

Impact of COVID Pandemic on Cancer Care: Cross-sectional Scenario of an Indian State (Bihar)

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Introduction: World Health Organization declared the novel coronavirus (COVID-19) outbreak as pandemic on March 11th 2020. Since then, it has massive impact on public health and economy. Various measures including lock-down, social distancing and massive vaccination drive are implemented globally to curb the spread of the pandemic.

Objective: The study is conducted to analyse the demography and census of the patients attending department of radiotherapy, All India Institute of Medical Sciences (AIIMS), Patna during the first wave hit of COVID-19 pandemic in 2020 to assess the impact of this pandemic on cancer care.

Methods and materials: Census data was retrieved digitally from 1st January 2020 to 15th June 2020 from Hospital Information system. We analyzed the visit of cancer patients to the day care chemotherapy unit, out patient department, and hospital admission and compared the data between pre-lockdown and post-lockdown periods.

Results: A total of 1175 patients with malignancy visited department of radiotherapy from 1st January to 23rd March 2020. After the lock down announcement of nationwide lock down the total number of patient visiting to radiotherapy department dropped to 445 patients. This decrease is not significantly correlating with age group of patients (age < 18 years, 18-70 years and >70 years). Between 24th March and 15th June, 123 patients were screened for SARS-CoV-2 patients before hospital admissions, three of them found to be positive for SARS-CoV-2 and were shifted to COVID ward. Distance of the affected district from the care giving hospital has massive impact on cancer care due to restricted logistic.

Conclusion: The cancer care in COVID pandemic is highly dependent on the judicious discretion of the oncologists to maintain the balance between added risk of COVID infection and benefit of treatment modalities. With massive vaccination drive, and effective implementation of lock down of the containment zones, the spread of the pandemic has to be restricted further, with the continuation of 'new normal' activities.

Introduction

World Health Organization (WHO) declared the novel coronavirus disease (COVID-19) outbreak as Public Health Emergency of International Concern (PHEIC) on 30th January 2020 and subsequently declared COVID-19 a pandemic on 11th March 2020. The Nationwide lockdown was announced by Government of India (GOI) on 24th March, 2020 to restrict the movement of a massive 1.3 billion population of the country as a preventive measure against the pandemic. India followed the lockdown in phase-wise manner and, containment for large outbreaks through geographic quarantine or 'cordon sanitaire' was carried out in different clusters across the country.

The districts were earlier designated as red-zones (hotspots), orange zones and green zones mainly

based on the cumulative positive cases and the doubling rate. As per the notification on 30th April 2020 by the Department of Health and Family Welfare, GOI there were 5 red zones, 20 orange zones and 13 green zones in Bihar and five most affected districts were Patna, Madhubani, Bhagalpur, Begusarai, and Siwan. The prolonged and widespread presence of COVID-19 pandemic globally has severely impacted the delivery of healthcare facility all over the country including the care of cancer patients. The shortfall of adequate health care infrastructure and human resources, vast supply-chain disruptions, and lack of foolproof evidence regarding the transmission, prevention and treatment strategies of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) have impeded patient care and safety severely.

The susceptibility of immuno-compromised cancer patients to influenza virus was well known before the emergence of SARS-CoV-2. Influenza increases the risk of hospital admission with severe respiratory distress four times, and the risk of death as 10 times higher when compared with patients without malignancy [1]. In a case study in three hospitals within Wuhan, China twenty-eight cancer patients were observed who were infected with SARS-CoV-2 [2]. Lung carcinoma was the most frequent cancer type in this study and eight patients were suspected to have hospital-associated transmission. If the malignancy related treatment was given within 14 days of developing symptoms, it leads to severe respiratory events. 53.6% of patients in this study were found to have severe events and the mortality rate was 28.6%. Several cancer centres globally have drastically reduced their services after this preliminary report from China came out. Although several international consensus guidelines are developed to steer the cancer care in the pandemic situation, it is an enormous dilemma for oncologists to decide what is best for their patients and the healthcare workers (HCW) and to keep the balance between risks and benefits of the treatment [3,4].

In this study, we analysed the characteristics of the cancer patients including demography, diagnosis, and distance from the hospital during the first wave in 2020 months to know the impact of COVID pandemic on cancer care in the hospital as well as in the State.

Materials and Methods

We retrieved the cancer patient data digitally from the Hospital information system (HIS) since 1st January 2020 to 15th June 2020 and compared the census between pre-lockdown (1st January to 23rd March) and post lockdown (24th March to 15th June) periods. The number of cancer patients visiting radiotherapy OPD, Flu clinic, daycare chemotherapy centre, and the number of admitted patients in IPD in this time duration are tabulated and analysed. The number of the patients from all thirty-eight districts of Bihar are analysed and the patient pool as per the average distance from the AIIMS Patna was also analysed in pre and post lockdown period.

Standard operating procedure (SOP) for the movement of the patient

In our institute, we maintained a strict SOP to prevent the spread of COVID-19 among the HCW, and other patients who are already vulnerable or suffering from multiple co-morbidities. HCW in the hospital were provided with adequate Personal Protective Equipments (PPE) as per the guidelines laid by Ministry of Health and Family Welfare, GOI [5]. The SOP for the movement of the cancer patient who visited our department during the COVID-19 pandemic is illustrated in Figure 1.

Figure 1. Departmental Standard Operating Procedure (SOP) for the Movement of the Patient.

Diagnostic test for SARS-CoV-2

All the patients who required admission in IPD underwent mandatory testing for SARS-CoV-2 by both nasopharyngeal and oropharyngeal swab and remained in holding wards till their report were prepared before transfer to IPD building to keep the IPD section sterile from the COVID infection. At our institute, we performed qualitative Real time transcriptase - polymerase reaction (RT-PCR) to detect RNA of SARS-CoV-2.

'AIIMS PATNA SWASTHYA' Mobile Application

This mobile app provides eConsultancy for the patients, registered at AIIMS Patna who can raise a request for telemedicine advice through the application and can view reports of laboratory investigations, department wise consultation schedule and tariffs. The department of Radiotherapy has started providing registration and telemedicine support to the cancer patients as well.

Difficulty in diagnosis and staging of cancer patients in COVID era

Most forms of endoscopy, particularly bronchoscopy, upper gastrointestinal endoscopy, nasopharyngoscopy, direct and indirect laryngoscopy are classified as aerosol-generating procedure (AGP), which increases the risk of SARS-CoV-2 transmission. Colonoscopy also carries risk due to the fecal shedding of the virus. British Society of Gastroenterology and Joint Advisory Group has recommended to carry out only therapeutic emergency and essential endoscopy and has put endoscopy for cancer staging and treatment planning as "Need discussion (Case-by-case)" category [6]. There has been a consensus among the American College of Gastroenterology, European Society of Gastrointestinal Endoscopy and the Asian Pacific Society for Digestive Endoscopy that all elective endoscopies should be suspended [7]. As a result, availability of different endoscopic services has been markedly decreased across the world leading to less number of cancer detection and delayed staging. On the contrary, demand for non-invasive imaging like computed tomography has increased, as it carries a lower risk of contamination.

Capacity for surgery has also been reduced amid the challenging and uncertain times of pandemic and mechanical ventilators have been kept reserved to provide additional critical care capacity for patients affected with COVID-19. The American College of Surgeons (ACS) has recommended that semi-elective surgeries, such as in incompletely obstructing colon cancers, esophageal stenting for malignant growth and surgeries for most gynaecological cancers should continue in the early stages of the pandemic and only emergency surgeries, like intervention in perforated, completely obstructed or actively bleeding cancers should be executed around the peak of the pandemic [8].

Due to the near-total lockdown for prolonged duration, there is an extreme bottleneck in public transportation in India. As a result, much fewer footfalls are observed in the healthcare facilities in the country. Furthermore, many cancer patients have been fearful of exposure to SARS-CoV-2 and have been less likely to present to hospitals for diagnostic workup leading to considerable delay in staging and more incidence of advanced presentation in ED with various acute medical and surgical conditions.

Triage of cancer patients for chemotherapy

Systemic chemotherapy may expose patients to a higher risk of becoming infected and may lead to worse outcomes once they incur COVID-19. Treatment with systemic chemotherapies should be decided on a case-by-case basis considering the following factors [9]. However, the treating oncologist should always keep in mind the risk of disease progression or increased rate of emergency admissions with medical and surgical complications.

1. Intent of the treatment and risk-benefit ratio associated with systemic chemotherapies should be judged meticulously. When the chemotherapy is associated with excellent improvement in outcomes, as for small-cell lung cancer or many acute hematological malignancies, there is consensus that the cycles of chemotherapy must continue. However, when the absolute benefit of chemotherapy is marginal, such as in the case of palliative chemotherapy or adjuvant for elderly and co-morbid patients, treatment may be postponed or alternative treatment options should be explored.
2. Less resource-intensive treatment regimes with a similar range of efficacy and lesser toxicity.
3. Level of immune-suppression associated with an individual chemotherapy regime. Age over 60 years, patients with pre-existing cardiovascular and respiratory disease are already vulnerable and more prone to developing severe manifestations if get infected with SARS-CoV-2.
4. Distance from the hospital and availability of transportation
5. Availability of local health care facilities in case of medical and surgical emergencies.

Considering these factors, we may categorise the cancer patients as per different priority level [10]. We took the decision of giving chemotherapies in our institute mostly on the priority level as illustrated in Table 1.

Priority level	Criteria	Examples
Level 1		Early breast cancer, Germ cell tumor of Ovary, Seminoma
Level 2		Medulloblastoma standard risks, Carcinoma Larynx, Stage III NSCLC [¥]
Level 3		Locally advanced gastric carcinoma, Locally advance Carcinoma Gall bladder
Level 4		Hepatocellular carcinoma, not a candidate for transplant
Level 5	Non-curative therapy with >50% chance of palliation or temporary tumour control but < 1 year life extension	Palliative chemotherapies, Supportive treatment
Level 6	Non-curative therapy with 15-50% chance of palliation or temporary tumour control and < 1 year life extension	Palliative chemotherapies, Supportive treatment, Best supportive treatment, Hospice

Table 1. Categorisation of Patients as Per the Priority Level During COVID-19 Pandemic.

Abbreviations, [€] Neoadjuvant chemotherapy; ^Y Radiotherapy; [¥] Non small cell carcinoma lung

Results

After analyzing the data which we retrieved digitally from the HIS since 1st January 2020 to 15th June 2020, we found a significant decrease in the number of total visits of the patients (footfalls) in

OPD and IPD, the absolute number of patients both newly registered and follow-up cases, after the announcement of lockdown in the country. Total visits in the department of Radiotherapy, AIIMS Patna was 2920 times by 1175 cancer patients from 1st January 2020 to 23rd March 2020. After the announcement of nationwide lock-down the number of visits dropped to 1038 times by 445 patients from 24th March 2020 to 15th June 2020. Though, no significant correlation was found in the vulnerable age groups (<18 years and >70 years) with the percentage of decrease in post-lockdown period. The detail of the census of the cancer patients in the pre and post lockdown period is tabulated in (Table 2) (Table 3) and (Table 4).

		Pre-Lockdown		Post-Lockdown	
		Count	Table N (%)	Count	Table N (%)
Age group	Up to 18 years	72	6.1	32	7.2
	> 18 - 30 years	108	9.2	35	7.9
	31 - 50 years	453	38.6	190	42.7
	51 - 70 years	485	41.3	169	38
	> 70 years	57	4.9	19	4.3
Sex	Male	515	43.8	181	40.7
	Female	660	56.2	264	59.3
Bihar / Other State	Other State	23	2	8	1.8
	Bihar	1152	98	437	98.2
Diagnosis of patients attending OPD ^Σ	Breast malignancy	233	19.8	99	22.2
	Gastrointestinal malignancy	311	26.5	124	27.9
	Genitourinary malignancy	204	17.4	77	17.3
	Head and neck malignancy, CNS Tumours	260	22.1	65	14.6
	Lung malignancy	76	6.5	42	9.4
	Paediatric malignancy	60	5.1	16	3.6
	Soft tissue Sarcoma	31	2.6	22	4.9
	Total number of daycare admission		465		351
Total number of IPD [£] admission		279		123	
Total number of cancer patients screened			NIL	123	

Table 2. Analysis of Patient Characteristics Including Demography, Diagnosis and Census in Pre and Post Lockdown Period.

Abbreviations, ^Σ Out patient department; [£] In patient department

	Pre-lockdown		Post-Lockdown	
	Frequency	Percent	Frequency	Percent
50 KM	400	34	154	34.6
51 - 100 KM	298	25.4	123	27.6
101 - 150 KM	316	26.9	110	24.7
151 - 200 KM	61	5.2	24	5.4
201 - 250 KM	43	3.7	17	3.8
> 251 KM	57	4.9	17	3.8

Total	1175	100	445	100
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Table 3. Analysis of Patient Population as Per the Distance from the Institute in Pre and Post Lockdown Period.

		Number	Percentage	Number	Percentage	
	Other States	23	2	8	1.8	
Low risk districts	Araria	9	0.8	6	1.3	
	Arwal	16	1.4	3	0.7	
	Jamui	16	1.4	8	1.8	
	Lakhisarai	8	0.7	2	0.4	
	Seohar	0	0	0	0	
Medium risk districts	Aurangabad	21	1.8	5	1.1	
	Banka	4	0.3	1	0.2	
	Bhojpur	57	4.9	24	5.4	
	Buxar	22	1.9	5	1.1	
	Darbhangha	20	1.7	9	2	
	East Champaran	31	2.6	17	3.8	
	Gaya	39	3.3	10	2.2	
	Gopalganj	20	1.7	6	1.3	
	Jehanabad	20	1.7	4	0.9	
	Kaimur	2	0.2	0	0	
	Katihar	15	1.3	5	1.1	
	Khagaria	18	1.5	10	2.2	
	Kishanganj	2	0.2	1	0.2	
	Madhepura	13	1.1	2	0.4	
	Munger	22	1.9	8	1.8	
	Muzaffarpur	48	4.1	21	4.7	
	Nalanda	39	3.3	27	6.1	
	Nawada	15	1.3	3	0.7	
	Purnia	16	1.4	3	0.7	
	Rohtas	18	1.5	5	1.1	
	Saharsa	19	1.6	6	1.3	
	Samastipur	39	3.3	15	3.4	
	Saran	75	6.4	33	7.4	
	Seikhpura	8	0.7	2	0.4	
	Sitamarhi	26	2.2	6	1.3	
	Supaul	11	0.9	3	0.7	
	Vaishali	60	5.1	22	4.9	
	West Champaran	16	1.4	8	1.8	
	High risk districts	Begusarai	29	2.5	9	2
		Bhagalpur	15	1.3	6	1.3
		Madhubani	22	1.9	8	1.8
		Patna	320	27.2	128	28.8
Siwan		30	2.6	9	2	
	Total	1175	100	445	100	

Table 4. Analysis of District Wise Census of Cancer Patients in Pre and Post Lockdown Period. Districts are Classified in Terms of Total Covid Positive Cases of at the Time of Writing of this Article.

Total of 123 patients was screened for infection with SARS-CoV-2 regardless of their symptoms and travel history before admission in IPD. Out of 123 patients, 3 patients were found positive for SARS-

CoV-2 and were shifted to COVID ward. Two positive patients were female; both were with diagnosis of carcinoma ovary and the male patient was diagnosed with carcinoma lung. Two of them were not our registered follow-up case and had recent inter-state travel history. One of the female patients had severe COVID related events and succumbed in the intensive care unit with respiratory failure.

Discussion

The COVID-19 pandemic has changed many of our perspectives including our social behaviours and way of living. The actual impact of the pandemic of this unprecedented scale actually can be fathomed only after it gets normalised. The healthcare system of many countries was nearly collapsed and required extensive support and resources for the restoration. The cancer care globally is no exception to suffer worst hit by the pandemic [11-13] With our retrospective study of the census of cancer patients of our institute particularly during the first wave of COVID-19 pandemic, we analysed several aspects of cancer care including the demographic distribution and overall impact of pandemic on the cancer care in the state. With slightly increased female: male ratio in the post lockdown era, we may observe that, there is apparently no domestic and social discrimination towards the female cancer patients in the time of economic and logistic crisis. In a society, where injustice and apathy are very common towards women and particularly towards the female cancer patients, this finding can be interpreted as a silver lining on the background of worrying gender discrimination in the country.

Similarly, the paediatrics age group (<18 years) and advanced age group (>70 years) follow almost similar percentage of the patient population in the pre and post lockdown era which might broadly reflect domestic and social attention towards them as well. Although, this is a single institute observation, these findings may be taken into consideration to infuse some positivity in our mind in this difficult time of crisis and adversity.

The number of cancer patients who visit our hospital from the neighbouring states and the country (particularly Nepal) has been reduced drastically due to the restricted transportation in the country. Though the number of the patients with incomplete treatment at other centres outside the state, increased gradually in our hospital after the beginning of unlocking.

In spite of the fact that the rank of the districts is inter-changing in terms of active cases over the course of pandemic, Patna remained as the topmost affected district in Bihar. After the announcement of lockdown on 24th March 2020, there was 60% decrease in patient population from Patna, the district where our institute itself is situated. We experienced a decrease in the tune of 70-60% of patient pool from the other top five affected districts as well namely Siwan, Madhubani, Begusarai and Bhagalpur. The massive impact of lock-down on the public transportation and overall socio-economic disruption lead to such a significant drop of the visits of the cancer patients. Unfortunately, a striking number of patients who need palliative and supportive care would lose their lives without proper intervention in this pandemic [14]. Many centres including us are continuing the systemic chemotherapies with curative intent during the pandemic. With the mandatory screening protocol before admission, we find 2.4% COVID positivity rate among the cancer patients (including those who returned from the other states). No patient with ongoing systemic chemotherapies was found with influenza like illness (ILI) or Severe acute respiratory infection (SARI).

Recommendations

Based on the observations made by the several international consensus guidelines, we adopted the following strategies to balance between risk and benefits of continuing treatment of our patients in the COVID-19 pandemic:

- Changing intravenous regimes to subcutaneous or oral if expected outcome is within similar range but with lesser toxicity. For example we introduced Tablet Capecitabine based regimen (CapOx) instead of infusion Injection 5-Fluorouracil (5-FU).
- Selecting regimens that are shorter in duration which can be administered in day-care facility.
- Considering 4-weekly or 6-weekly immunotherapy regimens rather than 2-weekly and 3-weekly protocol.
- Avoid dose-dense chemotherapy regime for the treatment of carcinoma breast. Avoid Injection Gemcitabine every weekly cycle.
- Radiotherapy can be given to replace or to delay other treatment modalities which carry higher infection risk. For example a short course of radiotherapy can be used to delay surgery in patients with rectal carcinoma.
- Prescribe oral routine medicines for the duration of a month where possible to minimise patient exposure in OPD.
- Consider deferring supportive therapies such as Injection denosumab and Injection zoledronic acid administration.
- Use of Granulocyte colony-stimulating factor (G-CSF) as prophylaxis to reduce the incidence of febrile neutropenia and related admission.
- Considering treatment breaks for long-term treatments (Drug Holiday), for example in carcinoma prostate.
- General measures across all services and facilities to reduce patient contact and maximise workforce capacity. To cut non-essential follow-up visits, reduce stay time in hospital.
- Minimise face-to-face interactions, increase consultations via telephone or video consultation. We have introduced a mobile application, 'AIIMS PATNA SWASTHYA' aiming reduced footfall in the hospital.

In conclusion, the cancer care in COVID pandemic is highly dependent on the judicious discretion of the oncologists who are responsible to maintain the balance between the added risk of infection and the benefits of the treatment modalities. Systemic chemotherapies can safely be administered to the cancer patients after the proper screening and triage, especially when the chance of cure is considerable. Available vaccines against COVID19 are also found safe and effective for patients with malignancy [15,16]. The constraints in logistics and disrupted economic factors might play a bigger role in healthcare as well as in the care of cancer patients. With the anticipation of further waves of SARS-CoV-2, we must be better prepared to provide adequate care to the 'vulnerable' cancer patients and policy makers of the country should judiciously implement restrictions whenever required to curb the peak of the infection. But logistics support for the cancer patients should be ensured, so that screening, new diagnosis, ongoing therapy as well as follow up visits remain continue full fledged in the hospitals. With successful vaccination drive, and effective implementation of lock down of the containment zones, the spread of the pandemic has to be restricted further, with the continuation of 'new normal' activities.

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Conflict of interest

Nil

References

References

1. Bitterman Roni, Eliakim-Raz Noa, Vinograd Inbal, Zalmanovici Trestioreanu Anca, Leibovici Leonard, Paul Mical. Influenza vaccines in immunosuppressed adults with cancer. *Cochrane Database of Systematic Reviews*. 2018. [DOI](#)
2. Zhang L., Zhu F., Xie L., Wang C., Wang J., Chen R., Jia P., Guan H.Q., Peng L., Chen Y., Peng P., Zhang P., Chu Q., Shen Q., Wang Y., Xu S.Y., Zhao J.P., Zhou M.. Clinical characteristics of COVID-19-infected cancer patients: a retrospective case study in three hospitals within Wuhan, China. *Annals of Oncology*. 2020; 31(7)[DOI](#)
3. Pramesh C.S., Badwe Rajendra A.. Cancer Management in India during Covid-19. *New England Journal of Medicine*. 2020; 382(20)[DOI](#)
4. COVID-19 Useful Resources | ESMO. <https://www.esmo.org/covid-19-and-cancer/covid-19-full-coverage/covid-19-useful-resources>. Accessed July 27, 2020.
5. Ministry of Health and Family Welfare Directorate General of Health Services [Emergency Medical Relief] Novel Coronavirus Disease 2019 (COVID-19): Guidelines on Rational Use of Personal Protective Equipment.
6. Endoscopy activity and COVID-19: BSG and JAG guidance | The British Society of Gastroenterology. <https://www.bsg.org.uk/covid-19-advice/endoscopy-activity-and-covid-19-bsg-and-jag-guidance/>. Accessed July 27, 2020.
7. Joint ACPGBI, BSG and BSGAR considerations for adapting the rapid access colorectal cancer pathway during COVID-19 pandemic | The British Society of Gastroenterology. <https://www.bsg.org.uk/covid-19-advice/covid-19-advice-for-healthcare-professionals/joint-acgbbi-bsg-and-bsgar-considerations-for-adapting-the-rapid-access-colorectal-cancer-pathway-during-covid-19-pandemic/>. Accessed June 17, 2020.
8. COVID-19: Elective Case Triage Guidelines for Surgical Care. <https://www.facs.org/covid-19/clinical-guidance/elective-case>. Accessed June 18, 2020.
9. Managing cancer patients during the COVID-19 pandemic. <https://www.esmo.org/guidelines/cancer-patient-management-during-the-covid-19-pandemic/consensus-recommendations-managing-cancer-patients-during-the-covid-19-pandemic>. Accessed August 13, 2021.
10. Specialty Guides for Patient Management during the Coronavirus Pandemic. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/869827/Coro. Accessed June 22, 2020.
11. Richards Mike, Anderson Michael, Carter Paul, Ebert Benjamin L., Mossialos Elias. The impact of the COVID-19 pandemic on cancer care. *Nature Cancer*. 2020; 1(6)[DOI](#)
12. Pareek Ananya, Patel Apurva A., Harshavardhan A., Kuttikat Philip G., Pendse Shantanu, Dhyani Aruj, Sharma Satish, Agarwal Nikesh, Maji Debajyoti, Reddy Ramidi G., Gupta Yuganshu, Panchal Harsha P., Parikh Sonia. Impact of nationwide lockdown on cancer care during COVID-19 pandemic: A retrospective analysis from western India. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*. 2021; 15(4)[DOI](#)
13. Singh Hemant Kumar, Patil Vijayraj, Chaitanya Ganne, Nair Deepa. Preparedness of the cancer hospitals and changes in oncosurgical practices during COVID-19 pandemic in India: A cross-sectional study. *Journal of Surgical Oncology*. 2020; 122(7)[DOI](#)



14. Singh Dharmendra, Singh Pritanjali, Mandal Avik, Rakesh Amrita, Verma Manika. Patterns of Care of Gallbladder Cancer During the COVID-19 Pandemic: An Experience of Tertiary Care Centre at Patna, India. *Asian Pacific Journal of Cancer Care*. 2020; 5(S1)[DOI](#)
15. Mandal Avik, Singh Pritanjali, Samaddar Arghadip, Singh Dharmendra, Verma Manika, Rakesh Amrita, Ranjan Rakesh. Vaccination of cancer patients against COVID-19: towards the end of a dilemma. *Medical Oncology*. 2021; 38(8)[DOI](#)
16. Garassino M, Vyas M, de Vries E, Kanesvaran R, Giuliani R, Peters S. The ESMO Call to Action on COVID-19 vaccinations and patients with cancer: Vaccinate. Monitor. Educate. *Annals of Oncology*. 2021; 32(5):579-581.