

Covid-19 Related Reduction in Paediatric Emergency Healthcare Utilization – A Concerning Trend

Christine Happle (✉ happle.christine@mh-hannover.de)

Medizinische Hochschule Hannover Zentrum für Kinderheilkunde und Jugendmedizin

Christian Dopfer

Medizinische Hochschule Hannover Zentrum für Kinderheilkunde und Jugendmedizin

med Wetzke

Medizinische Hochschule Hannover Zentrum für Kinderheilkunde und Jugendmedizin

Anna Zychlinsky Scharff

Medizinische Hochschule Hannover Zentrum für Kinderheilkunde und Jugendmedizin

Frank Mueller

Universitätsklinikum Göttingen

Frank Dressler

Medizinische Hochschule Hannover Zentrum für Kinderheilkunde und Jugendmedizin

Ulrich Baumann

Medizinische Hochschule Hannover Zentrum für Kinderheilkunde und Jugendmedizin

Michael Sasse

Medizinische Hochschule Hannover Zentrum für Kinderheilkunde und Jugendmedizin

Gesine Hansen

Medizinische Hochschule Hannover Zentrum für Kinderheilkunde und Jugendmedizin

Alexandra Jablonka

Medizinische Hochschule Hannover

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Abstract

Background: The COVID-19 pandemic has disrupted healthcare systems worldwide. Besides the direct impact of the virus on morbidity and mortality of patients, the effect of lockdown strategies on health and healthcare utilization become more and more apparent. Little is known on the effect of the pandemic on pediatric healthcare utilization. We examined the impact of the pandemic on pediatric emergency healthcare.

Methods: We conducted a monocentric, retrospective analysis of $n=5.424$ pediatric emergency visits between January 1st and April 19th of 2019 and 2020, and compared healthcare utilization in the month post lockdown 2020 to the same period in 2019.

Results: In the four weeks after lockdown in Germany began, we observed a massive drop of 63.8% in pediatric emergency healthcare utilization (mean daily visits $26.8 \pm \text{SEM } 1.5$ in 2019 vs. $9.7 \pm \text{SEM } 1$ in 2020, $p < 0.005$). This drop in cases occurred for both communicable and non-communicable diseases. A larger proportion of patients under one year old (daily mean of $16.6\% \pm \text{SEM } 1.4$ in 2019 vs $23.1\% \pm \text{SEM } 1.7$, $p < 0.01$ in 2020) and of cases requiring hospitalisation (mean of $13.9\% \pm \text{SEM } 1.6$ in 2019 vs. $26.6\% \pm \text{SEM } 3.3$ in 2020, $p < 0.001$) occurred during the pandemic. During the analysed time periods, few intensive care admissions and no fatalities occurred.

Conclusion: Our data illustrate a significant decrease in pediatric emergency room visits during the COVID-19 pandemic. Public outreach is needed to encourage parents to seek medical attention for pediatric emergencies in spite of the pandemic.

Background

The novel severe acute respiratory syndrome coronavirus (SARS-CoV-2) causing acute respiratory disease known as coronavirus disease 19 (COVID-19) first emerged in Wuhan, China in the end of 2019[1]. Despite efforts to contain the virus, COVID-19 cases emerged all over the world, and the WHO declared a public health emergency of international concern on January 30th. On March 11th 2020, the SARS-CoV-2 outbreak was officially designated a pandemic [2].

Globally, nations responded to this pandemic with lockdown strategies including social distancing, school closures and shelter-in-place orders for non-essential workers. At the same time, healthcare systems in Europe and elsewhere prepared for an unprecedented health emergency by reallocating resources to care for COVID-19 patients [3–6]. Public awareness of the pandemic was associated with a vast reduction in healthcare utilization in Italy and other countries [7–10]. As a result, increased adult and pediatric morbidity and mortality due to delayed healthcare utilization were reported [11, 12].

Initially, Germany took a moderate approach, relying largely on the responsibility and solidarity of its citizens. However, school closures were implemented beginning on March 16th, and an official, lockdown of public life, including mandatory closure of all non-essential retailers, was implemented starting on

March 23rd 2020. Severe cases of COVID-19 remained comparatively low in Germany (n = 163.175 confirmed SARS-CoV-2 infections with 6.692 fatalities as of May 4th 2020 [13]), and the healthcare system has thus far been spared an untenable influx of critically ill patients.

In this setting, we investigated pediatric emergency healthcare utilization in our tertiary care center in Hanover, Germany. We compare the rate and type of emergency department (ED) visits after lockdown commenced in March and April of 2020 to the equivalent period in the spring of 2019.

Methods

Study population

This study analysed data from n = 5.424 healthcare visits occurring between January 1st and April 19th 2019 and January 1st and April 19th 2020 in the pediatric ED of Hanover Medical School in Hanover, Lower Saxony. The ED is open to patients 24/7 with full time coverage by a designated nurse and pediatric doctor. During daytime hours, from 8 am to 5 pm Monday through Thursday and 8 am to 4:30 pm on Fridays, a designated pediatric ED physician provides care. Patients presenting to the ED outside these times are seen by pediatric house staff and/or an on-call pediatric hospitalist.

Data collection

All medical and demographic data were extracted from routine electronic records. Every onsite healthcare visit was documented in an electronic case reporting system including the patient's age and sex, date and time of visit, complaints, and suspected or confirmed diagnoses, as well as whether hospitalization was required. Diagnosis or primary complaint was identified for each patient and recorded according to the International Statistical Classification of Diseases and Related Health Problems system (ICD)-10-GM-2020. Communicable disease was defined as either diagnoses classified in group A/B of the (ICD)-10-GM-2020 coding system (communicable diseases) or as organ system specific reporting of an infectious disease. For analyses of suspected infectious diseases, the coding of the following signs and symptoms was included: fever, cough, stridor, dyspnoea, vomiting, and diarrhoea.

Statistical analyses

SPSS version 24.0 and Graphpad Prism version 5.02 were used. Normal distribution of all variables was assessed, and depending on data distribution, group differences were evaluated by Student's T or Mann Whitney U testing. P values below 0.05 were considered significant.

Ethics compliance

The analyses were approved by the Data Security Management and Institutional Review Board of Hannover Medical School.

Results

In total, $n = 5.424$ visits occurred during the analysed period between January 1st and April 19th 2019 and January 1st and April 19th of 2020 in the pediatric ED of our hospital. The mean age of all patients included in this analysis was 7.1 years (\pm SEM 0.1 yrs.), and 49.5% of cases were female. Given the fact that primary pediatric care in Germany is usually provided by pediatric practices during weekdays, more visits to the ED during weekends occurred. Overall, $16.4\% \pm$ SEM 1.5 of visits on Saturday/Sunday as compared to $13.5 \pm$ SEM 0.4 on weekdays occurred. When we compared daily visit frequencies between 2019 and 2020, we observed a striking reduction in the number of patients presenting to the ED after March 16th 2020, the day that school closures and a nationwide lockdown began (Fig. 1A,B).

In calendar weeks 12 to 15 of 2020, case numbers decreased by 63.8% compared the same time period in 2019 (mean $26.8 \pm$ SEM 1.5 visits per day in 2019 vs. mean $9.7 \pm$ SEM 1 in 2020, $p < 0.005$, Fig. 1C). This reduction in emergency healthcare utilization was observed during daytime as well as overnight (mean $10.1 \pm$ SEM 1.5 daily visits during daytime hours in 2019 vs. $3.5 \pm$ SEM 0.6 in 2020, $p < 0.05$, Fig. 1D and mean $16.6 \pm$ SEM 1.9 daily visits outside daytime hours in 2019 vs. mean $5.9 \pm$ SEM 0.8 in 2020, $p < 0.001$, Fig. 1E).

While the mean age of patients did not differ significantly between calendar weeks 12 to 15 in each year (mean age of $5.8 \pm$ SEM 0.2 years in 2019 and mean age of $5.8 \pm$ SEM 0.3 years in 2020) a significant increase in ED visits by infants below the age of one year occurred (mean of $16.6\% \pm$ SEM 1.4 in 2019 vs $23.1\% \pm$ SEM 1.7 in 2020, $p < 0.01$, Fig. 1F). No significant differences in the daily proportion of school children below the age of six years between the two analysed periods was observed (mean of $62\% \pm$ SEM 1.9 in 2019 vs $61.7\% \pm$ SEM 2.9 in 2020), nor did we find a difference in sex distribution (mean daily proportion of female patients $44.9\% \pm$ SEM 1.6 in 2019 vs $42.5\% \pm$ SEM 2.7 in 2020).

Next, we analysed the complaints or diagnoses recorded in the ED in both years. Diagnoses of primary complaints were reported in $n = 5.206$ visits (96%). When tracing the frequency of daily consultations for noncommunicable diseases and of those with confirmed infections or signs thereof (Fig. 2A/B), a clear drop in visits was observed for both disease types.

This was confirmed by a separate analysis comparing the frequency of daily visits for noncommunicable diseases in calendar weeks 12 to 15 of 2019 vs the same period in 2020. Here, a 58% decrease (mean $11.2 \pm$ SEM 0.7 visits per day in 2019 vs. mean $4.7 \pm$ SEM 0.5 visits per day in 2020, $p < 0.005$, Fig. 2C) was observed.

Daily visits for suspected or confirmed communicable diseases displayed a 70.2% decrease in the four weeks after lockdown began (mean $15.1 \pm$ SEM 1.5 visits per day in 2019 vs. mean $4.5 \pm$ SEM 0.5 visits per day in 2020, $p < 0.005$, Fig. 2C). The proportion of daily patients with infectious diseases or signs and symptoms of infection, however, did not differ between calendar weeks 12 to 15 from one year to another (mean daily proportion of $45\% \pm$ SEM 2.9 in 2019 vs. mean $54.5\% \pm$ SEM 3.9 visits per day in 2020, Fig. 2E).

We also investigated the specific complaints leading to pediatric ED visits in the calendar weeks 12 to 15 in 2019 and 2020. In both years, a proportion of diagnoses was either unknown or unspecific (in total 45.6% of diagnoses in 2019 and 32.9% of diagnoses in 2020). For reported diagnoses, the pattern of distribution was similar in both years. This held true even for critically ill patients. For example, three seizures in 2019, and two seizures in 2020 were observed during the four week period we analysed. As shown in Fig. 3A, however, some variation was observed, such as a larger proportion of patients presenting with malignant or neoplastic diseases in 2020 (1.6% 2019 vs. 11.6% in 2020). This change was confirmed by comparing absolute patients numbers (Fig. 3B). The only disease category with increased daily ER visits in after the lockdown began was that of malignant/neoplastic disease (mean of 0.18 visits per day \pm SEM 0.4 in 2019 vs. 0.21 \pm SEM 0.4 in 2020, $p < 0.05$). For the vast majority of noncommunicable diseases, daily visits were reduced (Fig. 2B). For example, complaints or diagnoses affecting the gastrointestinal system showed a decrease of 77.8% (mean of 1.3 visits per day \pm SEM 0.2 in 2019 vs. 0.3 \pm SEM 0.1 in 2020, $p < 0.005$), cases of intoxication or injury showed a 68.8% reduction (mean of 1.1 visits per day \pm SEM 0.2 in 2019 vs. 0.4 \pm SEM 0.1 in 2020, $p < 0.005$), and diagnoses and complaints affecting the eyes or ear were reduced by 89.5% in 2020 compared to 2019 (mean of 0.7 visits per day \pm SEM 0.2 vs. 0.1 \pm SEM 0.1, $p < 0.005$).

Similarly, the proportion of organ specific infectious diseases or signs thereof was analysed for the two time periods. As shown in Fig. 4A, the majority of daily diagnosed infections or typical complaints thereof concerned the respiratory or gastrointestinal tracts. In absolute numbers, presentations due to organ specific infectious disease decreased significantly during calendar weeks 12 to 15 of 2020 as compared to the same period in 2019 (Fig. 4B). Respiratory infections or signs thereof were reduced by 89% (4.9 visits per day \pm SEM 0.5 in 2019 vs. 1.6 \pm SEM 0.3 in 2020, $p < 0.005$), ear and throat infections or signs thereof were reduced by 88.2% (2.5 visits per day \pm SEM 0.4 in 2019 vs. 0.3 \pm SEM 0.1 in 2020, $p < 0.005$), and gastrointestinal infections or signs thereof were reduced by 85% (2.9 visits per day \pm SEM 0.5 in 2019 vs. 0.4 \pm SEM 0.1 in 2020, $p < 0.005$).

Finally, we analysed the rate of hospitalisation in the first month after pandemic-related school closures in 2020 as compared to the same period of time the previous year. Although the absolute rate of daily hospitalisation of pediatric ED patients dropped significantly (38.4% decrease; 4.5 visits per day \pm SEM 0.4 in 2019 vs. 3 \pm SEM 0.3 in 2020, $p < 0.001$, Fig. 1A), the proportion of hospitalisations among all patients presenting to the ED almost doubled in 2020 compared to 2019 (increase of 91%; mean of 13.9% \pm SEM 1.6 in 2019 vs. 26.6% \pm SEM 3.3 in 2020, $p < 0.001$, Fig. 1B). The duration of hospitalisation, however, was not different, neither overall, (mean of 5.5 days \pm SEM 0.6 in 2019 vs. 4.5 \pm SEM 0.3 in 2020, Fig. 1C), nor for particular subgroups such as patients below the age of one year, those with infectious diseases, or those requiring intensive care.

We observed a similar pattern of diagnoses leading to hospitalisation from the ED in both years. Infectious disease, perinatal pathologies, injuries, gastrointestinal issues and neoplastic disease belonged to the most common indications for admission. The largest changes in absolute patient numbers were observed in patients with neoplastic diseases (5.6% in 2019 vs. 14.9% in 2020), those with

pathologies of the perinatal period (22.5% in 2019 vs. 8.1% in 2020) and those with diseases of the heart and circulatory system (5.6% in 2019 vs. 0% in 2020).

During calendar weeks 12 to 15 in 2019, two patients presenting to the ED were admitted to the hospital's pediatric intensive care unit (PICU). No fatalities occurred amongst these patients. In the same four week period in 2020, two patients were admitted from the ED directly to the PICU, and no deaths were observed. Only one case of pediatric COVID-19 was diagnosed during the analysed period.

Discussion

Our data demonstrate a significant decrease in pediatric ED visits during SARS-CoV-2/COVID-19 associated lockdown in Germany. This finding is consistent with other reports on the substantial reduction in healthcare utilization in Europe and elsewhere during the current crisis [9, 10]. Although a pandemic related reduction in primary healthcare utilization for critically ill patients has been reported [7, 8, 11], little is known on the changes in pediatric emergency medicine thus far.

Lazzerini et al. recently reported twelve pediatric cases of delayed treatment due to parental concern of nosocomial COVID-19 infection from a healthcare facility [12]. Tragically, half of patients in this report were admitted to a PICU and four of them died.

We do not know whether the reduction in healthcare utilization in our emergency department in 2020 occurred due to lower morbidity or avoidance of hospital visits associated with the current pandemic. Although we can only speculate on the causes behind this dramatic reduction in case numbers, two main reasons appear to be most relevant.

Firstly, a massive flow of alarming medical information has resulted in high levels of uncertainty and fear across Europe and elsewhere [14]. Although children are less prone to severe courses of COVID-19 [15], the fear of contracting SARS-CoV-2 while visiting a doctor's office or hospital may have affected parental decision making during the early phase of this unprecedented health emergency [12]. In this context, effective public health communication appears to be a key factor, not only in fighting the spread of COVID-19, but in preventing healthcare avoidance for those in need [12, 16]. Currently, limited scientific understanding of the virus and its spread impedes evidence-based guidance for the public, which poses a significant challenge to health communicators worldwide [2]. However, pediatricians should emphasize to parents and young patients that the risks of avoiding hospital care in emergencies may exceed that of contracting SARS-CoV-2. The risk of infection may not be entirely irrational in times of patient overflow, overcrowded waiting areas, and insufficient personal protective equipment for medical staff [16, 17]. But in Germany, where the healthcare system thus far has not been overwhelmed by COVID-19, the risk of nosocomial infection within a hospital setting appears, at least for now, to be low [18]. During the period of time analysed in this study, in spite of extensive testing, only one child tested positive for SARS-CoV-2 in our pediatric emergency department.

The second likely reason for the reduction in ED visits, in particular for infectious diseases, lies in the lockdown strategies themselves. Even before governmental enforcement, many families practised rigorous social distancing. This measure, together with school closures, cancelation of public gatherings and shelter-in-place orders led to a dramatic decrease in the spread of communicable disease. For example, the influenza season came to a sudden and almost complete stop by calendar week 14 of 2020 [19]. This may also affect overall morbidity and mortality in children. While the publication from Italy reporting on pediatric deaths associated with parental fear of seeking emergency healthcare is alarming [12], overall pediatric mortality in Europe appears have dropped during the COVID-19 pandemic [20].

It could also be that parents were not afraid of visiting the ED but rationally chose not to come to the hospital but to rather “watch and wait” their offspring’s symptoms to respect the limited resources of the medical workforce during the current pandemic. In line with this, the increased proportion of hospital admissions among ED in the calendar weeks 12 to 15 of 2020 suggests a particular reduction of non-severe illnesses during lockdown. Also, although absolute case numbers were reduced in 2020, the increased proportion of presentation of infants below the age of one year demonstrates that children at particular risk for severe disease were still brought to the ED despite the pandemic. Fortunately, no fatalities were observed in our analysis. Although an increased rate of daily hospital admissions occurred, we found comparable durations of hospital stay and numbers of ICU admission between 2019 and 2020. This supports the hypothesis that even critically ill patients presented to our ED in time.

The overall low case numbers of severely ill children must to be taken into account when interpreting our data. The prevalence of ICU admissions, as well as of specific severe disease types such as seizures or neonatal sepsis were low in both time periods studied, prohibiting far-reaching conclusions. However, the Northern German Pediatric Intensive Care Network “PIN”, which is headquartered in Hannover and serves as a reference centre for more than 45 pediatric hospitals in Northern Germany, also reported no change in the number or severity of PICU admissions in calendar week 12–15 in 2020 as compared to 2019. Another limitation of our work lies in the fact that, due to the nature of our ED documentation system, in many instances only the primary complaint was recorded, rather than a concrete diagnosis. Furthermore, only the acute reason for presentation was analysed, while many children at our university hospital suffer from underlying, complex chronic conditions. We do not know why more children with neoplastic diseases presented to the ED after lockdown as compared to the same period in time in 2019, and further analyses will address healthcare utilization and complaints in specific subgroups such as chronically ill children during the current crisis.

Thus far, Germany has taken a moderate approach to lockdown strategies with a combination of legal restrictions to shut down public life and an appeal to the responsibility and solidarity of its citizens. The healthcare system, particularly in Northern Germany, was in the fortunate situation of having weeks to adapt and prepare for this unprecedented situation and has been able to provide adequate care to all patients suffering from COVID-19 or any other disease [21, 22].

Conclusions

The current pandemic puts pressure on healthcare systems around the globe. Our data clearly indicate that the COVID-19 outbreak is associated with a significant reduction in pediatric emergency healthcare utilization. Although we did not observe any critical cases due to delayed hospital admission in our analysis, the risk of avoidance or delay of the healthcare provision to critically ill children and adolescents may only become apparent in months and years to come. Germany is still in the fortunate position of having sufficient resources for patient care, but our data suggest that the current pandemic results in a dramatic reduction in the use of emergency medical care for children in our system. This may affect resource-limited healthcare systems to an even greater extent and the may extend beyond pediatric emergency medicine to insufficient healthcare and prevention for children in general. As such, public health communication should aim at minimizing possible pediatric “collateral damage” caused by the COVID-19 pandemic. We hope our analysis helps to adapt healthcare and communication strategies accordingly.

Declarations

Ethics approval and consent to participate

The analyses were approved by the Data Security Management and Institutional Review Board of Hannover Medical School.

Consent for publication

This manuscript does not contain any individual person’s data in any form (not applicable).

Availability of data and materials

The dataset necessary to interpret, replicate and build upon the findings reported in the article will be made available on reasonable request and can be obtained by contacting the corresponding author.

Competing interests

The authors have no competing interests to report.

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Authors` contributions

Research design: Christian Dopfer, Martin Wetzke, Alexandra Jablonka, Christine Happle

Data collection: Routine clinical care.

Data analysis: Christian Dopfer, Martin Wetzke, Alexandra Jablonka, Anna Zychlinsky Scharff, Christine Happle

Writing and contributing to writing of the manuscript: All authors

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Figures

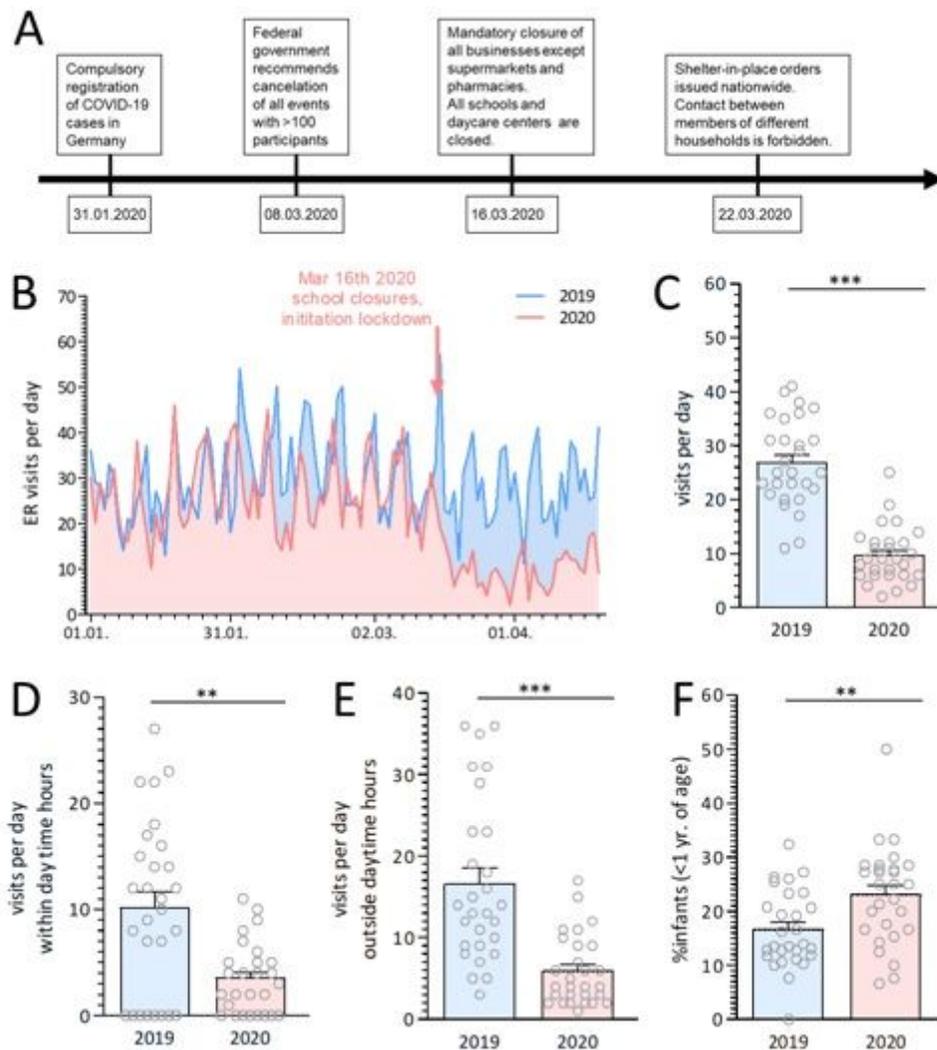


Figure 1

Reduced pediatric emergency healthcare utilization after the implementation of pandemic-related lockdown in Germany: A: scheme illustrating COVID-19 related lock-down strategy and dates in Germany. B: daily number of visits between January 1st and April 19th 2019 (blue) vs. 2020 (red). Arrow indicates Monday 16th (first day of school closures). C: visits per day in calendar weeks 12 to 15, D/E: visits per day within (D) and outside (E) ED daytime service in calendar weeks 12 to 15. F: increased proportion of daily visits of patients younger than one year (bars display mean + SEM (B-E) with overlaying dots representing single daily values, ** $p \leq 0.01$, *** $p \leq 0.005$).

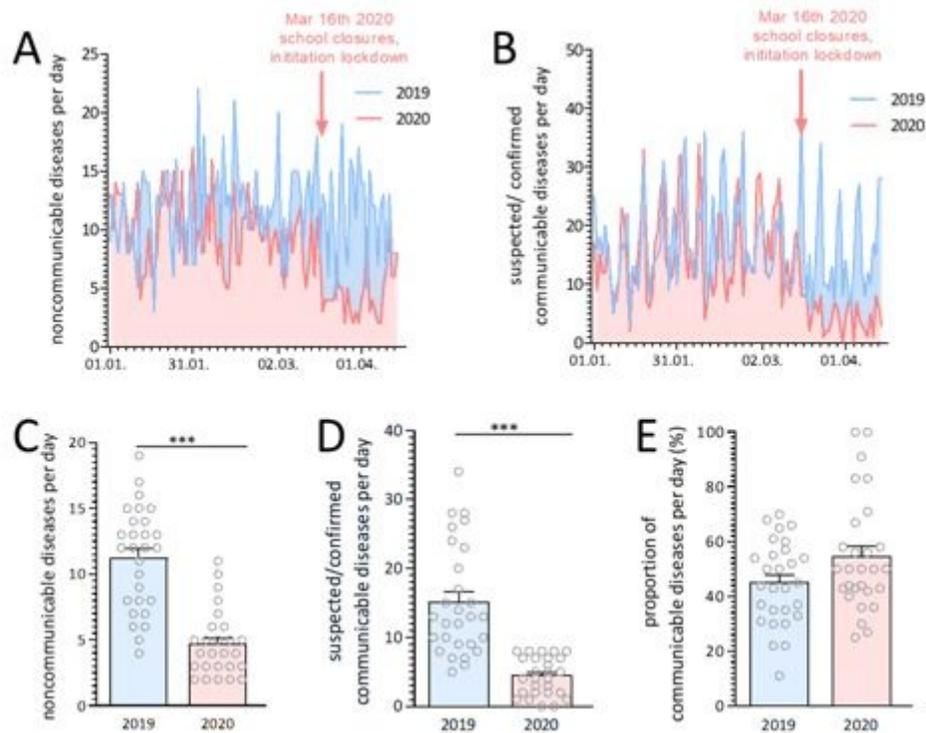


Figure 2

2 ED cases of patients presenting with noncommunicable disease as well as those with infectious disease or signs thereof were significantly reduced during the COVID-19 pandemic. A: daily number of visits between January 1st and April 19th 2019 (blue) vs. 2020 (red) by patients with noncommunicable diseases (A) and infectious diseases or signs thereof (B). C/D: reduced visits per day due to noncommunicable (C) or infectious diseases or typical signs thereof in calendar weeks 12 to 15. E: no change in the proportion of daily visits due to infectious diseases or typical signs thereof (bars display mean + SEM with overlaying dots representing single daily values (C-E), *** $p \leq 0.005$).

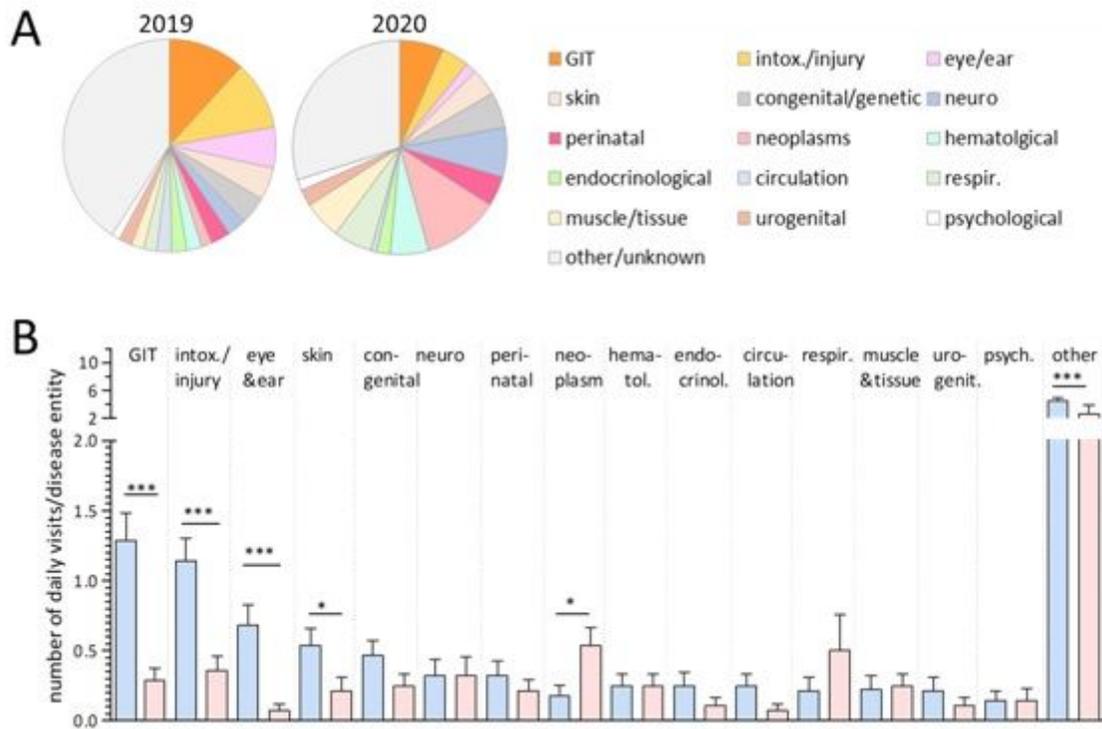


Figure 3

Distribution and frequency of ED presentation due to noncommunicable disease: A: proportion of organ system specific diagnoses in calendar weeks 12 to 15. B: daily number of visits per organ system specific disease entity in calendar weeks 12 to 15 (GIT: diseases/complaints of the gastrointestinal tract, intox.: intoxication, neuro: neurological diseases/complaints, neoplasm: neoplastic/malignant diseases/complaints, hematol.: hematological diseases/complaints, endocrinol.: endocrinological diseases/complaints, respir.: respiratory diseases/complaints, urogen.: urogenital diseases/complaints, psych.: psychiatric diseases/complaints; bars display mean + SEM, * $p \leq 0.05$, ** $p \leq 0.01$, *** 0.005).

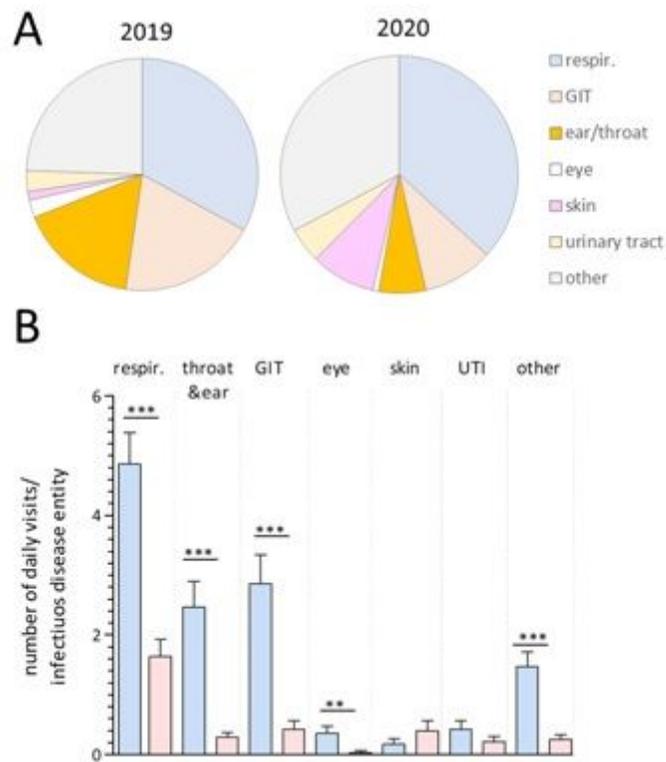


Figure 4

Distribution and frequency of infectious disease after lockdown began: A: proportion of organ system specific diagnoses in calendar weeks 12 to 15. B: daily number of visits per organ system specific disease entity in calendar weeks 12 to 15 (respir.: respiratory infections, GIT: infections of the gastrointestinal tract, UTI.: urinary tract infections; bars display mean + SEM, ** $p \leq 0.01$, *** 0.005).