Received: 12 March 2021 | Revised: 22 May 2021 | Accepted: 22 May 2021

DOI: 10.1111/eci.13623

ORIGINAL ARTICLE

WILEY

Impact of COVID-19 lockdown on routine oncology versus emergency care at a high volume cancer centre

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Funding information
No funding has been obtained for the conduct of this study.

Abstract

Background: We investigated the influence of population-wide COVID-19 lockdown measures implemented on 16, March 2020 on routine and emergency care of cancer outpatients at a tertiary care cancer centre in Vienna, Austria.

Methods: We compared the number/visits of cancer outpatients receiving oncological therapies at the oncologic day clinic (DC) and admissions at the emergency department (ED) of our institution in time periods before (pre-lockdown period: 1 January – 15 March 2020) and after (post-lockdown period: 16 March– 31 May 2020) lockdown implementation with the respective reference periods of 2018 and 2019. Additionally, we analysed Emergency Severity Index (ESI) score of unplanned cancer patient presentations to the ED in the same post-lockdown time periods. Patient outcome was described as 3-month mortality rate (3-MM).

Results: In total, 16 703 visits at the DC and 2664 patient visits for the respective time periods were recorded at the ED. No decrease in patient visits was observed at the DC after lockdown implementation ($P = .351$), whereas a substantial decrease in patient visits at the ED was seen ($P < .001$). This translates into a 26%-31% reduction of cancer-related patient visits per half month after the lockdown at the ED ($P < .001$ vs. 2018 + 2019). There was no difference in the distribution of ESI scores at ED presentation ($P = .805$), admission rates or 3-MM in association with lockdown implementation ($P = .086$).

Conclusion: We demonstrate the feasibility of maintaining antineoplastic therapy administration during the COVID-19 pandemic. However, our data underline the need for adapted management strategies for emergency presentations of cancer patients.

KEYWORDS

COVID-19, lockdown, oncology, oncologic basic care, oncologic emergency

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1 | INTRODUCTION

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is an enveloped RNA betacoronavirus causing COVID-19. Initially reported in Wuhan in the Chinese province of Hubei,[1] the World Health Organization (WHO) classified COVID-19 as a worldwide pandemic on 11 March 2020.[2] The symptoms of COVID-19 are heterogeneous and range from asymptomatic courses to (potentially) lethal acute respiratory distress syndrome (ARDS)[1] with a greatly varying case fatality rate (0.3% – 2.9%) in different regions. Age seems to be one of the most relevant risk factors with death rates exceeding 15% in patients >80 years.[1] Furthermore, high mortality rates have also been reported for patients with comorbidities (11% for patients with cardiovascular disease, 7% for diabetes and 6% for patients with chronic obstructive lung disease).[1]

Cancer patients appear to be at higher risk for COVID-19-associated complications, more intensive care unit (ICU) admissions and an increased mortality rate.[3,4] While two studies implied that active cytotoxic therapy is associated with severe COVID-19 courses and a higher mortality rate,[5,6] other studies did not find evidence of increased mortality in the context of ongoing antineoplastic therapy.[7,8] Additionally, a retrospective study with a total of 309 patients did not identify an association between active treatment and mortality. Notably, haematologic malignancies, lung cancer, lymphopenia and neutropenia were associated with dismal COVID-19 outcomes.[9] A European study showed that mortality is driven rather by age, comorbidities and COVID-19 complications than by active treatment in cancer patients.[10]

Patients with malignancies, however, may be especially susceptible to limitations of healthcare resources caused by effects of the pandemic.[11] A British population-based study estimated a substantial increase in cancer-specific mortality due to diagnostic delays for breast (7.9 - 9.6%), colorectal (15.3 - 16.6%), oesophageal (5.8 - 6.0%) and lung cancer (4.8 - 5.3%) up to 5 years after the initial diagnosis.[12] Current guidelines agree that patients with imminent risk of early cancer-related mortality (eg acute leukaemia, aggressive lymphomas, germ cell tumours, spinal cord compression) or patients with a greater magnitude of treatment benefit (eg curative radiochemotherapy for head and neck cancer, neoadjuvant or adjuvant therapy with substantial benefit) should not be withheld from treatment during the COVID-19 pandemic.[13]

Continuing oncological care also requires an operational emergency care unit in order to manage treatment- and malignancy-associated complications or emergencies.

In Austria, a strict lockdown was imposed during the first wave of SARS-CoV-2 infections between 16th of March and 29th of May 2020 and a series of measures were implemented. On the hospital's institutional level, additional safety measures were set up including a separate access point for oncological patients with structured controls by healthcare professionals, repeated SARS-COV-2 PCR-testing, restricted access for caregivers and visitors and minimization of hospital staff presence. However, by restricting access to hospitals, the physical as well as the psychological threshold for oncological patients to receive either standard therapies or emergency care might have been increased.

The objective of this retrospective analysis was therefore to detect potential lockdown-associated influences on cancer care as reflected by a potential decrease of oncological patient visits at both our DC for intravenous antineoplastic therapies as well as cancer-related visits at our ED during the first lockdown compared to the same period in the years 2018 and 2019.

2 | METHODS

This analysis was approved by the ethics committee of the Medical University of Vienna (vote number 1860/2020 and 1860/2017). Reporting of the study conforms to broad EQUATOR guidelines.[14]

2.1 | Observation periods

We defined the following observation periods: 1 January 2018 - 15 March 2018 ('reference period I 2018'), 16 March – 31 May 2018 ('reference period II 2018'); 1 January 2019 - 15 March ('reference period I 2019'), 16 March – 31 May 2019 ('reference period II 2019') and 1 January– 15 March 2020 ('pre-lockdown period') and 16 March – 31 May 2020 ('post-lockdown period') for this retrospective study.

2.2 | Patient cohorts

2.2.1 | DC cohorts

All patients with solid cancer treated at our oncologic DC during reference periods 2018/2019 and the pre- and post-lockdown period 2020 were included.

2.2.2 | ED cohort

The ED cohorts included all patients presenting with a malignant disease at the ED during reference period I + II 2018, reference period I + II 2019 and the pre-/post-lockdown period 2020. We have re-analysed the medical records of all ED visits between 1 March and 31 May of 2018 - 2020 ('investigational period') to identify patients with active cancer.

Malignancy-related emergency (MRE) presentations were defined as ED presentations by patients with active cancer either treated with systemic palliative therapy or best supportive care. Additionally, cancer patients treated with curative intent and undergoing adjuvant chemotherapy (excluding adjuvant hormonal therapy) were included. Patient visits in each year of the investigational periods were counted as individual patient visits.

2.3 | Data collection

Patient data were extracted and processed according to the General Data Protection Regulation 2016/679 from the electronic medical record (EMR) and controlled by licensed physicians (CM, TF and GJ). For ED and DC patients, demographic data and oncologic diagnoses were collected. At the ED, all patients with an ICD-10 diagnosis of cancer were initially included. Furthermore, for ED patients in the investigational periods, date of death, leading symptom for emergency visit, discharge diagnosis, inpatient admission, length of inpatient stay and Emergency Severity Index (ESI) score[15,16] at admission to the ED were recorded.

Outcome parameters included the comparison of the numbers of admissions to DC and ED between reference periods 2018, reference periods 2019 and the pre- and post-lockdown period 2020. The frequency of inpatient admission, length of inpatient stay, ESI score and 3-month mortality (3-MM) for ED patients was compared between the post-lockdown period 2020 with the respective reference periods 2018 and 2019.

2.4 | Statistical analysis

Age of patients is reported by median and range. Proportions of the most common malignancies are reported and juxtaposed for the reference periods and lockdown periods 2020. To better visualize patient frequencies, the data were aggregated by half month, since the lockdown was issued on 16 March 2020. Numbers of admissions to DC and ED per half month are represented as line diagrams. To investigate changes in patient numbers after the lockdown, linear models were analysed for the number of admissions to the DC and the ED, with the main effects year and period (reference periods I and II resp. pre- and post-lockdown period) as defined above and an interaction term between year and period. In a sensitivity analysis, the transition from pre- to post-lockdown was shifted from March 16 to March 1, when public awareness of the COVID-19 pandemic was already highly present. Additionally, number of admissions to the ED per half month beginning with March 16 were compared between all three years by an ANOVA.

To achieve a higher resolution for the analysis of developments of admission numbers, we considered every half month separately in Poisson regression models with the main effects year and half month and interaction eligible for stepwise variable selection according to Akaike information criterion. Estimates of the Poisson regression models are reported as exponential functions, allowing to deduce ratios of case numbers to the reference timepoint for the main effects year and half month and in case of interaction, to deduce the ratio of case numbers between two time points compared to the ratio of case numbers in the reference year (2019).

ESI scores were analysed by a linear model with the effects year and half month. Effects of year and of half month on 3-MM were analysed by a chi-square test.

3 | RESULTS

In total, 2883 patients and 16 703 visits were recorded at the DC (Figure S1). The majority of patients were female (1543/2883; 53.52%) (Figure S1); the median age was 65 years (range; 18 - 93). The most prevalent malignancies were breast cancer (516/2883; 17.90%), lung cancer (482/2883; 16.72%), pancreaticobiliary cancer (326/2883; 11.31%) and colorectal cancer (324/2883; 11.24%) (Table 1).

At the ED, we recorded a total of 2664 patient visits with an ICD-10 code for cancer for the respective time periods (Figure S1). In the investigational period, 1372 cancer patients were admitted for 1570 visits, with 524 (54.36%) being male and 440 (45.46%) female. This ratio remained almost unchanged when the years were analysed separately (Table 2). The majority of patients (84.75%) were in a palliative setting. Most frequently lung cancer patients consulted the ED (166/1372; 17.22%), followed by breast cancer patients (92/1372; 9.54%), patients with pancreaticobiliary cancer (86/1372; 8.92%) and prostate cancer patients (69/1372; 7.16%) (Table 2). Both the distribution of cancer types and the median age (68 years; range; 19-97) were similar for the three years analysed (Table 2).

3.1 | Differences between patient frequencies at the DC and the ED during the lockdown

DC patient frequencies suggest an overall decrease of treatment numbers in 2020 compared to the preceding years (Figure 1A). However, this can rather be explained by a reduction of patient referrals from other federal states than Vienna as established by the hospital`s management board than by lockdown measures. A linear model for the number of admissions to the DC with the two main effects year and period and an interaction term identified significantly less admissions per half month to the

TABLE 1 Patient characteristics at de DC for the reference and lockdown periods

Oncologic Day Clinic	Total (%)	2018 (%)	2019 (%)	2020 (%)
Patients	2883 (100)	977 (100)	1026 (100)	880 (100)
male	1340 (46.48)	447 (45.75)	484 (47.17)	409 (46.48)
female	1543 (53.52%)	530 (54.25)	542 (52.83)	471 (53.52)
median age	65 (18 - 93)	63 (18 - 93)	63 (19 - 92)	64 (19 - 93)
Diagnosis	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Anal Carcinoma	7 (0.24)	1 (0.10)	4 (0.39)	2 (0.23)
Breast Cancer	516 (17.90)	189 (19.34)	181 (17.64)	146 (16.59)
Colorectal Cancer	324 (11.24)	113 (11.57)	117 (11.40)	94 (10.68)
CUP	31 (1.08	7 (0.72)	12 (1.17)	12 (1.36)
Gastroesophageal Cancer	113 (3.92)	34 (3.48)	42 (4.09)	37 (4.20)
Gynaecologic Malignancy	35 (1.21)	18 (1.84)	10 (0.97)	7 (0.80)
Head and Neck Cancer	193 (6.69)	61 (6.24)	66 (6.43)	66 (7.50)
Hepatocellular Cancer	5 (0.17)	0 (0.00)	2 (0.19)	3 (0.34)
Lung Cancer	482 (16.72)	139 (14.23)	171 (16.67)	172 (19.55)
Lymphoma	82 (2.84)	32 (3.28)	29 (2.83)	21 (2.39)
Melanoma	10 (0.35)	4 (0.41)	4 (0.39)	2 (0.23)
Mesothelioma	18 (0.62)	9 (0.92)	4 (0.39)	5 (0.57)
Non-Melanoma Skin Cancer	8 (0.28)	2 (0.20)	3 (0.29)	3 (0.34)
Other	38 (1.32)	12 (1.23)	14 (1.36)	12 (1.36)
Pancreaticobiliary Cancer	326 (11.31)	127 (13.00)	116 (11.31)	83 (9.43)
Plasma cell Dyscrasia	311 (10.79)	104 (10.64)	122 (11.89)	85 (9.66)
Primary CNS Malignancy	61 (2.12)	17 (1.74)	23 (2.24)	21 (2.39)
Prostate Cancer	31 (1.08)	11 (1.13)	7 (0.68)	13 (1.48)
Renal Cell Carcinoma	103 (3.57)	31 (3.17)	37 (3.61)	35 (3.98)
Sarcoma	161 (5.58)	51 (5.22)	55 (5.36)	55 (6.25)
Testicular Cancer	6 (0.21)	2 (0.20)	3 (0.29)	1 (0.11)
Urothelial Carcinoma	22 (0.76)	13 (1.33)	4 (0.39)	5 (0.57)

DC in the pre-lockdown period compared to the reference period I in 2019 (−75.6 patients per half month (pph), P =.040) but no difference between reference periods I 2019 and 2018 (−25.2 pph, P =.476). No difference between reference periods I and II was identified for 2019 (−19 pph, P =.590). Likewise, no differences between the two reference periods were identified for 2018 or for the pre- and post-lockdown period 2020, as quantified by the interaction term between period II and year (2018: +11.2 pph, P =.822, 2020: −46.8 pph, P =.351; Table S1). This indicates that while there were overall less admissions to the DC in 2020 when compared to 2019 and 2018, no additional decrease was observed after implementation of the lockdown. When periods were redefined to include the first half of March into reference period II, that is into post-lockdown period as a sensitivity analysis, results did not change qualitatively (data not shown). We confirmed this association by employing Poisson regression models (for details see Table S2).

In contrast, patient admissions to the ED per half month were within the range of the preceding years for January and February followed by a sharp decrease from 1 March 2020

TABLE 2 Patient characteristics of ED visits for the investigational periods

Emergency Department	Total (%)	2018 (%)	2019 (%)	2020 (%)
Patients	1372 (100)	486 (35.42)	524 (38.19)	362 (26.38)
MRE patients	964 (100)	349 (36.20)	367 (38.07)	248 (25.73)
Male	524 (54.36)	195 (55.87)	195 (53.13)	134 (54.03)
Female	440 (45.64)	154 (44.13)	172 (46.87)	114 (45.97)
Median age	68 (18 - 97)	67 (20 - 96)	67 (18 - 97)	66 (22 - 95)
Palliative	817 (84.75)	287 (82.23)	313 85.29)	217 (87.50)
Curative	147 (15.25)	62 (17.77)	54 (14.71)	31 (12.50)
MRE visits	1136 (100)	420 (36.97)	417 (36.71)	299 (26.32)
Outpatient stay	271 (23.86)	106 (25.24)	99 (23.74)	66 (22.07)
Inpatient stay	865 (76.14)	314 (74.76)	318 (76.26)	233 (77.93)
Median length of stay (d)	7 (1 - 132)	7.5 (1 - 132)	7 (1 - 82)	7 (1 - 104)
Diagnosis	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Anal Carcinoma	2 (0.21)	1 (0.29)	1 (0.27)	0 (0.00)
Breast Cancer	92 (9.54)	38 (10.89)	32 (8.72)	22 (8.87)
Colorectal Cancer	57 (5.91)	20 (5.73)	20 (5.45)	17 (6.85)
CUP	6 (0.62)	2 (0.57)	1 (0.27)	3 (1.21)
Gastroesophageal Cancer	47 (4.88)	21 (6.02)	17 (4.63)	9 (3.63)
Gynaecologic Malignancy	61 (6.33)	23 (6.59)	25 (6.81)	13 (5.24)
Head and Neck Cancer	54 (5.60)	26 (7.45)	19 (5.18)	9 (3.63)
Haematologic Malignancy	39 (4.05)	16 (4.58)	13 (3.54)	10 (4.03)
Hepatocellular Cancer	26 (2.70)	6 (1.72)	10 (2.72)	10 (4.03)
Lung Cancer	166 (17.22)	54 (15.47)	57 (15.53)	55 (22.18)
Lymphoma	56 (5.81)	21 (6.02)	22 (5.99)	13 (5.24)
Melanoma	20 (2.07)	8 (2.29)	7 (1.91)	5 (2.02)
Mesothelioma	2 (0.21)	1 (0.29)	1 (0.27)	0 (0.00)
Non-Melanoma Skin Cancer	1 (0.10)	0 (0.00)	1 (0.27)	0 (0.00)
Other	27 (2.80)	9 (2.58)	12 (3.27)	6 (2.42)
Pancreaticobiliary Cancer	86 (8.92)	30 (8.60)	34 (9.26)	22 (8.87)
Plasma cell Dyscrasia	27 (2.80)	11 (3.15)	10 (2.72)	6 (2.42)
Primary CNS Malignancy	42 (4.36)	19 (5.44)	15 (4.09)	8 (3.23)
Prostate Cancer	69 (7.16)	20 (5.73)	31 (8.45)	18 (7.26)
Renal Cell Carcinoma	28 (2.90)	6 (1.72)	13 (3.54)	9 (3.63)
Sarcoma	30 (3.11)	9 (2.58)	12 (3.27)	9 (3.63)
Testicular Cancer	1 (0.10)	0 (0.00)	1 (0.27)	0 (0.00)
Urothelial Carcinoma	25 (2.59)	8 (2.29)	13 (3.54)	4 (1.61)

and remained consistently below the values of the preceding years (Figure 1B): a linear model for the number of admissions to the ED with the two main effects year and period and an interaction term identified no differences in admission numbers per half month to the ED in the reference period I of 2018 (+5.0 pph, P =.355) resp. pre-lockdown period 2020 (+4.4 pph, P =.415) compared to reference period I 2019. In 2019, a positive effect of transition to reference period II was seen (+ 13.8 pph, P =.016); however, in 2020 there was a sharp decrease in patient numbers from the pre-lockdown to the post-lockdown period, as quantified by the interaction term between year 2020 and period (−35.0 pph, P <.001). In 2018, no interaction between period and year was identified (−10.8 pph, P =.162; Table S3).

This indicates that in 2020 patient numbers showed little difference to 2019, however, after the lockdown a substantial decrease of patient numbers could be observed. When periods were redefined to include the first half of March into reference period II resp. post-lockdown period as a sensitivity analysis, results did not change qualitatively (data not shown).

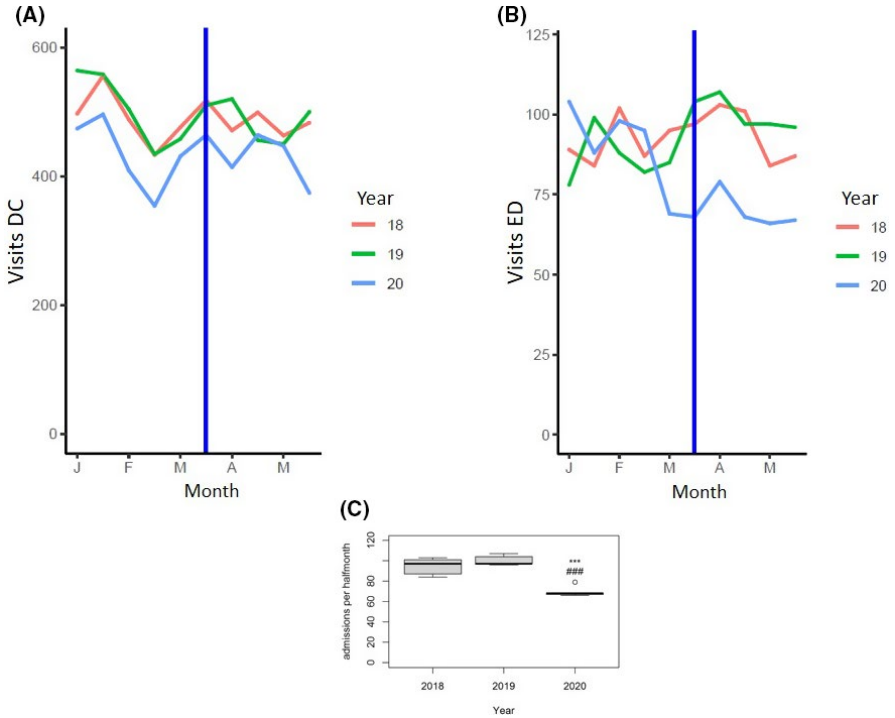

FIGURE 1 Visit frequency per half month at the DC (A) and the ED (B) for the reference and lockdown periods. (C) A clear decrease of patient visits was seen in the post-lockdown period 2020 *** P <.001 2020 vs. 2018, ### P <.001 2020 vs. 2019. J, January; F, February; M, March; A, April; M, May

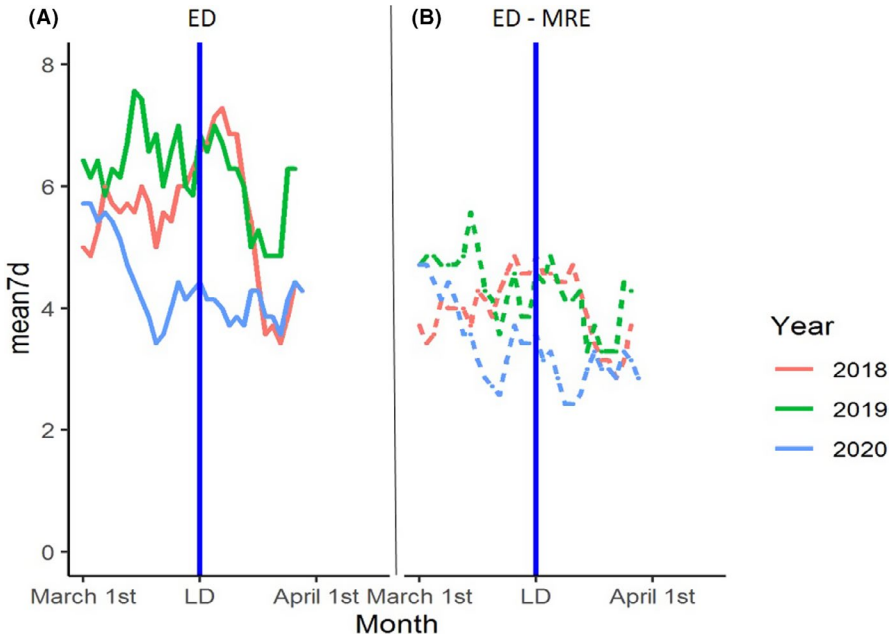

FIGURE 2 Patient visits in a 7-day mean at the ED in the investigational periods. A, All patients with an ICD-10 diagnosis for cancer were recorded. B, Only MRE visits were included. LD, Lockdown 16 March 2020

In contrast to the DC, stepwise variable selection according to Akaike Information of Poisson regression models selected a model with both main effects and interaction (for details see Table S4).

Additionally, number of admissions to the ED per half month beginning with the second half of March, when the lockdown was in place, were compared between all three years by an ANOVA, showing a decrease of 26%-31% of patient visits in 2020 compared to 2018 and 2019 (2018:472, 2019:501, 2020:348)(Figure 1C, Table 1). Tukey tests confirmed the difference between 2020 and both preceding years (2020 - 2019: P <.001 and 2020 - 2018: P <.001), whereas no difference was detected between 2019 and 2018 (P =.75).

3.2 | MRE and DC patients at the ED

In the investigational period, approximately 30% of patients visited the ED with an ICD-10 code for malignancy in each year did in fact not suffer from an active malignant disease (total: 924/1372, 70.26%; 2018 349/486, 66.60%; 2019 367/524, 70.04%; 2020 248/362, 68.51%) (Table 1), as

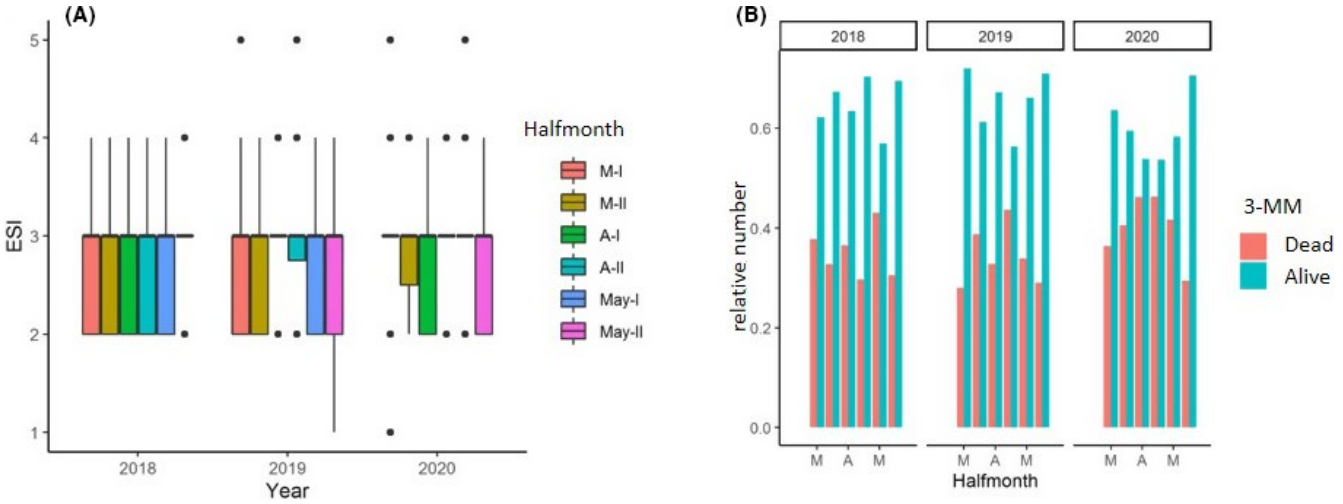

FIGURE 3 A, ESI score of MRE patients at the ED in the investigational periods. B, Relative 3-MM of MRE visits at the ED in the investigational periods. No difference in ESI Score distribution or 3-MM was discernible between the investigated periods. M-I, 1 March – 15 March; M-II, 16 March – 31 March; A-I, 1 April – 15 April; AII, 16 April – 30 April; May-I, 1 May – 15 May; May-II, 16 May- 31 May; M, March; A, April; M, May

demonstrated by re-analysis of individual patient charts. The dashed lines show number of admissions for MRE, which are naturally lower than the total numbers of admissions but show identical trends to total numbers (Figure 2).

There was no difference in age distribution of MRE for the investigational periods (data not shown). In order to further characterize the severity of MRE, we compared the ESI score at admission. No difference between years (P =.193) or half months (P =.365) could be identified by a linear model (Figure 3A). When the first half of March was excluded in a sensitivity analysis, results did not change qualitatively (data not shown). Additionally, no difference in the rate of inpatient admissions to the ED was discernible between the investigational periods (total: 865 (76.14%); 2018:314 (74.76%); 2019:318 (76.26%); 2020:233 (77.93%)). The median length of hospital stay was a consistent 7 days for all 3 years (Table 1). Finally, the 3-MM was comparable between the investigated time spans. No difference in 3-MM between half months (P =.124) or years (P =.091) was identified by Chi-squared test (Figure 3B). Of note, even when the first half of March was excluded, no difference between years was seen (2018:35%, 2019:34%, 2020:40%, P =.086). Additionally, we also analysed the proportion of DC patients among the total ED population. Between the second half of March and end of May of 2018, 2019 and 2020 84/408 (20.6%), 77/454 (17%) and 84/308 (18.8%) DC patients visited the ED as well.

4 | DISCUSSION

Delivering optimal medical services in order to maintain and improve the health of all citizens is the primary goal of a healthcare system. Keeping up with this duty during the COVID-19 pandemic poses a constant challenge for healthcare staff, medical institutions and resources. During the first wave of the COVID-19 pandemic, a hard lockdown was in place from 16 March to 29 May in Austria. Nationwide, the patient flow had to be re-directed and optimized due to an expected increase of COVID-19 cases. Anticipating the upcoming legislative measures, a restriction of patient visits only for active therapy or high priority check-ups was already implemented at our hospital from the 10th of March. Cancer patients not only represent a vulnerable population for SARS-CoV-2 infections,[3,5,6] but are also at risk for tumour- and therapy-related complications upon (COVID-19-related) interruption of oncological care.

In this large retrospective analysis, we observed that the patient frequency at our oncologic DC, despite being lower than in 2018 and 2019, was not influenced by the COVID-19 pandemic and remained unchanged compared to the months prior to the lockdown. This was achieved due to strict population-based and institutional safety measures implemented at our department as described previously.[17] A prevalence of only 0.4% of positive SARS-CoV-2 patients at our institution was found in this period.[17] Apart from that, the majority of guidelines recommended continuing of active cancer treatment especially for patients who are expected to derive a clear benefit from active treatment.[13,18,19] These recommendations are supported by several studies,[7,8] including data by Jee et al who showed that cytotoxic chemotherapy was not associated with more severe COVID-19 infections (HR 1.10, 95% CI 0.73 - 1.60).[9]

Apparently, physicians' perception of the necessity of continued oncological service and respective antineoplastic

therapies also translated into high patient acceptance of the safety measures instituted. This is reflected by our data clearly showing no reduction of patient frequency at the DC after lockdown, suggesting no physical or psychological barrier to hospital access in the large majority of our patients. Conversely, a survey distributed among medical oncologists worldwide reported that the activity of oncological clinics significantly decreased between June and July 2020. Only a minority of the participants (35.8%) denied a reduction of the activity load at their DC. [20] However, this survey might have been skewed towards academic breast cancer centres and biased by the particular country specific COVID-19 incidence during a single month. As for our ED, however, we did observe a declining number of cancer patients' visits with or without a MRE, which can be attributed to the COVID-19 lockdown as suggested by our statistical models. Interestingly, this decrease was already observed before the official lockdown on March 16th. Amongst the patients visiting the ED, however, the relative distribution of diagnoses as well as the severity of symptoms and emergencies did not differ between the periods analysed. Consequently, the severity of MRE in patients contacting the ED was comparable between the years, as no difference in the distribution of ESI scores at admission was identified. While this finding might be surprising and one might have expected an ESI score increase, several reasons could have contributed to this observation: The distribution of ESI score at admission was comparable to the report of Adler et al with the majority of cancer patients presenting with an ESI ≤3. Interestingly, in this analysis no association of ESI with 3-MM was seen. [21] Apart from that, cancer patients with fever are frequently classified with an ESI score of 3.[22,23] Thus, the neutrophil count and particularly febrile neutropenia, which is a well-known oncologic emergency, is often not accurately captured by the ESI score.[22,23]

Those findings support the hypothesis that the ESI score is not a reliable tool to predict the severity of a cancer patient's condition at the ED. However, we cannot rule out the possibility that patients were admitted to smaller regional hospitals instead of our tertiary care centre during the lockdown period.. Since respective regional or nationwide data are not available, the Austrian cancer-specific mortality rate during the lockdown period remains unknown. Of note, the 3-MM was similar between the three years analysed. Likewise, the rate of inpatient admissions and the length of inpatient stays was the same for all three years.

Interestingly, we recorded a higher overall rate of palliative patients (84.75%) compared to results from the literature (62.7%)[24] over all 3 years, probably explaining the higher inpatient admission rate (76.14%) in our cohort compared to other studies (30%-60%)[24-26] and the high 3-MM of 34 - 40%. Based on these findings, we conclude that oncological patients did attend the regular visits at our DC, but either avoided the ED or consulted alternative emergency services outside of our hospital beginning with early March. Of note, we have to point out that the results of our analysis particularly apply to the first wave of the pandemic. It is likely that the guidelines recommending treatment prioritization of distinct patient populations will be adapted in the near future considering the international immunization programmes. [13,18,27-29]

5 | CONCLUSION

This study demonstrates the feasibility of maintaining oncological therapy administration services at a tertiary centre DC during the COVID-19 pandemic, if strict institutional safety procedures are in place. However, the reasons for an almost 30% decline in ED visits by our oncological patients remain elusive, but did not result in observable deterioration of the outcome in our overall cohort.

CONFLICT OF INTERESTS

CM received honoraria from Boehringer Ingelheim, MSD, Amgen. Travel grants from MSD, Merck Darmstadt. MP has received honoraria for lectures, consultation or advisory board participation from the following for-profit companies: Bayer, Bristol-Myers Squibb, Novartis, Gerson Lehrman Group (GLG), CMC Contrast, GlaxoSmithKline, Mundipharma, Roche, BMJ Journals, MedMedia, Astra Zeneca, AbbVie, Lilly, Medahead, Daiichi Sankyo, Sanofi, Merck Sharp & Dome, Tocagen, Adastra. The following for-profit companies have supported clinical trials and contracted research conducted by MP with payments made to his institution: Böhringer-Ingelheim, Bristol-Myers Squibb, Roche, Daiichi Sankyo, Merck Sharp & Dome, Novocure, GlaxoSmithKline, AbbVie. MR received honoraria from: Celgene, Ipsen, Novartis, Eli Lilly, Eisai, Roche. TF received honoraria from MSD; Merck Darmstadt, Roche, BMS, Accord; Sanofi, Boehringer Ingelheim; Amgen, Pfizer.

AUTHOR CONTRIBUTIONS

Dr Minichsdorfer and Prof. Fuereder had full access to all of the data in the study and tooke responsibility for the integrity of the data and the accuracy of the data analysis. CM Methodology, Resources, Data curation, Writing original draft. GJ Data curation, Writing, Reviewing & Editing. CK Formal analysis, validation, Writing, Reviewing & Editing. AA Data curation, Writing, Reviewing & Editing. AC Data curation, Writing, Reviewing & Editing. SP Data curation, Writing, Reviewing & Editing. KR Data curation, Writing, Reviewing & Editing. CW Data curation, Writing, Reviewing & Editing. RB interpretation of data, revision and approval of the submitted manuscript. MP Resources, Reviewing & Editing. AL Resources, Reviewing & Editing. MR Resources, Reviewing

& Editing. TF Conceptualization, Supervision, Project administration, Writing, Reviewing & Editing.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Minichsdorfer C, Jeryczynski G, Krall C, et al. Impact of COVID-19 lockdown on routine oncology versus emergency care at a high volume cancer centre. *Eur J Clin Invest*. 2021;00:e13623. https://doi.org/10.1111/eci.13623