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COVID-19 in obstetrics 2020: the experience at a New York City medical center

https://doi.org/10.1515/jpm-2020-0365
Received July 31, 2020; accepted August 4, 2020; published online September 7, 2020

Abstract: The global spread of the SARS-CoV-2 virus during the early months of 2020 was rapid and exposed vulnerabilities in health systems throughout the world. Obstetric SARS-CoV-2 disease was discovered to be largely asymptomatic carriage but included a small rate of severe disease with rapid decompensation in otherwise healthy women. Higher rates of hospitalization, Intensive Care Unit (ICU) admission and intubation, along with higher infection rates in minority and disadvantaged populations have been documented across regions. The operational gymnastics that occurred daily during the Covid-19 emergency needed to be translated to the obstetrics realm, both inpatient and ambulatory. Resources for adaptation to the public health crisis included workforce flexibility, frequent communication of operational and protocol changes for evaluation and management, and application of innovative ideas to meet the demand.

Keywords: COVID-19; health system resources; obstetrics; pregnancy; SARS-CoV-2.

Introduction

The novel corona virus that is associated with the severe respiratory syndrome, SARS-CoV-2, was first identified in the United States near the Seattle region in February of 2020 [1]. The national response to this virus was limited. Air travel from China, thought to be where the virus emerged, was suspended, but air travel from Europe was still active for some time into March. The first identified case of novel SARS-CoV-2 in the New York City area was in March 2020.

The global spread of the SARS-CoV-2 virus during the early months of 2020 was rapid and exposed vulnerabilities in health systems throughout the world. The ability to adapt resources to successfully fight the pandemic was no better exemplified than in New York City and particularly at the Medical Center known as New York Presbyterian Queens (NYPQ), which was situated at the heart of the geographic location in New York City where the virus was most prevalent. This review will present an overview of the Medical Center's response—how the disease presented and how resources were adapted to combat the epidemic—with an emphasis on the obstetric experience.

Overview

NYPQ is a 535-bed hospital, level 1 trauma center and tertiary teaching hospital serving almost 2.5 million people in the borough of Queens and one of the 10 campuses of the $7 billion New York Presbyterian enterprise that is affiliated with two Ivy league medical schools, Weill Cornell Medicine and Columbia University Vagelos College of Physicians and Surgeons. The first case of COVID-19 at NYPQ was diagnosed on March 8th, 2020, however, the virus is thought to have arrived to New York City several weeks prior, with subsequent multiplication and spread around the Queens community. Hospital planning for this novel virus started weeks before the diagnosis of the first case but was limited by the paucity of guidance from the federal government and state authorities. The governmental interventions put forth beginning March 16th urging Americans to limit travel, avoid groups and stay home from school and non-essential employment all slowed the spread but had an incomplete impact on the daily tsunami of COVID-19 patients seen at the NYPQ facility from March 20th until April 10th. During this time period, the Queens pandemic peaked and NYPQ exceeded over 550 hospitalized patients and over 100 patients on mechanical ventilation.

In the months of March and April, 13,304 patients were evaluated and treated in the emergency department with approximately 70% of those being COVID related. From March 8 until July 15th the hospital encountered 2,684

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admissions with the majority being seen prior to June 1 for COVID-19. Over 2,055 patients were safely discharged from NYPQ, but unfortunately, despite receiving critical care in the Intensive Care Units (ICU), 629 patients succumbed to the Covid-19 virus, with an estimated mortality rate of 23.4%.

Planning, capital investment, structural and policy changes in transforming the hospital

Initial efforts were focused on creating capacity to manage an expected surge of patients. Planning and transforming standard hospital rooms into negative pressure rooms in both the ICUs and on various medical and surgical units of the hospital was one of the first goals in the capital planning, designed to keep virus within the room and prevent spread within the hospital. [2] This conversion was based on emerging information from the Centers of Disease Control (CDCs) website (https://www.cdc.gov/coronavirus/2019-nCoV/index.html) that a surge of highly acute patients was expected. There was an immediate focus on cohorting positive patients and persons under investigation (PUI) [patients with signs and symptoms of COVID-19 but with pending polymerase chain reaction (PCR) testing], and units were specifically designated as COVID-19 units. In addition, alternate areas of the hospital were identified for screening and evaluation of patients to offload the surge evident in the emergency department. This included establishing an outdoor tent, as well as employing various unused hospital spaces (an old blood bank space, two classrooms) for this purpose. There was an almost immediate demand for additional ICU beds, and the ICU bed capacity was tripled from 42 beds at baseline to 112 beds using postoperative acute care units (PACUs) and Post cardiac Catheterization areas. Finally, multiple structural and facility upgrades were needed and performed to support the changes in structural capacity. [3] These efforts are detailed in Figure 1. Table 1 shows several other early leadership and operational changes made at the hospital that also directly impacted how patients were cared for on the obstetric units.

Simultaneously, the leadership of the enterprise made resources available for the laboratory to focus on identifying and installing platforms for rapid PCR testing for SARS-CoV-2 testing using the Roche and Cepheid platforms. This helped establish an alternate pathway for testing instead of sending every test to the New York State (NYS) Department of Health (DOH) laboratories, which reported results in 3–5 days. This directly impacted the obstetrical service, so that when universal testing of admitted obstetrics patient was implemented on March 24th, results were available within 12 h with the use of the Roche system at Weill Cornell Medical Center (also part of the NYP system) for a period of about two weeks, and results were available subsequently within several hours with the use of the Cepheid system on site at NYPQ in early April. [4]

A robust infection control department of the hospital provided frequent communication in leadership huddles, unit huddles and daily reinforcement and guidance about this exploding situation. Written communications regarding the specifics of the personal protective equipment required for healthcare personnel was a critical part of the daily communication. During the peak of the pandemic at NYPQ alone equipment used daily was approximately-8,000 surgical masks, 1,500 N-95 masks, 3,500 isolation gowns. These numbers were 3–5 fold higher compared to baseline (the year prior).

Elective surgeries were canceled at the hospital effective March 16th but Centers of Medicare and Medicaid Services (CMS) did not cancel all surgeries until March 18th to create capacity across all hospitals in the country. This allowed for the conversion of post-operative care units to Covid ICUs, with redeployment of available staff.

A command center was established early in March that operated 24/7 and replicated an existing structure that was present in the New York Presbyterian system that included 10 Medical Centers throughout the New York City metropolitan area. It included specific personnel dedicated to logistics, supply chain, information technology, laboratory, pharmacy, telehealth, medical group (physicians' organization), nursing, data analytics, patient flow, transfer center, patient experience and patient services, human resources including workforce health and safety, communications and security. Daily conference calls with the enterprise and twice a day huddles and calls within the command center allowed for challenges and shortages to be handled and communicated effectively across the organization.

Restricting hospital visitation was another important policy change that helped control of spread of the virus. NYPQ followed the New York State (NYS) guidance issued on March 18, 2020, effectively banning hospital visitation, including for pregnant patients. On March 27, 2020 and on April 10, 2020, the NYS Department of Health issued updated guidance allowing one patient support person, or family member and/or legal representatives of patients in imminent end-of-life situations and also permitted patient support person at the patient bedside for:

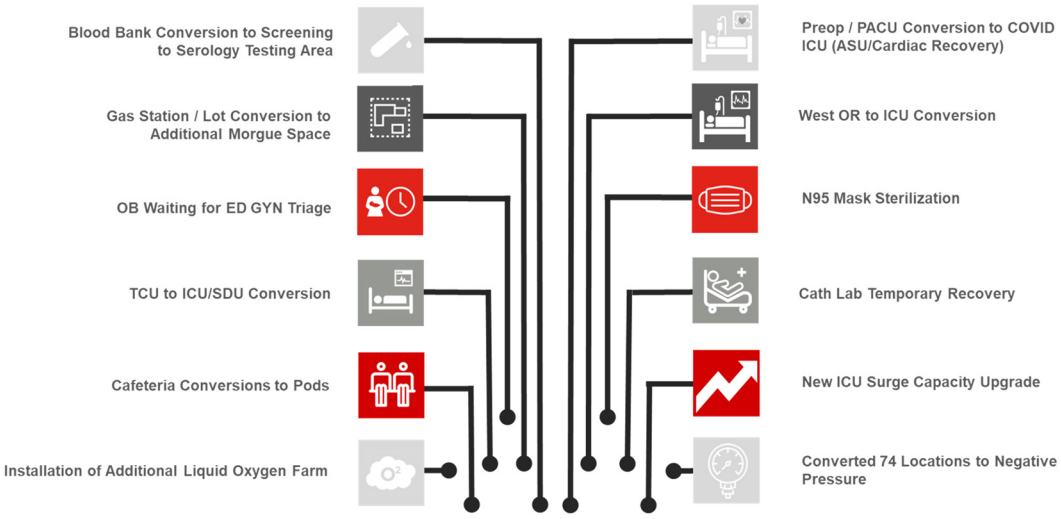

Figure 1: Structural and facility upgrades at New York Presbyterian Queens (NYPQ) in response to the COVID-19 pandemic. Conversions were based on emerging information from the CDCs website (https://www.cdc.gov/coronavirus/2019-nCoV/index.html). Many physical locations within the hospital were converted to clinical space. PACU=post anesthesia care unit, ICU=Intensive Care Unit, ASU=ambulatory surgery unit, OR=operating room, OB Waiting for ED GYN Triage=obstetric patient/family waiting area converted into triage area for Emergency Department Gynecology triage, TCU=transitional care unit, SDU=Step Down Unit.

- Patients in labor, delivery, and the remainder of the patients' admission.
- Pediatric patients.
- Patients for whom a support person has been determined to be essential to the care of the patient (medically necessary) including patients with intellectual and/or developmental disabilities and patients with cognitive impairments including dementia.
- Patients in immediate end-of-life situations.

Support persons were screened in an identical fashion to patients and admitted obstetric patients were allowed to choose a different support person if it became apparent that the chosen person was likely infected with COVID-19.

In order to help with communication a 24/7 family call center was established that assisted in providing updates for patients' families and offered a connection for families with critically ill patients to communicate with their loved ones via Face Time and WhatsApp. The family call center facilitated all these communications.

Staffing redeployment

Due to the significant increase in COVID cases and the relative shortage in healthcare workers across all fields, New York State released guidance to allow healthcare workers who were quarantined due to exposure to COVID-19 to return to work if asymptomatic. This included healthcare workers with high-risk exposures to a confirmed or probable COVID-19 patient. In addition, all healthcare workers were mandated to perform self-monitoring for illness due to the risk of unrecognized exposures. Staffing redeployment was necessary due to the surge in number of hospitalized patients and was handled both locally and at the New York Presbyterian (NYP) enterprise level. The enterprise set up an office that handled redeployments of house staff, advanced practice providers, physicians, locums (providers from other regions of the country) and volunteers. There was redeployment of over 750 clinical providers during the months of March, April, May and part of June. Similarly, there was a process to handle nursing redeployments and needs. Overall, NYPQ faced a critical shortage of nursing staff for the ICUs during the first few weeks of the COVID-19 crisis. This forced teams to manage mechanically ventilated patients outside the ICUs. The staffing improved as more agency and volunteer nurses arrived through the help of contracts that were signed with various national companies and organizations.

Management innovations

Multiple innovative services and programs were established which helped us manage our COVID-19 patients efficiently and with the highest quality care and are shown in Table 2. These included an early discharge program

Table 1: Early leadership and operational changes at New York Presbyterian Queens (NYPQ) in response to the COVID-19 pandemic.

Change	Reason
Frequent leadership huddles and unit huddles	Rapidly changing situation requires enhanced and frequent communication
PPE protocols and PPE conservation a. PPE placed in a central location in each unit to decrease theft b. Unified system-wide protocols for use of PPE and N-95 masks c. Providing one reusable N-95 mask to each staff member	Restricted availability of PPE
Establishment of a command center	Rapidly changing situation requires enhanced and frequent communication
Restricted visitation	Need to limit the spread of the virus
Universal PCR testing of all admitted obstetric patients	High rate of asymptomatic viral shedding in pregnant women with subsequent quarantining of staff who are then unavailable for work
Cancellation of elective surgeries a. Scheduled cesarean deliveries were NOT considered "elective"	Need for resources to be shifted to care of critically ill Covid patients
Redeployment of providers	Need for resources to be shifted to care of critically ill Covid patients
Availability of rapid PCR testing	Need to determine patients as asymptomatic, PUI or negative to triage patients to different locations and allot PPE

PPE, personal protective equipment; PUI, persons under investigation (with symptoms of COVID-19); PCR, polymerase chain reaction.

whereby patients with oxygen saturations >92% on exertion were discharged from the ED with oxygen for home use, pulse oximetry and close follow-up. In addition, a "Line Team" was created to facilitate IV access daily in the ICUs and a "Proning Team" was created to prone position patients requiring mechanical ventilation to improve oxygenation by recruiting the posterior and lower lung lobes. These teams allowed for displaced surgeons and interventionalists to contribute to the hospital COVID-19 workforce. Pediatric hospitalists also modified their roles and admitted adult patients up to the age of 50 with COVID-19 as the pediatric unit was similarly transformed to an adult COVID-19 unit. Creative thinking and workforce flexibility allowed for a complete transformation of a smaller multispecialty hospital to a COVID-19 regional presence.

The obstetric experience

New York State designations for maternal hospital care include levels 1–4. Level 4 is a Regional Perinatal Center, the highest level of care. NYPQ had a maternal care (L&D) designation of Level 3. Approximately 3,800 births occur each year at NYPQ. The Neonatal Intensive Care Unit (NICU) is also Level 3 and can care for nearly all neonatal patients, including those born at 22–23 weeks of gestation. Obstetrics was a separate entity for the hospital during the initial days of the pandemic. In the NYP system it was discovered in early March that admitted pregnant women were often asymptomatic and could expose and infect health care workers, so universal testing of admitted pregnant women was instituted on March 24th. (5) Once universal testing began, daily data were gathered regarding the rate of PCR testing positivity in pregnant admitted women. It was initially unclear what the rate of maternal fetal transmission was or how it could be prevented. The story of COVID-19 in pregnant women would evolve quickly in March and April to become the story of asymptomatic carriers and the encouraging possibility of preventing transmission with simple measures. [5]

In obstetrics, space, design and allotment made cohorting of patients a challenging issue. The NYPQ Labor and Delivery (L&D) unit has two negative pressure labor and delivery rooms. The mother baby (postpartum) floor

Table 2: Management innovations at NYPQ designed to manage overflow volume and improve patient outcomes.

Innovation	Reason
Admission criteria a. Oxygen saturation <90% on exertion (walk in place for 60 s)	Limit the number of admitted patients. Home oxygen was made available for patients requiring oxygen but not meeting admission criteria.
Early discharge a. Oxygen saturation >92% on exertion (walk in place for 60 s). This criterion was applied to non-obstetric patients[a].	Allowed improved ability to handle volume of admitted COVID patients
Line team	Improve efficiency of care and improve patient outcomes
Prone team	Improve efficiency of care and improve patient outcomes
Redeployment of displaced surgeons and interventionalists to care of patients on Covid units	Allowed improved ability to handle volume of admitted Covid patients
Transformation of pediatric unit to adult Covid unit	Allowed improved ability to handle volume of admitted Covid patients

[a]Table 3 for admission criteria for obstetric patients.

Table 3: Inpatient obstetric protocol and patient flow management changes at NYPQ.

Change	Reason
Universal PCR testing of admitted obstetric patients	Help in guiding management decisions, gathering data on rate of positivity and rate of symptomatic shedding
Criteria for admission a. Oxygen saturation <94% after 30 s of exertion (walking in place)	Protect fetal oxygenation
Cohorting of Covid positive and PUI obstetric patients	Limiting spread of virus within the hospital ward
Universal use of surgical masks for patients and staff	Limiting spread of virus within the hospital ward, protection of healthcare workers
Use of N-95 masks for the care of PUI and Covid positive obstetric patients	Protection of healthcare workers
Use of N-95 masks for the care of all obstetric patients during the second stage of labor and during vaginal and cesarean delivery	Protection of healthcare workers
L&D operating rooms changed to neutral pressure	Limit spread of virus within the hospital ward
Early discharge	Limit time patients spend at the hospital to decrease risk of viral transmission
Face shield for providers for all interactions between providers and patients	Limit spread of virus

PCR, polymerase chain reaction; PUI, person under investigation (with symptoms of COVID-19).

also has two negative pressure rooms. This made the labor and delivery space have a natural cohorting capability, however in the height of the public health emergency in New York City, there were times when more rooms were needed. Then the closest proximity room was chosen next. On both units, the COVID-19 positive patients were cohorted starting with the negative pressure rooms and then subsequent rooms of closest proximity. The L&D Triage unit evaluated all patients and thus included COVID-19 positive and negative patients. This state of affairs continued through the peak until mid-June, when cases became infrequent enough that some return to normalcy was possible.

In the Operating Suite for Labor and Delivery, pressure is normally kept positive within the operating rooms to prevent the slow seepage of infectious organisms from getting into the room. We initially considered converting one operating room to negative pressure so that one room could be devoted to cesarean delivery of COVID-19 positive patients, but this was not technically feasible. Instead all the rooms were converted to neutral pressure to allow any of them to be used for COVID-19 positive patients, while still providing some level of limit of viral spread. The obstetric PACU has bays separated by curtains, and thus daily education was performed for all staff regarding the need for space between patients in the PACU-leaving one bay empty between patients if possible.

Along with the early change to the obstetric unit of cohorting, was the early recognition of need for universal masking, patient and personnel. [6] The public health crisis in NYC was characterized by initial rationing of PPE, following CDC guidance. Initial guidance described provider and staff use of typical surgical masks for all patient encounters, with reserve of N-95 masks only for aerosolization procedures. Additionally, there was the directive of re use of masks and N-95 wear. Unfortunately, this early directive, based on difficulties with procurement invited suspicion and concern amongst staff that would later be difficult to dispel. There were staff exposures and illness, particularly after cases of COVID-19 intubation during cesarean. This led to the new guidance of N-95 use for all personnel, obstetric and anesthesia, during cesarean deliveries. Shortly after, guidance was offered that all patients presenting to the hospital should be masked upon arrival. A related issue for our nursing personnel was the potential for exposure during the expulsive "coaching" characteristic of modern obstetric practice for vaginal delivery. Personnel in the room with a patient noted that many patients could not push with a mask on and would take it off with potential for droplet exposure with no capacity for social distancing in that setting. There was no literature guidance or information about what the risks were in this situation, but it became very clear that for safety and comfort, N-95 was needed during pushing. Each OB provider and staff member was issued a personal N-95 for use in cesarean and the pushing phase of labor, with instructions to cover this mask with a standard surgical mask and discard the surgical mask after the delivery but reuse the N-95 if not grossly contaminated. This became a directive that was unique, in that pushing and expulsive effort is not typically thought of as "aerosolizing" however the plausibility of exposure during this particular scene was thought to be high. As the overall COVID-19positivity rate increased, the directive for N-95 was expanded to all clinical interactions. This was due to the high asymptomatic rate amongst obstetric patients, and was widened to all patients, regardless of results of PCR testing, due to the unknown false negative rate of the tests used. Recently, eye protection was included as standard protection for all clinical interactions. Guidance and policy was successively adapted to the dynamically changing clinical environment.

Obstetric criteria for admission and obstetric COVID-19 management

The early experience with admissions to the hospital underwent rapid evolution as the scope of the pandemic widened. For general medical patients the criteria for admission, which had included elevated respiratory rate greater than 25, hypoxemia by oxygen saturation below 92% and fever of more than 39 °C, quickly changed more stringent thresholds due to the onslaught of patients already meeting these criteria and overwhelming the availability of beds. In obstetrics, criteria for admission to the hospital focused primarily on obstetric criteria for hypoxemia, O_2 saturation less than 94%, or very elevated fevers and the threshold for admission was lowered for fever to 38.2 degrees. Elevated respiratory rate was and is a hallmark of COVID-19 disease, and routinely, rates of over 25 were seen in pregnant women without decompensation. As long as the O_2 saturation was maintained over 94% even with physical activity (walking), the obstetric patient was discharged to home. On imaging, admission criteria included chest X-ray that demonstrated pneumonia over more than one lobe. [7] Chest tomography showing ground glass appearance of the lungs was used postpartum and guided increased length of stay and possible transfer to an ICU setting. One of the most glaring qualities of COVID-19 disease is the rapidity of decompensation, and this was seen in obstetric patients also. The overwhelming majority of obstetric patients were able to remain on the obstetric service during admission, with supportive care (oxygen, acetaminophen, fluids) however once deterioration began, they were transferred to higher levels of care. First, the escalation was to Labor and Delivery for more acute nursing observation and care and next to whichever ICU had availability. The ICU team collaborated with the Maternal Fetal Medicine management team. Intermittent fetal monitoring was employed when the oxygen saturation was greater than 95% and was escalated to continuous fetal monitoring when the saturation deteriorated below this threshold. Fetal monitoring was used as a maternal vital sign and clinical decisions were made based on maternal and fetal status. In the ICU, intermittent fetal heart rate checks or continuous monitoring were performed by obstetric nursing. These criteria were developed and adapted in our health system on a daily basis as the pandemic evolved. They are well summarized in the publication from the Society for Maternal Fetal Medicine, Management Considerations for Pregnant Patients with Covid-19. [8]

Management of obstetric patients with COVID-19 disease was dependent on symptoms and aberrations from accepted vital sign parameters. Oxygen, either by nasal cannula or face mask was employed for all patients with oxygen saturation less than 94%. We did not discharge patients with oxygen therapy while pregnant, however we did prescribe outpatient pregnant patients with COVID-19 to obtain pulse oximeters and monitor oxygen saturation as per accepted guidelines. Acetaminophen was used for reducing fever up to 2 g in 24 h. Additionally, if there was chest X-ray finding of pneumonia, we started empiric antibiotic therapy with azithromycin 500 mg daily for a five-day course. Intravenous fluid management was largely supportive, unless fever was present. Discharged patients were prescribed pulse oximetry to monitor saturation, reliable patients were prescribed thromboprophylaxis, and all patients were seen by telehealth within 24 h of discharge. [8, 9]

Importantly, after delivery, the patient and father of the baby remained masked throughout the duration of the hospital stay. The mother was advised to wash hands prior to any contact with the infant, to wash the breast prior to breastfeeding and in COVID-19 positive mothers, to refrain from kissing the baby without properly wearing a mask. Early discharge was instituted on our maternity floor, where the mother baby dyad was discharged to home 24 h after vaginal delivery and 48 h after cesarean when there were no worrisome respiratory or obstetric signs or symptoms of morbidity.

Obstetric outpatient management

In an effort to minimize patient and provider exposure, outpatient obstetric management underwent rapid reorganization which included physical consolidation of office sites, reduction in in-person visits and simultaneous increase in telehealth visits. Four outpatient sites that provided obstetric care were consolidated to two. Staffing models were altered so that physicians were dedicated to the inpatient setting or the outpatient setting. This was most evident in the Maternal Fetal Medicine practice where two of the four providers were dedicated to the outpatient setting including sonography and procedures while two others managed inpatient care. This served to minimize Covid-19 exposure of both providers and patients.

In-person visits were limited to encourage women to stay at home, thus minimizing their need to use public transportation, and reducing their exposure to COVID-19. The suggested modified schedule for prenatal visits included in-person visits at initiation of prenatal care, again at 28 weeks gestation for glucose screening, at 36 weeks gestation for Group B Streptococcus testing, and weekly thereafter. Most patients would then have four or five telehealth visits. [10] Blood pressure, weight and fetal

movement assessment were performed during the in person visits, and when clinically indicated otherwise, such as if there were symptoms, i.e., persistent headache or decreased fetal movement. Due to the physiologic increase in blood pressure and increased risk of developing preeclampsia in the third trimester, women were prescribed a blood pressure cuff and instructed to monitor their blood pressure once weekly at home beginning around 28 weeks. [11] When possible, postpartum visits occurred via telehealth at six weeks after the delivery with home BP, depression screening and contraceptive counseling. Providers used their discretion to deviate from this suggested schedule as clinically necessary. The suggested schedule for prenatal visits is outlined in Table 4.

Maternal Fetal Medicine (MFM) visits for pregnancy comanagement, ultrasound and other antenatal testing (nonstress tests, biophysical profiles) also underwent reorganization. The Antenatal Testing Unit (ATU), which is physically located in the hospital, was moved off-site into a prenatal care location. This was done to reduce patient and provider exposure to the high density of COVID positive patients admitted to the hospital and to consolidate patient appointments with their ultrasound appointments so that patients could limit the number of times they needed to leave their home. All patients continued to receive a first trimester nuchal translucency scan and serum screening if desired, as well as a fetal anatomic survey scan at 18–20 weeks. Follow up ultrasound for indications such as placental location or evaluation of fetal growth for maternal disease such as hypertension or diabetes was deferred to a later gestational age, if possible. Scheduling and performance of diagnostic procedures such as chorionic villus sampling and amniocentesis continued as usual. Antenatal testing was continued for the usual indications. All patients were screened by telephone prior to their visit and again in person on the day of their visit to determine if they had been diagnosed with COVID-19 within the past two weeks, were symptomatic or considered a person under investigation (PUI). Partners and support persons were not allowed for prenatal visits, ultrasound, antenatal testing or procedures. All office staff and medical providers wore appropriate PPE and patients wore a mask throughout the examination. Rooms were thoroughly cleaned each morning prior to the first scan and again at the end of the day. Lastly, MFM visits were conducted via telehealth with in-person visits with the patient's primary obstetric provider as previously described. [12]

Table 4: Suggested schedule for prenatal visits at NYPQ during the COVID epidemic.

Gestational age	In-person visit yes (Y)/no (N)	Additional comments
6–10 weeks	Y	Initial visit/establish care
11–13 weeks	Y	Nuchal translucency/dating ultrasound (or noninvasive prenatal testing, as appropriate)
14–16 weeks	N	Telehealth visit
18–20 weeks	Y	Anatomy ultrasound
25–26 weeks	N	Telehealth visit
28 weeks	Y	Office visit for glucose screen, Tdap, antibody screen, CBC, RPR and Rh immune globulin if needed
30–35 weeks	N	2–3 telehealth visits
36 weeks	Y	Weekly office visits (including GBS)
Postpartum	N[a]	Telehealth visit if appropriate[a]

Tdap, tetanus, diphtheria and pertussis; CBC, complete blood count; RPR, rapid plasma regain test for syphilis; GBS, group B streptococcus culture of the vagina. [a]Standard wound check and standard postpartum visit is appropriate in patients without significant other morbidities.

Discussion

Hospital infrastructure was critical to being able to facilitate changes needed in obstetrics to weather the storm of SARS-CoV-2. Testing capacity and turnaround time became a hot button issue for admitted pregnant women, as their rate of asymptomatic carriage was high, compounding issues with exposure, risk and transmission. Staffing and redeployment particularly affected the Obstetric service, as staff is specialized and not easily replaced when out for illness or quarantine. Nonetheless, redeployment was a necessary and accepted measure. Hospital visitation was effectively ended in March, and subsequently modified to allow one support person during labor. Cohorting of COVID-19 positive patients on the maternity floor, and using negative pressure rooms in labor and delivery (if available) were early measures taken to try to confine exposure. Turning labor and delivery operating rooms to neutral pressure allowed any one of them to be used for COVID-19 positive cesarean deliveries. Mandating that all vaginal deliveries and cesareans be performed using N-95 masks mitigated the early transmissions seen in personnel and increased staff comfort with the unknown exposure risks likely inherent in obstetrics. Modifying the prenatal care schedule for visits and office interactions combined with the use of telehealth for provider visits increased patient and staff confidence that risk mitigation was important to those directing the healthcare system.

Obstetric SARS-CoV-2 disease was discovered to be largely asymptomatic carriage but included a small rate of severe disease with rapid decompensation in otherwise healthy women. Higher rates of hospitalization, ICU admission and intubation, along with higher infection rates in minority and disadvantaged populations, were clinical

suspected and ultimately documented. [9, 13] While obstetrics is a very separate discipline, for most hospitals it is an integral and complimentary addition to the structure of the hospital and the health system. During the time of COVID-19, the necessary changes that were occurring daily in the operations of the hospital had to be similarly translated into the inpatient and outpatient obstetrics realm to best care for this specific population of patients.

The most important lessons learned were 1) we needed to be flexible to adapt resources and workforce to the situation, 2) regular, frequent and calming communications were necessary that were as instructive as possible, and 3) hospital leaders needed to be committed and devote the necessary resources to the situation with an eye always to the goal of being able to care for all the patients who presented with this severe disease. In order to be successful, the situation required us to be committed and flexible with an emphasis on communication. We present our experience with the express desire that other centers use this as a guide for the systematic changes that may be necessary if Covid-19 surges or occurs at sites that are currently naïve to this virus.

Research funding: None declared.

Author contributions: All authors have accepted responsibility for the entire content of this manuscript and approved its submission.

Competing interests: Authors state no conflict of interest.

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