5%)	3.8% (2.4% - 4.9%)	1.2% (1.1% - 2.7%)
invasive** medication given	all n (%)	113 (6.6%)	100 (5.6%)	126 (6.8%)	84 (6.1%)
	n per week median (IQR)	9.0 (7.0 - 10.0)	7.0 (6.0 - 10.0)	9.0 (7.0 - 11.0)	6.0 (5.0 - 7.0)
	% per week median (IQR)	7.1% (5.4% - 8.2%)	5.6% (4.2% - 6.8%)	6.5% (4.6% - 8.5%)	5.8% (4.9% - 7.5%)
medication given per rectum	all n (%)	8 (0.5%)	14 (0.8%)	9 (0.5%)	3 (0.2%)
	n per week median (IQR)	1.0 (1.0 - 1.0)	1.0 (1.0 - 3.0)	1.5 (1.0 - 2.0)	1.0 (1.0 - 1.0)
	% per week median (IQR)	0.8% (0.7% - 0.8%)	0.8% (0.7% - 2.2%)	1.1% (0.7% - 1.5%)	1.1% (0.9% - 1.1%)
temperature measured	all n (%)	939 (54.5%)	1082 (60.1%)	1107 (59.6%)	851 (62.2%)
	n per week median (IQR)	71.0 (68.0 - 79.0)	85.0 (72.0 - 92.0)	81.0 (78.0 - 97.0)	56.0 (52.0 - 82.0)
	% per week median (IQR)	55.5% (50.9% - 58.1%)	59.3% (56.0% - 65.5%)	60.5% (55.6% - 63.3%)	63.0% (60.5% - 63.7%)

* not enough data for calculating difference in intubation rates

** invasive means any intravenous or intranasal or intramuscular or intraosseal medication given

MICU = mobile intensive care unit

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Paediatric prehospital emergencies and restrictions during the COVID-19 pandemic: a population-based study

Jelena Oulasvirta, MD[1,2]

Jussi Pirneskoski, MD[2]

Heini Harve-Rytsälä, MD, PhD[2]

Mitja Lääperi, MSc[2]

Mikael Kuitunen, MD, PhD[3]

Markku Kuisma, MD, PhD[2]

Heli Salmi, MD, PhD[1,3]

[1] Division of Anaesthesiology; Department of Anaesthesiology, Intensive Care and Pain Medicine; University of Helsinki and Helsinki University Hospital, P.O. Box 340, FI-00029 HUS, Finland

[2] Department of Emergency Medicine and Services, Helsinki University and Helsinki University Hospital, P.O. Box 340, FI-00029 HUS, Finland

[3]New Children's Hospital, University of Helsinki and Helsinki University Hospital, P.O. Box 347, FI-00029 HUS, Finland

Corresponding author:

Jelena Oulasvirta

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Postal address: Töölö Hospital, University of Helsinki and Helsinki University Hospital, P.O. Box 266, FI-00029 HUS, Finland

E-mail: jelena.oulasvirta@hus.fi

Telephone: +358 50 428 7622

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What is already known on this topic

- Compared to adults, children are less affected by the COVID-19 infection but may be affected by its control measures.
- Children may experience collateral damage because of the infection control measures, mainly designed to protect adults.
- The pandemic has decreased paediatric emergency department (ED) visits, but it is not clear how or if prehospital care has also been affected.

What this study adds

- The use of prehospital emergency medical services decreased in children after declaration of the state of emergency in Finland.
- During the pandemic, ambulance calls for children were more often in the most urgent category and due to trauma. Paradoxically, almost 60% of children were not transported to the ED.
- Societal measures targeted to protect adults against the pandemic affected children and their emergency medical care.

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ABSTRACT

Background

Children are less vulnerable to serious forms of the COVID-19 disease. However, concerns have been raised about children being the second victims of the pandemic and its control measures. Therefore, we wanted to study if the pandemic, the infection control measures and their consequences to the society projected to paediatric prehospital emergency medical services (EMS) contacts.

Methods

We conducted a population-based cohort study concerning all children aged 0-15 years with EMS contacts in the Helsinki University Hospital (HUH) area during 1.3.-31.5.2020 (study period) and equivalent periods in 2017-2019 (control periods). We analysed the demographic characteristics, time of EMS contact, reason for EMS contact, priority of the dispatch, reason for transportation, priority of transportation, if any consultations were made or additional units required, any medication or oxygen or fluids given, if intubation was performed, and whether paramedics took precautions when COVID-19 infection was suspected.

Results

The number of paediatric EMS contacts decreased by 30.4% from mean of 1794 contacts to 1369 (p=0.003). The EMS contacts were more often due to trauma, (+23.7%, p<0.05), dispatched in the most urgent category (+139.9%, p=0.001), additional help and the mobile intensive care unit (MICU) were more frequently requested (+43.3%, p=0.040 and +46.3%, p=0.049, respectively). However, EMS contacts resulted less often in ambulance transport (-21.1%, p<0.001). Alarmingly, there were 4 deaths during the study period compared to 0-2 during the control periods.

Conclusions

The number of EMS contacts decreased during the pandemic. Nevertheless, the children encountered by the EMS were more seriously ill than during the control periods.

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INTRODUCTION

Children seem to be less vulnerable to the serious forms of the COVID-19 disease by the new pandemic coronavirus SARS-CoV-2 than adults (1–3). Still, following the infection control measures and associated abrupt changes in healthcare delivery, children have not been spared from the health effects of the pandemic. Consequently, health professionals have expressed concern over children becoming second victims of the pandemic (4–6).

Instructions on social distancing and self-quarantine resulted in a considerable decrease in paediatric emergency department (ED) visits (4,5). Also, the emergency healthcare itself changed: In EDs and prehospital emergency medical services (EMS), infection control measures, including the use of personal protective equipment have slowed patient flows and resulted in modified treatment protocols. On the other hand, the ubiquitous presence of COVID-19 in news and media may have created a bias in clinicians, who may be prone to diagnostic errors, suspecting COVID-19 over more common conditions.

Decreasing unnecessary paediatric ED visits and ambulance calls has been a priority in paediatric emergency care already before the pandemic (7–9). However, alarmed by reports stating risks associated with decreases in paediatric ED visits (4,5) we wanted to study if the pandemic and social distancing measures were reflected in the amount and features of the EMS contacts with children as well. If these contacts had indeed substantially decreased, it would be important to analyse whether this change has taken place at the cost of health risks for children.

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METHODS

Study area and population

The Helsinki University Hospital (HUH) area in Southern Finland has 1 263 000 inhabitants including 217 000 0-15-years-old children (2019) (10) and consists of both urban and suburban regions covering 1 216 km^2. This study covers all prehospital ambulance responses for children (aged 0-15 years) in the HUH area during the study and control periods.

Organisation of emergency medical services and healthcare system

Finland has a publicly financed universal healthcare system for all residents. The public healthcare exclusively provides all prehospital emergency medical services. All emergency calls go to the governmental emergency response centre (ERC). A professional ERC operator categorises the leading complaint to form a dispatch code and determines a priority class from A (highest risk) to D (lowest risk) according to a formal protocol (11). In HUH area, all prehospital emergencies are responded to by HUH EMS consisting of 36 ambulances and three medical supervisor units staffed by emergency medical technicians, paramedics and two physician-staffed units. An emergency physician can be consulted by phone, or, requested on scene. Not all patients encountered by EMS are transported to hospital by ambulance. After on-scene examination and treatment, the EMS personnel may conclude that patient does not need ambulance transport. In that case they must inform the patient or the caregivers on how to observe and treat the condition and on whether or when to contact healthcare services again. The protocol on the treatment and transport of children for the EMS did not change during the pandemic. Nevertheless, preferring other treatment options over nebulised medication, was advised.

There are two 24/7 paediatric ED units with in-patient care in the area. In addition, smaller units offer primary level healthcare during office hours.

Data collection

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We retrieved all emergency responses concerning children (age 0-15 y) from the ambulance electronic patient record system (Merlot Medi®, CGI Suomi Oy) in HUH area between 1.3.2020 and 31.5.2020 (study period) and equivalent periods for three previous years: 1.3.2017 - 31.5.2017; 1.3.2018 - 31.5.2018; 1.3.2019 - 31.5.2019 (control periods). We chose control periods to cover three previous years and the same months in order to be able to account for any potential seasonal variation. The pandemic declaration by World Health Organisation (WHO) on 11 March, the Finnish Government announcement of the state of emergency in Finland on 16 March, and the reopening of schools on 14 May were included in the study period. We analysed the time of contact, reason for contact, dispatch priority, reason for transportation, priority of transportation, age, sex, native language, whether the patient received medications, oxygen, fluids or was intubated, whether a physician was consulted or requested on-scene or additional units required, and whether COVID-19 was suspected. We investigated eventual laboratory diagnostics for respiratory viruses (including SARS-CoV-2) from the Helsinki University Hospital in-hospital patient record system (Uranus®, CGI Suomi Oy and Apotti®, Epic Systems Corporation). A flow-chart of EMS contacts in 2020 and possible suspicion of COVID-19 infection is presented in Supplementary Material 2.

Statistical analysis

Because this is a retrospective study concerning a multidimensional and rapidly progressing medico-societal phenomenon, the possible confounders are multiple and their effects difficult to predict. As we did not aim at establishing causalities between the control measures and EMS contacts, but at noticing possible indicators of the effects of the pandemic on the health and welfare of children, we chose univariate analysis for the primary statistical method, since it gives the clinically most relevant answers to our study questions. Estimates and proportions are shown using medians and interquartile ranges (IQR) and number of events are shown using counts and percentages. To compare the change in EMS contacts during the study period to that of control periods, we used the Mann-Whitney U test or Wilcoxon signed-rank test depending on whether comparisons were made between all the observations or between the weeks of 2020 and the previous years. The analyses were performed using R 3.6.3 (12) and the visualisations using

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ggplot2-package (13). We used 0.05 as the level of significance. As the infection control measures changed during the study period, we used line plots with date as the X-axis to evaluate the eventual changes in our parameters.

This study is reported in compliance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cohort studies (Supplementary Material 3).

Ethical aspects and Patient and Public Involvement statement

This is a register-based study approved by the Institutional Review Board of Helsinki University Hospital (§24/2020). No public involvement was planned for this study, as the COVID-19 pandemic advanced rapidly.

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RESULTS

There were 28 680 prehospital EMS contacts during the study period, of which 1368 (4.8%) concerned children. This comprised a reduction of paediatric EMS contacts by 23.7% compared to the mean of 1794 contacts in control periods (Figure 1). There was no statistically significant variation within the control periods (Supplementary Material 1, Supplementary Table 2). Patients were younger: 5.3 years compared to 6.3 years ($p<0.001$) and there were proportionally less children speaking one of the national languages (Finnish or Swedish) as native language: 7.8% ($p=0.003$) (Figure 2). The sex distribution was equal in both periods (males 54.0% vs. 55.1%).

The changes in the characteristics of EMS dispatch and transportation codes are described in Table 1. The proportion of the highest priority A dispatch code rose by 139.9% ($p=0.001$). The absolute number of trauma patients decreased by 11.9% ($p<0.02$). However, their proportion increased by 23.7% ($p<0.05$). The proportion of non-transported patients increased by 21.1% ($p<0.001$) (Table 1, Figure 3). *(Table 1 and Figure 3 here)*

Additional help and the mobile intensive care unit (MICU) were more frequently requested on-scene (+43.3%, $p=0.040$ and +46.3%, $p=0.049$, respectively).Less treatments were performed in 2020 compared to the control periods: establishing an intravenous access decreased in proportion by 32.5% ($p=0.008$) and administering medications by 35.3% ($p<0.02$) (Table 2). *(Table 2 here)*

Four patients were dead on arrival of the EMS or died on-scene during the study period, as compared to 0 - 2 during the control periods (Table 3). *(Table 3 here)*

Table 3. Mortality presented by year during equivalent periods of 1.3.-31.5.

	2017	**2018**	**2019**	**2020**	**P-value**
All paediatric EMS contacts (n)	1722	1801	1857	1364	
Dead on arrival or on-scene (n)	2	0	1	4	0,060

EMS = Emergency Medical Services

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Of the 1368 children, COVID-19 infection was suspected in 103. Of these, 4 were previously known to be positive for SARS-CoV-2 and there were 2 new infections. However, 41 of the 1261 children not suspected as having COVID-19 by the EMS were tested for COVID-19 infection at the ED, with only 1 positive result.

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DISCUSSION

During a local epidemic peak of the COVID-19 pandemic, prehospital emergency care delivered to children decreased and its characteristics changed markedly. Emergency calls for children were more often categorised as urgent and an emergency medical physician or other additional help were more often needed. Concomitantly, the number of prehospital paediatric deaths during the pandemic was noteworthy. Therefore, our results suggest that the children encountered by the EMS during the pandemic were more seriously ill than before the pandemic. Paradoxically, the EMS contacts more likely led to not transporting the child to the ED (Figure 3).

Finland has not experienced high COVID-19 infection rates in the population so far. The highest demand for hospital beds and intensive care was experienced mid-April (14). Thus, the changes we noticed in the emergency healthcare to children were neither due to SARS CoV-2, nor to an overwhelming of the emergency healthcare system. Instead, they represent the changes in healthcare functionality, and in the behaviour of families with children.

We expected the decrease in the number of EMS contacts for children based on international reports about substantial decreases in the number of paediatric ED visits during the pandemic (15,16). Our figures were also congruent with those from the paediatric EDs in the area, which saw a 45% decrease in the number of visits after the beginning of the infection control measures, according to the hospital statistical data. The EMS contacts with children started to decrease immediately after the declaration of state of emergency, suggesting that the decrease was more societal than medical in nature.

The decrease in EMS contacts was probably due to several factors, which may represent both positive changes in the behaviour of caregivers, but also cause unnecessary risks to children. A successful public

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guidance during the state of emergency, encouraging parents to treat mild symptoms at home and avoid overcrowding EDs, could have eliminated some medically unjustifiable EMS contacts (9,17). In addition, infection control measures could have decreased the occurrence of acute infections in children and, hence, the occurrence of febrile seizures and dyspnoea, which are leading causes for paediatric EMS calls under normal circumstances (18). Still, especially the peak in the number of children who died on-scene warrants careful examination of the EMS contacts during the pandemic. Even if the increase in deaths is a preliminary finding and as such may be due to coincidence, we cannot confidently state that the decrease in EMS contacts was a positive proceeding. The ubiquitous presence of COVID-19 in media, reports about overcrowded EDs and a concomitant public guidance stating that all unnecessary contacts should be avoided, could have led to caregivers delaying ED visits and emergency calls even when medical attention would urgently have been needed. Noticeably, a recent report from adult EMS contacts in the UK states that the pandemic did not cause reluctance to call an ambulance in case of a real emergency, such as stroke or heart attack (19).

Our results suggest that the children encountered by the EMS during the pandemic were more seriously ill than during the control periods. Although the total number of EMS contacts decreased, the number of the most urgent EMS calls with priority class A increased. Simultaneously, the proportions of contacts requiring an emergency medical physician or other additional help increased. There were no changes in the EMS protocols that could account for such finding. The high number of paediatric out-of-hospital deaths may also be related to this notice.

Even though children encountered by the EMS during the pandemic seem to have been more seriously ill than before, the contacts more often led to not transporting the child to the ED. The increase in the proportion of EMS calls in which the patient was not transported in an ambulance (“non-transports”) is interesting, as in our system the non-transport rates were already high before pandemic (18,20). This

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finding is also paradoxical considering that non-urgent or non-medical complaints did not seem overexpressed during the study period. The increased tendency not to transport a child by ambulance may reflect the practical difficulties imposed by the infection control measures during the pandemic, such as a time-consuming obligation to thoroughly clean the ambulance after any transport. Also, non-transport decisions are not solely based on medical decision-making, but social and logistic issues are considered as well. In our urban study area other transport possibilities than ambulance, are easily available. During the pandemic, caregivers for older children were not allowed to escort the child in an ambulance. Thus, it is likely that if the ambulance transport was medically not necessary and if the caregiver needed to use another means of transport anyway, the child may have preferred the ride with the caregiver. In addition, similarly to laypersons, the EMS personnel were also exposed to media warning about overcrowded EDs and reporting about overwhelmed healthcare systems. Even without changes in protocols, the EMS personnel may have felt a need to ascertain that a maximal number of units are available at all times for urgent cases, and, opted not to transport when there was no explicit need for ambulance transportation.

We observed a decrease in the absolute rate of traumas, but non-traumatic emergencies decreased even more. This is interesting, as we hypothesised that the decrease in EMS dispatches during the pandemic would have been most pronounced for traumas. After all, due to social distancing, children had less school and sport activities and transports in motor vehicles. Under normal circumstances, these factors are major contributors for paediatric traumas (21). On the other hand, even if schools and activities were closed, playgrounds and other public outdoor areas remained open; thus, offering more unsupervised outside playing time. These changes from normal routines may have contributed to unpredicted new risks for traumas in children.

We found that the number of EMS calls for children speaking other language than the national languages (Finnish or Swedish) decreased similarly to other contacts but with a delay (Figure 2). In Finland, native

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language can be used as a proxy for recent immigrant background. Interestingly, several reports have addressed the vulnerability of ethnic minority groups to COVID-19 (22,23). Our results suggest that language and immigrant background may play a role: the information took more time to reach subpopulations with deficiencies in language skills and poor knowledge of the healthcare system. Consequently, in possible new pandemic waves, more attention should be paid to efficiently spreading accurate information in different languages and formats.

To evaluate if changes were specifically encountered by families with children, we also compared our findings to those in the total HUH population. In our area, EMS calls for adults also decreased by 11.1 % (p = 0.004) during the pandemic; but, in contrast to children, the absolute number of their most urgent contacts also decreased by 17.1 % (p = 0.004), and there was no increase in the on-scene mortality. In addition, the decrease in adult EMS contacts occurred already before the declaration of the state of emergency. The pattern for children is clearly different, which strengthens the concern raised by recent reports suggesting that children may have had to bear the burden of the restrictions of the COVID-19 pandemic differently to adults – even to the extent of becoming the "collateral damage" of the pandemic (6). Taken together, these findings suggest that in adults, behavioural changes (i.e., decrease in risk behaviours following social distancing, reluctance to contact medical care etc.) were responsible for most of the decrease in EMS contacts; and that, in contrast to children, the protective measures were truly protective for adults, decreasing the occurrence of severe acute illnesses and injuries. It remains to be solved how, in future pandemics, children could be protected from the negative impacts of measures designed to protect adults.

To protect the EMS and ED personnel from infections, and to optimise the use of critical resources, it would be crucial to be able to recognise children with probable or possible COVID-19. We found that calibration still needs to be done – in about half of the patients where EMS personnel suspected COVID-19, no COVID-19 tests were performed at the ED. On the other hand, only 41 of the 1261 patients in whom EMS

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personnel did not suspect COVID-19 infections, were tested for COVID-19 with one positive result. This implies that more explicit instructions for EMS personnel are needed (24).

Our study has several limitations. First, it is a single-centre study. Second, because of the rapid advance of the COVID-19 pandemic, this study is retrospective. We tried to address the lack of historic references and the question about possible pre-existing seasonal variation by comparing the data to equivalent periods of three previous years. Finally, mortality is such a rare event that no statistical conclusions can be drawn based on our data. However, we believe that this finding needs to be disclosed.

The pandemic created exceptional circumstances with rapid changes in the behaviour of families with children and the functionality of emergency healthcare. During recent pandemics, e.g. the H1N1 influenza in 2009, school closure and social distancing measures were never extended to children in a similar way (25). In our area, the setting was particularly interesting, as the prevalence of COVID-19 in the population remained low throughout the epidemic (14). Thus, our results may be generalisable to other similar situations of unexpected quick changes in the healthcare.

CONCLUSIONS

The total number of contacts decreased rapidly during the COVID-19 pandemic. Also, the children encountered by the EMS were more seriously ill, and we registered a noteworthy number of prehospital deaths compared to the control periods. Our results highlight the need to consider secondary effects of the pandemic and the control measures also on other populations than those originally targeted.

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A competing interests statement:

Authors do not have competing interests.

Contributions:

JO, HS, MaK, HHR conceptualised and designed the study, carried out the initial analyses, drafted the initial manuscript, and reviewed and revised the manuscript. JO, HS, HHR and JP collected the data. JP and MiK participated in the design of the study, reviewed the initial data collection and initial analyses, and critically reviewed and revised the manuscript. ML designed the data analysis instruments, coordinated and supervised data analysis, and critically reviewed the manuscript. All authors approved the final manuscript as submitted and agreed to be accountable for all aspects of the work.

Any checklist and flow diagram for the appropriate reporting statement,

STROBE, please see Supplementary Materials.

Patient consent form:

Not applicable.

Data availability statement:

Data are available upon reasonable request.

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FIGURE LEGENDS:

Figure 1: Basic information on paediatric EMS contacts in 2020 compared to equivalent periods in 2017-2019.

a) A number of weekly EMS contacts

b) A timeline of the course of the first pandemic wave and number of weekly EMS contacts.

1. World Health Organization declared the pandemic, 11 March 2020
2. Public social gatherings were limited to a maximum of 500 participants, 15 March 2020
3. The government announced the state of emergency, 16 March 2020
4. National restrictions and social distancing launched. Schools closed, 18 March 2020
5. Launching strict national border control, 19 March 2020
6. Isolation of Southern Finland started, 28, March 2020
7. Isolation of Southern Finland ended, 15 April 2020
8. Schools reopened, 14 May 2020

EMS = Emergency Medical Services

Figure 2: A timeline of the course of the first pandemic wave and proportion of EMS contacts with other-language-speakers.

1. World Health Organization declared pandemic, 11 March 2020
2. Public social gatherings were limited to a maximum of 500 participants, 15 March 2020
3. The government announced the state of emergency, 16 March 2020
4. National restrictions and social distancing launched. Schools closed, 18 March 2020
5. Launching strict national border control, 19 March 2020
6. Isolation of Southern Finland started, 28, March 2020
7. Isolation of Southern Finland ended, 15 April 2020
8. Schools reopened, 14 May 2020

EMS = Emergency Medical Services

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Figure 3: A timeline of the course of the first pandemic wave and proportion of non-transported patients

1. World Health Organization declared pandemic, 11 March 2020
2. Public social gatherings were limited to a maximum of 500 participants, 15 March 2020
3. The government announced the state of emergency, 16 March 2020
4. National restrictions and social distancing launched. Schools closed, 18 March 2020
5. Launching strict national border control, 19 March 2020
6. Isolation of Southern Finland started, 28, March 2020
7. Isolation of Southern Finland ended, 15 April 2020
8. Schools reopened, 14 May 2020

EMS = Emergency Medical Services

ORCID ID

Jelena Oulasvirta https://orcid.org/0000-0001-6750-4615

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Table 1. Change in the dispatch and transportation codes.

		Mean 2017-2019	2020	change	P-value
All EMS contacts	all n (%)	1794.3 (100.0%)	1368 (100.0%)		
	n per week median (IQR)	137.7 (130.7 - 142.0)	91.0 (86.0 - 132.0)	-30.4% (-36.6% - -12.8%)	**0,003**
Dispatch priority A*	all n (%)	55.3 (3.1%)	90 (6.6%)		
	n per week median (IQR)	3.7 (3.3 - 3.7)	8.0 (7.0 - 8.0)	90.9% (36.4% - 140.0%)	**0,031**
	% per week median (IQR)	2.7% (2.4% - 2.8%)	6.1% (5.7% - 8.4%)	139.9% (116.7 - 175.9%)	**0,001**
Dispatch priority B*	all n (%)	690.7 (38.5%)	478 (34.9%)		
	n per week median (IQR)	51.7 (50.3 - 55.7)	37.0 (30.0 - 43.0)	-29.0% (-42.3% - -20.7%)	**0,002**
	% per week median (IQR)	38.2% (36.7% - 40.5%)	36.1% (31.5% - 38.1%)	-8.7% (-15.9 - -2.3%)	**0,027**
Dispatch priority C*	all n (%)	932.7 (52.0%)	658 (48.1%)		
	n per week median (IQR)	71.3 (67.3 - 74.0)	44.0 (43.0 - 57.0)	-34.7% (-41.8% - -23.3%)	**0,001**
	% per week median (IQR)	52.1% (50.5% - 53.7%)	49.4% (45.7% - 51.4%)	-6.7% (-9.1 - -4.1%)	**0,048**
Dispatch priority D*	all n (%)	115.7 (6.4%)	143 (10.4%)		
	n per week median (IQR)	8.3 (7.3 - 11.0)	10.0 (8.0 - 12.0)	12.5% (-11.8% - 60.0%)	0,235
	% per week median (IQR)	6.5% (5.2% - 7.9%)	9.5% (8.1% - 11.4%)	65.0% (38.9 - 83.6%)	**0,001**
Transported patients	all n (%)	927.3 (51.7%)	578 (42.3%)		
	n per week median (IQR)	73.0 (67.0 - 74.7)	36.0 (34.0 - 54.0)	-49.1% (-52.0% - -27.7%)	**0,002**
	% per week median (IQR)	52.2% (51.4% - 52.9%)	41.9% (39.1% - 44.8%)	-19.5% (-27.0 - -13.4%)	**<0,001**
Transportation priority A*	all n (%)	12.3 (0.7%)	6 (0.4%)		
	n per week median (IQR)	1.0 (0.8 - 1.0)	1.0 (1.0 - 1.0)	50.0% (0.0% - 50.0%)	0,174
	% per week median (IQR)	0.7% (0.5% - 0.8%)	1.2% (0.9% - 1.2%)	107.2% (52.4 - 381.5%)	**0,031**
Transportation priority B*	all n (%)	92.3 (5.1%)	62 (4.5%)		
	n per week median (IQR)	7.0 (5.3 - 8.0)	5.0 (3.0 - 5.0)	-34.8% (-51.6% - -28.6%)	**0,004**
	% per week median (IQR)	5.4% (4.4% - 5.6%)	5.0% (3.5% - 5.7%)	-15.0% (-31.8 - 4.0%)	0,168
Transportation priority C*	all n (%)	602.0 (33.6%)	398 (29.2%)		
	n per week median (IQR)	45.3 (43.0 - 48.3)	25.0 (22.0 - 41.0)	-40.0% (-48.4% - -11.0%)	**<0,001**
	% per week median (IQR)	33.2% (31.9% - 34.5%)	29.1% (25.6% - 31.2%)	-8.8% (-24.2 - -2.0%)	**0,005**
Transportation priority D*	all n (%)	220.3 (12.3%)	113 (8.3%)		
	n per week median (IQR)	16.3 (15.0 - 18.0)	7.0 (6.0 - 9.0)	-60.9% (-63.3% - -45.0%)	**0,002**
	% per week median (IQR)	11.8% (11.6% - 13.0%)	7.4% (6.6% - 8.6%)	-37.7% (-46.2 - -27.2%)	**0,001**
Trauma patients	all n (%)	606.0 (33.8%)	504 (36.8%)		
	n per week median (IQR)	45.3 (39.0 - 51.3)	36.0 (31.0 - 41.0)	-11.9% (-24.5% - -9.6%)	**0,011**
	% per week median (IQR)	32.7% (29.6% - 37.1%)	39.0% (33.3% - 41.7%)	23.7% (-7.1 - 28.1%)	**0,048**
Non-transported patients	all n (%)	866.0 (48.3%)	786 (57.6%)		
	n per week median (IQR)	66.3 (64.0 - 68.3)	56.0 (50.0 - 68.0)	-7.8% (-26.8% - 0.0%)	**0,108**
	% per week median (IQR)	47.8% (47.1% - 48.7%)	58.1% (55.2% - 60.9%)	21.1% (15.0 - 28.4%)	**<0,001**

* the priority class from A to D refers to the urgency of the dispatch /transportation and /or to the risk of the symptom to a patient – A being the contact with highest urgency and risk and D the lowest urgency and risk

EMS = Emergency Medical Services

IQR = Interquartile Range

Table 2. Change in the additional units requested and interventions performed on-scene

		Mean 2017-2019	2020	change	P-value
additional help requested	all n (%)	86.7 (4.8%)	94 (6.9%)		
	n per week median (IQR)	6.3 (5.3 - 7.7)	7.0 (5.0 - 9.0)	23.5% (-29.4% - 31.3%)	0,529
	% per week median (IQR)	4.6% (4.0% - 5.6%)	6.8% (4.5% - 8.5%)	43.3% (0.7 - 117.7%)	**0,040**
MICU on-scene	all n (%)	26.0 (1.4%)	24 (1.8%)		
	n per week median (IQR)	1.7 (1.3 - 2.3)	2.0 (2.0 - 2.8)	0.0% (-13.2% - 50.0%)	0,435
	% per week median (IQR)	1.3% (0.9% - 1.7%)	2.3% (1.4% - 2.5%)	46.3% (-1.4 - 100.5%)	**0,049**
emergency physician consulted by phone	all n (%)	291.3 (16.2%)	236 (17.2%)		
	n per week median (IQR)	21.7 (21.3 - 23.0)	18.0 (15.0 - 20.0)	-28.4% (-36.3% - -1.7%)	**0,023**
	% per week median (IQR)	16.1% (15.3% - 17.1%)	17.6% (15.6% - 18.1%)	2.7% (-4.6 - 19.6%)	0,588
any measurements done on-scene	all n (%)	1693.0 (94.4%)	1280 (93.5%)		
	n per week median (IQR)	129.0 (124.0 - 134.3)	88.0 (78.0 - 124.0)	-29.0% (-37.6% - -12.3%)	**0,001**
	% per week median (IQR)	94.6% (94.0% - 94.9%)	93.9% (91.9% - 95.3%)	-0.0% (-2.2 - 1.6%)	0,455
intubation*	all n (%)	2.0 (0.1%)	3 (0.2%)		
	n per week median (IQR)	0.3 (0.3 - 0.3)	1.5 (1.2 - 1.8)		
	% per week median (IQR)	0.2% (0.1% - 0.2%)	1.3% (1.2% - 1.3%)		
supplementary oxygen given	all n (%)	41.7 (2.3%)	16 (1.2%)		
	n per week median (IQR)	3.0 (2.3 - 3.7)	2.0 (1.0 - 2.2)	-39.4% (-51.8% - 12.5%)	0,306
	% per week median (IQR)	1.9% (1.7% - 2.5%)	1.5% (1.2% - 2.4%)	-19.3% (-33.8 - 17.2%)	0,742
intravenous connection established	all n (%)	133.3 (7.4%)	65 (4.7%)		
	n per week median (IQR)	10.7 (8.3 - 12.3)	5.0 (3.0 - 7.0)	-52.6% (-70.7% - -30.8%)	**0,003**
	% per week median (IQR)	7.6% (5.9% - 9.0%)	4.4% (2.9% - 5.8%)	-32.5% (-56.8 - -24.9%)	**0,008**
any medication given	all n (%)	195.0 (10.9%)	111 (8.1%)		
	n per week median (IQR)	14.3 (12.3 - 15.3)	7.0 (6.0 - 9.0)	-44.7% (-63.6% - -37.9%)	**0,001**
	% per week median (IQR)	10.3% (8.9% - 11.9%)	7.6% (6.6% - 9.1%)	-35.3% (-44.2 - -12.9%)	**0,013**

* not enough data for calculating difference in intubation rates

** invasive means any intravenous or intranasal or intramuscular or intraosseal medication given

MICU = mobile intensive care unit

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Supplementary Materials:

1. Statistics on EMS contacts
2. A flow-chart of EMS contacts in 2020 and possible suspicion of COVID-19 infection

   EMS = Emergency Medical Services

   ED = Emergency Department

   resp infection = respiratory infection
3. A Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cohort studies

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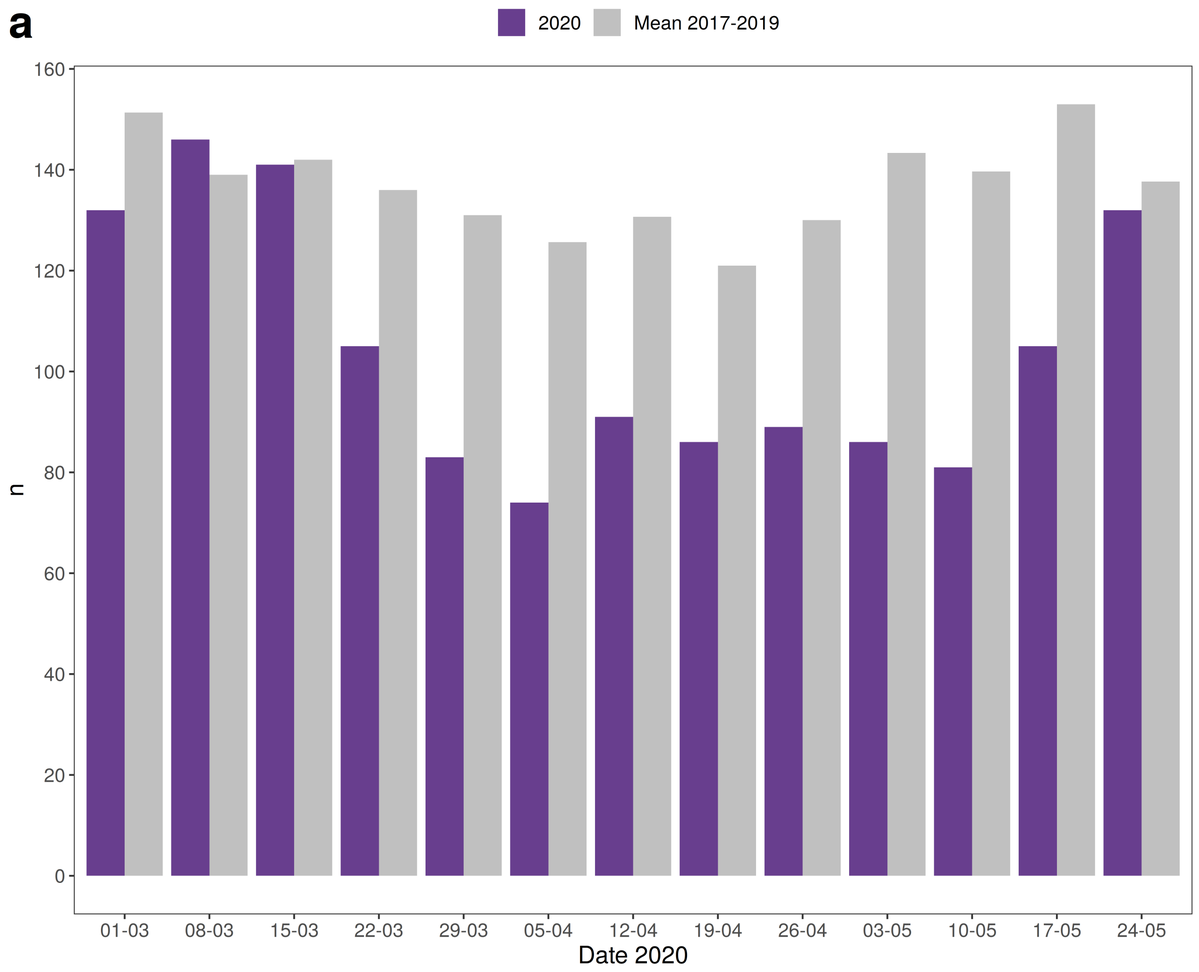
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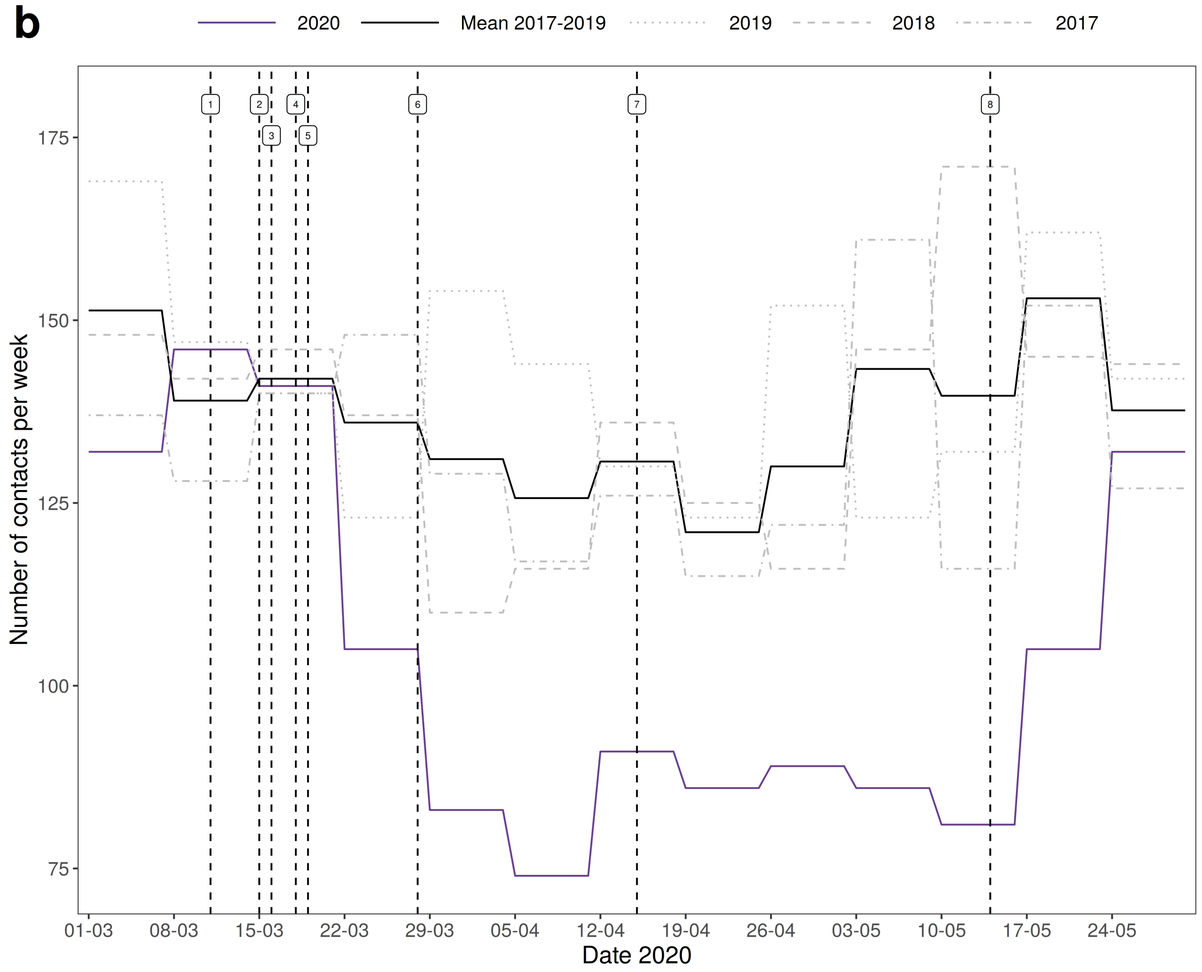
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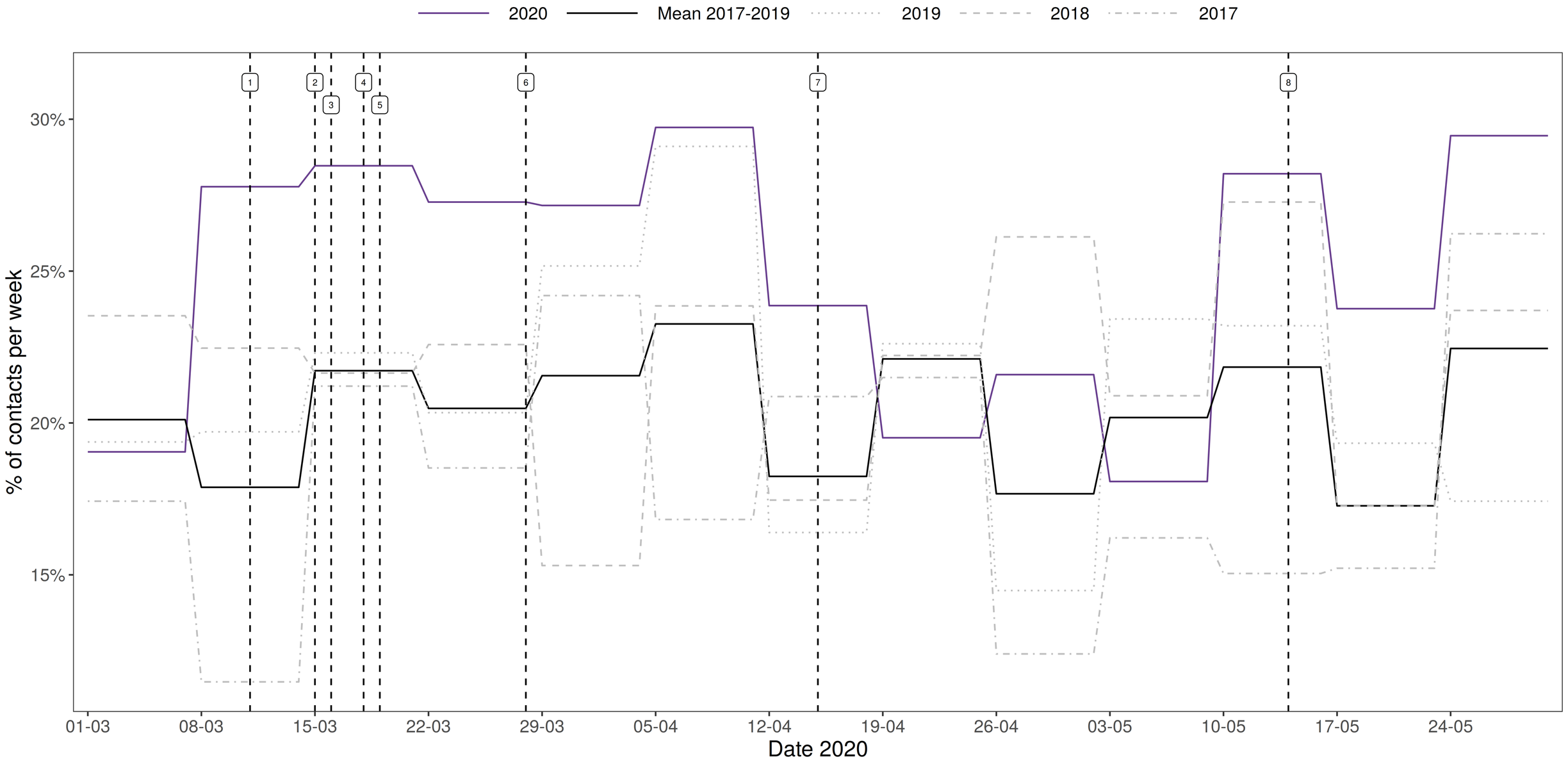
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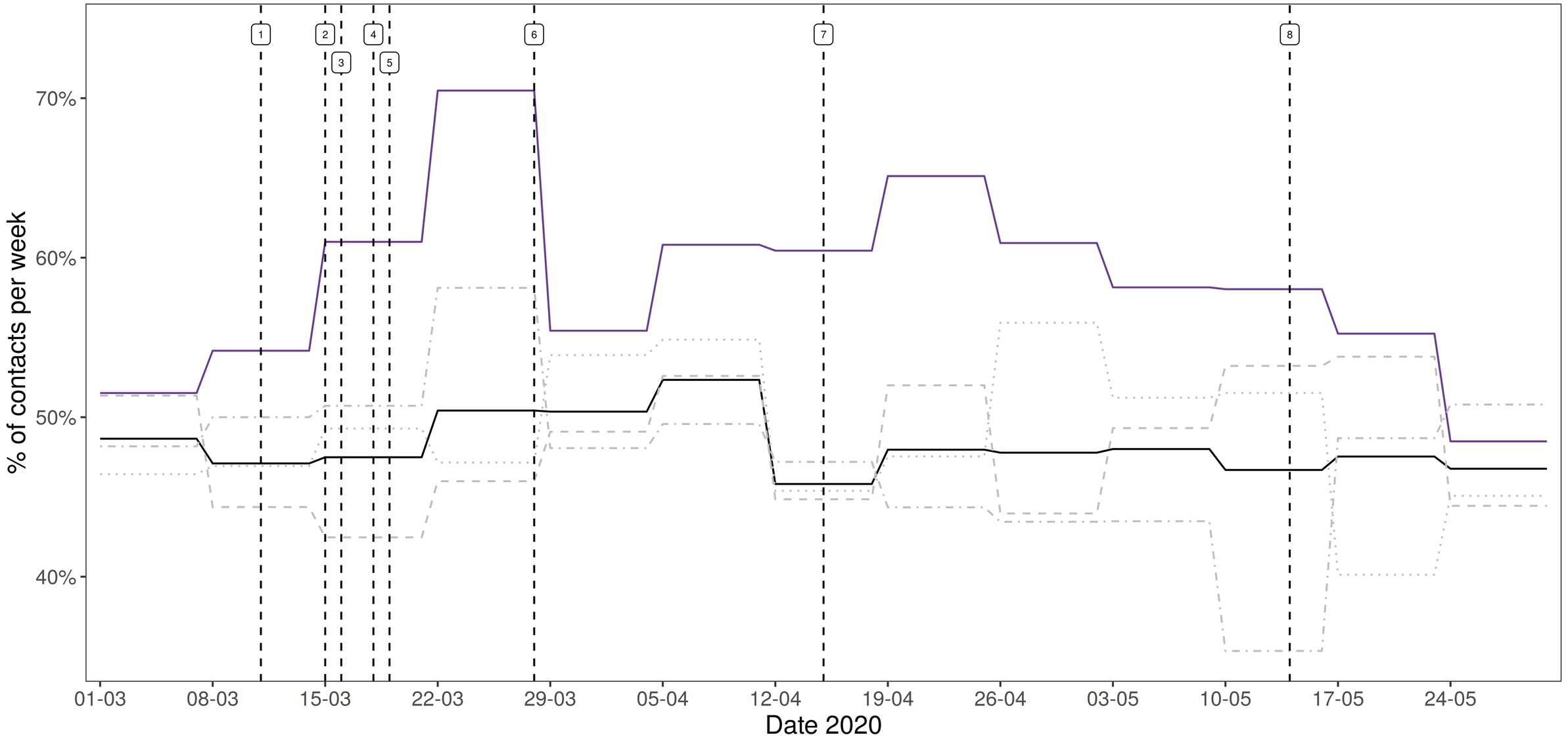
1
2
3
4
5
6
7
8
70%
60%
50%
40%
% of contacts per week
01-03
08-03
15-03
22-03
29-03
05-04
12-04
19-04
26-04
03-05
10-05
17-05
24-05
Date 2020

Supplementary Material 1: Supplementary statistics

Supplementary Table 1. Descriptive statistics.

		2017	2018	2019	2020
Age (years)		6.4 (2.0 - 13.2)	6.5 (1.9 - 12.6)	6.3 (2.1 - 12.5)	5.3 (1.8 - 12.0)
Sex (male)	all n (%)	915 (53.2%)	980 (54.6%)	1001 (54.1%)	753 (55.1%)
	n per week median (IQR)	67.0 (61.0 - 82.0)	75.0 (65.0 - 80.0)	76.0 (71.0 - 80.0)	53.0 (48.0 - 70.0)
	% per week median (IQR)	55.3% (51.7% - 55.6%)	55.2% (53.7% - 56.1%)	52.3% (51.8% - 58.3%)	54.3% (52.7% - 56.2%)
Native language (Finnish or Swedish)	all n (%)	1327 (81.8%)	1310 (77.7%)	1377 (79.1%)	991 (74.7%)
	n per week median (IQR)	104.0 (91.0 - 109.0)	104.0 (91.0 - 106.0)	102.0 (95.0 - 110.0)	69.0 (66.0 - 91.0)
	% per week median (IQR)	82.6% (78.8% - 84.8%)	77.5% (76.3% - 79.1%)	79.7% (76.8% - 80.7%)	72.8% (71.8% - 78.4%)

IQR = Interquartile Range

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Supplementary Table 2. The number of EMS contacts during the control periods for each month and their proportions (%) of all control-period EMS contacts. The Chi-squared test was used to calculate the significance of the variation within the control periods.

Year	March	April	June	p
2017	602 (11%)	516 (10%)	606 (11%)	0,10
2018	621 (12%)	524 (10%)	656 (12%)	
2019	643 (12%)	606 (11%)	609 (11%)	

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Supplementary Table 3. Change in the dispatch and transportation codes.

		2017	2018	2019	2020
All EMS contacts	all n (%)	1724 (100.0%)	1801 (100.0%)	1858 (100.0%)	1369 (100.0%)
	n per week median (IQR)	128.0 (122.0 - 140.0)	142.0 (125.0 - 146.0)	142.0 (130.0 - 152.0)	91.0 (86.0 - 132.0)
Dispatch priority A*	all n (%)	42 (2.4%)	43 (2.4%)	81 (4.4%)	90 (6.6%)
	n per week median (IQR)	3.0 (2.0 - 4.0)	3.0 (2.0 - 4.0)	5.0 (2.0 - 5.0)	8.0 (7.0 - 8.0)
	% per week median (IQR)	2.3% (1.6% - 2.6%)	2.1% (1.6% - 2.9%)	3.3% (1.6% - 4.1%)	6.1% (5.7% - 8.4%)
Dispatch priority B*	all n (%)	693 (40.2%)	677 (37.6%)	702 (37.8%)	478 (34.9%)
	n per week median (IQR)	53.0 (47.0 - 58.0)	49.0 (46.0 - 53.0)	53.0 (46.0 - 59.0)	37.0 (30.0 - 43.0)
	% per week median (IQR)	38.8% (37.3% - 42.3%)	39.0% (32.4% - 40.4%)	38.7% (34.4% - 40.7%)	36.1% (31.5% - 38.1%)
Dispatch priority C*	all n (%)	882 (51.2%)	969 (53.8%)	947 (51.0%)	658 (48.1%)
	n per week median (IQR)	65.0 (63.0 - 70.0)	74.0 (69.0 - 86.0)	72.0 (69.0 - 80.0)	44.0 (43.0 - 57.0)
	% per week median (IQR)	52.1% (50.4% - 54.3%)	54.0% (51.7% - 56.0%)	52.0% (47.3% - 56.9%)	49.4% (45.7% - 51.4%)
Dispatch priority D*	all n (%)	107 (6.2%)	112 (6.2%)	128 (6.9%)	143 (10.4%)
	n per week median (IQR)	7.0 (7.0 - 10.0)	8.0 (7.0 - 10.0)	10.0 (7.0 - 13.0)	10.0 (8.0 - 12.0)
	% per week median (IQR)	5.7% (4.8% - 7.1%)	5.8% (4.7% - 7.3%)	5.9% (5.6% - 8.8%)	9.5% (8.1% - 11.4%)
Transported patients	all n (%)	902 (52.4%)	930 (51.6%)	950 (51.2%)	578 (42.3%)
	n per week median (IQR)	67.0 (64.0 - 71.0)	74.0 (65.0 - 79.0)	71.0 (65.0 - 78.0)	36.0 (34.0 - 54.0)
	% per week median (IQR)	51.8% (50.0% - 55.7%)	50.9% (48.0% - 55.6%)	52.5% (48.5% - 53.8%)	41.9% (39.1% - 44.8%)
Transportation priority A*	all n (%)	8 (0.5%)	15 (0.8%)	14 (0.8%)	6 (0.4%)
	n per week median (IQR)	1.0 (1.0 - 1.8)	1.0 (1.0 - 2.0)	1.0 (1.0 - 2.0)	1.0 (1.0 - 1.0)
	% per week median (IQR)	0.9% (0.8% - 1.2%)	0.8% (0.7% - 1.4%)	0.8% (0.7% - 1.3%)	1.2% (0.9% - 1.2%)
Transportation priority B*	all n (%)	89 (5.2%)	84 (4.7%)	104 (5.6%)	62 (4.5%)
	n per week median (IQR)	6.0 (5.0 - 8.0)	7.0 (4.0 - 8.0)	8.0 (5.0 - 11.0)	5.0 (3.0 - 5.0)
	% per week median (IQR)	4.7% (3.9% - 5.7%)	5.1% (3.4% - 5.5%)	6.4% (3.4% - 6.6%)	5.0% (3.5% - 5.7%)
Transportation priority C*	all n (%)	587 (34.1%)	601 (33.4%)	618 (33.3%)	398 (29.2%)
	n per week median (IQR)	44.0 (40.0 - 47.0)	47.0 (42.0 - 50.0)	45.0 (41.0 - 50.0)	25.0 (22.0 - 41.0)
	% per week median (IQR)	33.3% (32.0% - 36.6%)	34.2% (30.4% - 37.1%)	33.3% (29.6% - 35.1%)	29.1% (25.6% - 31.2%)
Transportation priority D*	all n (%)	218 (12.7%)	230 (12.8%)	213 (11.5%)	113 (8.3%)
	n per week median (IQR)	15.0 (13.0 - 20.0)	17.0 (14.0 - 21.0)	15.0 (14.0 - 19.0)	7.0 (6.0 - 9.0)
	% per week median (IQR)	13.0% (10.3% - 14.6%)	12.9% (11.7% - 14.4%)	11.3% (9.9% - 13.2%)	7.4% (6.6% - 8.6%)
Trauma patients	all n (%)	605 (35.1%)	564 (31.3%)	649 (34.9%)	504 (36.8%)
	n per week median (IQR)	42.0 (40.0 - 50.0)	41.0 (33.0 - 48.0)	50.0 (40.0 - 56.0)	36.0 (31.0 - 41.0)
	% per week median (IQR)	33.8% (30.5% - 38.1%)	28.4% (25.5% - 32.9%)	34.0% (29.3% - 40.7%)	39.0% (33.3% - 41.7%)
Non-transported patients	all n (%)	820 (47.6%)	871 (48.4%)	907 (48.9%)	786 (57.6%)
	n per week median (IQR)	64.0 (58.0 - 70.0)	63.0 (61.0 - 72.0)	68.0 (63.0 - 78.0)	56.0 (50.0 - 68.0)
	% per week median (IQR)	48.2% (44.3% - 50.0%)	49.1% (44.4% - 52.0%)	47.5% (46.4% - 51.5%)	58.1% (55.2% - 60.9%)

* the priority class from A to D referres to the urgency of the dispatch /transportation and /or to the risk of the symptom to a patient – A being the contact with highest urgency and risk and D the lowest urgency and risk

EMS = Emergency Medical Services

IQR = Interquartile Range

Supplementary Table 4. Change in the interventions performed on-scene

		2017	2018	2019	2020
additional help requested	all n (%)	81 (4.7%)	74 (4.1%)	105 (5.7%)	94 (6.9%)
	n per week median (IQR)	6.0 (5.0 - 6.0)	5.0 (3.0 - 8.0)	7.0 (5.0 - 7.0)	7.0 (5.0 - 9.0)
	% per week median (IQR)	4.1% (3.9% - 4.7%)	3.4% (2.6% - 4.9%)	4.5% (4.1% - 5.4%)	6.8% (4.5% - 8.5%)
MICU on-scene	all n (%)	25 (1.5%)	23 (1.3%)	30 (1.6%)	24 (1.8%)
	n per week median (IQR)	2.0 (1.8 - 2.2)	2.0 (1.5 - 2.0)	2.0 (1.5 - 3.5)	2.0 (2.0 - 2.8)
	% per week median (IQR)	1.6% (1.2% - 1.9%)	1.4% (1.0% - 1.7%)	1.6% (1.1% - 2.6%)	2.3% (1.4% - 2.5%)
emergency physician consulted by phone	all n (%)	308 (17.9%)	261 (14.5%)	305 (16.4%)	236 (17.2%)
	n per week median (IQR)	23.0 (22.0 - 27.0)	20.0 (18.0 - 23.0)	23.0 (21.0 - 25.0)	18.0 (15.0 - 20.0)
	% per week median (IQR)	17.9% (16.8% - 20.0%)	15.4% (11.6% - 17.6%)	16.0% (14.3% - 18.5%)	17.6% (15.6% - 18.1%)
any measurements done on-scene	all n (%)	1615 (93.7%)	1695 (94.1%)	1769 (95.2%)	1280 (93.5%)
	n per week median (IQR)	120.0 (116.0 - 130.0)	131.0 (112.0 - 141.0)	135.0 (121.0 - 144.0)	88.0 (78.0 - 124.0)
	% per week median (IQR)	93.0% (92.2% - 94.9%)	94.9% (93.0% - 95.5%)	95.7% (93.8% - 96.3%)	93.9% (91.9% - 95.3%)
intubation*	all n (%)	2 (0.1%)	3 (0.2%)	1 (0.1%)	3 (0.2%)
	n per week median (IQR)	1.0 (1.0 - 1.0)	1.0 (1.0 - 1.0)	1.0 (1.0 - 1.0)	1.5 (1.2 - 1.8)
	% per week median (IQR)	0.8% (0.8% - 0.8%)	0.7% (0.7% - 0.7%)	0.6% (0.6% - 0.6%)	1.3% (1.2% - 1.3%)
supplementary oxygen given	all n (%)	38 (2.2%)	47 (2.6%)	40 (2.2%)	16 (1.2%)
	n per week median (IQR)	3.0 (2.0 - 4.0)	3.0 (2.0 - 5.0)	3.0 (2.0 - 4.5)	2.0 (1.0 - 2.2)
	% per week median (IQR)	2.4% (1.6% - 2.8%)	2.2% (1.7% - 3.6%)	2.4% (1.3% - 3.0%)	1.5% (1.2% - 2.4%)
intravenous connection established	all n (%)	128 (7.4%)	123 (6.8%)	149 (8.0%)	65 (4.7%)
	n per week median (IQR)	10.0 (8.0 - 11.0)	9.0 (7.0 - 11.0)	10.0 (10.0 - 14.0)	5.0 (3.0 - 7.0)
	% per week median (IQR)	8.5% (5.6% - 8.7%)	6.4% (5.8% - 7.5%)	8.0% (6.5% - 8.9%)	4.4% (2.9% - 5.8%)
any medication given	all n (%)	170 (9.9%)	206 (11.4%)	209 (11.2%)	111 (8.1%)
	n per week median (IQR)	14.0 (12.0 - 15.0)	14.0 (14.0 - 18.0)	15.0 (13.0 - 18.0)	7.0 (6.0 - 9.0)
	% per week median (IQR)	10.4% (8.8% - 12.1%)	10.3% (9.6% - 12.5%)	10.7% (9.0% - 13.1%)	7.6% (6.6% - 9.1%)

* not enough data for calculating difference in intubation rates

** invasive means any intravenous or intranasal or intramuscular or intraosseal medication given

MICU = mobile intensive care unit

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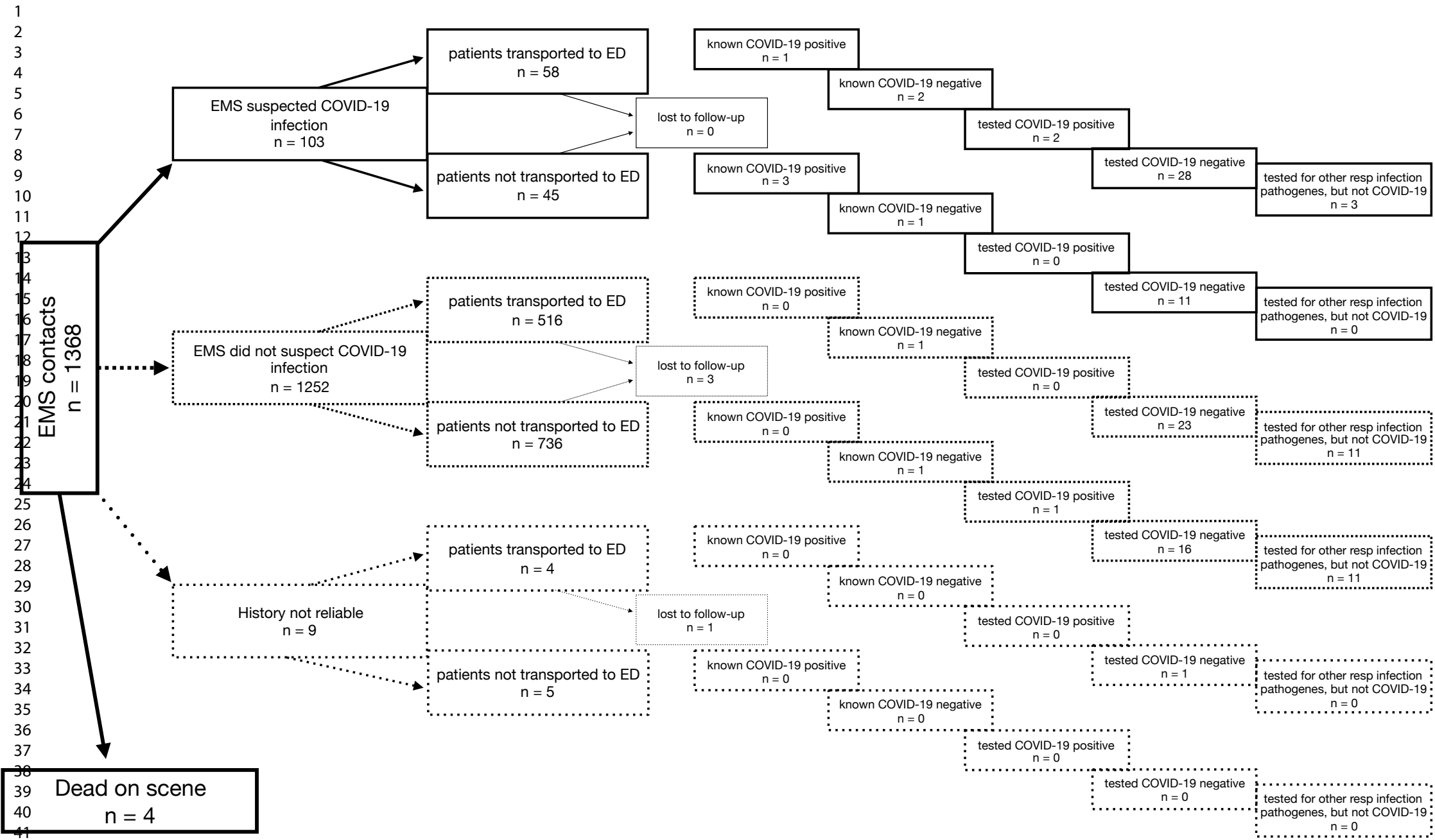
EMS contacts
n = 1368
EMS suspected COVID-19 infection
n = 103
patients transported to ED
n = 58
lost to follow-up
n = 0
patients not transported to ED
n = 45
known COVID-19 positive
n = 1
known COVID-19 negative
n = 2
tested COVID-19 positive
n = 2
tested COVID-19 negative
n = 28
tested for other resp infection pathogenes, but not COVID-19
n = 3
known COVID-19 positive
n = 3
known COVID-19 negative
n = 1
tested COVID-19 positive
n = 0
tested COVID-19 negative
n = 11
tested for other resp infection pathogenes, but not COVID-19
n = 0
EMS did not suspect COVID-19 infection
n = 1252
patients transported to ED
n = 516
lost to follow-up
n = 3
patients not transported to ED
n = 736
known COVID-19 positive
n = 0
known COVID-19 negative
n = 1
tested COVID-19 positive
n = 0
tested COVID-19 negative
n = 23
tested for other resp infection pathogenes, but not COVID-19
n = 11
known COVID-19 positive
n = 0
known COVID-19 negative
n = 1
tested COVID-19 positive
n = 1
tested COVID-19 negative
n = 16
tested for other resp infection pathogenes, but not COVID-19
n = 11
History not reliable
n = 9
patients transported to ED
n = 4
lost to follow-up
n = 1
patients not transported to ED
n = 5
known COVID-19 positive
n = 0
known COVID-19 negative
n = 0
tested COVID-19 positive
n = 0
tested COVID-19 negative
n = 1
tested for other resp infection pathogenes, but not COVID-19
n = 0
known COVID-19 positive
n = 0
known COVID-19 negative
n = 0
tested COVID-19 positive
n = 0
tested COVID-19 negative
n = 0
tested for other resp infection pathogenes, but not COVID-19
n = 0
Dead on scene
n = 4

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	#1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	#4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	#5
Objectives	3	State specific objectives, including any prespecified hypotheses	#5
Methods			
Study design	4	Present key elements of study design early in the paper	#5-#8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	#6-#8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	#6-#8
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	n/a
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	#6-#8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	#6-#8
Bias	9	Describe any efforts to address potential sources of bias	#5, #15
Study size	10	Explain how the study size was arrived at	#6-#8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	#7-#8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	#7-#8
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	n/a
		(*d*) If applicable, explain how loss to follow-up was addressed	Supplementary Material 2
		(*e*) Describe any sensitivity analyses	n/a

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Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Supplementary Material 1 and 2
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	Supplementary Material 2
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Supplementary Material 1
		(b) Indicate number of participants with missing data for each variable of interest	Supplementary Material 2
		(c) Summarise follow-up time (eg, average and total amount)	Figure 1, Supplementary Material 1,2
Outcome data	15*	Report numbers of outcome events or summary measures over time	Table 1-3, Supplementary Material 1
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Table 1,2, Supplementary Material 1
		(*b*) Report category boundaries when continuous variables were categorized	n/a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Supplementary Material 1
Discussion			
Key results	18	Summarise key results with reference to study objectives	#11
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	#11-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	#14-15
Other information			

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Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	#16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Paediatric prehospital emergencies and restrictions during the COVID-19 pandemic: a population-based study

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Keywords:	Epidemiology, Health services research

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Paediatric prehospital emergencies and restrictions during the COVID-19 pandemic: a population-based study

Jelena Oulasvirta, MD[1,2]

Jussi Pirneskoski, MD[2]

Heini Harve-Rytsälä, MD, PhD[2]

Mitja Lääperi, MSc[2]

Mikael Kuitunen, MD, PhD[3]

Markku Kuisma, MD, PhD[2]

Heli Salmi, MD, PhD[1,3]

[1] Division of Anaesthesiology; Department of Anaesthesiology, Intensive Care and Pain Medicine; University of Helsinki and Helsinki University Hospital, P.O. Box 340, FI-00029 HUS, Finland

[2] Department of Emergency Medicine and Services, Helsinki University and Helsinki University Hospital, P.O. Box 340, FI-00029 HUS, Finland

[3]New Children's Hospital, University of Helsinki and Helsinki University Hospital, P.O. Box 347, FI-00029 HUS, Finland

Corresponding author:

Jelena Oulasvirta

Confidential: For Review Only

Postal address: Töölö Hospital, University of Helsinki and Helsinki University Hospital, P.O. Box 266, FI-00029 HUS, Finland

E-mail: jelena.oulasvirta@hus.fi

Telephone: +358 50 428 7622

Keywords: emergency medical services, paediatrics, outcome, patient safety, emergency care, COVID-19

Word count: Abstract 253, main text about 2907

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What is already known on this topic

- Compared to adults, children are less affected by the COVID-19 infection but may be affected by its control measures.
- Children may experience collateral damage because of the infection control measures, mainly designed to protect adults.
- The pandemic has decreased paediatric emergency department (ED) visits, but it is not clear how or if prehospital care has also been affected.

What this study adds

- The use of prehospital emergency medical services decreased in children after declaration of the state of emergency in Finland.
- During the pandemic, ambulance calls for children were more often in the most urgent category and due to trauma. Paradoxically, almost 60% of children were not transported to the ED.
- Societal measures targeted to protect adults against the pandemic affected children and their emergency medical care.

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ABSTRACT

Background

Children are less vulnerable to serious forms of the COVID-19 disease. However, concerns have been raised about children being the second victims of the pandemic and its control measures. Therefore, we wanted to study if the pandemic, the infection control measures and their consequences to the society projected to paediatric prehospital emergency medical services (EMS) contacts.

Methods

We conducted a population-based cohort study concerning all children aged 0-15 years with EMS contacts in the Helsinki University Hospital (HUH) area during 1.3.-31.5.2020 (study period) and equivalent periods in 2017-2019 (control periods). We analysed the demographic characteristics, time of EMS contact, reason for EMS contact, priority of the dispatch, reason for transportation, priority of transportation, if any consultations were made or additional units required, any medication or oxygen or fluids given, if intubation was performed, and whether paramedics took precautions when COVID-19 infection was suspected.

Results

The number of paediatric EMS contacts decreased by 30.4% from mean of 1794 contacts to 1369 (p=0.003). The EMS contacts were more often due to trauma, (+23.7%, p<0.05), dispatched in the most urgent category (+139.9%, p=0.001), additional help and the mobile intensive care unit (MICU) were more frequently requested (+43.3%, p=0.040 and +46.3%, p=0.049, respectively). However, EMS contacts resulted less often in ambulance transport (-21.1%, p<0.001). Alarmingly, there were 4 deaths during the study period compared to 0-2 during the control periods.

Conclusions

The number of EMS contacts decreased during the pandemic. Nevertheless, the children encountered by the EMS were more seriously ill than during the control periods.

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INTRODUCTION

Children seem to be less vulnerable to the serious forms of the COVID-19 disease by the new pandemic coronavirus SARS-CoV-2 than adults (1–3). Still, following the infection control measures and associated abrupt changes in healthcare delivery, children have not been spared from the health effects of the pandemic. Consequently, health professionals have expressed concern over children becoming second victims of the pandemic (4–6).

Instructions on social distancing and self-quarantine resulted in a considerable decrease in paediatric emergency department (ED) visits (4,5). Also, the emergency healthcare itself changed: In EDs and prehospital emergency medical services (EMS), infection control measures, including the use of personal protective equipment have slowed patient flows and resulted in modified treatment protocols. On the other hand, the ubiquitous presence of COVID-19 in news and media may have created a bias in clinicians, who may be prone to diagnostic errors, suspecting COVID-19 over more common conditions.

Decreasing unnecessary paediatric ED visits and ambulance calls has been a priority in paediatric emergency care already before the pandemic (7–9). However, alarmed by reports stating risks associated with decreases in paediatric ED visits (4,5) we wanted to study if the pandemic and social distancing measures were reflected in the amount and features of the EMS contacts with children as well. If these contacts had indeed substantially decreased, it would be important to analyse whether this change has taken place at the cost of health risks for children.

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METHODS

Study area and population

The Helsinki University Hospital (HUH) area in Southern Finland has 1 263 000 inhabitants including 217 000 0-15-years-old children (2019) (10) and consists of both urban and suburban regions covering 1 216 km^2. This study covers all prehospital ambulance responses for children (aged 0-15 years) in the HUH area during the study and control periods.

Organisation of emergency medical services and healthcare system

Finland has a publicly financed universal healthcare system for all residents. The public healthcare exclusively provides all prehospital emergency medical services. All emergency calls go to the governmental emergency response centre (ERC). A professional ERC operator categorises the leading complaint to form a dispatch code and determines a priority class from A (highest risk) to D (lowest risk) according to a formal protocol (11). In HUH area, all prehospital emergencies are responded to by HUH EMS consisting of 36 ambulances and three medical supervisor units staffed by emergency medical technicians, paramedics and two physician-staffed units. An emergency physician can be consulted by phone, or, requested on scene. Not all patients encountered by EMS are transported to hospital by ambulance. After on-scene examination and treatment, the EMS personnel may conclude that patient does not need ambulance transport. In that case they must inform the patient or the caregivers on how to observe and treat the condition and on whether or when to contact healthcare services again. The protocol on the treatment and transport of children for the EMS did not change during the pandemic. Nevertheless, preferring other treatment options over nebulised medication, was advised.

There are two 24/7 paediatric ED units with in-patient care in the area. In addition, smaller units offer primary level healthcare during office hours.

Data collection

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We retrieved all emergency responses concerning children (age 0-15 y) from the ambulance electronic patient record system (Merlot Medi®, CGI Suomi Oy) in HUH area between 1.3.2020 and 31.5.2020 (study period) and equivalent periods for three previous years: 1.3.2017 - 31.5.2017; 1.3.2018 - 31.5.2018; 1.3.2019 - 31.5.2019 (control periods). We chose control periods to cover three previous years and the same months in order to be able to account for any potential seasonal variation. The pandemic declaration by World Health Organisation (WHO) on 11 March, the Finnish Government announcement of the state of emergency in Finland on 16 March, and the reopening of schools on 14 May were included in the study period. We analysed the time of contact, reason for contact, dispatch priority, reason for transportation, priority of transportation, age, sex, native language, whether the patient received medications, oxygen, fluids or was intubated, whether a physician was consulted or requested on-scene or additional units required, and whether COVID-19 was suspected. We investigated eventual laboratory diagnostics for respiratory viruses (including SARS-CoV-2) from the Helsinki University Hospital in-hospital patient record system (Uranus®, CGI Suomi Oy and Apotti®, Epic Systems Corporation). A flow-chart of EMS contacts in 2020 and possible suspicion of COVID-19 infection is presented in Supplementary Material 2.

Statistical analysis

Because this is a retrospective study concerning a multidimensional and rapidly progressing medico-societal phenomenon, the possible confounders are multiple and their effects difficult to predict. As we did not aim at establishing causalities between the control measures and EMS contacts, but at noticing possible indicators of the effects of the pandemic on the health and welfare of children, we chose univariate analysis for the primary statistical method, since it gives the clinically most relevant answers to our study questions. Estimates and proportions are shown using medians and interquartile ranges (IQR) and number of events are shown using counts and percentages. To compare the change in EMS contacts during the study period to that of control periods, we used the Mann-Whitney U test or Wilcoxon signed-rank test depending on whether comparisons were made between all the observations or between the weeks of 2020 and the previous years. The analyses were performed using R 3.6.3 (12) and the visualisations using

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ggplot2-package (13). We used 0.05 as the level of significance. As the infection control measures changed during the study period, we used line plots with date as the X-axis to evaluate the eventual changes in our parameters.

This study is reported in compliance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cohort studies (Supplementary Material 3).

Ethical aspects and Patient and Public Involvement statement

This is a register-based study approved by the Institutional Review Board of Helsinki University Hospital (§24/2020). No public involvement was planned for this study, as the COVID-19 pandemic advanced rapidly.

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RESULTS

There were 28 680 prehospital EMS contacts during the study period, of which 1368 (4.8%) concerned children. This comprised a reduction of paediatric EMS contacts by 23.7% compared to the mean of 1794 contacts in control periods (Figure 1). There was no statistically significant variation within the control periods (Supplementary Material 1, Supplementary Table 2). Patients were younger: 5.3 years compared to 6.3 years ($p<0.001$) and there were proportionally less children speaking one of the national languages (Finnish or Swedish) as native language: 7.8% ($p=0.003$). The number of EMS calls for children speaking another language, however, decreased with a delay. The sex distribution was equal in both periods (males 54.0% vs. 55.1%).

The changes in the characteristics of EMS dispatch and transportation codes are described in Table 1. The proportion of the highest priority A dispatch code rose by 139.9% ($p=0.001$). The absolute number of trauma patients decreased by 11.9% ($p<0.02$). However, their proportion increased by 23.7% ($p<0.05$). The proportion of non-transported patients increased by 21.1% ($p<0.001$) (Table 1). *(Table 1 here)*

Additional help and the mobile intensive care unit (MICU) were more frequently requested on-scene (+43.3%, $p=0.040$ and +46.3%, $p=0.049$, respectively).Less treatments were performed in 2020 compared to the control periods: establishing an intravenous access decreased in proportion by 32.5% ($p=0.008$) and administering medications by 35.3% ($p<0.02$) (Table 2). *(Table 2 here)*

Four patients were dead on arrival of the EMS or died on-scene during the study period, as compared to 0 - 2 during the control periods (Table 3). *(Table 3 here)*

Table 3. Mortality presented by year during equivalent periods of 1.3.-31.5.

	2017	**2018**	**2019**	**2020**	**P-value**
All paediatric EMS contacts (n)	1722	1801	1857	1364	
Dead on arrival or on-scene (n)	2	0	1	4	0,060

EMS = Emergency Medical Services

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Of the 1368 children, COVID-19 infection was suspected in 103. Of these, 4 were previously known to be positive for SARS-CoV-2 and there were 2 new infections. However, 41 of the 1261 children not suspected as having COVID-19 by the EMS were tested for COVID-19 infection at the ED, with only 1 positive result.

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DISCUSSION

During a local epidemic peak of the COVID-19 pandemic, prehospital emergency care delivered to children decreased and its characteristics changed markedly. Emergency calls for children were more often categorised as urgent and an emergency medical physician or other additional help were more often needed. Concomitantly, the number of prehospital paediatric deaths during the pandemic was noteworthy. Therefore, our results suggest that the children encountered by the EMS during the pandemic were more seriously ill than before the pandemic. Paradoxically, the EMS contacts more likely led to not transporting the child to the ED (Table 1).

Finland has not experienced high COVID-19 infection rates in the population so far. The highest demand for hospital beds and intensive care was experienced mid-April (14). Thus, the changes we noticed in the emergency healthcare to children were neither due to SARS CoV-2, nor to an overwhelming of the emergency healthcare system. Instead, they represent the changes in healthcare functionality, and in the behaviour of families with children.

We expected the decrease in the number of EMS contacts for children based on international reports about substantial decreases in the number of paediatric ED visits during the pandemic (15,16). Our figures were also congruent with those from the paediatric EDs in the area, which saw a 45% decrease in the number of visits after the beginning of the infection control measures, according to the hospital statistical data. The EMS contacts with children started to decrease immediately after the declaration of state of emergency, suggesting that the decrease was more societal than medical in nature.

The decrease in EMS contacts was probably due to several factors, which may represent both positive changes in the behaviour of caregivers, but also cause unnecessary risks to children. A successful public

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guidance during the state of emergency, encouraging parents to treat mild symptoms at home and avoid overcrowding EDs, could have eliminated some medically unjustifiable EMS contacts (9,17). In addition, infection control measures could have decreased the occurrence of acute infections in children and, hence, the occurrence of febrile seizures and dyspnoea, which are leading causes for paediatric EMS calls under normal circumstances (18). Still, especially the peak in the number of children who died on-scene warrants careful examination of the EMS contacts during the pandemic. Even if the increase in deaths is a preliminary finding and as such may be due to coincidence, we cannot confidently state that the decrease in EMS contacts was a positive proceeding. The ubiquitous presence of COVID-19 in media, reports about overcrowded EDs and a concomitant public guidance stating that all unnecessary contacts should be avoided, could have led to caregivers delaying ED visits and emergency calls even when medical attention would urgently have been needed. Noticeably, a recent report from adult EMS contacts in the UK states that the pandemic did not cause reluctance to call an ambulance in case of a real emergency, such as stroke or heart attack (19).

Our results suggest that the children encountered by the EMS during the pandemic were more seriously ill than during the control periods. Although the total number of EMS contacts decreased, the number of the most urgent EMS calls with priority class A increased. Simultaneously, the proportions of contacts requiring an emergency medical physician or other additional help increased. There were no changes in the EMS protocols that could account for such finding. The high number of paediatric out-of-hospital deaths may also be related to this notice.

Even though children encountered by the EMS during the pandemic seem to have been more seriously ill than before, the contacts more often led to not transporting the child to the ED. The increase in the proportion of EMS calls in which the patient was not transported in an ambulance (“non-transports”) is interesting, as in our system the non-transport rates were already high before pandemic (18,20). This

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finding is also paradoxical considering that non-urgent or non-medical complaints did not seem overexpressed during the study period. The increased tendency not to transport a child by ambulance may reflect the practical difficulties imposed by the infection control measures during the pandemic, such as a time-consuming obligation to thoroughly clean the ambulance after any transport. Also, non-transport decisions are not solely based on medical decision-making, but social and logistic issues are considered as well. In our urban study area other transport possibilities than ambulance, are easily available. During the pandemic, caregivers for older children were not allowed to escort the child in an ambulance. Thus, it is likely that if the ambulance transport was medically not necessary and if the caregiver needed to use another means of transport anyway, the child may have preferred the ride with the caregiver. In addition, similarly to laypersons, the EMS personnel were also exposed to media warning about overcrowded EDs and reporting about overwhelmed healthcare systems. Even without changes in protocols, the EMS personnel may have felt a need to ascertain that a maximal number of units are available at all times for urgent cases, and, opted not to transport when there was no explicit need for ambulance transportation.

We observed a decrease in the absolute rate of traumas, but non-traumatic emergencies decreased even more. This is interesting, as we hypothesised that the decrease in EMS dispatches during the pandemic would have been most pronounced for traumas. After all, due to social distancing, children had less school and sport activities and transports in motor vehicles. Under normal circumstances, these factors are major contributors for paediatric traumas (21). On the other hand, even if schools and activities were closed, playgrounds and other public outdoor areas remained open; thus, offering more unsupervised outside playing time. These changes from normal routines may have contributed to unpredicted new risks for traumas in children.

We found that the number of EMS calls for children speaking other language than the national languages (Finnish or Swedish) decreased similarly to other contacts but with a delay. In Finland, native language can

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be used as a proxy for recent immigrant background. Interestingly, several reports have addressed the vulnerability of ethnic minority groups to COVID-19 (22,23). Our results suggest that language and immigrant background may play a role: the information took more time to reach subpopulations with deficiencies in language skills and poor knowledge of the healthcare system. Consequently, in possible new pandemic waves, more attention should be paid to efficiently spreading accurate information in different languages and formats.

To evaluate if changes were specifically encountered by families with children, we also compared our findings to those in the total HUH population. In our area, EMS calls for adults also decreased by 11.1 % (p = 0.004) during the pandemic; but, in contrast to children, the absolute number of their most urgent contacts also decreased by 17.1 % (p = 0.004), and there was no increase in the on-scene mortality. In addition, the decrease in adult EMS contacts occurred already before the declaration of the state of emergency. The pattern for children is clearly different, which strengthens the concern raised by recent reports suggesting that children may have had to bear the burden of the restrictions of the COVID-19 pandemic differently to adults – even to the extent of becoming the "collateral damage" of the pandemic (6). Taken together, these findings suggest that in adults, behavioural changes (i.e., decrease in risk behaviours following social distancing, reluctance to contact medical care etc.) were responsible for most of the decrease in EMS contacts; and that, in contrast to children, the protective measures were truly protective for adults, decreasing the occurrence of severe acute illnesses and injuries. It remains to be solved how, in future pandemics, children could be protected from the negative impacts of measures designed to protect adults.

To protect the EMS and ED personnel from infections, and to optimise the use of critical resources, it would be crucial to be able to recognise children with probable or possible COVID-19. We found that calibration still needs to be done – in about half of the patients where EMS personnel suspected COVID-19, no COVID-19 tests were performed at the ED. On the other hand, only 41 of the 1261 patients in whom EMS

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personnel did not suspect COVID-19 infections, were tested for COVID-19 with one positive result. This implies that more explicit instructions for EMS personnel are needed (24).

Our study has several limitations. First, it is a single-centre study. Second, because of the rapid advance of the COVID-19 pandemic, this study is retrospective. We tried to address the lack of historic references and the question about possible pre-existing seasonal variation by comparing the data to equivalent periods of three previous years. Finally, mortality is such a rare event that no statistical conclusions can be drawn based on our data. However, we believe that this finding needs to be disclosed.

The pandemic created exceptional circumstances with rapid changes in the behaviour of families with children and the functionality of emergency healthcare. During recent pandemics, e.g. the H1N1 influenza in 2009, school closure and social distancing measures were never extended to children in a similar way (25). In our area, the setting was particularly interesting, as the prevalence of COVID-19 in the population remained low throughout the epidemic (14). Thus, our results may be generalisable to other similar situations of unexpected quick changes in the healthcare.

CONCLUSIONS

The total number of contacts decreased rapidly during the COVID-19 pandemic. Also, the children encountered by the EMS were more seriously ill, and we registered a noteworthy number of prehospital deaths compared to the control periods. Our results highlight the need to consider secondary effects of the pandemic and the control measures also on other populations than those originally targeted.

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A competing interests statement:

Authors do not have competing interests.

Contributions:

JO, HS, MaK, HHR conceptualised and designed the study, carried out the initial analyses, drafted the initial manuscript, and reviewed and revised the manuscript. JO, HS, HHR and JP collected the data. JP and MiK participated in the design of the study, reviewed the initial data collection and initial analyses, and critically reviewed and revised the manuscript. ML designed the data analysis instruments, coordinated and supervised data analysis, and critically reviewed the manuscript. All authors approved the final manuscript as submitted and agreed to be accountable for all aspects of the work.

Any checklist and flow diagram for the appropriate reporting statement,

STROBE, please see Supplementary Materials.

Patient consent form:

Not applicable.

Data availability statement:

Data are available upon reasonable request.

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FIGURE LEGENDS:

Figure 1: Basic information on paediatric EMS contacts in 2020 compared to equivalent periods in 2017-2019.

a) A number of weekly EMS contacts

b) A timeline of the course of the first pandemic wave and number of weekly EMS contacts.

1. World Health Organization declared the pandemic, 11 March 2020
2. Public social gatherings were limited to a maximum of 500 participants, 15 March 2020
3. The government announced the state of emergency, 16 March 2020
4. National restrictions and social distancing launched. Schools closed, 18 March 2020
5. Launching strict national border control, 19 March 2020
6. Isolation of Southern Finland started, 28, March 2020
7. Isolation of Southern Finland ended, 15 April 2020
8. Schools reopened, 14 May 2020

EMS = Emergency Medical Services

ORCID ID

Jelena Oulasvirta https://orcid.org/0000-0001-6750-4615

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Table 1. Change in the dispatch and transportation codes.

		Mean 2017-2019	2020	change	P-value
All EMS contacts	all n (%)	1794.3 (100.0%)	1368 (100.0%)		
	n per week median (IQR)	137.7 (130.7 - 142.0)	91.0 (86.0 - 132.0)	-30.4% (-36.6% - -12.8%)	**0,003**
Dispatch priority A*	all n (%)	55.3 (3.1%)	90 (6.6%)		
	n per week median (IQR)	3.7 (3.3 - 3.7)	8.0 (7.0 - 8.0)	90.9% (36.4% - 140.0%)	**0,031**
	% per week median (IQR)	2.7% (2.4% - 2.8%)	6.1% (5.7% - 8.4%)	139.9% (116.7 - 175.9%)	**0,001**
Dispatch priority B*	all n (%)	690.7 (38.5%)	478 (34.9%)		
	n per week median (IQR)	51.7 (50.3 - 55.7)	37.0 (30.0 - 43.0)	-29.0% (-42.3% - -20.7%)	**0,002**
	% per week median (IQR)	38.2% (36.7% - 40.5%)	36.1% (31.5% - 38.1%)	-8.7% (-15.9 - -2.3%)	**0,027**
Dispatch priority C*	all n (%)	932.7 (52.0%)	658 (48.1%)		
	n per week median (IQR)	71.3 (67.3 - 74.0)	44.0 (43.0 - 57.0)	-34.7% (-41.8% - -23.3%)	**0,001**
	% per week median (IQR)	52.1% (50.5% - 53.7%)	49.4% (45.7% - 51.4%)	-6.7% (-9.1 - -4.1%)	**0,048**
Dispatch priority D*	all n (%)	115.7 (6.4%)	143 (10.4%)		
	n per week median (IQR)	8.3 (7.3 - 11.0)	10.0 (8.0 - 12.0)	12.5% (-11.8% - 60.0%)	0,235
	% per week median (IQR)	6.5% (5.2% - 7.9%)	9.5% (8.1% - 11.4%)	65.0% (38.9 - 83.6%)	**0,001**
Transported patients	all n (%)	927.3 (51.7%)	578 (42.3%)		
	n per week median (IQR)	73.0 (67.0 - 74.7)	36.0 (34.0 - 54.0)	-49.1% (-52.0% - -27.7%)	**0,002**
	% per week median (IQR)	52.2% (51.4% - 52.9%)	41.9% (39.1% - 44.8%)	-19.5% (-27.0 - -13.4%)	**<0,001**
Transportation priority A*	all n (%)	12.3 (0.7%)	6 (0.4%)		
	n per week median (IQR)	1.0 (0.8 - 1.0)	1.0 (1.0 - 1.0)	50.0% (0.0% - 50.0%)	0,174
	% per week median (IQR)	0.7% (0.5% - 0.8%)	1.2% (0.9% - 1.2%)	107.2% (52.4 - 381.5%)	**0,031**
Transportation priority B*	all n (%)	92.3 (5.1%)	62 (4.5%)		
	n per week median (IQR)	7.0 (5.3 - 8.0)	5.0 (3.0 - 5.0)	-34.8% (-51.6% - -28.6%)	**0,004**
	% per week median (IQR)	5.4% (4.4% - 5.6%)	5.0% (3.5% - 5.7%)	-15.0% (-31.8 - 4.0%)	0,168
Transportation priority C*	all n (%)	602.0 (33.6%)	398 (29.2%)		
	n per week median (IQR)	45.3 (43.0 - 48.3)	25.0 (22.0 - 41.0)	-40.0% (-48.4% - -11.0%)	**<0,001**
	% per week median (IQR)	33.2% (31.9% - 34.5%)	29.1% (25.6% - 31.2%)	-8.8% (-24.2 - -2.0%)	**0,005**
Transportation priority D*	all n (%)	220.3 (12.3%)	113 (8.3%)		
	n per week median (IQR)	16.3 (15.0 - 18.0)	7.0 (6.0 - 9.0)	-60.9% (-63.3% - -45.0%)	**0,002**
	% per week median (IQR)	11.8% (11.6% - 13.0%)	7.4% (6.6% - 8.6%)	-37.7% (-46.2 - -27.2%)	**0,001**
Trauma patients	all n (%)	606.0 (33.8%)	504 (36.8%)		
	n per week median (IQR)	45.3 (39.0 - 51.3)	36.0 (31.0 - 41.0)	-11.9% (-24.5% - -9.6%)	**0,011**
	% per week median (IQR)	32.7% (29.6% - 37.1%)	39.0% (33.3% - 41.7%)	23.7% (-7.1 - 28.1%)	**0,048**
Non-transported patients	all n (%)	866.0 (48.3%)	786 (57.6%)		
	n per week median (IQR)	66.3 (64.0 - 68.3)	56.0 (50.0 - 68.0)	-7.8% (-26.8% - 0.0%)	**0,108**
	% per week median (IQR)	47.8% (47.1% - 48.7%)	58.1% (55.2% - 60.9%)	21.1% (15.0 - 28.4%)	**<0,001**

* the priority class from A to D refers to the urgency of the dispatch /transportation and /or to the risk of the symptom to a patient – A being the contact with highest urgency and risk and D the lowest urgency and risk

EMS = Emergency Medical Services

IQR = Interquartile Range

Table 2. Change in the additional units requested and interventions performed on-scene

		Mean 2017-2019	2020	change	P-value
additional help requested	all n (%)	86.7 (4.8%)	94 (6.9%)		
	n per week median (IQR)	6.3 (5.3 - 7.7)	7.0 (5.0 - 9.0)	23.5% (-29.4% - 31.3%)	0,529
	% per week median (IQR)	4.6% (4.0% - 5.6%)	6.8% (4.5% - 8.5%)	43.3% (0.7 - 117.7%)	**0,040**
MICU on-scene	all n (%)	26.0 (1.4%)	24 (1.8%)		
	n per week median (IQR)	1.7 (1.3 - 2.3)	2.0 (2.0 - 2.8)	0.0% (-13.2% - 50.0%)	0,435
	% per week median (IQR)	1.3% (0.9% - 1.7%)	2.3% (1.4% - 2.5%)	46.3% (-1.4 - 100.5%)	**0,049**
emergency physician consulted by phone	all n (%)	291.3 (16.2%)	236 (17.2%)		
	n per week median (IQR)	21.7 (21.3 - 23.0)	18.0 (15.0 - 20.0)	-28.4% (-36.3% - -1.7%)	**0,023**
	% per week median (IQR)	16.1% (15.3% - 17.1%)	17.6% (15.6% - 18.1%)	2.7% (-4.6 - 19.6%)	0,588
any measurements done on-scene	all n (%)	1693.0 (94.4%)	1280 (93.5%)		
	n per week median (IQR)	129.0 (124.0 - 134.3)	88.0 (78.0 - 124.0)	-29.0% (-37.6% - -12.3%)	**0,001**
	% per week median (IQR)	94.6% (94.0% - 94.9%)	93.9% (91.9% - 95.3%)	-0.0% (-2.2 - 1.6%)	0,455
intubation*	all n (%)	2.0 (0.1%)	3 (0.2%)		
	n per week median (IQR)	0.3 (0.3 - 0.3)	1.5 (1.2 - 1.8)		
	% per week median (IQR)	0.2% (0.1% - 0.2%)	1.3% (1.2% - 1.3%)		
supplementary oxygen given	all n (%)	41.7 (2.3%)	16 (1.2%)		
	n per week median (IQR)	3.0 (2.3 - 3.7)	2.0 (1.0 - 2.2)	-39.4% (-51.8% - 12.5%)	0,306
	% per week median (IQR)	1.9% (1.7% - 2.5%)	1.5% (1.2% - 2.4%)	-19.3% (-33.8 - 17.2%)	0,742
intravenous connection established	all n (%)	133.3 (7.4%)	65 (4.7%)		
	n per week median (IQR)	10.7 (8.3 - 12.3)	5.0 (3.0 - 7.0)	-52.6% (-70.7% - -30.8%)	**0,003**
	% per week median (IQR)	7.6% (5.9% - 9.0%)	4.4% (2.9% - 5.8%)	-32.5% (-56.8 - -24.9%)	**0,008**
any medication given	all n (%)	195.0 (10.9%)	111 (8.1%)		
	n per week median (IQR)	14.3 (12.3 - 15.3)	7.0 (6.0 - 9.0)	-44.7% (-63.6% - -37.9%)	**0,001**
	% per week median (IQR)	10.3% (8.9% - 11.9%)	7.6% (6.6% - 9.1%)	-35.3% (-44.2 - -12.9%)	**0,013**

* not enough data for calculating difference in intubation rates

** invasive means any intravenous or intranasal or intramuscular or intraosseal medication given

MICU = mobile intensive care unit

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Supplementary Materials:

1. Statistics on EMS contacts
2. A flow-chart of EMS contacts in 2020 and possible suspicion of COVID-19 infection

   EMS = Emergency Medical Services

   ED = Emergency Department

   resp infection = respiratory infection
3. A Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cohort studies

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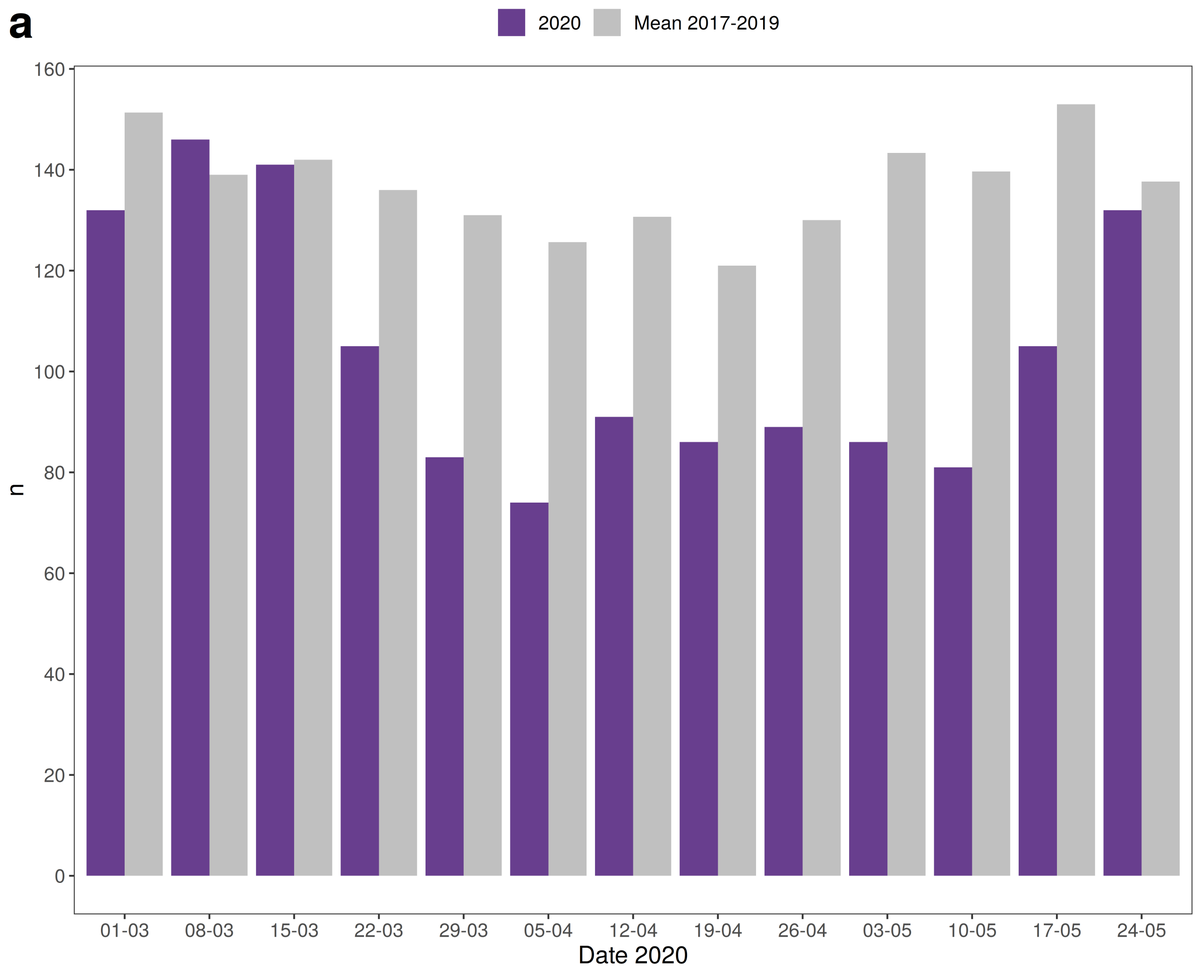
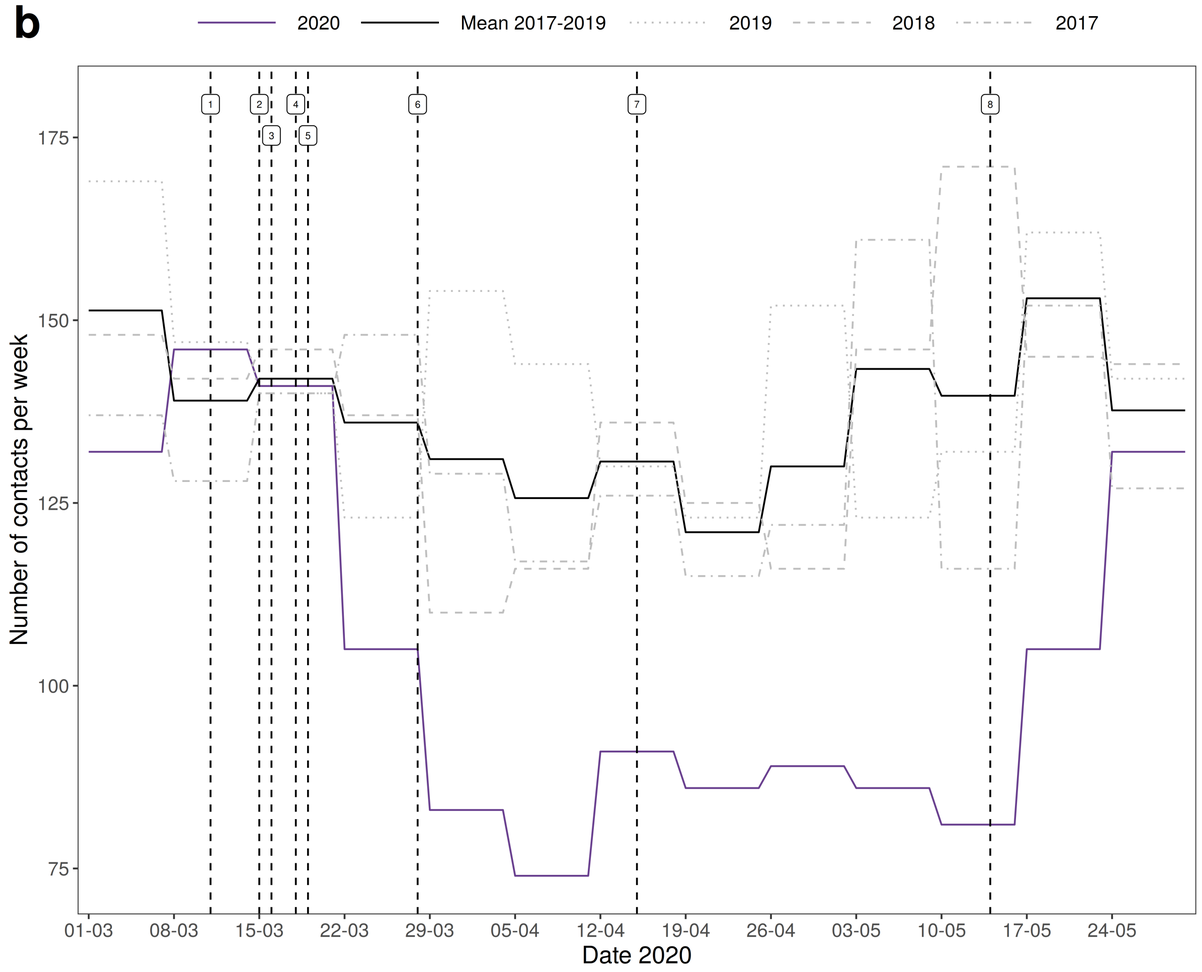

a
2020
Mean 2017-2019
n
160
140
120
100
80
60
40
20
0
01-03
08-03
15-03
22-03
29-03
05-04
12-04
19-04
26-04
03-05
10-05
17-05
24-05
Date 2020


b
2020
Mean 2017-2019
2019
2018
2017
1
2
3
4
5
6
7
8
Number of contacts per week
175
150
125
100
75
01-03
08-03
15-03
22-03
29-03
05-04
12-04
19-04
26-04
03-05
10-05
17-05
24-05
Date 2020

Supplementary Material 1: Supplementary statistics

Supplementary Table 1. Descriptive statistics.

		2017	2018	2019	2020
Age (years)		6.4 (2.0 - 13.2)	6.5 (1.9 - 12.6)	6.3 (2.1 - 12.5)	5.3 (1.8 - 12.0)
Sex (male)	all n (%)	915 (53.2%)	980 (54.6%)	1001 (54.1%)	753 (55.1%)
	n per week median (IQR)	67.0 (61.0 - 82.0)	75.0 (65.0 - 80.0)	76.0 (71.0 - 80.0)	53.0 (48.0 - 70.0)
	% per week median (IQR)	55.3% (51.7% - 55.6%)	55.2% (53.7% - 56.1%)	52.3% (51.8% - 58.3%)	54.3% (52.7% - 56.2%)
Native language (Finnish or Swedish)	all n (%)	1327 (81.8%)	1310 (77.7%)	1377 (79.1%)	991 (74.7%)
	n per week median (IQR)	104.0 (91.0 - 109.0)	104.0 (91.0 - 106.0)	102.0 (95.0 - 110.0)	69.0 (66.0 - 91.0)
	% per week median (IQR)	82.6% (78.8% - 84.8%)	77.5% (76.3% - 79.1%)	79.7% (76.8% - 80.7%)	72.8% (71.8% - 78.4%)

IQR = Interquartile Range

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Supplementary Table 2. The number of EMS contacts during the control periods for each month and their proportions (%) of all control-period EMS contacts. The Chi-squared test was used to calculate the significance of the variation within the control periods.

Year	March	April	June	p
2017	602 (11%)	516 (10%)	606 (11%)	0,10
2018	621 (12%)	524 (10%)	656 (12%)	
2019	643 (12%)	606 (11%)	609 (11%)	

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Supplementary Table 3. Change in the dispatch and transportation codes.

		2017	2018	2019	2020
All EMS contacts	all n (%)	1724 (100.0%)	1801 (100.0%)	1858 (100.0%)	1369 (100.0%)
	n per week median (IQR)	128.0 (122.0 - 140.0)	142.0 (125.0 - 146.0)	142.0 (130.0 - 152.0)	91.0 (86.0 - 132.0)
Dispatch priority A*	all n (%)	42 (2.4%)	43 (2.4%)	81 (4.4%)	90 (6.6%)
	n per week median (IQR)	3.0 (2.0 - 4.0)	3.0 (2.0 - 4.0)	5.0 (2.0 - 5.0)	8.0 (7.0 - 8.0)
	% per week median (IQR)	2.3% (1.6% - 2.6%)	2.1% (1.6% - 2.9%)	3.3% (1.6% - 4.1%)	6.1% (5.7% - 8.4%)
Dispatch priority B*	all n (%)	693 (40.2%)	677 (37.6%)	702 (37.8%)	478 (34.9%)
	n per week median (IQR)	53.0 (47.0 - 58.0)	49.0 (46.0 - 53.0)	53.0 (46.0 - 59.0)	37.0 (30.0 - 43.0)
	% per week median (IQR)	38.8% (37.3% - 42.3%)	39.0% (32.4% - 40.4%)	38.7% (34.4% - 40.7%)	36.1% (31.5% - 38.1%)
Dispatch priority C*	all n (%)	882 (51.2%)	969 (53.8%)	947 (51.0%)	658 (48.1%)
	n per week median (IQR)	65.0 (63.0 - 70.0)	74.0 (69.0 - 86.0)	72.0 (69.0 - 80.0)	44.0 (43.0 - 57.0)
	% per week median (IQR)	52.1% (50.4% - 54.3%)	54.0% (51.7% - 56.0%)	52.0% (47.3% - 56.9%)	49.4% (45.7% - 51.4%)
Dispatch priority D*	all n (%)	107 (6.2%)	112 (6.2%)	128 (6.9%)	143 (10.4%)
	n per week median (IQR)	7.0 (7.0 - 10.0)	8.0 (7.0 - 10.0)	10.0 (7.0 - 13.0)	10.0 (8.0 - 12.0)
	% per week median (IQR)	5.7% (4.8% - 7.1%)	5.8% (4.7% - 7.3%)	5.9% (5.6% - 8.8%)	9.5% (8.1% - 11.4%)
Transported patients	all n (%)	902 (52.4%)	930 (51.6%)	950 (51.2%)	578 (42.3%)
	n per week median (IQR)	67.0 (64.0 - 71.0)	74.0 (65.0 - 79.0)	71.0 (65.0 - 78.0)	36.0 (34.0 - 54.0)
	% per week median (IQR)	51.8% (50.0% - 55.7%)	50.9% (48.0% - 55.6%)	52.5% (48.5% - 53.8%)	41.9% (39.1% - 44.8%)
Transportation priority A*	all n (%)	8 (0.5%)	15 (0.8%)	14 (0.8%)	6 (0.4%)
	n per week median (IQR)	1.0 (1.0 - 1.8)	1.0 (1.0 - 2.0)	1.0 (1.0 - 2.0)	1.0 (1.0 - 1.0)
	% per week median (IQR)	0.9% (0.8% - 1.2%)	0.8% (0.7% - 1.4%)	0.8% (0.7% - 1.3%)	1.2% (0.9% - 1.2%)
Transportation priority B*	all n (%)	89 (5.2%)	84 (4.7%)	104 (5.6%)	62 (4.5%)
	n per week median (IQR)	6.0 (5.0 - 8.0)	7.0 (4.0 - 8.0)	8.0 (5.0 - 11.0)	5.0 (3.0 - 5.0)
	% per week median (IQR)	4.7% (3.9% - 5.7%)	5.1% (3.4% - 5.5%)	6.4% (3.4% - 6.6%)	5.0% (3.5% - 5.7%)
Transportation priority C*	all n (%)	587 (34.1%)	601 (33.4%)	618 (33.3%)	398 (29.2%)
	n per week median (IQR)	44.0 (40.0 - 47.0)	47.0 (42.0 - 50.0)	45.0 (41.0 - 50.0)	25.0 (22.0 - 41.0)
	% per week median (IQR)	33.3% (32.0% - 36.6%)	34.2% (30.4% - 37.1%)	33.3% (29.6% - 35.1%)	29.1% (25.6% - 31.2%)
Transportation priority D*	all n (%)	218 (12.7%)	230 (12.8%)	213 (11.5%)	113 (8.3%)
	n per week median (IQR)	15.0 (13.0 - 20.0)	17.0 (14.0 - 21.0)	15.0 (14.0 - 19.0)	7.0 (6.0 - 9.0)
	% per week median (IQR)	13.0% (10.3% - 14.6%)	12.9% (11.7% - 14.4%)	11.3% (9.9% - 13.2%)	7.4% (6.6% - 8.6%)
Trauma patients	all n (%)	605 (35.1%)	564 (31.3%)	649 (34.9%)	504 (36.8%)
	n per week median (IQR)	42.0 (40.0 - 50.0)	41.0 (33.0 - 48.0)	50.0 (40.0 - 56.0)	36.0 (31.0 - 41.0)
	% per week median (IQR)	33.8% (30.5% - 38.1%)	28.4% (25.5% - 32.9%)	34.0% (29.3% - 40.7%)	39.0% (33.3% - 41.7%)
Non-transported patients	all n (%)	820 (47.6%)	871 (48.4%)	907 (48.9%)	786 (57.6%)
	n per week median (IQR)	64.0 (58.0 - 70.0)	63.0 (61.0 - 72.0)	68.0 (63.0 - 78.0)	56.0 (50.0 - 68.0)
	% per week median (IQR)	48.2% (44.3% - 50.0%)	49.1% (44.4% - 52.0%)	47.5% (46.4% - 51.5%)	58.1% (55.2% - 60.9%)

* the priority class from A to D referres to the urgency of the dispatch /transportation and /or to the risk of the symptom to a patient – A being the contact with highest urgency and risk and D the lowest urgency and risk

EMS = Emergency Medical Services

IQR = Interquartile Range

Supplementary Table 4. Change in the interventions performed on-scene

		2017	2018	2019	2020
additional help requested	all n (%)	81 (4.7%)	74 (4.1%)	105 (5.7%)	94 (6.9%)
	n per week median (IQR)	6.0 (5.0 - 6.0)	5.0 (3.0 - 8.0)	7.0 (5.0 - 7.0)	7.0 (5.0 - 9.0)
	% per week median (IQR)	4.1% (3.9% - 4.7%)	3.4% (2.6% - 4.9%)	4.5% (4.1% - 5.4%)	6.8% (4.5% - 8.5%)
MICU on-scene	all n (%)	25 (1.5%)	23 (1.3%)	30 (1.6%)	24 (1.8%)
	n per week median (IQR)	2.0 (1.8 - 2.2)	2.0 (1.5 - 2.0)	2.0 (1.5 - 3.5)	2.0 (2.0 - 2.8)
	% per week median (IQR)	1.6% (1.2% - 1.9%)	1.4% (1.0% - 1.7%)	1.6% (1.1% - 2.6%)	2.3% (1.4% - 2.5%)
emergency physician consulted by phone	all n (%)	308 (17.9%)	261 (14.5%)	305 (16.4%)	236 (17.2%)
	n per week median (IQR)	23.0 (22.0 - 27.0)	20.0 (18.0 - 23.0)	23.0 (21.0 - 25.0)	18.0 (15.0 - 20.0)
	% per week median (IQR)	17.9% (16.8% - 20.0%)	15.4% (11.6% - 17.6%)	16.0% (14.3% - 18.5%)	17.6% (15.6% - 18.1%)
any measurements done on-scene	all n (%)	1615 (93.7%)	1695 (94.1%)	1769 (95.2%)	1280 (93.5%)
	n per week median (IQR)	120.0 (116.0 - 130.0)	131.0 (112.0 - 141.0)	135.0 (121.0 - 144.0)	88.0 (78.0 - 124.0)
	% per week median (IQR)	93.0% (92.2% - 94.9%)	94.9% (93.0% - 95.5%)	95.7% (93.8% - 96.3%)	93.9% (91.9% - 95.3%)
intubation*	all n (%)	2 (0.1%)	3 (0.2%)	1 (0.1%)	3 (0.2%)
	n per week median (IQR)	1.0 (1.0 - 1.0)	1.0 (1.0 - 1.0)	1.0 (1.0 - 1.0)	1.5 (1.2 - 1.8)
	% per week median (IQR)	0.8% (0.8% - 0.8%)	0.7% (0.7% - 0.7%)	0.6% (0.6% - 0.6%)	1.3% (1.2% - 1.3%)
supplementary oxygen given	all n (%)	38 (2.2%)	47 (2.6%)	40 (2.2%)	16 (1.2%)
	n per week median (IQR)	3.0 (2.0 - 4.0)	3.0 (2.0 - 5.0)	3.0 (2.0 - 4.5)	2.0 (1.0 - 2.2)
	% per week median (IQR)	2.4% (1.6% - 2.8%)	2.2% (1.7% - 3.6%)	2.4% (1.3% - 3.0%)	1.5% (1.2% - 2.4%)
intravenous connection established	all n (%)	128 (7.4%)	123 (6.8%)	149 (8.0%)	65 (4.7%)
	n per week median (IQR)	10.0 (8.0 - 11.0)	9.0 (7.0 - 11.0)	10.0 (10.0 - 14.0)	5.0 (3.0 - 7.0)
	% per week median (IQR)	8.5% (5.6% - 8.7%)	6.4% (5.8% - 7.5%)	8.0% (6.5% - 8.9%)	4.4% (2.9% - 5.8%)
any medication given	all n (%)	170 (9.9%)	206 (11.4%)	209 (11.2%)	111 (8.1%)
	n per week median (IQR)	14.0 (12.0 - 15.0)	14.0 (14.0 - 18.0)	15.0 (13.0 - 18.0)	7.0 (6.0 - 9.0)
	% per week median (IQR)	10.4% (8.8% - 12.1%)	10.3% (9.6% - 12.5%)	10.7% (9.0% - 13.1%)	7.6% (6.6% - 9.1%)

* not enough data for calculating difference in intubation rates

** invasive means any intravenous or intranasal or intramuscular or intraosseal medication given

MICU = mobile intensive care unit

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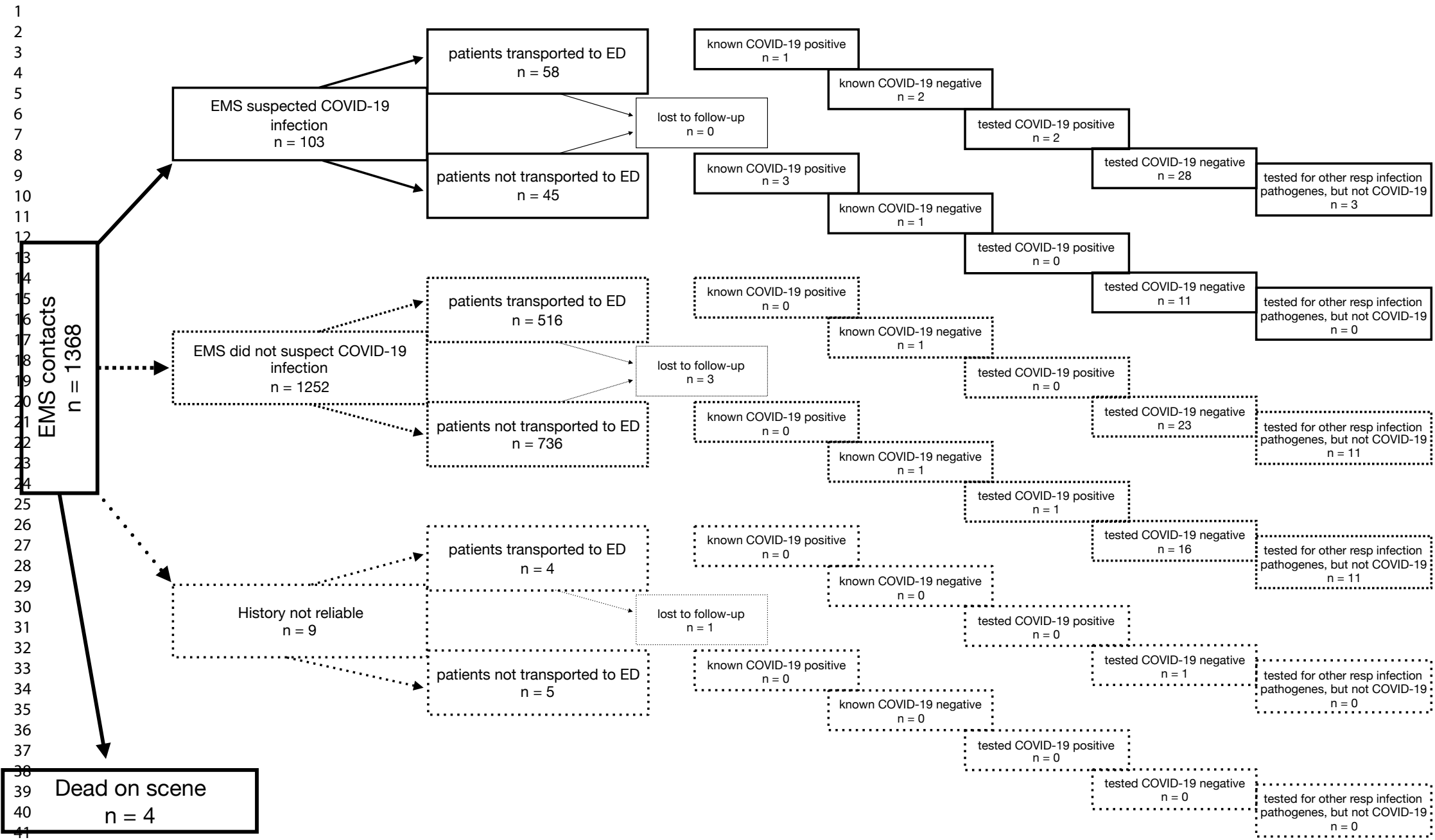
EMS contacts
n = 1368
EMS suspected COVID-19 infection
n = 103
patients transported to ED
n = 58
lost to follow-up
n = 0
patients not transported to ED
n = 45
known COVID-19 positive
n = 1
known COVID-19 negative
n = 2
tested COVID-19 positive
n = 2
tested COVID-19 negative
n = 28
tested for other resp infection pathogenes, but not COVID-19
n = 3
known COVID-19 positive
n = 3
known COVID-19 negative
n = 1
tested COVID-19 positive
n = 0
tested COVID-19 negative
n = 11
tested for other resp infection pathogenes, but not COVID-19
n = 0
EMS did not suspect COVID-19 infection
n = 1252
patients transported to ED
n = 516
lost to follow-up
n = 3
patients not transported to ED
n = 736
known COVID-19 positive
n = 0
known COVID-19 negative
n = 1
tested COVID-19 positive
n = 0
tested COVID-19 negative
n = 23
tested for other resp infection pathogenes, but not COVID-19
n = 11
known COVID-19 positive
n = 0
known COVID-19 negative
n = 1
tested COVID-19 positive
n = 1
tested COVID-19 negative
n = 16
tested for other resp infection pathogenes, but not COVID-19
n = 11
History not reliable
n = 9
patients transported to ED
n = 4
lost to follow-up
n = 1
patients not transported to ED
n = 5
known COVID-19 positive
n = 0
known COVID-19 negative
n = 0
tested COVID-19 positive
n = 0
tested COVID-19 negative
n = 1
tested for other resp infection pathogenes, but not COVID-19
n = 0
known COVID-19 positive
n = 0
known COVID-19 negative
n = 0
tested COVID-19 positive
n = 0
tested COVID-19 negative
n = 0
tested for other resp infection pathogenes, but not COVID-19
n = 0
Dead on scene
n = 4

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	#1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	#4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	#5
Objectives	3	State specific objectives, including any prespecified hypotheses	#5
Methods			
Study design	4	Present key elements of study design early in the paper	#5-#8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	#6-#8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	#6-#8
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	n/a
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	#6-#8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	#6-#8
Bias	9	Describe any efforts to address potential sources of bias	#5, #15
Study size	10	Explain how the study size was arrived at	#6-#8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	#7-#8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	#7-#8
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	n/a
		(*d*) If applicable, explain how loss to follow-up was addressed	Supplementary Material 2
		(*e*) Describe any sensitivity analyses	n/a

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Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Supplementary Material 1 and 2
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	Supplementary Material 2
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Supplementary Material 1
		(b) Indicate number of participants with missing data for each variable of interest	Supplementary Material 2
		(c) Summarise follow-up time (eg, average and total amount)	Figure 1, Supplementary Material 1,2
Outcome data	15*	Report numbers of outcome events or summary measures over time	Table 1-3, Supplementary Material 1
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Table 1,2, Supplementary Material 1
		(*b*) Report category boundaries when continuous variables were categorized	n/a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Supplementary Material 1
Discussion			
Key results	18	Summarise key results with reference to study objectives	#11
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	#11-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	#14-15
Other information			

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Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	#16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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