

Barriers to seeking emergency care during the COVID-19 pandemic may lead to higher morbidity and mortality – a retrospective study from a Swiss university hospital

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Summary

AIMS OF THE STUDY: While COVID-19 significantly overburdens emergency rooms (ERs) and hospitals in affected areas, ERs elsewhere report a marked decrease in patient numbers. This study aimed to investigate the assumption that patients with urgent problems currently avoid the ER.

METHODS: Electronic health records from the ER of a large Swiss university hospital were extracted for three periods: first, the awareness phase (*ap*) from the publication of the national government's initiative "How to protect ourselves" on 1 March 2020 to the lockdown of the country on 16 March; second, the mitigation phase (*mp*) from 16–30 March; finally, patients presenting in March 2019 were used as a control group. We compared parameters including a critical illness as the discharge diagnosis (e.g., myocardial infarction, stroke, sepsis and ER death) using logistic and linear regression, as well as 15-day bootstrapped means and 95% confidence intervals for the control group.

RESULTS: In the three periods, a total of 7143 patients were treated. We found a 24.9% (42.5%) significant decline in the number of patients presenting during the *ap* (*mp*). Patients presenting during the *mp* were more likely to be critically ill. There was an increase of 233% and 367% (*ap* and *mp*, respectively) of ER deaths (none related to COVID-19) compared to the control period. Apart from polytrauma (increase of 5% in the *mp*), all other critical illnesses as discharge diagnosis showed a lower incidence in descriptive analysis. Significantly more patients died in the ER in both the *ap* and *mp*.

CONCLUSIONS: Barriers to seeking emergency care during COVID-19 pandemic may lead to higher morbidity and mortality. Healthcare authorities and hospitals must ensure low barriers to treatment and business as usual for all patients.

Keywords: COVID-19, pandemics, pneumonia/infections, emergency care systems, emergency department utilisation

Introduction

While COVID-19 significantly overburdens emergency rooms (ERs) and hospitals in affected areas [1], ERs elsewhere report a marked decrease in patient numbers [2]. This observation has led to concerns that critically ill patients may seek medical attention either not at all or not in a timely manner [2]. As a result, the largest university hospital in Europe – the Charité Berlin – recently called on heart attack and stroke patients to seek immediate medical assistance if symptoms occur [3]. Our aim was to empirically investigate the assumption that patients with urgent problems currently avoid the ER and to determine which patient groups have the greatest share in the decline in patient numbers, in order to facilitate potential interventions.

Methods

The university hospital ER in Bern, the capital of Switzerland, provided retrospective electronic health records for this exploratory study. In 2019, this ER cared for over 50,000 adult patients across all branches of medicine, excluding paediatric patients, who are treated in a children's hospital close by. Every Swiss citizen has health insurance and may seek ER care when needed. Early in the pandemic, we installed a COVID-19 test centre next to the ER, in which a SARS-CoV-2 nasopharyngeal swab of people in good general condition was performed if test criteria were fulfilled. However, people who needed a physician were treated directly in our ER.

Data were extracted for three periods: first, the *awareness phase* (*ap*) from the publication of the national government initiative "How to protect ourselves" on 1 March 2020 to the lockdown of the country on 16 March; second, the *mitigation phase* (*mp*) from 16–30 March; finally, patients presenting in March 2019 were used as a control group. The mitigation measures introduced in mid-March 2020

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included the closure of schools, restaurants, borders and system irrelevant facilities. Furthermore, the federal government advised the population to stay at home apart from food purchasing and physician consultations.

For all phases, the following data were extracted from the ER's electronic health system (E-Care, ED 2.1.3.0, Turnhout, Belgium): (i) patient characteristics (sex and age) and (ii) consultation characteristics (the triage status, chief complaints, the discharge diagnosis field of the medical ER report in full-text and the discharge procedure [hospitalisation, ER death, discharge]).

Triage status is assessed routinely for all patients by specially trained nurses using the Swiss triage scale [4], including documentation of the chief complaint. Triage categories 1 (life-threatening problem that requires an immediate start of treatment) to 3 (acute problem, start of treatment within 30 minutes) are defined as urgent. Semi-urgent problems (4) should be treated within 2 hours and non-urgent problems (5) may wait longer than 2 hours before further work-up.

The chief complaints were categorised into different groups (see appendix 1).

Specific diagnoses reflecting critical illness, namely cerebrovascular insult (CVI), myocardial infarction, aortic dissection, ileus, sepsis, pulmonary embolism, polytrauma, ER death and return of spontaneous circulation (ROSC) after cardiopulmonary arrest, were determined using a validated full-text diagnosis parser. The parser was validated through comparison of 500 manually coded, randomly selected full-text diagnoses. The inter-rater agreement was assessed using Gwet's AC, the recommended measure to assess low prevalence outcomes [5]. Gwet's AC was >0.9, indicating a "very good" agreement [6].

To overcome the problem of lack of power, a composite outcome *critical illness* was computed, which is defined as the presence of any of the specific diagnoses and no documented ambulant discharge. Missing data were rated as the absence of the variable of interest, such that if a diagnosis was not documented, it was not present. All consultations were treated as independent observations.

Changes in patient numbers over time were illustrated by determining the number of ER consultations per day in the three periods, together with a linear fit.

For each variable, the following measures were obtained: (i) the absolute numbers in the *ap* and *mp*, (ii) an absolute number and accompanying 95% confidence interval (CI) in the control phase through a bootstrap-approach by random selection of 15 days out of all days in March 2019 and recording the numbers in this subset – a procedure we repeated 100 times – to provide an estimate for the magnitude of natural fluctuation, and (iii) the relative risk, the odds of an event in the *ap* or *mp* compared with the control phase (March 2019). The geometric mean ratio (GMR) between the phases was calculated for the continuous outcome age. For all odds ratios (ORs) and GMRs a 95% CI and a p-value was determined. A p-value of <0.05 was considered significant.

The competent ethics committee of the Canton of Berne deemed this study a quality evaluation and exempts from full ethical review (Req-2020-00382).

Results

In the three periods, a total of 7143 patients (*ap* n = 1765; *mp* n = 1293; March 2019 n = 4085) were treated. We found a 24.9% (42.5%) decline in the number of patients presenting during the *ap* (*mp*) compared with the control group (fig. 1), a significant decline ($F = 54.86$, $df = 56$, $r^2 = 0.75$).

Table 1 shows the frequency of the studied variables in the different periods, as well as the relative risks of an event in the *mp* or *ap* compared with the control phase.

Semi-urgent triage was associated and hospital admission negatively associated with the *ap*. The risk of presenting with a respiratory complaint increased in the *ap*. Patients during the *mp* were triaged significantly more urgently, were less likely to present for muscular-skeletal or traumatic chief complaints and more likely to present for respiratory reasons. Patients presenting during the *mp* were more likely to be critically ill and had higher odds of admission after cardiopulmonary resuscitation with ROSC or/and death in the ER.

The absolute number of all specified diagnoses except for ER death and ROSC or ER death in both the *ap* and the *mp* was smaller than the bootstrapped mean of a 15-day control period in March 2019. Most of the absolute numbers in *ap* and *mp* were within the 95% CI of the bootstrapped mean. Significantly fewer patients had ileus as discharge diagnosis in the *ap* and more patients died in the ER in both the *ap* and *mp*. None of the ER deaths, but three of the patients with ROSC after cardiovascular resuscitation, were thought to be due to hypoxaemia possibly related to COVID-19.

The absolute numbers for the studied characteristics in the three phases as well as the relative change in the absolute numbers for the COVID-19 phases compared with the mean of the first and second halves of March 2019 are shown in table S1 in appendix 1. There was an increase of 233% and 367% (*ap* and *mp*, respectively) of ER death, and of 29% and 53% in patients with ROSC or ER death, compared with the control period in 2019. Apart from polytrauma, with an increase of 5% in the *mp* phase, all other critical discharge diagnoses decreased. For instance, the incidence of myocardial infarction and CVI decreased in the *mp* by about 16% and 8%, respectively, for instance.

Figure 1: Total number of patients per day during different phases of the COVID-19 pandemic in March 2020 compared to the control group in March 2019. A linear fit of each scatter plot is shown in dotted lines.

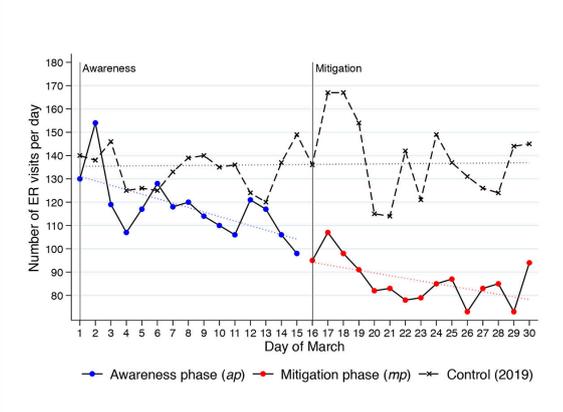


Table 1: Patient characteristics by period, compared with the control group.

	March 2020 (COVID-19)				March 2019
	Awareness phase (n = 1765)		Mitigation phase (n = 1293)		Control (15-day) (n = 2043, mean)
	Abs. no.	Risk (95% CI)*	Abs. no.	Risk (95% CI)*	Abs. no. (95% CI)†
Sex, male	1011	1.02 (0.91–1.14)	710	0.92 (0.81–1.05)	1157 (1077–1237)
Age group, years					
18–24	235		146		270 (221–319)
25–44	554		420		576 (503–649)
45–64	489		375		592 (539–645)
>65	483	0.99 (0.96–1.02)	349	1.00 (0.97–1.03)	569 (514–624)
Triage					
Life-threatening	138	0.99 (0.81–1.22)	124	1.24 (1.00–1.55)	142 (111–173)
High urgent	478	1.05 (0.92–1.19)	383	1.19 (1.03–1.36)	520 (466–574)
Urgent	963	0.90 (0.81–1.01)	698	0.88 (0.78–1.00)	1166 (1072–1260)
Semi-urgent	151	1.24 (1.01–1.53)	77	0.84 (0.65–1.09)	153 (118–188)
Non-urgent	27	1.01 (0.64–1.59)	9	0.45 (0.23–0.92)	21 (6–36)
Chief complaint					
Trauma	204	0.87 (0.73–1.03)	138	0.79 (0.65–0.96)	274 (236–312)
Musculoskeletal	96	0.86 (0.68–1.10)	53	0.64 (0.47–0.87)	148 (122–174)
Gastrointestinal	109	0.74 (0.59–0.92)	85	0.79 (0.62–1.01)	160 (129–191)
Respiratory	99	1.66 (1.28–2.16)	134	3.23 (2.53–4.13)	79 (54–104)
Neurological	197	0.87 (0.73–1.03)	149	0.90 (0.74–1.09)	249 (213–285)
Cardiovascular	164	1.11 (0.91–1.35)	117	1.08 (0.86–1.34)	180 (153–207)
Genitourinary	47	0.91 (0.65–1.28)	35	0.93 (0.63–1.36)	57 (39–75)
Ear/nose/throat/eye	177	0.77 (0.64–0.92)	138	0.82 (0.67–1.00)	238 (189–287)
Discharge diagnosis					
CVI/TIA	68	1.15 (0.86–1.55)	63	1.48 (1.09–2.00)	77 (59–95)
STEMI/NSTEMI	13	0.70 (0.37–1.30)	18	1.33 (0.76–2.31)	22 (11–33)
Aortic dissection	4	0.54 (0.18–1.62)	6	1.12 (0.44–2.84)	8 (0–16)
Ileus	2	0.36 (0.08–1.58)	6	1.46 (0.55–3.85)	10 (5–15)
Sepsis	15	1.02 (0.55–1.88)	15	1.40 (0.76–2.58)	17 (7–27)
Pulmonary embolism	6	0.51 (0.21–1.24)	8	0.94 (0.42–2.06)	15 (5–25)
Polytrauma	7	1.68 (0.75–3.77)	9	0.95 (0.39–2.30)	10 (1–19)
ER death	5	3.87 (0.92–16.2)	7	7.41 (1.91–28.7)	2 (0–5)
ROSC or ER death	11	1.50 (0.70–3.21)	13	2.43 (1.18–5.02)	7 (0.2–14)
Critically ill‡	105	1.00 (0.79–1.27)	116	1.56 (1.24–1.96)	127 (99–154)
Discharge at home	1118	1.08 (0.96–1.21)	782	0.96 (0.84–1.09)	1212 (1102–1322)
Hospital admission	509	0.88 (0.78–1.00)	401	0.98 (0.86–1.12)	641 (579–703)

Abs. no. = absolute number; CI = confidence interval; CVI = cerebrovascular insult; ER = emergency room; (N)STEMI = (non) ST-elevation myocardial infarction; ROSC = return of spontaneous circulation; TIA = transient ischaemic attack * Geometric mean ratio (95% confidence interval) for continuous variables, odds ratio (95% CI) for binary variables, control group as baseline; significant associations ($p < 0.05$) marked in bold. † The absolute numbers with accompanying CIs are obtained by bootstrapping (choosing 15 days of March 2019 randomly and calculating the absolute number) with 100 replications. ‡ One of the listed discharge diagnoses and no documented ambulant discharge.

Discussion

The decrease in patients we observed during the time of COVID-19 was of similar magnitude to the reductions reported elsewhere [2]. As expected, more patients presented with respiratory chief complaints.

Various factors may explain the observed decline in patient numbers [7]. First, fewer patients require emergency care (e.g., due to a reduction in activities that result in trauma or muscular-skeletal problems) or, second, patients with minor complaints opt for self-care. A third potential reason may be that patients who in fact should present, do not (e.g., for fear of cross-infection with the novel coronavirus). Our data suggest that all these effects occur. Furthermore, our data were consistent with two studies published very recently [8, 9].

Giamello et al. analysed discharge diagnoses of ER patients in Italy during the COVID-19 pandemic using a similar design to the present study. They found a significant decline – up to 68% reduction compared with one year

before – in the number of ER patients. Patients presenting with non-urgent problems such as lower back pain and general malaise, as well as trauma patients, consulted significantly less often. However, they also found a significant decrease (45%) of patients with acute coronary syndrome and concluded that patients' avoidance of the ER during a pandemic may lead to higher morbidity and mortality caused by other diagnoses, such as myocardial infarction, that are not related to the pandemic [8].

In our study, relative reductions were found in all critical diagnoses studied apart from ROSC after cardiopulmonary resuscitation and ER death. However, apart from ER death, most of the numbers were within the 95% CIs of the absolute numbers for the control group. One possible explanation for why our numbers did not reach significance regarding myocardial infarction is that the decline in patients in our study was less extreme than in the ER studied in Italy, where mitigation measures were stricter than in Switzerland.

Baldi and colleagues found a 58% increase of out-of-hospital cardiac arrests in four provinces of the Lombardy region, Northern Italy [9]. In 22.6% of these, no relation to the COVID-19 outbreak was found, which might indicate that people did not seek emergency care at the appropriate time.

Our study was limited to a single centre and to a short observation period. Furthermore, as with all retrospective study, it was prone to information bias. However, this bias was likely to be distributed equally in the different phases, thus it would lead to non-differential error. The lack of power to detect a possible present significant difference in some of the categories due to a small sample size and the shortness of the phases studied (15 days) was a further limitation. Last, we did not correct for multiple testing and handled multiple consultations of the same patient as independent observations.

In conclusion, barriers to seeking emergency care during the COVID-19 pandemic may lead to higher morbidity and mortality. Healthcare authorities and hospitals must ensure low barriers to treatment and business as usual for patients with chronic or acute on chronic illnesses. Additionally, patients must be informed and be aware of the importance of seeking emergency healthcare at appropriate times, independently of an ongoing pandemic.

Disclosure statement

No financial support and no other potential conflict of interest relevant to this article were reported.

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Appendix 1

Supplementary information

Categorisation scheme for the chief complaints according to Aronsky et al.*

1. Cardiovascular complaint: cardiac arrest, cardio-vascular complications, chest pain, fainting/syncope
2. Ear/nose/throat: ear/nose/throat problem with an otolaryngologist as the leading emergency department physician
3. Eye complaint: ear/nose/throat problem with an ophthalmologist as the leading emergency department physician
4. Gastrointestinal complaint: abdominal pain, abdominal problems, body aches (anal), haemorrhage
5. Genitourinary complaint: flank pain, genitourinary problem.
6. Musculoskeletal complaint: back pain, body aches, leg pain, neck pain
7. Neurological complaint: convulsions, seizures, dizziness, headache, neurological complaint, unconsciousness, stroke
8. Respiratory complaint: respiratory problems
9. Trauma: bites, burns, fall, orthopaedic injury, electric shock, rape, stabbing, industrial/machinery accidents, gunshot wound
10. Other complaint: allergies/medical reaction, needlestick/PEP, diabetic problems, procedure, medication refill, temperature related, weakness, foreign body, overdose (intentional), social problems, substance abuse, dental, toothache, fever, infection, skin complaint/trauma, fluid/nutrition alteration, follow-up, other

* Aronsky D, Kendall D, Merkley K, James BC, Haug PJ. A comprehensive set of coded chief complaints for the emergency department. *Acad Emerg Med Off J Soc Acad Emerg Med.* 2001;8(10):980–9.

Table S1: Absolute numbers of characteristics in the three studied phases and relative differences of the awareness respectively mitigation phases and the control phase.

	Awareness phase			Mitigation phase			Average 2 weeks March 2019
	Abs. no.	Abs. diff.	Rel. diff.	Abs. no.	Abs. diff.	Rel. Diff.	Abs. no.
Sex, male	1011	-152	-13.0%	710	-453	-38.9%	1163
Age group, years							
18–24	235	-50	-17.5%	146	-139	-48.8%	285
25–44	554	-51	-8.4%	420	-185	-30.5%	605
45–64	489	-92	-15.8%	375	-206	-35.4%	581
>65	483	-88	-15.3%	349	-222	-38.8%	571
Triage							0
Life-threatening	138	-23	-14.0%	124	-37	-22.7%	161
High urgent	478	-57	-10.7%	383	-152	-28.4%	535
Urgent	963	-204	-17.5%	698	-469	-40.2%	1167
Semi-urgent	151	8	5.6%	77	-66	-46.2%	143
Non-urgent	27	-4	-12.9%	9	-22	-71.0%	31
Chief complaint							
Trauma	204	-64	-23.9%	138	-130	-48.5%	268
Musculoskeletal	96	-32	-24.7%	53	-75	-58.4%	128
Gastrointestinal	109	-58	-34.7%	85	-82	-49.1%	167
Respiratory	99	29	40.4%	134	64	90.1%	71
Neurological	197	-62	-23.9%	149	-110	-42.5%	259
Cardiovascular	164	-185	-53.0%	117	-232	-66.5%	349
Genitourinary	47	-13	-21.0%	35	-25	-41.2%	60
Ear/nose/throat/eye	177	-83	-31.8%	138	-122	-46.8%	260
Discharge diagnosis							
CVI/TIA	68	-1	-0.7%	63	-6	-8.0%	69
STEMI/NSTEMI	13	-9	-39.5%	18	-4	-16.3%	22
Aortic dissection	4	-5	-52.9%	6	-3	-29.4%	9
Ileus	2	-5	-69.2%	6	-1	-7.7%	7
Sepsis	15	-2	-11.8%	15	-2	-11.8%	17
Pulmonary embolism	6	-8	-55.6%	8	-6	-40.7%	14
Polytrauma	7	-2	-16.7%	9	1	5.9%	9
ER death	5	4	233.3%	7	6	366.7%	2
ROSC or ER death	11	3	29.4%	13	5	52.9%	9
Critically ill*	105	-17	-13.6%	116	-6	-4.5%	122
Discharge at home	1118	-139	-11.1%	782	-475	-37.8%	1257
Hospital admission	509	-134	-20.8%	401	-242	-37.6%	643

Abs. diff. = absolute difference; Abs. no. = absolute number; CI = confidence interval; CVI = cerebrovascular insult; ER = emergency room; (N)STEMI = (non) ST-elevation myocardial infarction; Rel. diff. = relative difference; ROSC = return of spontaneous circulation; TIA = transient ischaemic attack * One of the listed discharge diagnoses and no documented ambulant discharge.