

EDITORIAL

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Italy and COVID-19: the changing patient flow in an orthopedic trauma center emergency department

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On 12 March 2020, the World Health Organization declared a pandemic by Coronavirus disease (COVID-19) [1]. Despite the lockdown measures adopted to stop the spread of SARS-CoV-2, we are dangerously close to 400,000 deaths worldwide [2].

In Northern Italy, the overwhelming number of COVID-19 patients required a complete reorganization of the healthcare system [3, 4]: wards were converted into COVID-19 care units, and deferrable surgeries and outpatient consultations were suspended. Some hospitals were designated hubs for specific urgent conditions [5], with the need to maximize resources and reduce patient crowding, reducing potential nosocomial COVID-19 spread.

Major changes in the patient flow at the emergency department (ED) of Galeazzi Orthopaedic Institute in Milan, a major trauma center, were evident. The analysis of this aspect during the first month of the pandemic (12 March to 12 April 2020) compared to the same period in 2019 demonstrated marked differences in length of emergency department stay, request for chest radiographs, discharge diagnosis, triage color-code at admission and discharge (*white code*: non-urgent patients; *green code*: urgent but non-critical patients; *yellow code*: fairly critical patients; *red code*: patients at danger of death), and emergency department arrival and discharge modalities.

The number of patients in this 1-month period was 2558 in 2019 and 670 in 2020, an overall patient flow reduction of 73.8%. Patients' demographics and diagnoses at discharge are summarized in Table 1. Average patients' age was significantly higher in 2020 than in 2019 ($t_{(3226)} = 14.75$, $p < 0.0001$), with a marked reduction in the number of pediatric emergencies (age ≤ 18 years old) during lockdown (OR 0.31, 95% CI 0.23–0.42, $p < 0.0001$). The mean emergency department length of stay significantly decreased in 2020 ($t_{(3226)} = 10.85$, $p < 0.0001$). Furthermore, during the pandemic, more chest plain radiographs were requested (OR 6.11, 95% CI 4.81–7.77, $p < 0.0001$). The number of patients discharged with a diagnosis other than "fracture" (therefore including sprains, contusions, back pain) was markedly reduced (OR 0.24, 95% CI 0.20–0.28, $p < 0.0001$) in 2020. On the other hand, both proximal femoral fractures showed a remarkable increase (OR 13.6, 95% CI 9.31–19.85, $p < 0.0001$) during the pandemic, as did the overall rate of fragility fractures in the elderly (OR 7.57, 95% CI 5.87–9.76, $p < 0.0001$).

Table 2 reports the triage codes at admission and discharge. A reduction of 8.9% and 14.1% for white and green codes, respectively, was found in the pandemic month. As expected, comparing the walking wounded (green and white codes) and urgent patient (yellow and red codes) rates in 2019 and 2020, an odds ratio of 0.12 (95% CI 0.09–0.15, $p < 0.0001$) was found. Similarly, triage at discharge presented a reduction of the white codes and a relative increase of all the other triage categories (OR 0.56, 95% CI 0.44–0.70, $p < 0.0001$).

The rate of patients brought to emergency department by ambulance increased in 2020 (Table 2) (OR 5.56, 95% CI 4.52–6.84, $p < 0.0001$). Finally, in 2020 more patients

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Table 1 Demographics and clinical data in standard and pandemic conditions

		NG	PG	Absolute variation	Relative variation
Sex: N (%)	Male	1323 (51.7)	297 (44.3)	- 77.5%	- 7.4%
	Female	1235 (48.3)	373 (55.7)	- 69.5%	7.4%
Age: mean ± SD (years)		41.2 ± 23.5 [0, 98]	56.3 ± 23.9 [0, 99]	36.7%	-
ED stay ± SD (min)		146 ± 63 [2, 839]	106 ± 140 [5, 180]	- 27.4%	-
Pediatric patients (%)		633 (24.7)	62 (9.2)	- 90.2%	- 15.5%
Chest radiographs (%)		145 (5.7)	180 (26.9)	24.1%	21.2%
Diagnosis (%)	Clavicle fractures	13 (0.5)	5 (0.7)	- 61.5%	0.2%
	Proximal humeral fractures	30 (1.2)	25 (3.7)	- 16.7%	2.5%
	Humeral shaft fractures	2 (0.1)	8 (1.2)	300%	1.1%
	Elbow fractures	45 (1.7)	14 (2.1)	- 68.9%	0.4%
	Wrist and hand fractures	202 (7.9)	73 (10.9)	- 63.9%	3%
	Vertebral fractures	15 (0.6)	6 (0.9)	- 60%	0.3%
	Proximal femoral fractures	38 (1.5)	114 (17.0)	200%	15.5%
	Other femoral fractures	6 (0.2)	9 (1.4)	50%	1.2%
	Patellar fractures	15 (0.6)	5 (0.7)	- 66.7%	0.1%
	Tibia fractures	27 (1.1)	12 (1.8)	- 44.4%	0.7%
	Foot and ankle fractures	161 (6.3)	59 (8.8)	- 63.4%	2.5%
	Pneumonia	3 (0.1)	14 (2.1)	366.7%	2%
	Other	2001 (78.2)	336 (48.7)	- 83.2%	- 29.5%
Total		2558	670	- 73.8%	

SD standard deviation, NG non-pandemic group (2019), PG pandemic group (2020)

were hospitalized and fewer were discharged home (OR 10.72, 95% CI 8.23–13.97, $p < 0.0001$).

COVID-19 produced not only an overcrowding of healthcare facilities by patients with severe respiratory syndromes, but also a change in emergency department patient flow. There was a marked reduction in the number of pediatric emergency in this pandemic period and an increased proportion of proximal femoral fractures. The pattern of emergency department outflow also changed, with a significant reduction of the emergency department stay, an increase of 25% in patients requiring urgent hospital admission, and a decrease of 24% in patients discharged at home.

Since 10 March 2020, the Italian populace have been allowed to leave home only for proved and undefeatable reasons such as work (i.e., healthcare professionals), buying food or essential goods, and urgent health reasons. Restriction of social contacts, open-air activities, and sports performed in gyms and swimming pools were deemed the safest measure in the absence of a vaccine and efficient medical therapies [6–8]. These measures led to a drop of patients presenting for non-urgent chronic reasons (such as tendinopathy, back pain, osteoarthritis-related pain), sports-related injuries (sprains, contusions, dislocations, minor fractures), and minor road accidents. Therefore, fewer minor traumas came to emergency department, explaining the decreasing percentages of non-

urgent admission codes, autonomous emergency department arrivals, and home discharge. For the same reasons, pediatric emergencies decreased by 15.5%. On the other hand, trauma was concentrated in regional hubs, leading to a greater number of patients with severe trauma requiring surgery: fragility fractures, such as those involving proximal femur especially, and humerus, vertebral, and pelvic branch fractures in older adults, increased in percentage during lockdown.

The COVID-19 pandemic has led to an increase in the number of required chest plain radiography, usually needed only in case of rib fractures or for patients over 45 years before surgical treatment. Patients admitted for COVID-19 share with femoral fractures common features such as the arrival by ambulance, the yellow code at admission, and the rapid admission to hospital. Nevertheless, the increase in yellow code patients was only 6.2% compared to 2019.

The first month of COVID-19 pandemic led to a 73% reduction in the overall emergency department patient flow of our Regional Trauma Hub, specifically set up in response to this worldwide disaster. A similar decrease in emergency department patient flow was reported in Canada, Taiwan, and Hong Kong during the SARS epidemic (2003–2004), and this should be partially attributed to people's perception of the emergency department as a place of infection [9–11].

Table 2 Priority categories (triage code) at admission and discharge in standard and pandemic conditions

Triage Code		Non-Pandemic Group (2019)		Pandemic Group (2020)		Absolute variation	Relative variation
Admission	White code ●	647	25.3%	110	16.4%	-83.0%	-8.9%
	Green code ●	1804	70.5%	378	56.4%	-79.0%	-14.1%
	Yellow code ●	107	4.2%	178	26.6%	66.4%	22.4%
	Red code ●	0	0.0%	4	0.6%	400.0%	0.6%
Discharge	White code ●	579	22.6%	94	14.0%	-83.8%	-8.6%
	Green code ●	1946	76.1%	523	78.1%	-73.1%	2.0%
	Yellow code ●	33	1.3%	50	7.5%	51.5%	6.2%
	Red code ●	0	0.0%	3	0.4%	400.0%	0.4%
ED arrival mode							
Ambulance		232	9.1%	239	35.7%	3.0%	26.6%
By themselves		2322	90.8%	421	62.8%	-81.9%	-27.9%
Police service		2	0.1%	10	1.5%	400.0%	1.4%
Not reported		2	0.1%	0	0.0%	-100.0%	-0.1%
ED discharge mode							
Home		2305	90.1%	439	65.5%	-81.0%	-24.6%
Admission to hospital		96	3.8%	196	29.3%	104.2%	25.5%
Other		157	6.1%	35	5.2%	-77.7%	-0.9%
Total		2558		670		-73.8%	

Emergency department arrival mode and emergency department discharge mode in the two conditions
 ED emergency department

In this COVID-19 era, frontline medical staff in emergency departments are facing new challenges to diagnose and treat patients [12]. Understanding the trend of patient flow in a trauma hub emergency department is important to better manage the preventive isolation of each patient attending this service. A key strategic element is demand forecast to help staff to plan their activities in the long and the short-term [13]. The effects of the worldwide pandemic on several surgical activities have been scantily reported [14–16]. For what concerns emergency department, reports have been focusing only on targeted SARS-CoV-2 test programs [17–19].

Social isolation certainly reduced the risk of trauma among the general population, and the fear of contagion probably kept non-urgent patients away from the emergency department. Evidence-based programs are fundamental to identify new strategies to maximize National Health System resources and decrease the time which patients spend in the emergency department, reducing overcrowding.

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FL: study design, data collection, original draft preparation; IM: manuscript correction, statistical analysis; RA: manuscript correction; LM: manuscript correction; NM: study design and supervision, manuscript correction; GMP: study design and supervision, manuscript correction. The author(s) read and approved the final manuscript.

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Competing interests

None.

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