Longitudinal Quantitative Analysis of Radiation Oncology Staff Illness in a New York City Center during COVID-19: The Impact of New Guidelines on Operations and Employee Health

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Abstract

Purpose: The novel coronavirus (COVID-19) forced radiation oncology clinics to overhaul operational policies, but the effect on employee safety has not, to our knowledge, been reported. The New York Proton Center (NYPC), a large freestanding clinic in New York City, New York, presents a 1-month experience of employee-reported health outcomes after the infiltration of COVID-19 and enforcement of policies designed to mitigate its impact.

Materials and Methods: In March 2020, new operational policies were implemented, including rigorous and frequent sanitation, visitor and treatment restrictions, distribution of personal protective equipment, work-from-home orders, and isolated nursing and radiation therapy teams. Employees of NYPC were prospectively monitored for exposure and symptoms of COVID-19. Work hours lost because of illness or quarantines were quantified from March 1, 2020, to March 31, 2020.

Results: Among 95 total employees, 23 (24%) were quarantined because of symptoms (n = 15; 65%), high-risk exposure (n = 5; 22%), or self-quarantined with personal concern (n = 3; 13%). Of 44 full-time, on-site employees, 39% (n = 17, including 6 therapists and 5 nurses) missed significant work time, including 6 (14%) with confirmed COVID-19. At full capacity, NYPC would have used 7260 work hours during March 2020 from the full-time, on-site staff, which was reduced by 18.8% overall (25.2% of nursing and 13.3% of therapy work hours), all in the latter half of the month. Among the therapist lost work hours, 92% were from 2 of 7 distinct, isolated therapy teams (29%). Without isolation, the exposure was modeled to have been 100%.

Conclusion: Despite losing significant staff hours in our department because of COVID-19, early and aggressive adoption of current, recommended policy guidelines outlined in this manuscript allowed NYPC to continue patient operations at full capacity.

Keywords: COVID-19; coronavirus; proton center; employee health

Introduction

On March 1, 2020, the first COVID-19 case in the region was diagnosed just north of the Bronx, New York. Less than 3 weeks later, New York City (NYC) emerged as the
worldwide epicenter of the novel coronavirus pandemic, with 41,771 cases as of March 31, 2020, and growing exponentially. As with many radiation oncology clinics during this difficult time, the New York Proton Center (NYPC) faced the challenge of effectively treating cancer and prioritizing the safety of patients and staff. Like other freestanding radiation oncology settings, that needed to be accomplished without the support of a hospital system and the ability for on-site COVID-19 testing. The detrimental effect of the virus on patients with cancer has been previously reported,1,2 as have institutional policies and very recent American Society for Radiation Oncology (ASTRO)/European Society for Radiation Oncology (ESTRO) recommendations to mitigate the risk of spread.3–5 To date, however, there have been no reports, to our knowledge, on what impact the virus and mitigating measures have had on employee health and staffing in a radiation oncology department. Anticipating the outbreak would eventually reach our institution, we prospectively monitored the health of our staff after early adoption of new planning and staffing models and report on our 1-month experience managing a large, freestanding cancer center in what was the highest-risk city in the world for contracting COVID-19. The goal of this study is to inform other centers about staffing needs and to allow other radiation oncology departments to predict how the “new normal” of operational policies can affect their staff, in an effort to maximize safety.

Materials and Methods
With permission and full cooperation from the NYPC staff, as well as approval from the institutional review board, during the month of March 2020, we prospectively monitored the health of our employees and tracked the onset and duration of COVID-19–related signs and symptoms, sick contacts, travel, potential exposure to those with the severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) infection, clinical workup, COVID-19 testing, and dates absent from work because of illness or quarantine. Employees were categorized as full-time, on-site (n = 44; 46%); rotational, on-site (n = 36; 38%); and full-time, off-site (n = 15; 16%). The full-time, on-site employees were further analyzed as the radiation therapy group (n = 24; 55%), nursing staff (n = 8; 18%), and receptionists, managers, and technicians (n = 12; 27%). The main endpoints of interest were the number of employees who developed COVID-19–related symptoms, and the number of work hours lost from illness and quarantine. Expected work hours for the month were calculated for full-time, on-site staff, by multiplying the length of a shift (7.5 hours) by the number of days in March (n = 22) and the number of employees at full operation. Of note, some duties for quarantined nurses, such as treatment visits through telemedicine, could be accomplished remotely, but we still counted those as lost work hours because nursing is still needed onsite to fulfill all responsibilities.

Timeline of Operations
A summary of operational changes is illustrated in Figure 1. Senior management at the NYPC began daily COVID-19–specific meetings on March 1, 2020 (designated as day 1), when the first confirmed cases of COVID-19 infection in NYC were revealed. On day 5, infection control and prevention measures were put in place that included increasing facility alcohol-based sanitization of all public surfaces (every 2 hour intervals), restricting staff travel, limiting the size of meetings to 5 people, restricting visitors, increased educational signage, and previsit telephone screening to assess for symptoms or sick contacts.

On day 11, further disinfectant measures included alcohol-based cleaning of all treatment tables, immobilization devices, and exam rooms after every patient contact. Employees were strongly reminded not to present to work if they developed fever or respiratory or other symptoms or if they had close contact with someone known or suspected to have COVID-19 and to report that information to their managers to receive clearance before returning to work.

On day 15, a day before the city closed down public venues, evolving preventive measures were escalated to prohibit handshaking and all nonvirtual meetings. Patient-facing staff were provided personal protective equipment, including individual N-95 masks. Patients were limited to one visitor (over age 12 years), and all patient encounters—including consultations, follow-ups, and treatment visits—were transitioned to tele- alternatives unless in-person evaluation was absolutely necessary. All patients and staff were required to conduct daily in-person screenings for illness and sick contacts upon entering the facility. Nonclinical staff began working exclusively from home, and clinical teams that could operate on a rotational basis did so. This limited the number of physicians (2 of 5; 40%), physicists (2 of 8; 25%), physics assistants (1 of 2; 50%), dosimetrists (2 of 9; 22%), and information technology staff (2 of 4; 50%) onsite each day. Clinical teams that required onsite presence 5 d/wk remained, including 24 therapists (55%)/3 radiology technicians (7%), 8 nurses (18%), 1 medical assistant (2%), 2 facilities management personnel (5%), and 6 receptionists (14%). Therefore, 44 staff were scheduled onsite full time, and 57 staff were expected onsite each day. (Table)
In addition, strategic initiatives were implemented to limit exposure between therapy and nursing teams. Before the outbreak, each treatment room (3 gantry, 1 fixed beam) used 2 to 3 therapists at a time and 6 therapists total during a three-shift, 15-hour warm-up and treatment day. For COVID-19 precautions, the midday gantry shift was eliminated, and therapists were reassigned to the other shifts. The PM (2:00 PM to 10:00 PM) shift now arrived after the AM shift (6:00 AM to 2:00 PM) completed their workday. Each room had 2 therapists per shift, and those therapists did not interact with any other therapists (7 separate therapy teams were created), including not having shared breaks or covering other treatment rooms. Nursing schedules that were previously staggered became consistently 3 shifts: a postanesthesia care unit (PACU)/AM team (2 PACU nurses, 1 from NYPC and 1 rotating nurse) from 6:00 AM to 2:00 PM; team A (3 nurses, 1 medical assistant [MA]) from 8:00 AM to 4:00 PM; and team B (3 nurses) from 2:00 PM to 10:00 PM. The three teams, despite overlapping times, strictly did not interact throughout the day (Figures 2 and 3).

On day 19, staff with fevers, shortness of breath, and/or altered taste or smell were recommended to remain quarantined, seek medical care, and insist on COVID-19 testing. For those with negative COVID-19 testing, return to work was acceptable after 48 hours of being asymptomatic. Staff with positive COVID-19 tests were prohibited from returning to work until meeting the COVID-19 recovery definition per the New York State Department of Health. Contact tracing was also completed for those individuals to inform and quarantine fellow staff members who may have been exposed. Three days later, all nonessential businesses in NYC were closed.

### Figure 1. Summary of operational changes. Key: The y-axis on the left and blue bars represent the number of confirmed COVID-19 cases in New York City, and the y-axis on the right and orange line represents the number of symptomatic patients at New York Proton Center. The stars represent the number of employees who tested positive for COVID-19 and when they were tested.

| New York City Policies | Day 5 | Day 11 | Day 15 | Day 19 | Day 22 | Day 30 |
|------------------------|------|-------|-------|-------|-------|-------|
| Department education  | • Gatherings limited to <500 people | • Public venues shut down | • Social distancing advised | • All non-essential businesses closed |
| Screen patients        | • Immobilization and treatment couches sanitized after each patient use | • Non-clinical staff to work from home | • COVID-19+ patients cannot be treated until after serologically cleared |
| Employee travel ban    | • Monitor employees not to visit each other | • Clinical staff hours limited and shifts staggered | • Symptomatic, suspicious patients must get COVID-19 testing and treatment held until results are negative |
| Visitors restricted    | • Symptomatic employees dismissed until asymptomatic | • No handshaking | • New staff policies: o Symptomatic staff must get COVID-19 testing and remain at home until results are negative |
| Additional custodial staff | • Staff interacting with patients change clothes upon entering the building | • Broad PPE | • Updated anesthesia policy: o All anesthesia cases require COVID-19 testing before simulation and before first fraction o For each subsequent fraction, daily screening and temperatures required |

| New York Proton Center Policies | Symptomatic Employees (%) |
|--------------------------------|---------------------------|
| • Department education        | 0%                        |
| • Screen patients             | 0%                        |
| • Employee travel ban         | 0%                        |
| • Visitors restricted         | 0%                        |
| • Additional custodial staff  | 3% (3/95)                 |
| • Immobilization and treatment couches sanitized after each patient use | 8% (8/95) |
| • Monitor employees           | 16% (15/95)               |

Hasan et al (2020), *Int J Particle Ther*
Results

The NYPC employs 90 staff and 5 radiation oncologists (n = 95 employees). As of March 31, 2020, 20 of the 95 primary NYPC employees (21%) had been removed from work, either because of concerning symptoms (n = 15; 75%) or high-risk exposure (n = 5; 25%). In addition, 3 staff members (3%), including 1 with prior symptoms who was cleared to return to work, chose to self-furlough because of concerns for increased personal or family susceptibility to COVID-19 infection, for a total of 23 staff members (24%) missing significant work time in a 1-month span, most of which occurred during the latter 15-day period (Figure 1).

Employee Health

Those employees with symptoms (n = 15) had fever (n = 9; 60%), sore throat (n = 8; 53%), cough (n = 7; 47%), fatigue (n = 7; 47%), anosmia/hypogeusia (n = 6; 40%), myalgias (n = 5; 33%), headaches (n = 2; 13%), nasal congestion (n = 2; 13%), and dyspnea (n = 1; 7%). Symptoms other than fatigue resolved after a median of 2 days (range, 1 day to not resolved). By the end of the month, 5 of the 23 staff (22%) had returned to work after successful quarantine and/or negative test results.
Six of the 95 individuals (6%) have tested positive for SARS-CoV2, 4 (4%) have pending tests, and 5 (5%) remain in quarantine.

On day 16, more than 2 weeks after the first confirmed COVID-19 case in NYC, the first NYPC staff member with concerning symptoms presented and was immediately quarantined and put on paid leave. All known contacts were notified. Influenza A testing returned positive, and symptoms resolved within 48 hours, and that employee returned to work 48 hours after complete symptom resolution.

On day 19, a lead therapist developed fever and myalgias; after which, COVID-19 testing was conducted, and positive results were received 8 days later. On day 20, another lead therapist developed symptoms. Positive COVID-19 testing results were received 9 days later. On day 25, a staff therapist, who had been in close contact with the first senior therapist and quarantined, developed symptoms. That therapist’s machine partner, who remains asymptomatic, was immediately quarantined. Positive COVID-19 testing results were received 6 days later. Also on days 19 and 22, two separate staff nurses developed symptoms and ultimately received positive COVID-19 results 7 and 9 days later. A nurse on the same team as the affected individual was quarantined and shortly thereafter developed mild, different symptoms that lasted 24 hours. She was refused COVID-19 testing and returned 7 days after initiation of her symptoms. On days 29 and 31, two additional staff nurses developed symptoms, both with COVID-19 testing pending.

Overall, by day 31, the number of onsite staff affected included 2 of 3 lead therapists (66%; 2 positive), 5 of 24 staff therapists/technicians (21%; 1 positive, 1 furloughed, 3 quarantined), 5 of 7 staff nurses (71%; 3 positive, 1 test pending, 1
for developing and have worse outcomes from COVID-19 infection,2,6 most do not have the luxury of delaying treatment
NYPC to minimize attrition at each infectious event and maintain full operation. Although oncology patients are at a higher risk
health, retracing sick contacts, rigorous sanitation, telemedicine appointments, and restructuring staff schedules allowed
month of the initial detection of COVID-19 in NYC. However, proactive measures, such as prospectively monitoring employee
recommendations by NYC or New York State. Despite our best efforts, the spread of the novel coronavirus inevitably affected
oncology clinics. Management at NYPC established internal COVID19-specific policies weeks before any mandates or even
pandemic, and we hope lessons learned from NYPC and the discussion to follow helps optimize staff safety in radiation
therapy and nursing teams by contact-tracing of known sick employees with their colleagues based on previously established
schedules, but any contract-tracing modeling leads to 100% spread or quarantine.

Work Hours
At full operational capacity and an assumption of 100% staff availability, in a month like March 2020 with 22 business days,
NYPC uses 7260 work hours (7.5 h/employee/d) from full-time, on-site staff, per month, including 3960 work hours (55%) from
the 24-person radiation-therapy team, 1485 work hours (20%) from the 9-person nursing team, and 1815 work hours (25%)
from the other 11 staff. After enforcement of new recommended operational guidelines during the month of March 2020, the
presence of COVID-19 directly or indirectly led to a reduction of 1365 total work hours (18.8%), including 375 hours (a 25.2%
reduction) of nursing work and 560 hours (13.3%) of radiation therapist work. All of these losses occurred during the second
half of the month, so for the last 12 business days of March, 37.6%, 50.4%, and 26.6% work hours for all on-site staff, nursing
staff, and radiation therapist staff, respectively, were lost. Of note, 92% of lost work hours from nonfurloughed radiation
therapists were due to 4 therapists from 2 of the 7 isolated-gantry shifts (29%). Two of those 4 were in close contact outside of
work. There were no other reported illnesses or necessary quarantines among the 20 remaining therapists distributed across
the 5 other gantry shifts (71%). We attempted to estimate the number of work hours that may have been lost before isolating
therapy and nursing teams by contact-tracing of known sick employees with their colleagues based on previously established
schedules, but any contract-tracing modeling leads to 100% spread or quarantine.

Discussion
We recognize and appreciate all health care workers who risk their personal and family safety caring for patients during this
pandemic, and we hope lessons learned from NYPC and the discussion to follow helps optimize staff safety in radiation
oncology clinics. Management at NYPC established internal COVID19-specific policies weeks before any mandates or even
recommendations by NYC or New York State. Despite our best efforts, the spread of the novel coronavirus inevitably affected
our department, reducing total staff hours for the month by almost 20% and affecting 39% of the full-time staff within the first
month of the initial detection of COVID-19 in NYC. However, proactive measures, such as prospectively monitoring employee
health, retracing sick contacts, rigorous sanitation, telemedicine appointments, and restructuring staff schedules allowed
NYPC to minimize attrition at each infectious event and maintain full operation. Although oncology patients are at a higher risk
for developing and have worse outcomes from COVID-19 infection,2,8 most do not have the luxury of delaying treatment
should staff shortages arise. Oncology clinics must, therefore, have the foresight to be proactive early to mitigate transmission.
Equally important as the policies themselves is that most were implemented early, just days after the first COVID-19 case
was detected in NYC. The exponential rise of cases within NYC correlated with the timing of affected staff. That trend
emphasizes the critical importance of taking early action before a dramatic increase in community transmission. Without such
early intervention and especially separating therapists and nurses into teams, we likely would have needed to quarantine such
a critical mass of staff that it would make continuing treating at full (or potentially even reduced) capacity impossible. In our
experience, it appears allowing staff to work remotely is critical in reducing the risk of exposure, with 17 of 44 full time on-site
employees (39%) affected, compared with 4 of 36 rotational employees (11%) and 1 of 15 full-time, off-site employees (7%).
The fact that numerous employees became sick before any patients were known to be affected by COVID-19 underscores the
risk of community transmission from work commutes, especially in a city like NYC, which is heavily dependent on public
transportation.

Another challenge facing oncology clinics is limited access to SARS-Cov2 testing. Some employees were refused testing
even with symptoms and/or high-risk exposures, and those who were tested took on average 8 days for results to return. Given
the delay in test results combined with the recommended quarantine duration, staff shortages can occur quickly and put
tremendous strain on facilities. Hopefully, new testing systems now approved by the US Food and Drug Administration will
increase access and allow more timely decision-making for patients and staff.

This study is limited by its retrospective nature and lack of broad applicability. As a freestanding center, we were able to
harbor a well-controlled environment with a specific oncologic patient population. Patients with other medical conditions, such
as those requiring surgery, may be more prone to infection. Nevertheless, it is reasonable to suspect that similar precautionary
measures in any clinic can result in similar results. Rigorous screening and sanitation, as well as isolating shifts of staff who work closely with patients can be implemented regardless of the patient population, albeit perhaps not as successfully.

Our 1-month experience as a freestanding radiation oncology center demonstrates that, despite early and aggressive measures (which are now recommended by leading organizations in radiation oncology) taken by clinical administration to contain the viral spread, it will likely reach the doors of most clinics. However, based on our data, we can only assume that, without such aggressive measures, a far greater proportion of staff would be affected. In fact, without separating our nursing and therapy staff into teams, the illnesses that our staff sustained if operating how we had been under pre–COVID-19 conditions would have resulted in no longer being able to operate at full capacity and potentially could have required us to close because of a widespread quarantine of nursing and therapy staff. Therefore, we recommend promptly enforcing screening, monitoring, and quarantine measures. In addition, telemedicine initiatives and restructuring of staff schedules are critical to mitigating work-hour losses, minimizing employee overlap, and ensuring the fewest number of quarantined individuals per event. These proactive initiatives are paramount to optimizing the safety of our colleagues and patients as we approach the peak of this pandemic.

ADDITIONAL INFORMATION AND DECLARATIONS

Conflicts of Interest: The authors have no relevant conflicts of interest to disclose.

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Ethical Approval: All data were collected under internal review board–approved protocol.

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