

The Impact of the Coronavirus Disease 2019 Pandemic on the Clinical Environment

Shannon N. Youngblood¹ and Sara L. Johnson²

¹University of Arkansas for Medical Sciences, Little Rock, Arkansas, and Ochsner Medical Center, Baton Rouge, Louisiana; and

²Nuclear Medicine Technology Certification Board, Tucker, Georgia, and AdventHealth University, Orlando, Florida

The Nuclear Medicine Technology Certification Board performed an impact survey on the coronavirus disease 2019 pandemic to better assess the current state of nuclear medicine practice within the United States, as well as the perceptions and experiences of technologists working during the pandemic. **Methods:** A web-based automation platform was used to create, collect, and analyze the survey data. **Results:** The survey revealed many department protocol variations during the pandemic, a decrease in patient volume, and several other concerns and issues. Experiences regarding staffing and wage changes were varied. **Conclusion:** This research showed significant inconsistencies in practice and stresses to nuclear medicine technology during the pandemic, as well as concerns for the workforce pipeline. NMTCB decided to delay the JTA process and conduct additional research regarding the workforce.

Key Words: CNMT; research methods; statistical analysis; COVID-19; job task analysis; staffing

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Recent studies have shown that nuclear medicine professionals have been directly impacted by the coronavirus disease 2019 (COVID-19) pandemic. Several global studies were performed in the spring and summer of 2020 showing a widespread reduction in nuclear medicine procedures (1–3). Early surveys showed disruptions to the supply chain, including the availability of radiopharmaceuticals and the ⁹⁹Mo/^{99m}Tc generator supply (2). Freudenberg et al. conducted a global survey including 72 countries and found an average 54% decline in nuclear medicine imaging procedures, including a 60% overall decline in myocardial perfusion imaging and a 67% decrease in thyroid uptake and scan procedures (2). The decline in procedures occurred primarily because nuclear medicine departments were postponing routine and elective scans or had concerns over infection prevention (3). Czernin et al. also reported that patient volume was reduced to accommodate staffing shortages that were due to staff illness (4). Nuclear medicine therapies were also significantly reduced (5).

Image prioritization was recommended and may have contributed to the reduction in studies performed. The International Atomic Energy Agency released technical guidance for nuclear medicine departments, including a detailed chart to help departments prioritize procedures (6). The chart showed prioritization for oncologic procedures, especially PET imaging, as well as emergent procedures such as gastrointestinal bleeding or ventilation/perfusion (V/Q) lung scans. Several general imaging studies were deprioritized or deemed nonessential, such as parathyroid imaging and bone scans performed for nononcologic indications (6).

Nuclear medicine departments also modified procedures to maximize infection prevention efforts. Changes to daily functions included the development of new infection control and prevention protocols specific to nuclear medicine, longer time slots for patients to allow for room sanitization, and increased use of personal protective equipment (7). Imaging protocols were also modified. Myocardial perfusion imaging protocols in some cases were modified to pharmacologic-only or stress-first protocols (8). In some institutions, patients were switched to cardiac PET protocols. One-day imaging was preferred for all studies that would typically take multiple days to perform. V/Q lung scans were greatly modified over concerns about infection prevention in staff and COVID-19–related conditions (7,9,10). Modifications to V/Q lung scan protocols included switching to Technegas (Cyclomedica Australia) for ventilation, performing the scan as perfusion only, and switching the protocol to SPECT or SPECT/CT (7,10). Perfusion-only lung SPECT/CT is a useful tool for detecting COVID-19–related lung disease in addition to detecting pulmonary embolism (10).

Supply shortages and supply chain issues greatly disrupted daily operations during the pandemic (4,5). Shortages of personal protective equipment, radioisotopes, cold kits, and generators were reported (5). Procurement and allocation of personal protective equipment were a concern for many nuclear medicine departments (7). It became critical, yet challenging, for department leadership to advocate for the proper allocation of personal protective equipment to nuclear medicine personnel who face the same infection risk yet are less visible to management than other health-care workers, such as nurses (7). Shortages for various radiopharmaceuticals have been ongoing and include mebrofenin, sulfur colloid, mertiatide, methylene diphosphonate, pyrophosphate,

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For correspondence or reprints, contact Sara L. Johnson (sjohnson@nmtcb.org).

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and sestamibi (11). ^{177}Lu and ^{131}I shortages due to reactor and supply issues were also reported (5,11).

Lastly, staffing issues have remained a concern and a challenge for employers, as well as a cause of stress for many nuclear medicine technologists (NMTs) (4,5). Modifications to staffing in nuclear medicine departments include reducing staff, reassigning staff to assist in other areas, reducing hours due to decreased volume, extending shifts to longer hours to accommodate sick staff, and developing A and B teams (12). Some staff were furloughed or laid off. Some received decreased pay for decreased hours, whereas others received crisis pay (12). Staffing shortages exist in nuclear medicine and other imaging modalities, with concerns over safety due to the pandemic and lack of support compared with other health professions being cited as contributing factors (13).

The Nuclear Medicine Technology Certification Board (NMTCB) routinely analyzes the current status of the field and uses these data to ensure that the board's entry-level examination remains reflective of current nuclear medicine practices. This is one way the NMTCB ensures that applicants are being tested on the knowledge, skills, and competencies needed to enter the workforce. The NMTCB conducts a job task analysis (JTA) every 5 y to examine current practices as a way to ensure that the certified NMT (CNMT) examination remains relevant to current practices (14). As part of the JTA, an extensive literature review is performed to create a draft list of tasks and procedures performed by NMTs. A survey is then sent to participating NMTCB-CNMTs, who determine the importance and level of competency required for entry into the workforce. The NMTCB's last JTA process was in 2017, and the next began in 2022.

On the basis of previous pandemic research and other feedback from the nuclear medicine community, the NMTCB board of directors and staff have had concerns that the ongoing pandemic may still be impacting nuclear medicine. Research from the pandemic showed several modifications to current nuclear medicine practices and protocols, supply chain issues, and significant job-related stressors for technologists. Conducting a JTA while nuclear medicine is still experiencing pandemic changes, shortages, protocol modifications, and a decreased volume for some procedures would impact the results of a JTA. If certain imaging and therapy procedures are not being performed or the frequency of certain procedures is still being altered because of the pandemic, the data from the JTA would likely be inaccurate, potentially resulting in unnecessary changes to examinations and certification processes. Therefore, the NMTCB performed a COVID-19 impact survey to better assess the current state of nuclear medicine practice within the United States, as well as the perceptions and experiences of technologists working during the pandemic. The results of this survey have been used to make data-driven decisions within the NMTCB, including determining whether it was necessary to delay the JTA process, as well as providing more insight into the experiences of working NMTs.

MATERIALS AND METHODS

The NMTCB review board approved this study as exempt under section 45CFR46.104, and the requirement to obtain informed consent was waived. All participants were provided full disclosure regarding the purpose of the survey and voluntarily indicated informed consent when selecting to open, participate, and conclude the survey. A mixed-study single-group analysis was used to survey CNMTs in the NMTCB e-mail database. The survey consisted of 19 multiple-choice answers with an option for open-ended responses after each question (all questions and answers are available at the end of this article, as well as online as Supplemental Data at <http://jnmt.snmjournals.org>). Survey instructions included a disclaimer that the survey was voluntary, that it should require less than 5 min to complete, and that results would be anonymous and confidential. A survey invitation was sent to active holders of a CNMT credential who live within the United States and have an e-mail address on file with the NMTCB. The invitation was sent via e-mail on August 20, 2021. Two reminder emails were sent: one on August 30, 2021, and the other on September 7, 2021. The survey was closed on September 14, 2021.

Mailchimp, a web-based automation platform, was used to create, collect, and analyze the survey data. The survey was sent via e-mail to 19,379 NMTs. In total, 7,466 participants opened the survey. Of these, 3,600 completed it fully. Incomplete responses were excluded from the data analysis. Respondents were provided the opportunity to submit individual comments for each question. Analysis of response data was based on the frequency of responses. Survey comments were open-coded and compared for themes.

RESULTS

The survey was sent via e-mail to 19,379 NMTs and received 7,466 open notifications and 3,600 completed responses, for an 18.57% completion rate. Most respondents were full-time NMTs (74.9%) (question 1). A relatively even distribution of department size was reported, with 27.9% of departments employing 1–2 NMTs; 25%, 3–4; 21.4%, 5–7; and 16%, more than 10 (question 2). Most respondents were employed in hospital-based settings (65%) (question 3). Additional respondent workplace employment included outpatient imaging centers (12.5%), cardiac centers (11%), and PET facilities (5%). Respondents were geographically distributed, with responses representing 11 states.

Staffing

When asked if working hours increased or decreased during the pandemic, responses were varied (question 4). Work hours increased by 10%–25% for 8% of respondents, whereas 22.7% of respondents stated their hours decreased by 10%–25%. Another 9.1% of respondents stated their hours were drastically reduced by 26%–50%. Although the reduction of work hours may invoke trepidation, 45% of respondents stated their normal work hours did not change. Most respondents also did not change employers during the pandemic (question 5).

Many respondents entered open-text comments regarding working hours during the pandemic. One respondent wrote, “At the beginning, March to December 2020, we went from 80 h biweekly to 72 h then down to 60 h. All outpatient

scans were canceled because of the COVID-19 patients in the hospital. We lost some members of staff to COVID-19, some were laid off, and we are now fully operational back to 80 h biweekly plus overtime. The hospital has hired 2 new nuclear medicine techs, and most of the department has now cross-trained in diagnostic CT.” Another commented that working hours “both increased and reduced by 10%–25% over the last 18 mo depending on the current events surrounding COVID-19 (i.e., reduced surgery volumes impacting productivity or reduced staff).” Overall feedback from responses and comments indicated that early in the pandemic, many NMTs experienced reductions in hours and pay or were furloughed. However, as of summer 2021, most had returned to normal working hours or were getting overtime hours due to staffing shortages.

Wages

When asked if they experienced a change in wages or salary in the past 18 mo, 33% of respondents reported an increase (question 6). No change was reported by 54.3% of respondents. The comments revealed that some NMTs received bonus hazard pay and others received cost-of-living adjustments or annual increases. Many others reported that no raises were given to anyone in the radiology department or hospitalwide. Wages decreased for 9.9% of respondents, for reasons such as having their position eliminated, being furloughed, or having a pay decrease due to a decrease in hours worked.

Patient Volumes

Respondents reported a decrease in volume for all patient types (question 7). When asked about a reduction in patient volume, 47.5% of respondents reported a decrease in outpatients, 20.4% reported a reduction in inpatients, and 11.77% reported a reduction in emergency room patients. Another 15.7% reported a decrease in on-call procedures. The comments indicated that the greatest reductions occurred in 2020 at the beginning of the pandemic, when stay-at-home orders were in place and elective procedures were canceled. One NMT reported, “At the beginning of the pandemic, we didn’t get patients, except for emergencies and PET patients.” Many respondents commented that volumes are starting to return to pre-pandemic levels for all procedures.

Protocol Variations

Respondents reported many protocol variations and modifications to department protocols during the pandemic (questions 9–11). The most significant change in nuclear medicine protocols due to COVID-19 was in V/Q studies. Many respondents reported an increase in V/Q and myocardial perfusion imaging studies (question 10). A perfusion-only protocol for V/Q studies was implemented in 56.5% of departments regardless of the COVID-19 status of the patient (question 11).

Most respondents (61.8%) reported that their facility required them to perform examinations on COVID-19–positive patients (question 12). Additionally, several protocol variations were made for procedures on COVID-19–positive

patients (question 13). For identified COVID-19–positive patients, 50.6% of respondents followed a perfusion-only protocol for V/Q studies. Other affected nuclear medicine protocols included myocardial perfusion imaging studies, with pharmacologic-only stress portions performed by 14.6% of respondents. Nineteen percent of respondents performed studies on COVID-19–positive patients only at the end of the day. Interesting to note is that 29.9% of respondents reported that their department did not modify existing protocols and that 26.8% of respondents reported no modification of any nuclear medicine studies when performed on a COVID-19–positive patient. Respondents reported changes to allow for distancing of patients while waiting for their procedure, an increase in cleaning time between patients, and additional stressors due to COVID-19–related issues.

Other Concerns

Through survey questions and open comments, respondents reported several other pandemic-related concerns and issues: low patient volumes (58.9%), supply shortages (45.9%), staffing shortages (35.9%), and reassigned duties (28.85%) (question 14). Fifty-four percent of respondents reported no current changes in wages or salary, and 87% had not changed employers during the previous 18 mo. Regarding the vaccination battle, 57.9% of respondents reported that their institution or employer required either vaccination or a written attestation or request for an exemption (question 15). A large percentage (83.3%) of NMTs reported not having tested positive for COVID-19 during the past 18 mo, with those testing positive stating they acquired the virus occupationally (7.3%) and 6.8% through community transmission (question 16).

Throughout the survey, respondents were given the opportunity to comment freely on their experiences working as an NMT during the pandemic. Comments included an initial reduction in patients during the unexpected shutdown period and employers who did not allow employees to know the COVID-19 status of patients. A frequent concern expressed by the NMTs is what challenges to their livelihood will arise as new variants emerge and what approach will be best for handling current issues, both professionally and personally. Many nuclear medicine educators went from classroom teaching to online teaching, which posed its own hurdles.

Although 67.2% of NMTs reported that they do not plan to retire within the next 5 y, a staggering 28.4% reported that they do plan to retire within the next 5 y (question 17). Respondents reported a desire to leave their existing employer or profession if required to receive the vaccine against their will or if facing stressful working conditions, staffing shortages, health risks, depression, lack of respect for their profession, or lack of leadership from administrators. The staffing shortages that have been noted in other radiologic modalities, such as radiography, CT, and MRI, have shown the value of holding multimodality certifications, as well as the need for more nuclear medicine advanced associate professionals.

DISCUSSION

This survey was sent on August 20, 2021, when federal vaccine mandates for health-care workers were being created but had not yet been implemented by most employers. On September 9, 2021, President Biden issued a mandate that all employers with more than 100 workers require their employees to be vaccinated or tested for the virus weekly, affecting about 80 million Americans. Workers at health facilities that receive federal Medicare or Medicaid were mandated to be fully vaccinated. This was a controversial topic, and many NMTs who had medical or religious exemptions for other vaccines were at risk of losing their job. The comments submitted in our survey revealed that many NMTs were unhappy about the mandate and feared being fired. Many also expressed that they did not feel comfortable with the efficacy and safety of the vaccine but would agree to receive it if forced by their employer. The timing of the vaccine mandate, which was enacted during the active survey collection period, may have caused respondents to alter their original opinion.

The NMTCB used the data from this survey to drive decisions about the JTA and how to further assess the current state of nuclear medicine technology. Temporary reductions or avoidance of some procedures, along with protocol modifications, may negatively impact the validity and reliability of the JTA process. Because the JTA impacts the content of the entry-level certification examination, it is imperative that temporary changes adopted during the pandemic either be returned to previous practices or be converted into permanent practices. As a result of this survey, the NMTCB delayed the JTA process by 1 y to allow staffing, patient volumes, and protocol modifications to stabilize.

Comments about a desire to retire or leave the field were a cause for concern. A question was added to the annual NMTCB renewal in 2022 to reach every NMTCB certificate holder and attain a more accurate picture of whether the study result was reflective of the overall field: “Do you plan to retire or leave the field of nuclear medicine within the next 5 y?” Approximately 13% stated that they do plan to leave in the next 1–5 y, with 87% stating that they have no plans to leave in the near future. Although this provides a more accurate picture of workforce attrition and is less concerning than the COVID-19 impact survey showed, it still incites some concern over the workforce pipeline and the potential for future staffing shortages.

CONCLUSION

To project what the future will hold for our profession, additional research is warranted encompassing the long-term effects of the pandemic on the field of nuclear medicine. We must adapt to challenges and changes as they arise. It is encouraging that exciting and innovative radiopharmaceuticals, safety measures, and theranostics are on the horizon. The demand for nuclear medicine professionals with multimodality certifications and skills, as well as the

need for more nuclear medicine advanced associates, has risen exponentially because of the effects of COVID-19 and the surge in theranostics. However, an increase in new technologists entering the field is needed to meet the staffing demands caused by retiring technologists and expansions of the field. The JTA, which was initially delayed because of the results of this survey, will be conducted throughout 2023 and the results implemented in 2024. The NMTCB also recently conducted a salary survey, the results of which are forthcoming. As we look toward the future, the NMTCB is committed to continuous support and guidance of the nuclear medicine profession by providing resources such as this survey and the salary survey and by offering additional certifications in CT, PET, radiation safety, and nuclear cardiology, as well as the opportunity to earn certification as a nuclear medicine advanced associate.

DISCLOSURE

No potential conflict of interest relevant to this article was reported.

KEY POINTS

QUESTION: How has the COVID-19 pandemic impacted nuclear medicine technology?

PERTINENT FINDINGS: COVID-19 greatly impacted the clinical environment for NMTs. Changes to clinical practice may impact the NMTCB’s JTA and examination development process. The results of this survey also created concerns over workforce retention.

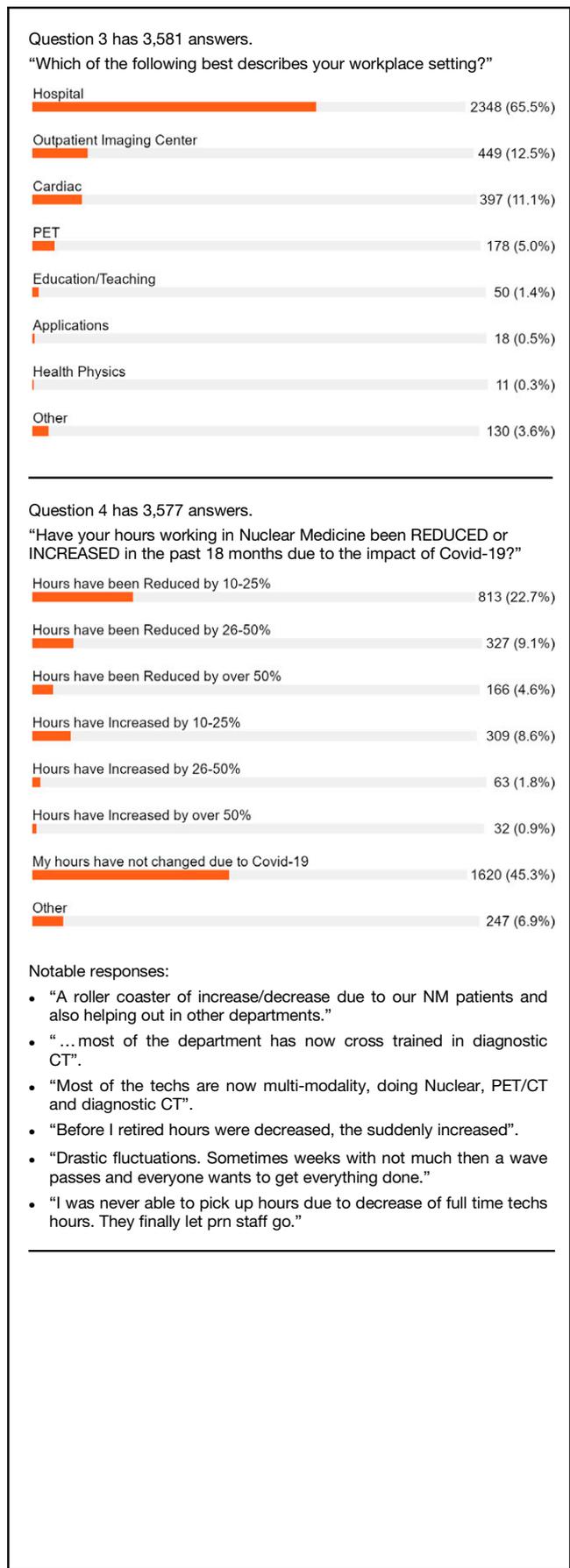
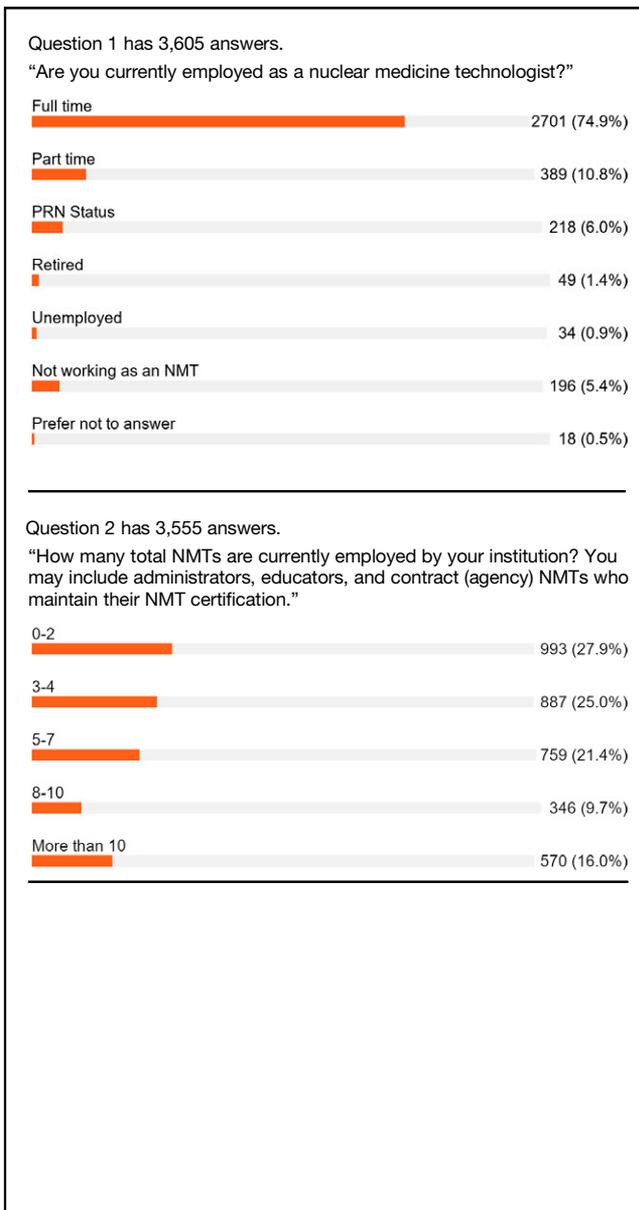
IMPLICATIONS FOR PATIENT CARE: Care of patients during future pandemics may be improved by the planning that surveys such as ours enables.

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APPENDIX



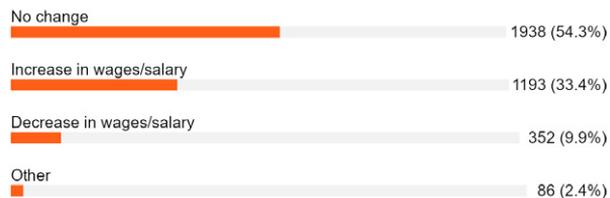
Question 5 has 3,584 answers.

“Have you changed employers during the past 18 months?”



Question 6 has 3,569 answers.

“Have you experienced a change in wages/salary in the past 18 months?”

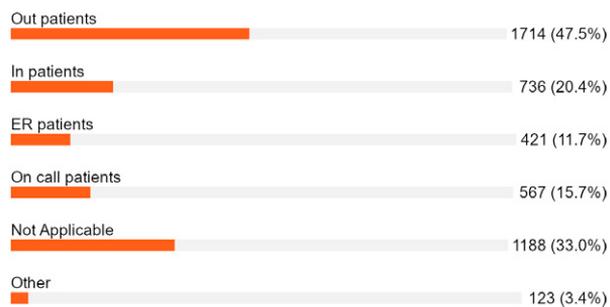


Notable responses:

- “From March 2020 – June 2020 hours AND pay reduced by 50%.”
- “All raises were put on hold.”
- “As a front line worker, nurses are being offered higher pay, but we are getting these patients right from the ER and exposed everyday.”
- “There has been no restitution for any of us, just keep coming in grinding the pavement and come back tomorrow. We are providing the best care to Covid patients, and they cut our hours or don't want to pay what we should be getting, it's very sad oh and then try to make us work extra shifts in other areas of hospital and not pay extra”.
- “Didn't get a regular raise, they stopped contributing to retirement, kept the bonuses for the company.”
- “Everyone's salary was decreased by 20% For the same period above. We were not allowed to work over 32 hours per week.”
- “Used up all PTO due to slow down.”

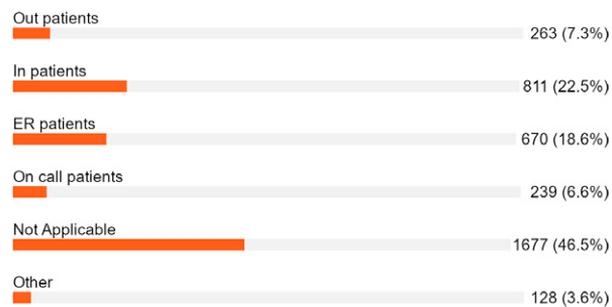
Question 7 has 3,302 answers.

“If you work in a hospital setting, have you experienced a REDUCTION in the following patient types due to the COVID pandemic?”



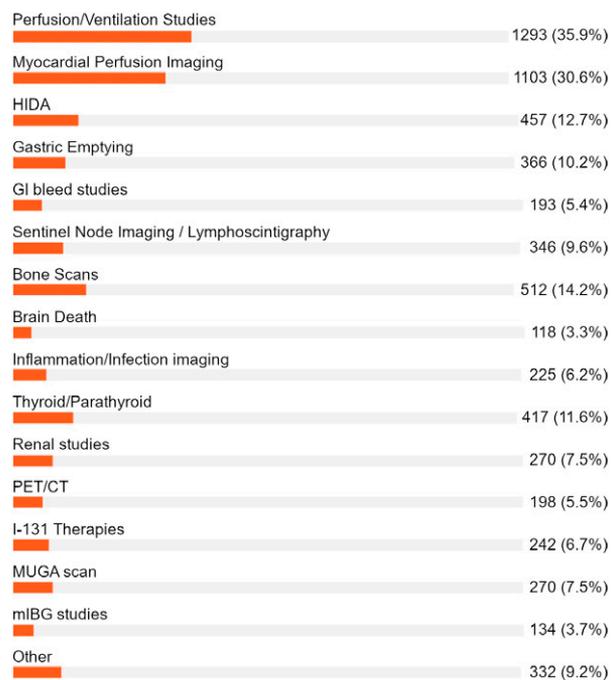
Question 8 has 3,051 answers.

“If you work in a hospital setting, have you experienced an INCREASE in the following patient types due to the COVID pandemic?”



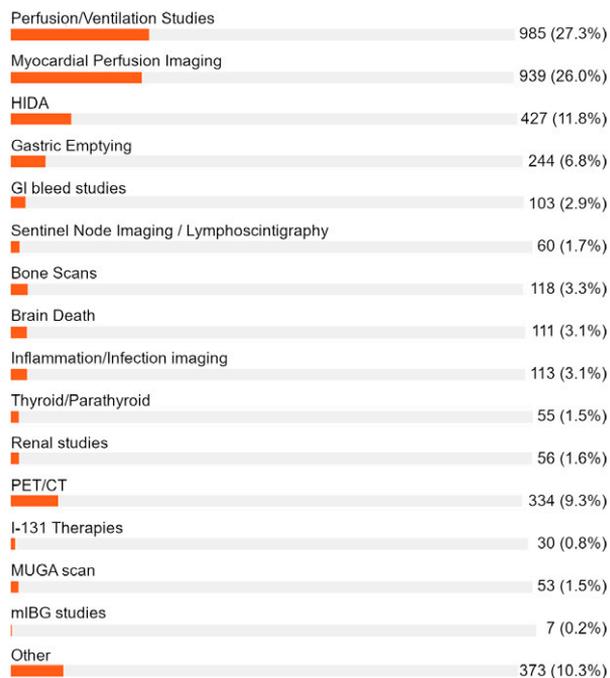
Question 9 has 2,900 answers.

“Which nuclear medicine studies and procedures do you feel have had the most volume REDUCTION due to Covid-19 at your institution? Pick all that apply:”



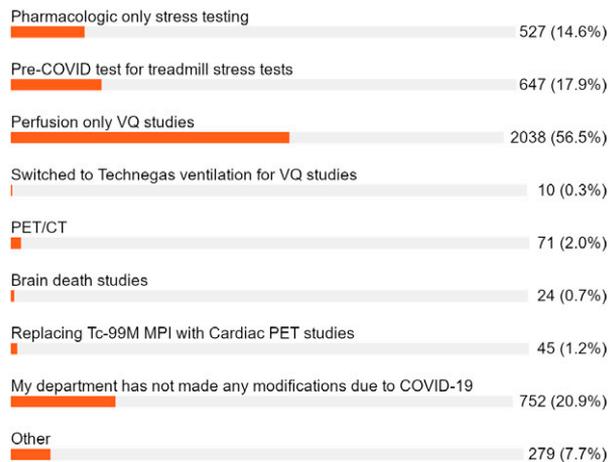
Question 10 has 2,541 answers.

“Which nuclear medicine studies and procedures do you feel have had the most volume INCREASE due to Covid-19 at your institution? Pick all that apply.”



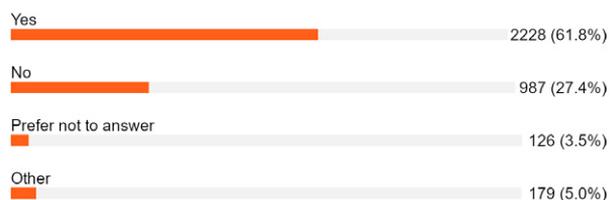
Question 11 has 3,382 answers.

“Which of the following modifications has your department made due to COVID-19? Pick all that apply.”



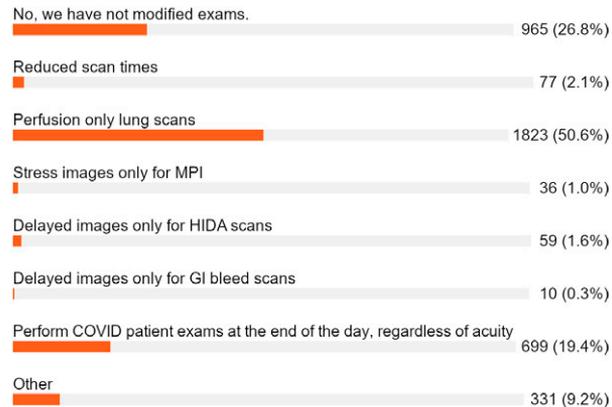
Question 12 has 3,490 answers.

“Does your facility require you to perform exams on COVID positive patients?”



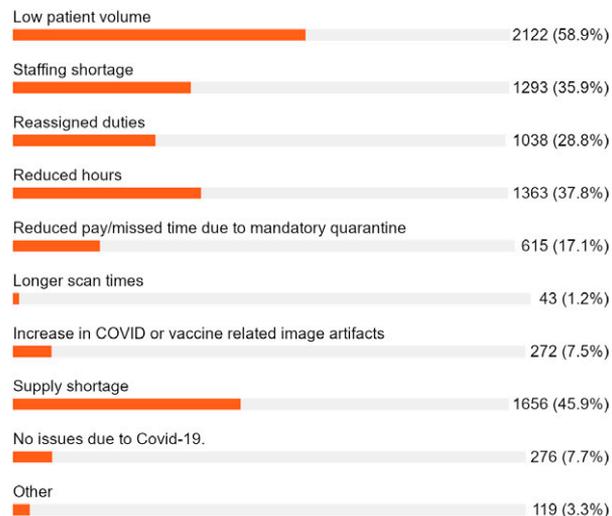
Question 13 has 3,233 answers.

“Have you modified any exams when imaging known COVID positive patients?”



Question 14 has 3,480 answers.

“Which of the following issues has your department faced during the pandemic?”

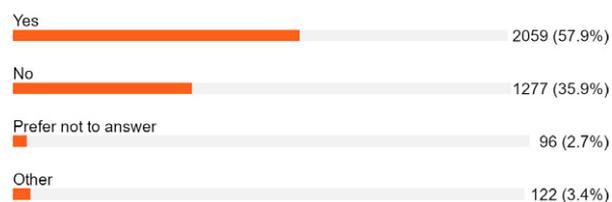


Notable responses:

- “A great many issues as an educator – virtual classrooms, delayed clinical experiences, trying to graduate students on time, recruiting efforts especially international students.”
- “I was told by a text ‘no patients, no work, you and your coworker figure out who will work one day next week.’ Not fired. ‘Good luck’, when asked to work again I carried a lot of anger and apprehension. I don’t want to work with doctors anymore, they were not caring toward me or my colleges.”
- “More responsibilities, cleaning, sanitizing, more stress and increased demand.”
- “Reduced pay/missed time due to mandatory quarantine.”

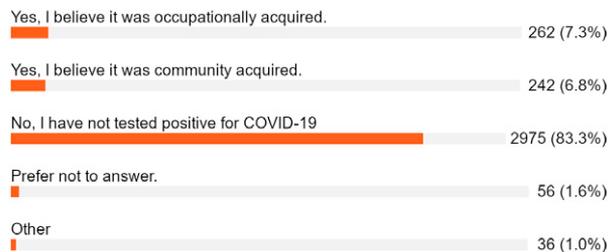
Question 15 has 3,554 answers.

“Is your institution or employer requiring you to be vaccinated against Covid-19 or provide written attestation that you have been vaccinated?”



Question 16 has 3,571 answers.

"In the past 18 months have you tested positive for COVID-19?"



Question 17 has 3,571 answers.

"Do you plan to retire from your current position within the next five years?"



Notable responses:

- "Already retired to much stress to deal with, no help from administration."
- "Can't retire in 5 years but would like to change fields."
- "I have been not employed as an NMT for approximately one month. I am changing professions . . . I no longer desire to work in healthcare or a hospital setting."
- "I plan to leave my current position due to the pandemic and lack of protocols to ensure staff safety."
- "... I'm finding this whole process not really worth my time for what I'm paid in relation to the daily stress of all the unknowns of this whole Covid-19 thing; the daily tussles with my co-workers just because we all are so exhausted and so over all the highs/lows . . ."
- "I use to love my job; but the risks of exposure that I take on the daily; along with the constant inter-department squabbling that goes on because everyone is just plain exhausted by all of this Covid-19 crap – have me re-thinking my 'why' for showing up each day for work."
- "Making me rethink what else I can do with my certification."
- "Not retiring. Planning to leave the field of nuclear medicine for something better. It is not a profession I would ever recommend to anyone. Abusive hospital systems make this field unbearable. Not to mention most of what we do does not have a significant impact on patient outcomes."
- "... this pandemic took a toll on me. I don't know if I want to stay working in the medical field."
- "... if I find a job outside of the medical field that is enjoyable I will probably not return to NM. Employers have cut staff in nuclear so short that there have been injuries due to transport and lifting of patients in past years. Not worth being crippled due to a lack of management understanding."
- "... Healthcare as burnt me out"

Question 18 has 3,605 answers.

"Which state/location do you work?"

Multiple answers.

Question 19 has 436 answers.

"If you would like to submit additional comments regarding your experience working as a nuclear medicine technologist during the Covid-19 pandemic, please type your feedback here. All individual survey responses are anonymous."

Notable responses:

- "I realize this employer (and medical staff,) in no unclear terms, does not care about its employees. Stress testing resume as soon as patients agreed to come in, professional society recommendations were ignored completely, weren't in the conversation."
- "My decision for retirement was strongly based upon the fact I felt working conditions were too stressful. My underlying risk factors were minimized by my employer and because I worked solo, there was never anyone else to assist in any way. Work on this job for over 19 years."
- "Additional cleaning protocols were put in place without additional time allowed in the schedule to effectively clean between patients."
- "... I am now pursuing a nursing degree."
- "As always, the department is overlooked by administrators."
- "As the pandemic continues I have seen a more nonchalant attitude. This scares me since my state has not taken the pandemic seriously enough."
- "I was forced to use my sick/vaca time and could not get any unemployment. Now I am left with no sick/vaca time. Seems ridiculously unfair, since we were deemed 'essential'."
- "At the beginning of the pandemic, our hours were cut by 50%..."
- "At the start of the pandemic, I was mocked by my manager for requesting to wear a mask. They were of limited supply. There was hoarding of masks and PPE. I don't want to complain, just want to record these facts for posterity!"
- "Attention needs to be made more public that not all front line hospital workers are nurses."
- "... new students have suffered their education has suffered big time and for no reason except for unneeded restrictions. The patient load we are seeing is also from unneeded restrictions people are sick because they neglected their health."
- "Creating a work life balance during a pandemic is difficult than normal – having to blow through PTO for children needing to be quarantined due to daycare exposure etc. staff out for Covid quarantines but not adjusting schedules properly."
- "Most staffing shortages at the nuc med tech level are due to management reacting to volatile metrics and imposing "doing with the least staffing resources possible" philosophies, rather than developing strategic flexibility with smarter staffing margins. We simply need more techs, and more flexible techs hired."
- "... management does not really tend to the safe practices of their employees. Physicians write orders when our radiologist do not understand why this positive COVID patient needs this order. ... Sometimes it just seems all about the money just checking the box because there is nothing else to for the patient."
- "Due to shortage of some kits or isotopes, one Doctor said, 'what a perfect way to kill a dying modality!'"
- "Our biggest challenge now is supply shortages including gloves, IVs, butterflys, meds such as CCK, and radiopharmaceuticals such as Mebrofenin."
- "Even though patient volumes have increased within the past few months, my Nuclear Medicine department will be closing indefinitely."
- "Ever since I have graduated I have not worked in the field much for several years. A significant amount of technologists have stayed in the same positions making it difficult to allow new persons to come in."
- "Everyone seems very overworked and underpaid in general within the healthcare system. Covid simply made everything more stressful."
- "Everything seems to have become a political issue."
- "Feel like some PET patients may have delayed follow-up scans, which resulted in delay treatments."
- "Forced mandates on vaccination and unfair work practices."
- "... have also been tasked with housekeeping and secretarial duties as there's been a shortage in those areas. If we complain about doing these extra duties in addition to our own work we've been told to shut up and be glad that we have jobs!"
- "Our physicians informed us that we're not allowed to. enter their offices or the reading room because they don't want to be exposed to us as we're 'dirty' and everything we touch is 'contaminated'."