Crisis clinical pathway for COVID-19

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ABSTRACT

The pandemic of COVID-19 has been particularly severe in the New York City area, which has had one of the highest concentrations of cases in the USA. In March 2020, the EDs of New York-Presbyterian Hospital, a 10-hospital health system in the region, began to experience a rapid surge in patients with COVID-19 symptoms. Emergency physicians were faced with a disease that they knew little about that quickly overwhelmed resources. A significant amount of attention has been placed on the problem of limited supply of ventilators and intensive care beds for critically ill patients in the setting of the ongoing global pandemic. Relatively less has been given to the issue that precedes it: the demand on resources posed by patients who are not yet critically ill but are unwell enough to seek care in the ED. We describe here how at one institution, a cross-campus ED physician working group produced a care pathway to guide clinicians and ensure the fair and effective allocation of resources in the setting of the developing public health crisis. This 'crisis clinical pathway' focused on using clinical evaluation for medical decision making and maximising benefit to patients throughout the system.

INTRODUCTION

The first case of COVID-19 in the New York City region was diagnosed on 1 March 2020. By 19 March, there were 3951 known cases in the city.[1] Emergency medicine providers were little prepared. Early publications had revealed the high morbidity and mortality of the illness, reported on typical findings and identified prognostic indicators. Answers to practical questions such as which patients should get laboratory testing, which patients should get imaging and which patients should be admitted were not yet known.[2]

The disease spread rapidly through the city. By the third week of March, clinicians were becoming well acquainted with the illness. Several of the sites in our health system had begun to experience a rapid increase in patient arrivals and acuity of illness. Despite hospital mitigation strategies such as the suspension of elective procedures and expansion of inpatient admitting capacity, available beds were soon saturated and even surge bed locations were overwhelmed. This was seen earliest at the site located in the borough of Queens, a 535-bed community teaching hospital where the ED averages 120 000 annual visits. Near the end of the month, that ED had held up to 208 boarding inpatients, well exceeding the usual boarding patient count of 60 during annual influenza surges and nearly four times the number of licenced ED beds. As each site began to experience similar surges, it became evident that ED resources would not be able to meet demand.

COVID-19 tests resource limits

Even outside the setting of an acute crisis, medical resources are not infinite and 'while meeting the needs of individual patients, physicians are required to provide health care that is based on the wise and cost-effective management of limited clinical resources'.[3] Indeed in *Emergency Medicine*, awareness of our need to steward resources has long been recognised as a fundamental feature of the specialty.[4]

Clinicians across the system were becoming acutely aware that normal operating procedures could not be sustained. This stress was compounded by the existing uncertainty about the best clinical approach to these patients. The accelerating surge made it clear that a proactive approach was necessary to align patient needs and resources.[5] The American College of Physicians states in their 2011 white paper, 'resource allocation decisions are policy decisions that are most appropriately made at the system level, not at the bedside'.[6] Individual clinicians are limited in their abilities to make these decisions, as the full implications of individual actions are not visible to the patient or provider nor align with their instincts towards maximum individual benefit. In order to be equitable, these decisions require uniform implementation. The senior leadership of the EDs across the hospital system designated a working group to produce a guideline to create a consistent approach to care at the various campuses appropriate to the demands of the evolving crisis.

METHODS: DEVELOPING A NOVEL PATHWAY FOR A NOVEL PANDEMIC

On 19 March, a team of five ED physicians met to design a pathway that would accomplish that goal. The group was selected by system leadership to provide balanced representation of the various sites. The individuals were chosen based on knowledge of clinical operations at their local sites, administrative experience and evidence-based medicine expertise.

In the first meeting, the working group reviewed their clinical knowledge and experience at their respective sites. The overall goal of the pathway and approach was discussed and principles were agreed on. We did not define a formal consensus-generating approach. As it was apparent that the situation was rapidly worsening and the need for this pathway was urgent, we met virtually three times over the course of 1 week and worked on the pathway together over email daily.

We conducted formal literature search on MEDLINE for all topics related to COVID-19. In addition, we hand searched the websites of the Centers

for Disease Control and Prevention and the WHO. We manually reviewed the titles in the National Library of Medicine's curated web hub, LitCovid.[7] Social media also became a source of information, as first-hand reports and translated Italian documents became available.[8] While the WHO had released general recommendations, they were not specific enough to address the bedside ED issues that were of foremost importance to our group. Few other guidelines specific to COVID-19 were available.

We had however accumulated significant collective clinical experience with COVID-19 by this point. It was clear that the prevalence of the disease in the city was very high and that patients were presenting with a variety of complaints outside of fever and cough. Marked hypoxaemia was common but even more concerning was the frequency with which patients with initially normal pulse oximetry readings desaturated dramatically while in the ED. Clinicians also observed that some patients without significant dyspnoea at rest became markedly breathless and cyanotic with even minimal exertion. This locally generated shared knowledge, in the absence of more rigorously collected data, became foundational to our approach.

THE CRISIS CLINICAL PATHWAY

We determined from the outset that diagnosis of COVID-19 would not be a goal of the guideline. Rather, we saw this pathway as representing a high-level resource allocation tool, which would preserve the global resource of ED operating capacity to care for patients. We conceptualised operating capacity as a system bound by input, throughput and output. Throughput could be improved by standardising and streamlining patient evaluation to involve only steps that would meaningfully impact care.[9] Output also has an outsized effect on ED throughput and was being largely determined by hospital inpatient capacity.[10] As our hospital system has no physically separate observation capacity, our admitting patterns had an outsized effect on output performance. In the setting of this crisis, we determined that we would need to reserve admission for patients who were candidates for medical interventions with significant morbidity or mortality benefit. As treatment for COVID-19 was largely supportive at that point, the need for supplemental oxygen would be the main determinant of disposition.

The pathway (figure 1) was therefore designed around a clinical assessment of illness severity in order to stratify patients who presented with potential COVID-19 symptoms by need for treatment. We developed this classification in our working group in an ad hoc manner. Patients who were well appearing with normal respiratory vitals were classified into the mild illness group and would largely be discharged without further evaluation. Patients with marked respiratory distress or evidence of shock were classified as severe and would be admitted. Patients with unwell appearance or with significant abnormalities in respiratory rate or oxygen saturation were classified as moderate and were likely to be admitted after some evaluation.

The following methods of evaluation were considered.

Risk factors

Patient characteristics and pre-existing conditions, most notably age, had been found to be frequently associated with more severe COVID-19.[2 11] Others conditions, such as obesity, were anecdotally linked to morbidity although at the time only very preliminary data were available from the Chinese literature.[12] In this context, we elected to use risk factors to slightly modify classification of severity.

Imaging

The typical findings of COVID-19 on plain CXR and chest CT, as well as their association with prognosis had been discussed in the literature.[13] Chest imaging, largely chest CT, had been a mainstay of the workup of patients in China.[14] On review of this evidence, it seemed CT in particular might have value as a diagnostic tool for COVID-19.[15] However, in our hospitals, this would have posed an enormous burden, and diagnostic sensitivity was not the purpose of our pathway. We reserved CT for evaluation of other symptom aetiologies such as pulmonary embolism when clinically indicated.

In addition, we were unable to identify literature demonstrating the utility of plain chest films (CXR). While CXR findings might have some prognostic significance, it did not seem it would be strong enough to override clinical severity of illness. Furthermore, as radiology services were being overwhelmed in the early part of the surge, we chose to only perform imaging on patients who had already been identified as requiring admission.

We realised without imaging, alternative diagnoses such as bacterial pneumonia might be missed in patients being discharged. The limitations of physical examination for pneumonia diagnosis is well known.[16] However, as there is no conclusive evidence that treatment based on clinical examination leads to worse outcomes than when X-rays are used, we recommended that providers treat with antibiotics based on their history and exam.[17]

Laboratory tests

Broad testing for SARS-CoV-2 was not an option because of limited test availability. Standard respiratory viral pathogen testing was available, but we found no clear clinical utility to those tests since they would not exclude concurrent COVID-19 infection. We considered the use of other laboratory tests to distinguish severity of illness, as there were laboratory findings known to be associated increased morbidity and mortality.[18] We were aware of literature suggesting lymphopaenia could be used as part of a risk-stratification score for viral pneumonias and that it had been used in similar fashion in some protocols from China.[18 19] Still, given the resource consumption involved, we concluded there was not enough evidence to recommend the use of any laboratory criteria for disposition decisions. We therefore suggested laboratory testing be reserved for patients for whom admission was already planned on other grounds.

Exertional hypoxaemia

Providers had observed many patients with normal oxygen saturation at rest would markedly desaturate with even minimal exertion. Colleagues in Italy reported similar findings on social media and in unofficially translated care guidelines.[20] We decided to try to identify these patients, who we believed were at increased risk for precipitous decompensation and should be admitted. Exertional testing for respiratory illness has been infrequently described in the emergency medicine literature.[21] We designed a 1 min exertion test based on our observation that most patients were desaturating quickly or not at all. We set the abnormal threshold at 90%, which would stay above the inflection point on the oxygen–haemoglobin dissociation curve.

Observation

A brief period of observation was recommended for moderately ill patients who were being discharged, as this group included patients who would often have been admitted under normal conditions. Given the lack of external observation space in the hospital system, this did represent a real demand on ED resources. However, as we expected this to be more than offset by ability to safely reduce admissions, we believed it would not be detrimental to ED throughput.

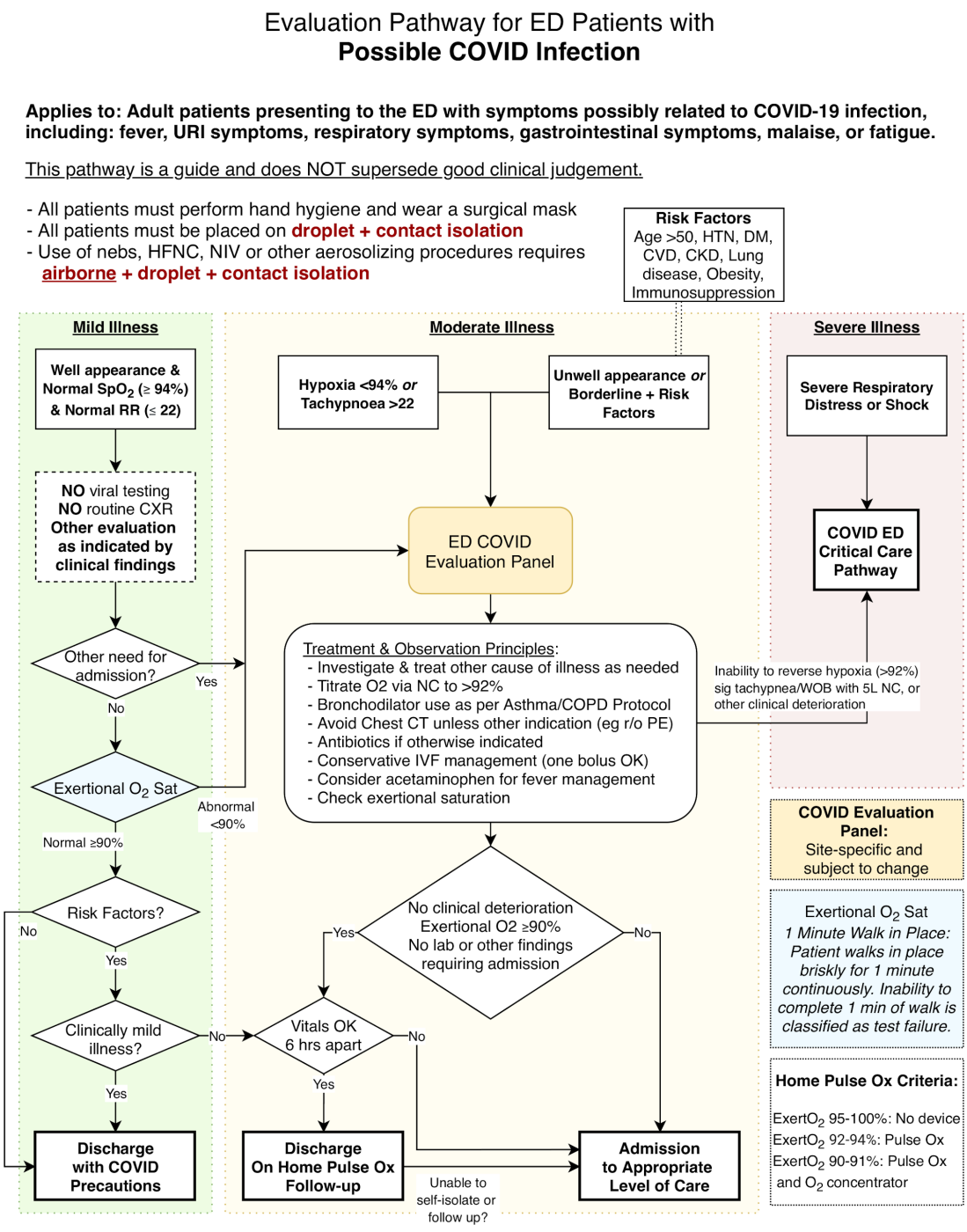

Figure 1 Evaluation pathway for ED patients with possible COVID-19 infection. CKD, chronic kidney disease; CVD, cardiovascular disease; DM, diabetes; HFNC, high flow nasal cannula; HTN, hypertension; NC, nasalcannula; Nebs, nebulized medications; NIV, non-invasive ventilation; PE, pulmonary embolism; RR, respiratory rate; SpO2, pulse oximetry.

Ability to return

We recognised that even after passing exertional testing and brief observation, these patients were at significant risk for further decompensation. For this reason, we conditioned discharge of all but the most mildly ill of these patients on their ability to participate in isolation, follow-up and return. Patients who were not able to do so were considered at excess risk and were admitted for care.

IMPLEMENTATION

Because this clinical pathway reflected deviation from normal standards of care, we requested review of our proposal from the hospital ethics committee. They agreed that in the setting of the crisis, tolerating increased diagnostic uncertainty and potential progression of illness outside of the hospital was acceptable if applied equally. The pathway was subsequently approved by cross-campus ED senior leadership as well.

On 25 March, just 6 days after the group first met, the pathway was released. It was distributed to clinicians through various and overlapping modalities. The leadership of each site emailed the pathway to their respective groups. In addition, the pathway was reviewed and discussed in various virtual physician 'huddles' that had been initiated by the EDs to communicate with clinicians during the crisis. Electronic copies were uploaded on intranet sites, and physical copies were printed and posted. The pathway was shared

with inpatient medicine, infectious disease and outpatient medical leadership for distribution to their staff as well.

Temporary external care tents were also being erected by the hospital system outside of each site. This allowed diversion of patients who met low-risk criteria away from the main ED for clinical evaluation, counselling and discharge.

As this pathway was finalised, a parallel workgroup had been building up telehealth and remote health resources. We were able to use their work to define a follow-up regimen that targeted a series of 2–3 phone calls or video visits in the first 48 hours after discharge. The hospital was able to obtain pulse oximeters and eventually portable oxygen concentrators as well. With a robust follow-up service, we were able to increase the level of hypoxaemia that was considered suitable for discharge, further reducing admissions.

DISCUSSION

Confronted with an illness we knew little about, we designed a pathway that relied mostly on clinical evaluation. Care pathways should ideally be based on scientifically accumulated medical knowledge about tools such as laboratory tests, imaging and risk scores. We do not yet have that level of understanding about COVID-19. Instead, we focused on eliminating what seemed to be ineffective and variable laboratory and imaging strategies individual providers had been using and replaced it with a more structured clinical approach.

Admission decisions are often made on the basis of risk of acute decompensation, rather than an identified need for treatment. This is usually an ethical and patient-centred approach. In the midst of the surge, we recognised that hospitalisation based on risk was preventing us from giving effective care to patients who needed it acutely. We hoped that reducing the admission rate by increasing the acceptable level of risk on discharge would mean we could deliver a higher quality of care overall. Only by being proactive about this did we feel it would be possible to continue to apply a careful and fair standard to all of our patients.

The medical literature is replete with warnings of the need to prepare for crises like this one by discussing and planning for implementation of crisis standards of care (CSC).[22] While the important consideration of ventilator and ICU bed availability loomed large in the public discussion of COVID-19,[23] experts have long understood that all resources, whether inpatient beds, nurses, phlebotomists, medications or laboratory reagents, are critical and subject to scarcity and require active management in a crisis.[24] Indeed, just before COVID-19 reached official pandemic status, experts tried to remind us of the importance of developing and using CSCs to mitigate further degradation of conditions.[25] Our clinical pathway effectively defined a CSC for our EDs. Rather than define standards for allocation of individual resources, it took a holistic approach that allowed us to conserve items that were scarce, such inpatient beds, and make more effective use of things that were relatively plentiful, such as telehealth capacity or portable pulse oximeters.

It would have been ideal to have this process in development before we were in the midst of the surge. We were not able to include other stakeholder; although we consulted with faculty with expertise in clinical ethics and disaster medicine, none were directly involved in this work that took place in the span of less than a week. We hope that other institutions may take a more proactive approach and not be required to do this work in such an accelerated timeframe.

CONCLUSIONS

The pandemic proved to be more severe in New York City than other regions of the United States.[26] In the 2 months after this pathway was introduced, 1040 patients were discharged with pulse oximeters and a further 792 patients being discharged with oxygen concentrators for use at home. Most of these 1832 patients were seen in the first month the pathway was in effect. It is likely that without it, many of those patients would have been admitted.

Even with this pathway in place, conditions in the various sites continued to worsen through the beginning of April. At a site in Northern Manhattan, patients were waiting on average over 29 hours for inpatient beds to become available in the 2 weeks after implementation. This would likely have been longer, but many patients expired in the ED before they could be transferred; this ED would see over 80 deaths in the month after the pathway was released. At an ED in Queens, total patient boarding time reached 35 137 hours for that month, compared with 9038 hours the year before. It is unclear if an even more aggressive approach to discharge could have brought more overall benefit to our patients.

The outcomes of patients with clinically moderate illness who were discharged and enrolled in the follow-up programme are currently being analysed. As we understand the dynamics of the disease in our own population in a more rigorous way, we expect to improve our ability to provide care for our patients as the pandemic continues.

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