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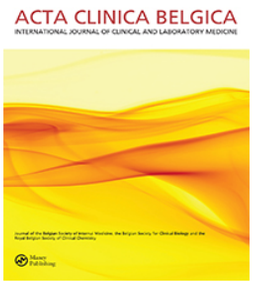

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Immersion in an emergency department triage center during the Covid-19 outbreak: first report of the Liège University hospital experience

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ABSTRACT

Objectives: Since the beginning of the novel coronavirus outbreak, different strategies have been explored to stem the spread of the disease and appropriately manage patient flow. Triage, an effective solution proposed in disaster medicine, also works well to manage Emergency Department (ED) flow. The aim of this study was to describe the role of an ED Triage Center for patients with suspected novel coronavirus disease (Covid-19) and characterize the patient flow.

MethodsIn March 2020, we established a Covid-19 triage center close to the Liège University EDs. From March 2 to March 23, we planned to analyze the specific flow of patients admitted to this triage zone and their characteristics in terms of inner specificities, work-up and management. During this period, all patients presented to the ED with symptoms suggestive of Covid-19 were included in the study.

Results: A total amount of 1071 patients presented to the triage center during the study period. 41.50% of the patients presented with flu-like symptoms. In 82.00% of the cases, no risk factor of virus transmission was found. The SARS-Cov2 positive patients represented 29.26% of the screened patients. 83.00% of patients were discharged home while 17.00% were admitted to the hospital.

Conclusion: Our experience suggests that triage centers for the assessment and management of Covid-19 suspected patients is an essential key strategy to prevent the spread of the disease among non-symptomatic patients who present to the EDs for care. This allows for a disease-centered work-up and safer diversion of Covid-19 patients to specific hospital units.

KEYWORDS
Emergency Department; novel Coronavirus; triage; pandemic

Introduction

In December 2019, the Chinese city of Wuhan faced the emergence of multiple cases of pneumonia from an unknown aetiology. In January 2020, specialists identified the pathogen as a coronavirus and finally named it severe acute respiratory syndrome-related coronavirus 2 (SARS-Cov2). The novel coronavirus was responsible for severe cases of pneumonia and started spreading among the population in Wuhan [1]. Despite strong measures to contain the virus from spreading, the epidemiological situation worsened dramatically due to the populations modern lifestyle, which led to more severe containment measures. On January 30th, the World Health Organization recognized the novel coronavirus as an international public health emergency. Within that time, Europe started to show signs of spread of the virus and, since then, a global pandemic was declared [2].

Global pandemics are recognized as historical facts only by the modern society. The current healthcare organization is facing a major health crisis with the management of this novel coronavirus disease (Covid-19). When compared to China, Europe had more time to be prepared, however, political challenges reflected a difficulty in evaluating which strategies would be most effective [3,4]. Recruitment of multiple medical personnel, acquiring necessary equipment, cancelling elective surgeries, increasing hospital bed capacities and creating crisis management teams may seem like extreme measures, but they become essential strategies to fight the consequences of a pandemic [5]. For Emergency Departments (ED), an additional stressor lies in identifying specific areas to deal with the inflow of patients. Indeed, rapid isolation of potentially infected patients seems to be an essential way to limit the spread of the epidemic [6,7].

EDs are known to be overcrowded and in the context of a pandemic, those departments are certainly among the first to see patients with suspected Covid-19. The use of specific triage centers is known to offer a buffer solution in many disaster situations [8]. Facing the present major pandemic status, the University Hospital of Liège decided to build a specific triage

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center close to the EDs. This Covid-19 Center was built with the aim to evaluate patients suspected to suffer from Covid-19, while other patients were being treated within the 'classical' EDs.

The main goal of the present study is to describe the role of this specific triage center for patients potentially infected with the novel coronavirus and to share our experience in the management of those Covid-19 suspected patients while retaining the usual treatment capabilities of emergency services for other usual patients.

Furthermore, we aim to describe the profile of patients who were admitted to those triage centers and analyze their characteristics, notably their initial symptoms at presentation in the ED's, their screening tests and results.

Methods

Study settings

The study was conducted in the Liège University Hospital EDs (CHU) composed of two different centers named the Sart Tilman site (CHU-ST) and ND Bruyères site (CHU-NDB). In total, these sites see 100,000 patients annually. CHU-ST is a tertiary care hospital in the suburban area of Liège while CHU-NDB is an urban secondary hospital. The present study was conducted during the first three weeks of March 2020, from March 2 to March 23, and included all patients suspected to be infected with the SARS-Cov2 and directed to the triage centers located close to the EDs.

The triage center

On the night of March 2, CHU-ST University Hospital was confronted with its first case of Covid-19. The patient presented with dyspnea and was not directly identified as a potentially Covid-19 patient. This experience made us aware of the real risk of intrahospital contamination if we did not take specific prevention measures. From the start, the important need to reduce the spread of the disease and restrict the risk of contamination to the rest of the organization, including the healthcare workers, became a stark reality. The same day, an innovative organization plan was discussed, and a specific area was assigned to assess patients with suspected Covid-19. In this way, such a triage zone was initially located within the CHU-ST site and several test days later, the same organization was developed in the CHU-NDB site. However, the assignment of a specific area for Covid-19 suspected patients into the ED was neither a totally appropriate nor a definitive solution. A few days later, we decided to open a new triage center outside the hospital, creating two different areas: one for the assessment of Covid-19 suspected patients and one for non-suspected patients. In practice, patients presenting to the EDs were triaged to evaluate if they presented Covid-19 suggestive symptoms. Patients without Covid-19 symptoms and free of suspicion were directed to the classical EDs, while the others were sent to the specific center. The assessment, work-up and management of Covid-19 suspected patients were all executed in the specific center. During the study period, patients were eligible to be screened for SARS-Cov2 if they presented one of the following criteria: respiratory symptoms and/or fever in a healthcare provider, an immunosuppressed patient or a nursing home resident, and all patients who required an admission to the hospital. The initial Covid-19 triage process is summarized in Figure 1.

The CHU-ST and CHU-NDB triage centers were composed of six monitored beds, one resuscitation room, one waiting room and three and two examination rooms, respectively. From their arrival to their discharge, patients suspected of SARS-Cov2 infection were treated in specific areas without contact with un-suspected patients. According to the severity of their condition, patients were either discharged home or hospitalized. Suspected cases in need of a hospitalization were directed to specific Covid-19 units. The establishment of the triage centers was made in only a few days resulting in a complete reorganization of the emergency departments to deal with the pandemic.

Data recruitment

From March 2 to March 23, all patients presented to the EDs were triaged at the EDs hospital and directed either to classical EDs or the Covid-19 Center. All patients admitted to the Covid-19 specific center were included in the study. Their characteristics were encoded in a data base by the investigators (age, gender, date and time of arrival, symptoms encountered, destination and outcome). The activity of the center was also monitored (patient flow, biological analysis performed, and radiological resources needed). Classical EDs activity was concomitantly monitored in term of patient flow. The number of SARS-Cov2 screening tests performed was noted. The screening tests were made with appropriate deep nasopharyngeal swab specimens and analyzed using the reverse-transcription polymerase chain reaction (RT-PCR) method. This method was chosen as the reference to distinguish SARS-Cov2 positive and negative populations.

Statistical analysis

Results were expressed as means ± standard deviations (SDs) for quantitative variables and as counts

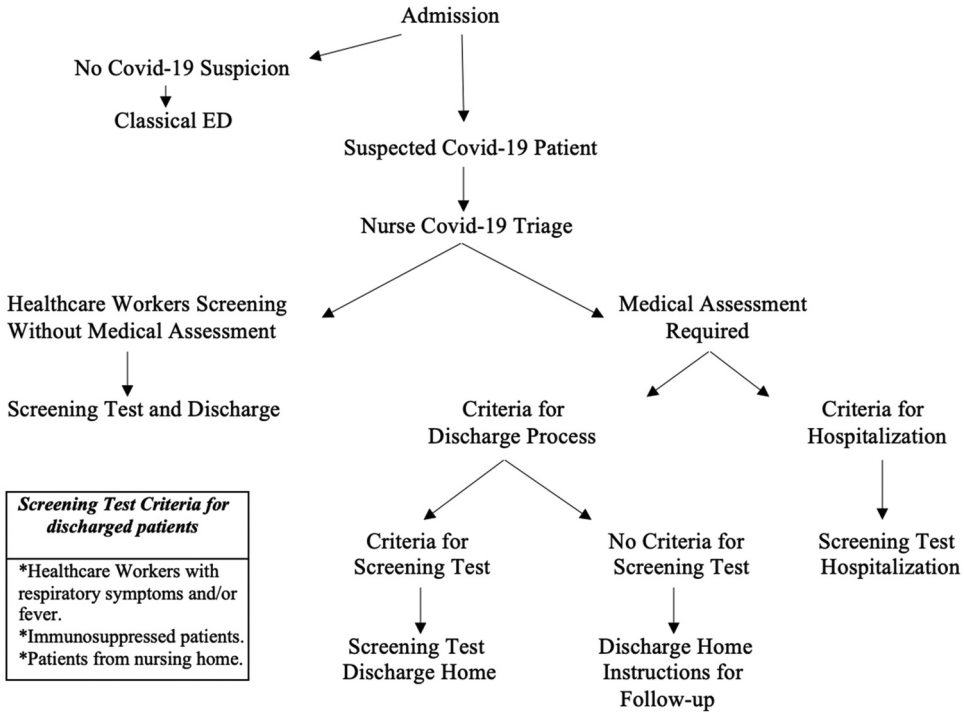

Figure 1. Triage process in the emergency department centers from 2 March to 23 March.

and percentages (%) for qualitative variables. The analyses were carried out using R statistical software.

Results

Participant characteristics

A total of 1071 patients was involved in the study with a mean age of 41.14 ± 20.66 years old [range: 0.1–-101 years]. The number of female patients was higher (n = 631, 58.90%) than male patients (n = 439, 41.00%). The characteristics of the patients are summarized in Table 1.

Triage centers patient flow

During the study, 1071 patients presented to the triage centers, among them 750 were admitted to the CHU-ST triage center and 321 to the CHU-NDB triage center from March 2 to March 23 (22 days). The mean admissions per day was 34.09 ± 22.69 [range: 5–88] at the CHU-ST Center and 21.4 ± 9.66 [range: 5–33] at the CHU-NDB triage center. Figure 2 depicts the patient admissions growth curve. During the interval of this study, the estimated mean of EDs admissions was 225.9 per day for the two sites. In comparison, patient attendance in March 2019 was 268 per day.

Novel SARS-Cov2 coronavirus screening

Among the total population (N = 1071), 598 patients (55.84%) were screened for the detection of SARS-Cov2 and 473 (44.16%) patients were not. Accordingly, 126 (39.25%) patients were tested at CHU-NDB and 472 (62.93%) at CHU-ST. Among the screened patients, 175 (29.26%, n = 598) were tested positive for SARS-Cov2, representing 16.34% of the total admissions to the two triage centers. The results are presented in Table 1.

Transmission risk factors

Among the population at the triage center, a transmission risk factor was found in 17.8% of the cases. Among them, 9.1% (n = 97) came back from an endemic country, 7.3% (n = 78) was in direct contact with a SARS-Cov2 positive patient and 1.4% (n = 15) of the patients was in contact with an asymptomatic person who was in contact with a SARS-Cov2 positive patient. In 82% (n = 878) of the cases, no risk factor for the virus transmission was found. The results are presented in Table 1.

The transmission risk factors were examined according to the SARS-Cov2 coronavirus screening. The results presented in Table 2 show that patients who tested negative for the SARS-Cov2 coronavirus seemed to be more exposed to the transmission risk factors. Specifically, 53 (12.50%) patients had traveled to an endemic country but tested negatively compared to 9 (5.10%) of those who tested positively.

Symptoms

The population used for this study with a specific medical record represented 1030 patients while 41 files were lost due to patient movements.

Table 1. Socio-demographics, screening and testing results, and symptoms exhibited by the patients according to triage centers.

Variable	Categories	Number (%) CHU-NDB (n = 321)	CHU-ST (n = 750)	Both sites (N = 1071)
Gender	Male	157 (48.90)	282 (37.60)	439 (41.00)
	Female	164 (51.10)	467 (62.30)	631 (58.90)
	Missing	0 (0.00)	1 (0.10)	1 (0.10)
Age group (M = 41.14 ± 20.66)	0–9 years	92 (28.70)	5 (0.70)	97 (9.10)
	10–19 years	18 (5.60)	28 (3.70)	46 (4.30)
	20–29 years	34 (10.60)	125 (16.70)	159 (14.80)
	30–39 years	37 (11.50)	175 (23.30)	212 (19.80)
	40–49 years	39 (12.10)	161 (21.50)	200 (18.70)
	50–59 years	32 (10.00)	123 (16.40)	155 (14.50)
	60–69 years	32 (10.00)	78 (10.40)	110 (10.30)
	70–79 years	20 (6.20)	34 (4.50)	54 (5.00)
	> 80 years	17 (5.29)	21 (2.80)	38 (3.55)
Screening Test	Yes	126 (39.25)	472 (62.93)	598 (55.84)
	No	195 (60.75)	278 (37.07)	473 (44.16)
Covid-19 testing result	Positive	35 (27.80)	140 (18.70)	175 (29.26)
	Negative	91 (72.20)	332 (44.30)	423 (70.74)
Transmission risk factor	Travel in endemic country	3 (0.90)	94 (12.50)	97 (9.10)
	Contact with positive patients	10 (3.10)	68 (9.10)	78 (7.30)
	Contact with asymptomatic person who was in contact with a positive patient	1 (0.30)	14 (1.90)	15 (1.40)
	Unknow origin	307 (95.60)	571 (76.10)	878 (82.00)
	Missing	0 (0.00)	3 (0.40)	3 (0.30)
Symptoms	Asymptomatic	2 (0.60)	6 (0.80)	8 (0.70)
	Upper respiratory tract infection (sore throat, nasal congestion, sneezing, mild fever)	62 (19.30)	165 (22.00)	227 (21.20)
	Isolated fever	18 (5.60)	5 (0.70)	23 (2.10)
	Isolated headache	0 (0.00)	5 (0.70)	5 (0.50)
	Flu-like symptoms (myalgia, asthenia, fever)	110 (34.30)	335 (44.70)	445 (41.50)
	Mild lower respiratory tract infection (cough, fever, sputum)	91 (28.30)	160 (21.30)	251 (23.40)
	Moderate lower respiratory tract infection (cough, fever, sputum, dyspnea)	20 (6.20)	30 (4.00)	50 (4.70)
	Respiratory distress (dyspnea, cough, fever, low oxygen saturation)	8 (2.50)	7 (0.90)	15 (1.4)
	Digestive symptoms (diarrhea, nausea)	3 (0.90)	3 (0.40)	6 (0.6)
	Missing	7 (2.18)	34 (4.50)	41 (3.8)
Thoracic x-ray	Imaging	29 (9.00)	79 (10.50)	108 (10.10)
	No imaging	292 (91.00)	671 (89.50)	963 (89.90)
Chest computed tomography (CT)	Imaging	55 (17.10)	83 (11.10)	138 (12.90)
	No imaging	266 (82.90)	667 (88.90)	933 (87.10)
Lung ultrasound	Imaging	1 (0.30)	12 (1.60)	13 (1.20)
	No imaging	320 (99.70)	738 (98.40)	1058 (98.80)
Destination	Self-isolation at home	238 (74.10)	651 (86.80)	889 (83.00)
	Covid-19 intensive care unit (n = 11, 55% SARS-Cov2 Positive)	6 (1.90)	14 (1.90)	20 (1.90)
	Covid-19 classical unit (n = 58, 35.58% SARS-Cov2 Positive)	77 (24.00)	85 (11.30)	162 (15.10)

Among the studied population (N = 1030), 41.50% (n = 445) presented flu-like symptoms, 23.40% (n = 251) mild lower respiratory tract infection symptoms, 21.20% (n = 227) upper respiratory tract infection symptoms, 4.70% (n = 50) moderate lower respiratory tract infection symptoms, 2.10% (n = 23) isolated fever, 1.40% (n = 15) respiratory distress symptoms, 0.70% (n = 8) were asymptomatic, 0.6% (n = 6) presented digestive symptoms and finally, 0.5% (n = 5) presented with isolated headache. The results are summarized in Table 1.

The symptoms encountered in the SARS-Cov2 positive population and in the SARS-Cov2 negative population (n = 598) are detailed in Table 3. Among the positively tested patients, the three most observed symptoms were: flu-like (n = 81, 46.3%), mild lower respiratory tract infection (n = 37, 21.10%) and moderate lower respiratory tract infection (n = 21, 12.00%). On the other hand, upper respiratory tract infection symptoms (n = 109, 25.80%) and mild lower respiratory tract infection symptoms (n = 81, 19.10%) were the second and third most observed symptoms in negatively tested patients after the most observed flu-like symptoms (n = 162, 38.30%).

Resource utilization

As shown in Table 1, a thoracic x-ray was required in 10.10% (n = 108) of the cases. Chest computed tomography (CT) was performed in 12.90% of the patients (n = 138) while practitioners used lung ultrasound in 1.20% of the cases (n = 13).

Patients' destination

Among the global population (N = 1071), 83.00% (n = 889) of the patients were discharged home while 17.00% (n = 182) were admitted to the hospital.

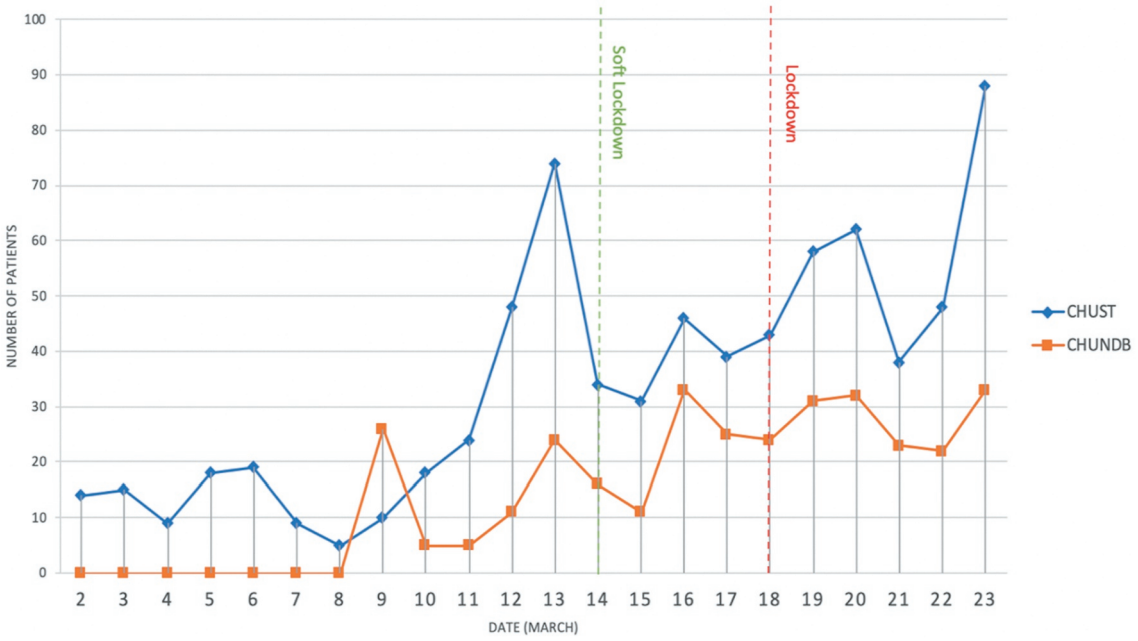

Figure 2. Patients' admissions growth curve for both CHU sites (CHU ST and CHUNDB) and the dates of soft lockdown and complete lockdown.

Table 2. Transmission risk factors reported in the SARS-Cov2 positive group compared with the SARS-Cov2 negative group.

	Number (%)	
Transmission risk factors	SARS-Cov2 Positive (n = 175)	SARS-Cov2 Negative (n = 423)
Travel in endemic country	9 (5.10)	53 (12.50)
Contact with positive patients	19 (10.90)	38 (9.00)
Contact with asymptomatic person who was in contact with a positive patient	3 (1.70)	8 (1.90)
Unknow origin	144 (82.30)	321 (75.90)
Missing	0 (0.00)	3 (0.70)

Table 3. Symptoms encountered in the SARS-Cov2 positive population compared with the SARS-Cov2 negative population.

	Number (%)	
Symptoms	SARS-Cov2 Positive (n = 175)	SARS-Cov2 Negative (n = 423)
Flu-like symptoms (myalgia, asthenia, fever)	81 (46.3)	162 (38.30)
Mild lower respiratory tract infection (cough, fever, sputum)	37 (21.10)	81 (19.10)
Moderate lower respiratory tract infection (cough, fever, sputum, dyspnea)	21 (12.00)	27 (6.40)
Upper respiratory tract infection (sore throat, nasal congestion, sneezing, mild fever)	18 (10.30)	109 (25.80)
Respiratory distress (dyspnea, cough, fever, low oxygen saturation)	5 (2.90)	9 (2.10)
Isolated fever	5 (2.90)	7 (1.70)
Asymptomatic	0 (0.00)	1 (0.20)
Isolated headache	0 (0.00)	3 (0.70)
Digestive symptoms (diarrhea, nausea)	0 (0.00)	3 (0.70)
Missing	8 (4.60)	21 (5.00)

Among those hospitalized patients (N = 182), 15.10% (n = 162) were admitted into a Covid-19 Unit and 1.9% (n = 20) were in the Covid-19 intensive care unit (ICU). Out of the population of patients in Covid-19 classical units, 35.8% (n = 58) were positive for SARS-Cov2 infection. Among the Covid-19 ICU admitted patients, 55% (n = 11) were confirmed positive for SARS-Cov2 infection. These results are presented in Table 1.

Discussion

Belgium was confronted with the first Covid-19 patient on 4 February 2020. This patient was a Belgian traveler who was evacuated from Wuhan and directly quarantined at the Saint Pierre Hospital in Brussels. The disease spread to the Belgian territory after the 2 March 2020 when many travelers came back from their holidays, mainly from Italy.

Facing the spread of the disease among the Belgian population, EDs were in need of a solution to appropriately manage those patients who were potentially infected. Different measures have been proposed to help healthcare facilities and practitioners in the management of novel coronavirus infected patients. Providing the population with better information about when to seek care and the possibility of adopting a 'wait and see' attitude for patients in containment at home was one of those proposals. Indeed, primary care physicians in Belgium were confronted with a lack of appropriate medical equipment (personal protective equipment, PPE) limiting the possibility of visiting patients at home. However, many patients were in need of medical attention, either related to a specific health condition or due to anxiety caused by the pandemic. Telehealth, such as telephone consultations or other digital systems, have been proposed as a solution to establish a contact between general practitioners and patients leading to a better feeling of

safety for the patients and the possibility to continue to follow fragile patients with chronic diseases at home [9,10]. Regardless of the pandemic, many patients still needed a physical examination by a doctor, additional diagnostic procedures or hospitalization. Unable to see their own doctors, the only solution left to those patients was to seek help in the EDs, this use of EDs represented an organizational dilemma. Knowing that managing non-infected patients in the same area as potentially infected patients is correlated with a major risk of spreading the disease among the population and hospital units, EDs sought another option.

Creating two different wards (a clean ward and an infected ward) is not an easy task. Indeed, SARS-Cov2 associated symptoms are mainly nonspecific as demonstrated by our 3 weeks experience and in agreement with previous reports [11]. Flu-like symptoms (fever, myalgia, asthenia) were the main complaints of the admitted patients. While in the SARS-Cov2 positive population, symptoms of moderate lower tract respiratory infection tend to be more frequent than in the SARS-Cov2 negative population, none of those symptoms are specific of Covid-19. Conversely, symptoms of upper respiratory tract infection seem to be more predominant in the SARS-Cov2 negative population but likewise, this statement does not permit a clear differentiation between the two populations in an ED admission triage. This is the reason why the vast majority of visits were directed to the Covid-19 triage center with appropriate personal protective equipment, droplet and contact precautions.

Specific wards for potentially infected patients are even more important because the assessment of the risk of infection by SARS-Cov2 based on potential contamination risk factors is scarce. If at the beginning of the pandemic state, some travelers were clearly identified, this trend did not last. Globally, about half of the patients were not associated with a particular risk of transmission. This is probably related to the fact that at this point, the virus was spreading freely on the Belgian territory.

An interesting point of epidemiological data is that we observed similarities between the variability of ED Covid-19 related admissions in the CHU-ST and CHU-NDB sites even if those centers differ in terms of functions and characteristics as previously mentioned. It is difficult to evaluate their exact meanings but we believe this is potentially due to episodes of patients' exposure to the virus in the Liège area. Regarding non-suspected patients, we noted a slow decrease of admissions, which probably need further investigation.

Another aspect of the value of specific triage centers is the ability of healthcare workers to be appropriately trained to use the particular medical equipment and to be aware of the specific screening criteria. Indeed, in Belgium, strict criteria for Covid-19 screening were imposed by the government. Among the population presenting to the triage center during the study, 55.84% have been screened. The rest of the suspected patients (44.16%) were discharged home with advice to self-isolate. Triage, work-up and follow-up measures were discussed weekly by a specific Covid-19 team to inform and train healthcare workers at the centers. Indeed, a thoughtful organization is the key to improve care in such an uncomfortable time for patients and healthcare providers [12,13].

An important aspect of specific triage centers is the collaboration with specialized Covid-19 Hospital Units and ICUs. Around 83.00% of the patients were sent home the same day. Concerning the 17.00% of those in need of a hospitalization, the ability of the hospital to directly provide a bed in a specific isolated ward is an additional protection to limit the spread of the virus into the different clean hospital units. Indeed, the population which required hospitalization was directly admitted either in Covid-19 classical units (15.10%) or in Covid-19 ICU (1.90%) pending the results of the screening tests. It is far more important in the ICU to be cautious, where more than half of the suspected patients were confirmed SARS-Cov2 positive, and yet they were in an environment where there was serious risk of transmission of the virus to fragile patients.

The same way, a certain autonomy in terms of imaging is required since the transport of a potentially infected patient to the usual radiology department can lead to deleterious consequences including increased exposure. From the start, the triage center was independent for x-rays but given the essential role of chest CT for this particular condition, it lead to the implementation of a specific CT device into the triage center [14].

Limitations

A potential bias of the SARS-Cov2 positive and negative populations is the possibility of false negative PCR which is unfortunately hard to evaluate. However, no negative patients came back to the EDs with another test revealing positive results.

Conclusion

Facing a major pandemic is not an easy task for ED practitioners. The establishment of specific triage centers close to the ED is a crucial strategy to decrease the spread of the disease among other inpatients and healthcare workers. The identification of the SARS-Cov2 infected patients at the time of initial triage is difficult because symptoms are mainly nonspecific and can be related to other viral or bacterial infections. Moreover, the assessment of the risk of exposure to the virus tend to be more difficult as the epidemic progresses because no obvious transmission risk factors are identified. Triage and work-

up in specific areas outside the classical EDs permit the patient's orientation to the appropriate hospital unit without risk of contamination of the other non-infectious hospital areas.

Disclosure statement

The authors report no conflict of interest.

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