International Emergency Nursing 66 (2023) 101241

Contents lists available at ScienceDirect

International Emergency Nursing

journal homepage: www.elsevier.com/locate/aaen

Association between Covid-19 surge and emergency department patient flow and experience

M. Christien Van Der Linden [a,*], Lisette Kunz [b], Merel Van Loon-Van Gaalen [c], Geesje Van Woerden [d], Naomi Van Der Linden [e]

[a] Acute Care, Research and Development, Haaglanden Medical Centre, P.O. Box 432, 2501 CK The Hague, the Netherlands
[b] Department of Pulmonology, Haaglanden Medical Centre, P.O. Box 432, 2501 CK The Hague, the Netherlands
[c] Emergency Department, Haaglanden Medical Centre, P.O. Box 432, 2501 CK The Hague, the Netherlands
[d] Outbreak Management Team, Emergency Department, Haaglanden Medical Centre, P.O. Box 432, 2501 CK The Hague, the Netherlands
[e] Healthcare Financing & Health Economics, Department of Health Technology and Services Research, Technical Medical Centre, University of Twente, P.O. Box 217, 2700 AE Enschede, the Netherlands

ARTICLE INFO

Keywords:
Emergency department
Covid-19
Crowding
Patient experience

ABSTRACT

Background: Preparations for Covid-19 in the Netherlands included hospital reconfigurations to increase capacity for the expected surge at the emergency department (ED). We describe patients' ED length of stay (LOS), crowding and experiences of patients with respiratory complaints during the first Covid-19 peak.
Methods: Retrospective analysis of demand, ED LOS, crowding, and a patient experience survey during a 12-week period in 2020 and similar periods in 2018 and 2019. Crowding levels were calculated using the National ED OverCrowding Scale.
Results: The number of patients with respiratory complaints increased significantly, while total ED numbers were unchanged. Although presentation during the Covid-19 peak and needing hospital admission were associated with a longer ED LOS in patients with respiratory complaints, significantly less crowding occurred compared with the 2018 and 2019 periods. Increased ED LOS was associated with lower patient experience scores.
Conclusion: Advanced warning and its associated preparation within the hospital and the community prevented significant delays in ED throughput during the first Covid-19 peak.

1. Background

During the yearly returning influenza outbreaks, many patients present to emergency departments (EDs), potentially causing crowding. Adverse effects of ED crowding include delayed patient care, delayed critical interventions, and decreased patient satisfaction [1–4]. During the first Covid-19 peak in the Netherlands, early 2020, occurring simultaneously with the influenza season in the Netherlands, we feared substantial crowding. Warned by the Chinese and Italian experiences [5–7] we expected the ED being overwhelmed with patients suffering from shortness of breath and in need of hospitalization. Meanwhile, a decrease in number of hospital visits from patients with non-Covid-related complaints was reported internationally, probably due to measures such as the stay-at-home policy, hospitals delaying elective surgery, and people's fear of getting infected [8].

The lay press in the Netherlands reported an increase in the number of patients with (suspected) Covid-19 infection and an increase in the number of hospitalizations, especially among older patients with underlying comorbidities. Regulations in the Netherlands focused on flattening the curve of new Covid-19 infections in order to have enough equipped Intensive Care Unit (ICU) beds and available staff. The Hospital Outbreak Management Team (OMT) undertook preparations to

Abbreviations: ED, Emergency department; CT, Computer Tomography; GP, General Practitioner; GPC, General Practitioner Cooperative; HMC, Haaglanden Medical Centre; ICU, Intensive care unit; IQR, Interquartile range; LOS, Length of stay; METC, Medical ethical review board; NEDOCS, National Emergency Department OverCrowding Scale; NS, Non-significant; OMT, Outbreak management team; PPE, Personal Protection Equipment; SD, Standard deviation; SE, Standard error; SPSS, Statistical package for the social sciences; USA, United States of America.

* Corresponding author.
E-mail addresses: c.van.der.linden@haaglandenmc.nl (M.C. Van Der Linden), l.kunz@haaglandenmc.nl (L. Kunz), m.van.loon@haaglandenmc.nl (M. Van Loon-Van Gaalen), g.van.woerden@haaglandenmc.nl (G. Van Woerden), n.vanderlinden@utwente.nl (N. Van Der Linden).

https://doi.org/10.1016/j.ienj.2022.101241
Received 14 August 2021; Received in revised form 18 October 2022; Accepted 15 November 2022
Available online 21 November 2022
1755-599X/

Box 1
Preparations to increase capacity and to provide a safe working environment for staff during first Covid-19 peak.

Triage protocol.

Personal protective equiment orders.

Reconfiguration of the hospital and creating capacity, including:

-Installing extra beds at the ICU.

-Reshaping the ED into compartments separating Covid-19 suspected patients from non-suspected Covid-19 patients, according to predefined criteria.

-Expanding the ED capacity by using treatment rooms at the policlinics.

-Expanding admission units for Covid-19 suspected patients.

-Cancelling outpatient visits.

-Cancelling surgery procedures.

Staff training, especially for healthcare workers from other fields and retired nurses, in order to expand ED staff.

Extra staffing, including:

-Involving medical specialists at ED, working side-by-side with the 24/7 available EPs.

-Hiring nurse assistants supporting at ED, ICU, and inpatient wards.

-Recruiting health practitioners with critical care skills and training.

GPC as alternative site for stable patients with suspected Covid-19.

Extra CT-scan at the ED.

Abbreviations: CT, Computer Tomography; ED, emergency medicine; EP, emergency physician, GPC, general practitioner cooperative; ICU, intensive care unit.

increase capacity of available inpatient beds on inpatient floors and ICUs and to provide a safe working environment for staff (Box 1).

The resulting impact on patient flow, ED crowding and patient experiences during this first Covid-19 peak are largely unknown.

Patient experience is one of the performance measures used for healthcare quality evaluation and for setting priorities in quality improvement activities. Healthcare, even during a pandemic, must be safe, people-centred, timely and efficient [9]. To fulfil the 'timely' and 'safety' aspects, ED staff minimise waiting times for patients and reduce crowding. Both aspects are particularly challenging during a pandemic. Patients with suspected Covid-19 are isolated since the virus is highly contagious. Isolation negatively influences length of stay (LOS), and it negatively affects patient experiences [10]. ED staff need to wear protective gear that may create a feeling of discomfort for patients; the patient does not see the doctor and nurse behind the protective equipment, which may hinder building a relationship of trust [11]. This is especially important, as patients may fear that they are suffering from a potentially fatal disease.

The aim of this study was to describe changes in ED LOS, crowding and experiences of patients with respiratory complaints during the first Covid-19 peak in the Netherlands. We assessed patient experiences among patients with respiratory complaints, using a survey that captured the patients' perspectives on the ED process. We hypothesized that the Covid-19 peak led to increased ED LOS for patients with respiratory complaints, and increased crowding. We also expected negatively impacted patient experiences for patients with respiratory complaints.

2. Methods

2.1. Setting

This study was performed in a non-academic, inner-city teaching hospital in The Hague, a seaside city in the Netherlands, home to more than 500,000 people. The 30-bed ED serves as a regional level 1 trauma and acute neurovascular centre, and receives approximately 54,000 adult and paediatric patient visits annually. All patients who present at the ED are registered in the hospital database and subsequently triaged using the Manchester Triage System (MTS) as immediate (level 1), highly urgent (level 2), urgent (level 3), standard (level 4) or non-urgent (level 5). After triage, patients eligible for treatment by a general practitioner (GP) are redirected to a co-located GP cooperative (GPC). Remaining patients are assessed at the ED. Before February 2020, an ED nurse triaged patients arriving at the ED to the GPC or to the ED, following predefined criteria. From February 2020 onwards, a GPC assistant determined whether patients had to be directed to the GPC or ED, based on predefined criteria [12].

The usual 24/7 staffing on the ED includes emergency nurses, emergency physicians (EPs) and residents of the major specialties. During day and evening shifts, a nurse practitioner is available for patients with minor injuries and minor illnesses. During peak hours at the ED (from noon until eight pm), a cardiologist, an internal medicine specialist, a neurologist, a radiologist and a surgeon work side-by-side with the EPs and the residents. Other medical specialists are available in the hospital (office hours) and on-call (out-of-office hours) when consulted. During the 2020 study period, a pulmonologist was also available at the ED from five to eight pm, aiming for improved patient flow for patients with respiratory complaints.

2.2. Study design

The regional medical ethics committee and the institutional review board approved the study (METC LDD, N20.008).

We performed a descriptive mixed mode study using a retrospective chart review, in a 12-week period (26 January to 18 April 2020). We obtained data from the same periods in 2018 and 2019 to compare patient numbers and patient flow, for the general ED population and for the subgroup of patients with respiratory complaints, because there was

an awareness of Covid-19 as a respiratory disease [13–14]. Additionally, we performed a patient experience survey in the subgroup of patients with respiratory complaints presenting for Pulmonology during the Covid-19 outbreak. Patients with respiratory complaints were defined as patients who were assigned the category 'Shortness of breath' at triage. We excluded patients under the age of 18 and patients redirected to the GPC.

2.3. Chart review

We collected and recorded demographic details and visit characteristics (date and time of arrival, type of medical complaint, crowding level at arrival, triage level, date and time of ED discharge, and discharge disposition) in a de-identified database. Acuity level was categorized into urgent (immediate, high-urgent, and urgent) and non-urgent (standard and non-urgent). We calculated ED LOS by subtracting arrival time from discharge time. We measured the degree of crowding with the National ED Overcrowding Score (NEDOCS), a multidimensional scale ranging from zero to 200 [15]. The NEDOCS score accurately correlates with the degree of crowding as perceived by the ED staff at the study setting [16]. A computer programme calculates the NEDOCS scores at 15-min intervals. If the NEDOCS is 60 or higher, the ED is considered to be busy [15].

2.4. Patient experience survey

We measured patient experience in the patients with respiratory complaints who were assessed by Pulmonology during the first Covid-19 peak in 2020, using a survey based on the Picker Patient Experience Questionnaire (PPE-15) [17]. The survey was conducted by phone within three days of a patients' ED visit. If the patient was not available or able to answer the phone, a spouse, caregiver, or family member was asked to participate. The survey included questions regarding patients' experiences with waiting time, first contact with their physician, information supply, and communication. Questions had three to five response options (Appendix A). We coded neutral answers and the most positive answer as "non-problem", and the remaining responses as "problems". Overall patient experience (response to the question "Please rate your overall experience at our ED") and likelihood of recommendation (response to the question "How likely would you be to recommend this ED to friends and family?") were scored using a 10-point Likert scale. In 2018 and 2019, the same survey was used in a limited number of unselected patients from the general ED population.

2.5. Outcomes

Outcome variables were ED LOS, number of admitted patients experiencing a LOS of more than 4 h, crowding level at arrival of the patient as measured by the NEDOCS score, and number of patients arriving during extreme busyness (NEDOCS score between 60 and 100) and during crowding (NEDOCS score above 100). We describe all outcomes for the total study population as well as for patients with respiratory complaints, during the Covid-19 peak in 2020 and the matching periods in 2019 and 2018. For patients with respiratory complaints who were assessed by Pulmonology during the first Covid-19 peak, we additionally assessed their experiences during their visit and compared them with the experiences of the general population in 2019 and 2018.

2.6. Data analysis

We used descriptive statistics, Chi Square tests, and Kruskal-Wallis tests to compare the three years simultaneously.

To better understand factors associated with ED LOS we created multivariable linear regression models for the general ED population as well as for the patients with respiratory complaints, including study year, age, arrival time, and arrival by ambulance, referral status, triage level, and presenting problem in the models as potential covariates. ED LOS was log-transformed due to the non-normal distribution. Using backward stepwise selection, we subsequently removed the largest p-values until all p-values were smaller than 0.05.

Overall experience scores and recommendation scores of the patients with respiratory complaints arriving during the first Covid-19 peak were compared with the scores of the general population in 2018 and 2019. This latter analysis was solely considered hypothesis generating, since patient selection and survey procedures differed between the periods (e.g. by phone in 2020 vs. face-to-face in earlier years). We performed linear regression analyses to identify the association between patient experience scores, recommendation scores, patient characteristics and visit characteristics.

Significance thresholds were set at $p \leq 0.05$. We used the statistical package for the social sciences (SPSS Statistics for Windows 26.0 Armonk, New York, USA) for analysis.

3. Results

3.1. Patient characteristics

During the 12-week study period in 2020, 9274 ED visits were registered, which was similar to the total number of ED visits in the control periods (Table 1). Median age of patients was higher compared with the previous years. Arrivals by ambulance increased significantly and number of self-referrals decreased significantly.

The number of patients with respiratory complaints increased from 763 (in the 2018 study period) to 941 (in the 2020 study period), and the number of self-referrals decreased (Table 2). Admission percentage of respiratory patients varied from 57.4% in 2018, 51.8% in 2019, to 52.5% in 2020.

3.2. Patient flow

In the 2020 study period, median ED LOS was shorter for discharged patients and longer for patients who needed hospital admission, compared with the control periods, while the level of crowding reduced significantly (Table 3). In multivariable analysis, presentation in the 2019 and 2020 study periods, a higher age, transport by ambulance, referral by a GP, an urgent triage level, and needing hospital admission were significant predictors for a longer ED LOS, while arrival during the evening shift was associated with a shorter LOS. Presenting with a psychiatric disorder, feeling unwell, having abdominal complaints or shortness of breath was associated with a longer LOS (Table 4).

Focusing on the patients with respiratory complaints, we observed a significant increase in ED LOS for discharged patients compared with previous years. LOS for patients needing hospital admission and crowding levels were higher in the 2019 study period compared with 2018 and 2020 (Table 5). Presentation in the 2019 or 2020 study periods, a higher age, being referred by a GP, an urgent triage level, and needing hospital admission were significant predictors for a longer ED LOS (Table 6).

3.3. Patient experience survey

During the 12-week study period, 219 patients with respiratory complaints (response rate 35.7%) completed the survey. Compared with non-responders, respondents arrived more often during the day shift (60.3% vs. 51.6%), and were more often referred to the ED by their GP (53% vs. 44.3%). In the remaining characteristics and flow indicators, we observed no differences between responders and non-responders, suggesting that our respondent group was representative for the population with respiratory complaints (Appendix B).

A large proportion of the respondents indicated a lack of involvement in care and treatment decisions (76.2%). To the question, "Were you involved in the decision-making process concerning your

Table 1
Patient and visit characteristics in the general ED population.

	2018 N = 8589	2019 N = 9394	2020 N = 9274	*P*-value[1]
Median age in years (IQR)	53 (34–70)	54 (35–70)	57 (37–73)	<0.001
Age categories n (%)				
18–24 y	886 (10.3)	874 (9.3)	728 (7.8)	<0.001
25–49 y	3027 (35.2)	3214 (34.2)	2943 (31.7)	<0.001
50–69 y	2509 (29.2)	2832 (30.1)	2749 (29.6)	0.39
70–84 y	1643 (19.1)	1872 (19.9)	2131 (23.0)	<0.001
≥85 y	524 (6.1)	602 (6.4)	723 (7.8)	<0.001
Arrival time				
Day shift (7.30 am – 3.39 pm)	3773 (43.5)	4110 (43.8)	4176 (45.0)	0.09
Evening shift (3.30 pm – 11.29 pm)	3484 (40.6)	3779 (40.2)	3706 (40.0)	0.71
Night shift (11.30 pm – 7.29 am)	1368 (15.9)	1505 (16.0)	1392 (15.0)	0.11
Arrival by ambulance	2900 (33.8)	3356 (35.7)	3448 (37.2)	<0.001
Self-referred	2666 (31.0)	2759 (29.4)	1290 (13.9)	<0.001
Referral by GP	2191 (25.3)	2484 (26.4)	3622 (39.1)	<0.001
Urgent[2] triage level n (%)[3]	6356 (76.7)	7149 (78.6)	6181 (77.6)	0.02
Presenting problem, n (%)[4]				
Abdominal pain	1389 (16.8)	1532 (16.8)	1429 (17.9)	0.08
Back pain	101 (1.2)	122 (1.3)	92 (1.2)	0.54
Chest pain & syncope	1311 (15.8)	1531 (16.8)	677 (8.5)	<0.001
Ear / nose / throat / eye problem	150 (1.8)	121 (1.3)	93 (1.2)	0.002
Headache & head injury	657 (7.9)	651 (7.2)	558 (7.0)	0.05
Limb problem	1091 (13.2)	1151 (12.6)	1070 (13.4)	0.30
Psychiatric disorder	352 (4.2)	344 (3.8)	347 (4.4)	0.13
Severe trauma & falls	483 (5.8)	610 (6.7)	718 (9.0)	<0.001
Shortness of breath	763 (9.2)	885 (9.7)	941 (11.8)	<0.001
Unwell patient	756 (9.1)	873 (9.6)	830 (10.4)	0.02
Wounds & local infections	462 (5.6)	537 (5.9)	585 (7.3)	<0.001
Other[5]	769 (9.3)	744 (8.2)	624 (7.8)	0.002
Hospital admission, total	2527 (29.4)	2843 (30.3)	2696 (29.1)	0.18

Abbreviations: GP, General Practitioner; IQR = Interquartile Range;.
[1] *P*-values are calculated using $\chi 2$ tests, except for median age, which we calculated with the Kruskal-Wallis test; [2]Immediate, high-urgent, and urgent triage level; [3]Triage level is based on 25,344 (93%) of the patient visits, due to 1913 missing values; [4]Medical complaint is based on 25,349 (93%) of the patient visits, due to 1908 missing values; [5]Other, medical complaint occurring < 300 times during the study period, including abuse, allergy, chemical injury, dental problem, diabetes, epileptic seizure, facial complaint, insertion foreign object, neck pain, pregnancy problem, sexually acquired infection, and skin problem.

treatment?" eighty-four of the 193 respondents (43.5%) answered "No, not at all", and 63 of 193 respondents (32.6%) said "A little" (Table 7). Concerning discharge information, 64.8% of the respondents indicated a lack of information about when to proceed with normal activities, and 60.6% regarding information about 'red flags' to observe at home.

Almost half of the patients reported problems with the waiting times between the diagnostic procedures (48.2%) and with the total ED LOS (47.2%).

Respondents rated their ED experience with a mean of 7.72 (SD 1.42), similar to the mean experience scores in 2019 (7.75, SD 2.18, $p = 0.335$) and 2018 (8.08, SD 1.22, $p = 0.129$). The mean recommendation score in the 2020 group was 7.39 (SD 1.55), comparable with scores in 2019 (7.33 (SD 3.23, $p = 0.915$) and lower compared with 2018 (8.11 (SD 1.13), $p = 0.006$).

Table 2
Patient and visit characteristics of the patients presenting with respiratory complaints.

	2018 N = 763 (8.9% of 8589)	2019 N = 885 (9.4% of 9394)	2020 N = 941 (10.1% of 9274)	*P*-value[1]
Median age in years (IQR)	68 (55–78)	67 (55–77)	65 (50–76)	0.001
Age categories n (%)				
16–24 y	26 (3.4)	34 (3.8)	25 (2.7)	0.355
25–49 y	128 (16.8)	138 (15.6)	210 (22.3)	<0.001
50–69 y	251 (32.9)	302 (34.1)	329 (35.0)	0.669
70–84 y	274 (35.9)	310 (35.0)	289 (30.7)	0.047
≥85 y	84 (11.0)	101 (11.4)	88 (9.4)	0.317
Arrival time				
Day shift (7.30 am – 3.39 pm)	358 (46.9)	417 (47.1)	447 (47.5)	0.970
Evening shift (3.30 pm – 11.29 pm)	285 (37.4)	354 (40.0)	341 (36.2)	0.239
Night shift (11.30 pm – 7.29 am)	120 (15.7)	114 (12.9)	153 (16.3)	0.100
Arrival by ambulance	339 (44.4)	359 (40.6)	400 (42.5)	0.285
Self-referred	157 (20.6)	150 (16.9)	97 (10.3)	<0.001
Referral by GP	300 (39.3)	394 (44.5)	429 (45.6)	0.024
Urgent[2] triage level n (%)	670 (87.8)	755 (85.3)	803 (85.3)	0.249
Hospital admission	438 (57.4)	458 (51.8)	494 (52.5)	0.047

Abbreviations: GP, General Practitioner; IQR = Interquartile Range;
[1] *P*-values are calculated using $\chi 2$ tests, except for median age, which we calculated with the Kruskal-Wallis test; [2]Immediate, high-urgent, and urgent triage level.

Table 3
Patient flow indicators in the general ED population.

	2018 N = 8589	2019 N = 9394	2020 N = 9274	*P*-value[1]
Median ED length of stay for discharged patients (IQR)	126 (74–185)	135 (86–196)	**118 (48–187)**	<0.001
Median ED length of stay for admitted patients (IQR)	198 (139–271)	215 (152–287)	**221 (158–286)**	<0.001
Admitted patients experiencing ED LOS > 4 h n / admitted patients (% of admitted patients)[2]	853/2523 (33.8)	1143/2835 (40.3)	**1117/2692 (41.5)**	<0.001
Median NEDOCS at arrival of the patient (IQR)	45 (23–66)	49 (29–71)	**32 (14–54)**	<0.001
Patients arriving during NEDOCS 61–100 at ED n (%)	1456 (17.0)	4220 (44.9)	**2082 (22.4)**	<0.001
Patients arriving during NEDOCS > 100 at ED n (%)	260 (3.0)	573 (6.1)	**55 (0.6)**	<0.001

Abbreviations: ED, Emergency Department; IQR = Interquartile Range; LOS, length of stay; NEDOCS, National Emergency Department OverCrowding Score.
[1] *P*-values are calculated with the Kruskal-Wallis test (length of stay and NEDOCS), and the Chi[2] test (Admitted patients experiencing LOS > 4 h and NEDOCS-level at patients' arrival); [2]Calculated in admitted patients, 2523 (in 2018), 2835 (in 2019), and 2692 (in 2020).

3.4. Operational factors influencing patient experience

The score for overall experience was highly correlated with likelihood to recommend ($r = 0.79$, $p < 0.001$). In the final model for overall experience, hospital admission was significantly associated with higher scores. There was a 0.657-point increase in overall experience when

Table 4
Multivariable linear regression analysis of factors independently associated with log-transformed ED length of stay (all patients).

Variables associated with log-transformed length of stay	Beta (SE)	P [1]	Beta (SE), Final model	P [1]
Constant	1.898 (0.010)	<0.001	1.885 (0.008)	<0.001
Study period				
2018	Reference	–	Reference	–
2019	0.031 (0.004)	<0.001	0.031 (0.004)	<0.001
2020	0.030 (0.004)	<0.001	0.030 (0.004)	<0.001
Age in years	0.002 (0.000)	<0.001	0.002 (0.000)	<0.001
Arrival time				
Day shift	Reference	–	Reference	–
Evening shift	−0.019 (0.004)	<0.001	−0.018 (0.004)	<0.001
Night shift	−0.005 (0.005)	0.325	–	–
Arrival by ambulance	0.074 (0.005)	<0.001	0.075 (0.004)	<0.001
Self-referred	−0.002 (0.005)	0.748	–	–
Referral by GP	0.078 (0.005)	<0.001	0.080 (0.004)	<0.001
Urgent[2] triage level n (%)	0.104 (0.005)	<0.001	0.104 (0.005)	<0.001
Presenting problem, n (%)				
Abdominal pain	0.031 (0.008)	<0.001	0.041 (0.005)	<0.001
Back pain	−0.003 (0.017)	0.848	–	
Chest pain & syncope	−0.015 (0.008)	0.065	–	–
Ear/nose/throat/eye problem	−0.180 (0.016)	<0.001	−0.171 (0.015)	<0.001-
Headache & head injury	−0.011 (0.009)	0.216		
Limb problem	−0.137 (0.008)	<0.001	−0.127 (0.006)	-<0.001
Psychiatric disorder	0.161 (0.011)	<0.001	0.170 (0.009)	<0.001
Severe trauma & falls	Reference		Reference	–
Shortness of breath	0.037 (0.009)	-<0.001	0.047 (0.006)	<0.001
Unwell patient	0.063 (0.009)	<0.001	0.073 (0.006)	<0.001
Wounds & local infections	−0.139 (0.010)	<0.001	−0.129 (0.008)	<0.001
Other[3]	−0.081 (0.009)	<0.001	−0.072 (0.007)	<0.001
Hospital admission	0.113 (0.004)	<0.001	0.113 (0.004)	<0.001

Abbreviations: ED, emergency department; GP, General Practitioner; NS, Non-Significant; SE, Standard Error.
[1] *P* values were calculated using multivariate linear regression analyses using ED length of stay as a dependent variable, adjusted for study period, number of pulmonology patients, patient demographics, and visit characteristics; [2]Immediate, high-urgent, and urgent triage level; [3]Other, medical complaint occurring < 300 times during the study period, including abuse, allergy, chemical injury, dental problem, diabetes, epileptic seizure, facial complaint, insertion foreign object, neck pain, pregnancy problem, sexually acquired infection, and skin problem.

hospital admission was needed, $p = 0.003$. Increased total ED LOS was significantly associated with lower overall experience, with a 0.003-point decrease in every minute increase in LOS ($p = 0.01$). Similar to overall experience, a longer ED LOS was associated with lower scores in likelihood to recommend; a 0.005-point decrease in score for every minute increase in ED LOS (Table 8).

Table 5
Patient flow indicators in the patients with respiratory complaints.

	2018 N = 763	2019 N = 885	2020 N = 941	P-value[1]
Median ED length of stay for discharged patients (IQR)	154 (115–210)	162 (122–216)	177 (128–231)	0.003
Median ED length of stay for admitted patients (IQR)	215 (165–292)	239 (190–300)	224 (177–279)	0.002
Admitted patients experiencing LOS > 4 h n / admitted patients (% of admitted patients)[2]	173 (39.5)	228 (49.8)	201 (40.7)	0.003
Median crowding level[1] at arrival of the patient (IQR)	47 (20–71)	51 (31–74)	33 (15–53)	0.02
Patients arriving during NEDOCS 61–100 at ED n (%)	59 (13.4)	196 (33.4)	99 (16.1)	<0.001
Patients arriving during NEDOCS > 100 at ED n (%)	9 (2.0)	35 (6.0)	1 (0.2)	<0.001

Abbreviations: ED, Emergency Department; IQR = Interquartile Range; LOS, length of stay; NEDOCS, National Emergency Department OverCrowding Score.
[1] *P*-values are calculated with the Kruskal-Wallis test (length of stay and NEDOCS), and the Chi[2] test (Admitted patients experiencing LOS > 4 h and NEDOCS-level at patients' arrival); [2]Calculated in admitted patients, 438 (in 2018), 458 (in 2019), and 494 (in 2020).

Table 6
Multivariable linear regression analysis of factors independently associated with log-transformed ED length of stay for patients with respiratory complaints.

Variables associated with log-transformed length of stay	Beta (SE)	P [1]	Beta (SE), Final model	P [1]
Constant	2.052 (0.020)	<0.001	2.033 (0.018)	<0.001
Study year				
2018	Reference	–	Reference	–
2019	0.030 (0.010)	0.002	0.031 (0.010)	0.002
2020	0.031 (0.010)	0.002	0.033 (0.010)	0.001
Age in years	0.002 (0.000)	<0.001	0.002 (0.000)	<0.001
Arrival time				
Day shift	Reference	–	Reference	–
Evening shift	−0.025 (0.009)	0.005	−0.023 (0.008)	0.006
Night shift	−0.008 (0.013)	0.517	–	–
Arrival by ambulance	−0.004 (0.010)	0.718	–	–
Self-referred	−0.023 (0.014)	0.101	–	–
Referral by GP	0.015 (0.010)	0.126	0.024 (0.008)	0.003
Urgent[2] triage level n (%)	0.065 (0.012)	<0.001	0.067 (0.012)	<0.001
Hospital admission	0.098 (0.009)	<0.001	0.099 (0.009)	<0.001

Abbreviations: ED, emergency department; GP, General Practitioner; NS, Non-Significant; SE, Standard Error.
[1] *P* values were calculated using multivariate linear regression analyses using ED length of stay as a dependent variable, adjusted for patient demographics and visit characteristics. [2]Immediate, high-urgent, and urgent triage level; [3]Other, medical complaint occurring < 25 times during the study period, including abdominal pain, back pain, ear/nose/throat/eye problem, headache, head injury, limb problems, psychiatric disorders.

Table 7
Results from the survey on patient experiences (N = 219).

Items of the survey[1]	Proportion of responders reporting "a problem" or "not fully satisfied" on the items of the survey[1]
Information about the waiting times	**75/202 (37.1)**
Waiting time until first contact doctor	**66/194 (34.0)**
Waiting times between the diagnostic procedures	**93/193 (48.2)**
Total length of stay at the emergency department	**91/193 (47.2)**
Confidence in the experience of the doctors and nurses	**12/193 (6.2)**
Understandable explanation about the results of the diagnostic procedures	**39/190 (20.5)**
Information about treatment	**19/193 (9.8)**
Involvement in care and treatment decisions	**147/193 (76.2)**
Information about when to proceed with your normal activities	**125/193 (64.8)**
Information about danger signals to observe at home	**117/193 (60.6)**
Expectations of level of care	**27/193 (14.0)**
Overall experience and recommendation scores[2]	**N = 193 (88.1%)**
Mean overall experience score (SD)	**7.72 (1.42)**
Mean recommendation score (SD)	**7.39 (1.55)**
Recommendation score 0–6	**32 (16.6)**
Recommendation score 7 or 8	**129 (66.8)**
Recommendation score 9 or 10	**32 (16.6)**

Abbreviations: SD, Standard Deviation.
[1] The proportion of responders reporting a problem on number of answers to each of the survey items; Percentage in parenthesis. [2]10-point Likert scale: 0 (not satisfied at all) to 10 (very satisfied). 10-point Likert scale: 0 (not likely at all) to 10 (very likely).

Table 8
Association between overall experience and likelihood to recommend with patient characteristics and operational measures.

	Patient satisfaction (1–10)		Likelihood to recommend (1–10)	
Independent variable	**Beta Coefficient (SE)**	***P***	**Beta Coefficient (SE)**	***P***
Constant	8.123 (0.286)	<0.001	8.369 (0.307)	<0.001
Self-referred to the ED	NS	NS	−1.055 (0.488)	0.03
Hospital admission	0.657 (0.221)	0.003	NS	NS
Total ED length of stay	−0.003 (0.001)	0.01	−0.005 (0.002)	0.001
Admitted patients with ED length of stay > 4 h	NS	NS	0.872 (0.341)	0.011

Abbreviations: ED, emergency department; NS, Non-Significant; SE, Standard Error.

4. Discussion

Our findings show that during the first Covid-19 peak in 2020, ED crowding decreased significantly. This was probably due to the system-wide collective response and hospital preparations which increased resources for the ED, and public health messaging, which may have decreased ED visits in some patient groups.

4.1. Patient flow

In 2020, we expected a surge in seriously ill patients due to Covid-19, occurring during the yearly influenza season. Warned by the testimonials and images on television of the dramatic circumstances in other countries and early research reports [5–7], our OMT initiated preparations to increase capacity for our influenza and Covid-19 patients and to provide a safe working environment for our staff. During the first Covid-19 peak, we observed no change in total number of ED visits in the 2020 period compared with previous years, while simultaneously more ED and ICU staff and resources were available. The 2020 influenza season in the Netherlands was relatively mild and lasted only 5 weeks, partly overlapping with the first Covid-19 peak. The 14-week lasting influenza season in 2019 was severe, probably explaining the higher ED LOS for admitted patients and the high crowding levels in the 2019 period compared with the 2020 period.

In the Netherlands as well as internationally, researchers reported a decrease in number of patients with non-Covid-related complaints, explained by regulations (stay-at-home policy, reduced community activity such as sports which reduces injuries), hospital management postponing elective surgery, and patients who avoid medical care out of fear of contracting the virus [8]. This coincides with our findings: the number of total ED visits remained unchanged because the number and proportion of patients with respiratory complaints increased while simultaneously a decrease in patients with other complaints occurred. For example, significantly less patients with chest pain and syncope arrived at our ED during the first Covid-19 peak. Other studies also found reductions in admission for acute coronary syndromes, even in areas not heavily affected by the outbreak [18].

Public health messaging was both a promise and a curse in that it decreased ED volume but may be associated with increased morbidity and mortality in the community for non-COVID illnesses [19–20]. Some studies suggest a decline in ED attendances mainly due to patients with minor injuries and minor illnesses [21], but these patients were excluded in our study, since they are assessed at the GPC.

The higher proportion of arrivals by ambulance and lower proportion of self-referrals compared with the control periods suggests a sicker population in the 2020 period, which may partially be an effect of the change of the triage process of self-referrals in February 2020. The unchanged admission percentage argues against this, however, we cannot rule out that physicians used different admission and discharge thresholds during the Covid-19 peak.

The LOS of patients with respiratory complaints who were discharged home during the Covid-19 peak was significantly longer compared with the control periods. We hypothesize that the use of isolation procedures may have negatively impacted ED LOS, as shown by Beysard et al. [22]. During the control periods, ED staff applied isolation procedures in patients with suspected or confirmed influenza. In 2020, ED staff worked in protective gear when approaching the majority of patients, considering all patients with suspicious complaints as potentially Covid-19 positive. Test results, only available when patients needed hospital admission, took at least one day.

4.2. Patient experiences

Comparing patient experiences between different years is difficult: patient selection and survey procedures differed between the periods. Moreover, during the first Covid-19 peak, we introduced a variety of process changes, with more ED staff and available resources, which may have influenced patient experiences. The drop in crowding could have led to higher patient experience scores as suggested in other studies [4]. Unfortunately, experience scores were unchanged, and recommendation scores were lower. Likely, ED staff were less often present in the patients' room because the use of protective gear is time-consuming. Moreover, staff had to be very careful with the protective gear, because of an imminent shortage. The isolated circumstances may have led to lower patient scores.

The score for overall experience was highly correlated with likelihood to recommend, similar to the findings of Nichol et al [23]. Patient satisfaction can be seen as the gap between patients expectations and experience [24]. Worse experience may reflect suboptimal care or different expectations of care quality [25]. Patients who needed hospital

admission had higher scores in overall experience compared with discharged patients. Discharged patients may have been disappointed in not getting a Covid-19 test. Covid-19 tests were scarce during the first Covid-19 peak, only available if hospital admission was necessary.

Increased ED LOS was significantly associated with lower overall experience and lower scores in likelihood to recommend, similar to findings from Nyce et al. [26]. Although waiting times and LOS in our ED are relatively short, compared with international standards [27–29], waiting is difficult for patients [26,30]. Maybe it is even more difficult during a pandemic, when less distraction and communication is possible. For example, family was not allowed in the assessment rooms and ED staff comes in less often. Interestingly, acuity based on the MTS was not significantly associated with overall experience, nor for likelihood to recommend. Thus, a longer LOS reduces experience and recommendation scores regardless of how urgent the condition of the patients, similar to the study of Nichol et al [23].

The vast majority of our patients reported problems with the item of patients' involvement in care. This finding may be not surprising during a crisis situation, although similar findings were found in a Norwegian study from 2017 [25]. According to our findings, we should focus on shared decision-making, on providing discharge information, and on decreasing patients' waiting times between diagnostic procedures and on decreasing total ED LOS.

5. Limitations

Our study includes data from a single level-one hospital, located in the Netherlands. Patients in our country have 24/7 access to primary care services, which enables EDs to focus on rapid assessment and emergency stabilisation of seriously ill and injured patients. Generalizability of our findings cannot be assumed in countries with different healthcare systems and in hospitals which were more heavily impacted by the outbreak.

We identified patients with respiratory complaints by selecting the patients who were assigned the triage category 'Shortness of breath'. This group is an underestimation of the total group of patients with suspected Covid-19 infection, since patients with a Covid-19 infection may present with many other symptoms such as fever and abdominal complaints. Although some of our patients may have presented with chronic respiratory diseases, all patients with shortness of breath were assessed within the Covid-19 guidelines, and thus considered 'suspected Covid-19′.

Finally, this was a descriptive study using retrospective data. Although the quality of the data is high, associations do not entail causality.

6. Implications for further research

We could not include all factors in the regression analysis that may have influenced patients' experiences, such as whether or not the patient was isolated at the ED, received testing or not, and (the number of) individual patient/provider interactions. It would be interesting to assess the effect of isolation procedures and contact moments with professionals on patients' experience in a future study.

Crowding scores in our study, measured with the NEDOCS instrument, do not necessarily match nursing workload. Wearing protective gear, to be changed for every patient, limits productivity [31]. Protocols regarding protective gear, diagnostics and treatment were regularly adapted based on new information, thereby causing an overload of information to the ED staff [5,31]. The fear of becoming infected and the fear of being contagious and infecting others may aggravate perceived workload [32]. Further research is needed on provider outcome and experiences when caring for patients in respiratory isolation.

7. Conclusions

Advanced warning and its associated preparations within the hospital and the community prevented significant delays in ED throughput during the first Covid-19 peak. The increase in number of patients with respiratory complaints was combined with a drop in some other patient groups. Although presentation during the Covid-19 peak and needing hospital admission were associated with a longer ED LOS in patients with respiratory complaints, significantly less crowding occurred.

Ethical Statement

All procedures performed in this study were in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

The ethical review committee of Southwest Holland granted approval and exemption. Patient consent was not required.

Funding source

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CRediT authorship contribution statement

M. Christien Van Der Linden: Conceptualization, Formal analysis, Writing – original draft. **Lisette Kunz:** Conceptualization, Writing – review & editing. **Merel Van Loon-Van Gaalen:** Writing – review & editing. **Geesje Van Woerden:** Writing – review & editing. **Naomi Van Der Linden:** Conceptualization, Formal analysis, Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors thank Aad van den Berg, Ellen Berrevoets, Pascale van der Kallen, and Roger van Rietschote for their help with the data collection, and Margje van der Leeuw, who provided language editing.

References

[1] Bernstein SL, Aronsky D, Duseja R, et al. The effect of emergency department crowding on clinically oriented outcomes. Acad Emerg Med 2009;16:1–10.
[2] Carter EJ, Pouch SM, Larson EL. The relationship between emergency department crowding and patient outcomes: a systematic review. J Nurs Scholarsh 2014;46:106–15.
[3] Morley C, Unwin M, Peterson GM, Stankovich J, Kinsman L. Emergency department crowding: A systematic review of causes, consequences and solutions. PLoS One 2018;13:e0203316.
[4] Wang H, Kline JA, Jackson BE, et al. The role of patient perception of crowding in the determination of real-time patient satisfaction at Emergency Department. Int J Qual Health Care 2017;29:722–7.
[5] Faccincani R, Pascucci F, Lennquist S. How to Surge to Face the SARS-CoV-2 Outbreak: Lessons Learned From Lombardy, Italy. Disaster Med Public Health Prep 2020:1–3.
[6] Shen Y, Cui Y, Li N, et al. Emergency Responses to Covid-19 Outbreak: Experiences and Lessons from a General Hospital in Nanjing, China. Cardiovasc Intervent Radiol 2020;43:810.
[7] Paganini M, Conti A, Weinstein E, Della Corte F, Ragazzoni L. Translating COVID-19 pandemic surge theory to practice in the emergency department: how to expand structure. Disaster Med Public Health Prep 2020:1–10.
[8] Wong L, Hawkins J, Murrell K. Where are all the patients? Addressing Covid-19 fear to encourage sick patients to seek emergency care. NEJM Catalyst Innovations in Care Delivery 2020.
[9] WHO WHO. Quality of care [online]. Available at: https://www.who.int/health-topics/quality-of-care#tab=tab_1. Accessed 15-03-2021.

[10] Abdelhadi A. Patients' satisfactions on the waiting period at the emergency units. Comparison study before and during COVID-19 pandemic. J Public Health Res 2021;10.
[11] Hoernke K, Djellouli N, Andrews L, et al. Frontline healthcare workers' experiences with personal protective equipment during the COVID-19 pandemic in the UK: a rapid qualitative appraisal. BMJ Open 2021;11:e046199.
[12] Huibers LA, Sloot S, Giesen P, Van Veen M, van Ierland Y, Moll H. Wetenschappelijk onderzoek Nederlands Triage Systeem [In Dutch]. Nijmegen: IQ healthcare 2009.
[13] Guan W-j, Ni Z-y, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. New Engl J Med 2020;382:1708–20.
[14] Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. New Engl J Med 2020.
[15] Weiss SJ, Derlet R, Arndahl J, et al. Estimating the degree of emergency department overcrowding in academic medical centers: results of the National ED Overcrowding Study (NEDOCS). Acad Emerg Med 2004;11:38-50.
[16] Van Der Linden MC, Van Loon M, Gaakeer MI, Richards JR, Derlet RW, Van Der Linden N. A different crowd, a different crowding level? The predefined thresholds of crowding scales may not be optimal for all emergency departments. Int Emerg Nurs 2018;41:25–30.
[17] Jenkinson C, Coulter A, Bruster S. The Picker Patient Experience Questionnaire: development and validation using data from in-patient surveys in five countries. Int J Qual Health Care 2002;14:353–8.
[18] Kastritis E, Tsitsimpis K, Anninos E, et al. Significant reduction in the visits to the emergency room department during the COVID-19 pandemic in a tertiary hospital in Greece: Indirect victims of the pandemic? Medicine 2020;99.
[19] Baldi E, Auricchio A, Klersy C, et al. Out-of-hospital cardiac arrests and mortality in Swiss Cantons with high and low COVID-19 incidence: A nationwide analysis. Resuscitation Plus 2021;6:100105.
[20] Gormeli Kurt N, Gunes C. How has Covid-19 pandemic affected crowded emergency services? Int J Clin Pract 2020;74:e13624.
[21] Medicine. RCoE. COVID-19: resetting emergency department care, 20202020.
[22] Beysard N, Yersin B, Meylan P, Hugli O, Carron P-N. Impact of the 2014–2015 influenza season on the activity of an academic emergency department. Intern Emerg Med 2018;13:251–6.
[23] Nichol JR, Fu R, French K, Momberger J, Handel DA. Association between patient and emergency department operational characteristics and patient satisfaction scores in a pediatric population. Pediatr Emerg Care 2016;32:139–41.
[24] Beattie M, Murphy DJ, Atherton I, Lauder W. Instruments to measure patient experience of healthcare quality in hospitals: a systematic review. Syst Rev 2015;4:97.
[25] Leonardsen A-CL, Grøndahl VA, Ghanima W, et al. Evaluating patient experiences in decentralised acute care using the Picker Patient Experience Questionnaire; methodological and clinical findings. BMC Health Serv Res 2017;17:685.
[26] Nyce A, Gandhi S, Freeze B, et al. Association of Emergency Department Waiting Times With Patient Experience in Admitted and Discharged Patients. J Patient Experience 2021;8:23743735211011404.
[27] Cardin S, Afilalo M, Lang E, et al. Intervention to decrease emergency department crowding: does it have an effect on return visits and hospital readmissions? Ann Emerg Med 2003;41:173–85.
[28] Richards JR, Ozery G, Notash M, Sokolove PE, Derlet RW, Panacek EA. Patients prefer boarding in inpatient hallways: correlation with the national emergency department overcrowding score. Emergency Med Int 2011;2011.
[29] Chan TC, Killeen JP, Kelly D, Guss DA. Impact of rapid entry and accelerated care at triage on reducing emergency department patient wait times, lengths of stay, and rate of left without being seen. Ann Emerg Med 2005;46:491–7.
[30] Sonis JD, Aaronson EL, Lee RY, Philpotts LL, White BA. Emergency department patient experience: a systematic review of the literature. J Patient Experience 2018;5:101–6.
[31] Lam KK, Hung SYM. Perceptions of emergency nurses during the human swine influenza outbreak: A qualitative study. Int Emerg Nurs 2013;21:240–6.
[32] Liu C-Y, Yang Y-z, Zhang X-M, et al. The prevalence and influencing factors in anxiety in medical workers fighting COVID-19 in China: a cross-sectional survey. Epidemiol Infect 2020;148.