The novel coronavirus (SARS-CoV-2) and subsequent disease (coronavirus disease 2019 [COVID-19]) was identified in Wuhan, China, in December 2019,¹ and first reported in the United States on January 22, 2020.² Since then, the number of COVID-19 cases has continued to rapidly rise across the country, with a cumulative 525,704 confirmed cases³ and a total of 6,930 COVID-19 deaths⁴ as of April 11, 2020. Early reports have also indicated that older adults or adults with underlying comorbid illness and/or suppressed immune response are more likely to be severely affected by COVID-19.⁵ Concurrent with this new health threat, patients in the United States continue to be diagnosed with cancer. It is estimated that 1.7 million new cancer cases were diagnosed in 2019 in the United States,⁶ many of whom are currently receiving or will require treatment amid the crisis.

The COVID-19 pandemic poses a challenge for cancer patient management, due to the implementation of social distancing to reduce transmission of SARS-CoV-2⁷–⁸ and the depletion of health care resources⁹ and personal protective equipment (PPE) supplies. In March 2020, the Centers for Medicare and Medicaid Services (CMS) temporarily expanded coverage for beneficiaries to receive health care services through virtual visits¹⁰ to facilitate social distancing. In the same month, surgeons were advised by the US Surgeon General and by the American College of Surgeons (ACS)¹¹ to triage and postpone elective surgeries in order to conserve PPE and to prepare for a surge in COVID-19 patients requiring all levels of care. Professional societies such as the Society of Surgical Oncology,¹² the American Society of Clinical Oncology (ASCO),¹³ the American Society for Radiation Oncology,¹⁴ the American Society of Breast Surgeons,¹⁵ and the Society of Gynecologic Oncology (SGO),¹⁶ are also issuing recommendations regarding cancer care delivery during the pandemic. We sought to describe the determinants of oncology treatment plan changes from the physician perspective during the COVID-19 pandemic.

METHODS
Study Design and Participants
We conducted a cross-sectional anonymous online survey study of physicians who treat cancer patients in the United States. The study was reviewed and deemed exempt by the University of Minnesota Institutional Review Board. All participants were provided with an information sheet about the study and confirmed eligibility before completing the online survey. Eligibility criteria included being a physician (MD or
DO) who treats cancer patients in the United States, physician age: 18 years or older, and ability to read/write in English.

Recruitment

Individuals were recruited over a 2-week period (March 27 to April 10, 2020) using snowball convenience sampling methods with social media platforms Facebook (posting in national and Minnesotan physician groups and various women physician groups), LinkedIn, and Twitter (from University of Minnesota Masonic Cancer Center, American Cancer Society, and personal twitter accounts of the authors). Invitations to participate in the survey were also posted on ACS, ASCO, and SGO (physician-only) online discussion forums. In addition, emails with a survey link were sent by the American Cancer Society to cancer programs in the North Region, covering 13 states. Survey data were collected and stored using REDCap, a web-based data collection tool.17

Measures

Survey items included demographics and measures of clinical practice size and location, personal concerns about COVID-19, effects of COVID-19 pandemic on cancer patient treatment, sources of information about COVID-19, and emotional health. Validated measures were used or modified as appropriate when possible. General demographic data on participants were obtained by self-report but no identifying data were collected. The number of COVID-19 cases in each state was determined using data from the Centers of Disease Control and Prevention (CDC) as of April 3, 2020,2 the half-way point during the study recruitment period. The categorization provided by the CDC resulted in 4 groups to which respondents were assigned, based on the number of confirmed COVID-19 cases in their state: 101 to 500, 501 to 1000, 1001 to 5000, and >5001 or more.

Physicians were asked whether they had to cancel/postpone/alter cancer treatments (surgery, chemotherapy, radiation therapy) and response options were “yes,” “no,” “no, but will have to reassess this,” and “not applicable.” Physicians who answered “yes” were then asked to select reason(s) for altering cancer treatment plans from a list of prespecified options. Physicians were asked to select all reasons that applied, rather than being limited to ascribing their decisions to a single motivation.

Statistical Methods

The analyses for this study were limited to participants who provided their oncology specialty (surgical, medical, radiation). Participant characteristics and responses were summarized using descriptive statistics. We assessed factors associated with treatment decision-making (“yes altered” vs. “no but plan to reassess”) using χ² tests and Fisher Exact tests as appropriate for categorical variables, and t tests assuming unequal variances for continuous variables. We also compared reasons for altered treatment plans by medical specialty using χ² tests. Data were analyzed using SAS 9.4 (Cary, NC), and P-values <0.05 were considered statistically significant.

RESULTS

Physician Demographics and Practice Characteristics

A total of 548 individuals clicked on the survey link and 486 (88.7%) were eligible physicians who proceeded on to the survey itself (Fig. 1). Among eligible physicians, 435 provided information about their medical specialty (surgical, medical oncology, radiation oncology, other), of which 24 physicians reported “other” and were excluded from this analysis. In our study of 411 oncology physicians, 241 (58.6%) were surgeons, 106 (25.8%) medical oncologists, and 64 (15.6%) radiation oncologists (Table 1). The majority (92.8%) of respondents practiced full time. Approximately half of the respondents practiced at an academic institution (54.6%), in a large city (47.3%), and in hospitals with 500 or more beds (45.3%). Physicians reported treating a range of different cancer types, including breast (61.6%), colorectal (45.1%), hepatopancreaticobiliary (32.2%), head and neck (23.8%), hematologic (25.3%), genitourinary (18.8%), and gynecologic (15.4%) malignancies.

Physicians from 43 of the 50 states, as well as the District of Columbia, responded to the survey. There were no respondents from Alaska, Delaware, Nebraska, New Hampshire, New Mexico, South Dakota, and Wyoming. States with at least 10 respondents included Minnesota (61, 16.6%), California (34 physicians, 9.2%), Texas (19, 5.2%), Florida (18, 4.9%), Wisconsin (17, 4.6%), Maryland (16, 4.4%), Pennsylvania (16, 4.4%), Ohio (15, 4.1%), New York (14, 3.8%), Massachusetts (12, 3.3%), North Carolina (12, 3.3%), Washington (12, 3.3%), and New Jersey (11, 3.0%).

A majority of respondents were from states with >1000 confirmed COVID-19 cases (as of April 3, 2020), with 38.0% practicing in states with 1001 to 5000 cases, and 37.2% practicing in states with >5000 cases. Over half of the respondents (57.0%) thought they had adequate PPE for clinical practice. There were no differences in the reported adequacy of PPE by the statewide number of confirmed COVID-19 cases (P=0.99).

Cancer Treatment Plan Alterations and COVID-19

Participants reported that the COVID-19 pandemic has significantly interfered with their ability to provide treatment to active cancer patients (mean, 66.6±24.4 on severity scale, from 0= no problem to 100= severe problem). Of the respondents, 282 (68.6%) reported they have already altered treatment plans; 126 respondents had not yet altered plans, and of these, 118 (94%) planned to reassess. Most (71.5%) surgeons reported cancelling or postponing their patients’ cancer surgery, with 70.2% of those who delayed cases referring patients for alternative treatment in the meantime. Similarly, a majority of medical oncologists (64.4%) and radiation oncologists (73.4%) reported altering their patients’ chemotherapy and radiation therapy plans, respectively.

Most physicians in all 3 specialties were concerned about their patients’ risk of COVID-19 exposure (Table 2). However, medical oncologists were more likely than surgeons or radiation

![FIGURE 1. Flow diagram of survey respondents.](image-url)
TABLE 1. Physician Demographics and Clinical Practice Characteristics (N = 411)

| Characteristic                              | N  | Mean ± SD |
|---------------------------------------------|----|-----------|
| Age (y)                                     | 324| 45.9 ± 9.5|
| Years in practice                           | 343| 12.9 ± 10.0|
| Sex                                         |    |           |
| Male                                        | 139| (36.0)    |
| Female                                      | 244| (63.2)    |
| Nonbinary sex identification                | 3  | (0.8)     |
| Missing                                     | 25 |           |
| Race/ethnicity                              |    |           |
| White, non-Hispanic                         | 258| (74.1)    |
| Asian Indian                                | 37 | (10.6)    |
| Chinese                                     | 17 | (4.9)     |
| Hispanic                                    | 12 | (3.5)     |
| Other                                       | 24 | (6.9)     |
| Missing                                     | 63 |           |
| Medical specialty                           |    |           |
| Surgery                                     | 241| (58.6)    |
| Medical oncology                            | 106| (25.8)    |
| Radiation oncology                          | 64 | (15.6)    |
| Clinical work                               |    |           |
| Yes—full time                               | 358| (92.8)    |
| Yes—part time                               | 27 | (7.0)     |
| No                                          | 1  | (0.3)     |
| Missing                                     | 25 |           |
| Academic practice                           |    |           |
| No                                          | 175| (45.5)    |
| Yes                                         | 210| (54.6)    |
| Missing                                     | 26 |           |
| Hospital size                               |    |           |
| Small hospital (fewer than 100 beds)        | 31 | (8.0)     |
| Medium hospital (100-499 beds)              | 167| (43.3)    |
| Large hospital (500 or more beds)           | 175| (45.3)    |
| Ambulatory clinic only (no inpatients)       | 13 | (3.4)     |
| Missing                                     | 25 |           |
| Community size                              |    |           |
| Rural area                                  | 18 | (5.0)     |
| Small city or town                          | 80 | (22.4)    |
| Suburb near a large city                    | 90 | (25.2)    |
| Large city                                  | 169| (47.3)    |
| Missing                                     | 54 |           |
| Cancers treated (select all that apply)     |    |           |
| Bone                                        | 37 | (10.4)    |
| Breast                                      | 220| (56.1)    |
| Colorectal                                  | 161| (45.1)    |
| Genitourinary                               | 67 | (18.8)    |
| Gynecologic                                 | 55 | (15.4)    |
| Head and neck                               | 85 | (23.8)    |
| Hematologic                                 | 115| (32.2)    |
| Hepatobiliarycorticibiliary                  | 83 | (23.3)    |
| Lung                                        | 158| (44.3)    |
| Skin and soft tissue                        | 74 | (20.7)    |
| Other                                       | 64 | (17.9)    |
| Missing                                     | 54 |           |
| Number of confirmed COVID-19 cases in state of clinical practice* |    |           |
| 101-500                                     | 13 | (3.5)     |
| 501-1000                                    | 78 | (21.2)    |
| 1001-5000                                   | 140| (38.0)    |
| 5001 or more                                | 137| (37.2)    |
| Missing (did not provide state of clinical practice) | 43 | |
| Adequate PPE for clinical practice           |    |           |
| No                                          | 176| (43.0)    |
| Yes                                         | 233| (57.0)    |
| Missing                                     | 2  |           |

*As of April 3, 2020. COVID-19 indicates coronavirus disease 2019; PPE, personal protective equipment.

The sweep of the pandemic across the world has prompted rapid and drastic changes to many aspects of daily and professional life. Physicians who are not considered frontline in diagnosing and managing COVID-19 patients have nonetheless had to rapidly adapt to changes in medical practice and policies in order to continue to provide care for conditions other than COVID-19. These changes affect patients with cancer, who by the nature of treatment of this heterogeneous disease require frequent clinical evaluation and yet are also at high risk for severe manifestations of COVID-19 due to immunosuppression. It is too early to tell how cancer patients will be affected directly by the virus and also indirectly by the consequences of the pandemic. Early data from China suggest that cancer patients may be at increased risk of severe illness from COVID-19, though susceptibility may be attributable to age, underlying lifestyle differences such as smoking history, or presence of cancer. Without definitive data, it is challenging for physicians to

DISCUSSION

At ~10 to 11 weeks after the first confirmed case of COVID-19 in the United States, we found that the majority of physicians had already altered the oncology treatment plans, including surgery, chemotherapy, and radiation therapy, for their patients.
TABLE 2. Self-reported Reasons for Having Already Made Cancer Treatment Plan Changes During the COVID-19 Pandemic by Medical Specialty (N = 282)*

| Reasons for Altering Treatment Plans (Select All That Apply) | Surgeons (N = 168) | Medical Oncologists (N = 67) | Radiation Oncologists (N = 47) | P       |
|------------------------------------------------------------|-------------------|-----------------------------|-------------------------------|---------|
| Personal concern about my patients’ exposure risk          | 116 (69.1)        | 61 (91.0)                   | 37 (78.7)                     | 0.002   |
| Personal concern about exposure risks to other hospitalized patients | 63 (37.5)        | 20 (29.9)                   | 22 (46.8)                     | 0.18    |
| Personal concern about hospital staff and health care worker exposure risk | 86 (51.2)        | 27 (40.3)                   | 29 (61.7)                     | 0.08    |
| Personal concern about blood bank shortages                | 23 (13.7)         | —                           | —                             | —       |
| Desire to conserve PPE at my institution                  | 114 (67.9)        | 7 (10.5)                    | 12 (25.5)                     | < 0.0001|
| Institutional mandate due to COVID-19                      | 120 (71.4)        | 23 (34.3)                   | 12 (25.5)                     | < 0.0001|
| Surgeon General or professional medical organization       | 124 (73.8)        | 23 (34.3)                   | 24 (51.1)                     | < 0.0001|
| Closure of patient and family accommodations due to COVID-19 | 4 (2.4)           | 10 (14.9)                   | 6 (12.8)                      | 0.0008  |
| New strict visitor policy due to COVID-19                  | 23 (13.7)         | 18 (26.9)                   | 16 (34.0)                     | 0.003   |
| Patient transportation concerns due to COVID-19            | —                 | 15 (22.4)                   | 11 (23.4)                     | —       |

*Bold values indicate statistical significance (P < 0.05).
*Respondents were asked to select all that apply.
COVID-19 indicates coronavirus disease 2019; PPE, personal protective equipment.

To determine how to balance the risks of COVID-19 exposure and the consequence of postponing or altering cancer treatment in their patients.

Many professional medical societies as well as recognized experts in the field have published recommendations and editorials on triaging and managing patients with cancer during this new health crisis. However, as with any patient management, there is no “one size fits all” algorithm. We did observe that physicians who practice in states with higher numbers of confirmed COVID-19 cases were more likely to have altered their treatment plans but do not have longitudinal data to assess how case numbers affect cancer care.

We found that the drivers for altering treatment plans differed by specialty of the oncology physician. For surgeons in particular, recommendations from professional medical societies played a significant role. Various professional medical societies did differ in the timing and level of detail in their recommendations for managing cancer patients during COVID-19, and thus it is difficult to draw specific conclusions regarding the differences on reliance on these recommendations across medical specialties (surgery vs. medical oncology vs. radiation oncology), given that this is a single cross-sectional survey. However, our findings highlight the important roles that professional medical societies can play when we are confronted with a health crisis that reaches all disciplines. It is important that societies make recommendations in a timely manner, and also to update them frequently as needed. Even logistical and operational changes such as visitor restrictions and cancelation of patient accommodation/travel can have significant impact on the delivery of oncology care, particularly when multiple visits in succession are necessary. Medical and radiation oncologists are having to take these factors into consideration when making treatment recommendations to cancer patients, especially for those who have transportation, mobility and/or financial challenges.

Finally, there is the concern about COVID-19 exposure itself. Most physician respondents of all specialties were concerned about their patients’ risk of contracting SARS-CoV-2. Medical oncologists especially have had to weigh the risks of potentially immunosuppressive treatment against the cancer treatment benefits in this unprecedented context. Furthermore, approximately half of our survey respondents also cited concerns regarding exposure risks to health care workers. Cancer treatments involve interactions with multiple other health care workers, such as medical assistants, nurses, surgical technicians, nurse anesthetists, phlebotomy laboratory staff, radiation therapists, etc., in addition to physicians involved, which challenge the social distancing paradigm.

We found that physicians who practice in states with a higher COVID-19 case count were more likely to have already altered cancer treatment plans. This finding is in keeping with what we would have expected, as resources are more likely to be diminished in these states and physician concern heightened. We also observed that women were more likely to have already altered cancer-treatment plans. Additional analysis of the self-reported reasons for altering treatment plans revealed no sex differences in the endorsements of the reasons listed in Table 2. It is not readily apparent why women were more likely to have already altered treatment plans.

When data for this analysis were collected, public health concerns many parts of the United States were primarily centered around an impending surge in COVID-19 cases of uncertain magnitude; but in some states, COVID-19 cases were already spiking. Alterations to cancer care during this time have to be interpreted in the context of this sudden unprecedented health crisis and the surrounding uncertainty. In the long run, altered cancer treatment regimens will also have public health consequences. Cancer treatments and screenings that have been delayed but cannot be canceled will create a care backlog, and may negatively affect cancer outcomes in the future. By reducing the population’s vulnerability to one threat, we inevitably risk increasing its vulnerability to other threats. Cancer care recommendations going forward will likely change again as the balance of COVID-19 versus cancer risks keeps shifting with time.

**Limitations**

There are several limitations to this study. Because it is a survey-based study, there is an inherent response bias. It may be that physicians who have found that they have had to adjust their practice as a result of the pandemic were more likely to participate in this survey study. We chose a social media...
Cancer management during the COVID-19 pandemic has altered treatment plans for oncology physicians. The American Journal of Clinical Oncology conducted a survey of 400 oncology physicians to examine how the COVID-19 pandemic has impacted cancer treatment plans. The survey found that 72.8% of respondents have altered treatment plans, with alterations occurring more frequently in larger hospitals and academic practices. The survey also revealed that 28.2% of respondents have not altered treatment plans and did not plan on reassessing; these respondents were excluded from the analysis. The survey found that female physicians were more likely to have already altered treatment plans, and this may have biased the findings. The survey also highlighted the importance of communication and the need for timely updates from professional organizations. The study provides a glimpse of the physician perspective early on in the COVID-19 pandemic.

CONCLUSION

Cancer care treatment plan changes have occurred during the COVID-19 pandemic. In addition to concerns regarding COVID-19 exposure risks, physicians are having to weigh additional factors, such as conservation of PPE, external recommendations, and operational changes when deciding how to care for oncology patients during this health crisis. This has implications for how standard cancer care is reinstated after the pandemic has resolved.

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