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# Administration of Emergency Medicine

## Drive-Through Medicine: A Novel Health Care Delivery Mechanism for the COVID-19 Pandemic

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**Abstract—Background:** Coronavirus disease 2019 (COVID-19) placed additional strain on an already struggling health care system. In response, novel solutions such as telehealth have been explored, however, there is significant room for innovation in health care delivery. **Objectives:** The aim of our study was to evaluate the effectiveness of a drive-through medical treatment system for evaluating patients with COVID-like symptoms. **Methods:** We designed a prototype drive-through medical treatment facility (DMF) to triage large volumes of patients quickly and efficiently, while fully evaluating, treating, and discharging low-risk patients. A retrospective chart review was performed to extract clinical and logistical metrics. **Results:** A total of 2164 patients were evaluated between May 1 and July 1, 2020. Overall accuracy for patient classification was 92.4% (95% confidence interval [CI] 91.2–93.5%). Screening criteria resulted in a return with need for workup or admission rate of 0.25%, yielding a sensitivity of 83.3%

(95% CI 65.3–94.4%). Of those presenting to the DMF, 179 patients (8.3%) were diverted to the main emergency department (ED) for further evaluation, of which 14% received diagnostic workups and 5% subsequent admission to an inpatient service, yielding a specificity of 92.8% (95% CI 91.7–93.9%). Length of stays for those seen in the DMF vs. the main ED (M = 38 min vs 149 min) yielded a mean difference of 111 min per encounter and a total time savings of 3762 h. **Conclusion:** Drive-through medical systems can accurately triage patients presenting with potential COVID-19 and effectively treat lower-risk patients, thereby reducing ED utilization. Published by Elsevier Inc.

**Keywords—**health care delivery systems; drive-through; SARS-CoV-2; COVID-19; pandemic; surge response

### Introduction

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Emergency departments (ED) have long represented a bastion of care and the safety net of the modern U.S. health care system. Their performance has been viewed as the proverbial “canary in the coal mine,” reflective of the status of the health system at large (1). In the past decade, EDs have struggled to accommodate increasing patient volumes. ED crowding is a growing dilemma, with 90% of ED directors reporting overcrowding as a recurrent problem and studies reporting diversion in up to 50% of EDs (2). The impact of ED crowding on morbidity,

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mortality, medical errors, staff burnout, and excessive cost is well documented (3). Since the first case of coronavirus disease 2019 (COVID-19) in the United States in January of 2020, EDs nationwide have further had to weather the variable influx of patients (4). Furthermore, COVID-19 has raised challenges, including staff safety and mitigating the potential for spread of infection within the very confines of the ED itself. Existing systemic issues have been further exacerbated and have highlighted the need for increased capacity within the U.S. health care system.

Efforts to adapt to the threat of the coronavirus have expedited the rise of novel and unconventional methods for health care distribution. Medical visits via telephone, text, and even video conferencing is growing (5). As a whole, telemedicine, which gained traction prepandemic, has seen exponential growth, with telehealth visits increasing 63-fold (6). However, telemedicine visits are not a substitute for in-person visits and are neither feasible nor appropriate for all patients and clinical scenarios. Meanwhile, EDs continue to experiment with innovative methods for patient flow such as split flow and “provider in triage” models in an effort to increase capacity. In the wake of COVID-19, there has been a proliferation of screening facilities to facilitate mass testing both for clinical and epidemiologic purposes. These testing sites are often outdoor and drive-through venues, benefitting from minimizing contact exposure and facilitating rapid throughput. These sites have been found to be a feasible and efficient option for screening, testing, and counseling stable patients (7). However, most of the facilities are primarily for point-of-care testing, which, like telemedicine, limits their ability to actually evaluate and treat ill patients.

In an effort to bridge this gap, in May of 2020 we devised a drive-through medical treatment facility (DMF) to provide clinical evaluation and treatment of patients presenting with potential COVID-19. Patients had favorable perceptions of our novel treatment system (8). However, the effectiveness of such systems is unknown. By outlining our DMF’s structure, methods, and analyzing our treatment outcomes through retrospective review of all DMF and DMF-diverted charts, we evaluated the value of such a delivery mechanism.

## Materials and Methods

### Setting

The study was conducted at Naval Medical Center Portsmouth a 298-bed federal, academic hospital with nine branch clinics and an ED census of 86,000 annually.

### Study Concept

The DMF was developed to allow full evaluation, dispositioning, and treatment of patients with potential COVID-19 symptoms. It was designed with several factors in mind: handling large volumes of patients quickly and efficiently; effectively triaging patients based on risk; fully evaluating, treating, and discharging low-risk patients who may be infected with COVID-19 while preventing nosocomial spread of COVID within the confines of the ED. It was staffed Monday through Saturday, 9 AM–4 PM. We report the experience with this system from May 1 to July 1, 2020. This protocol was approved by the Naval Medical Center Portsmouth Institutional Review Board.

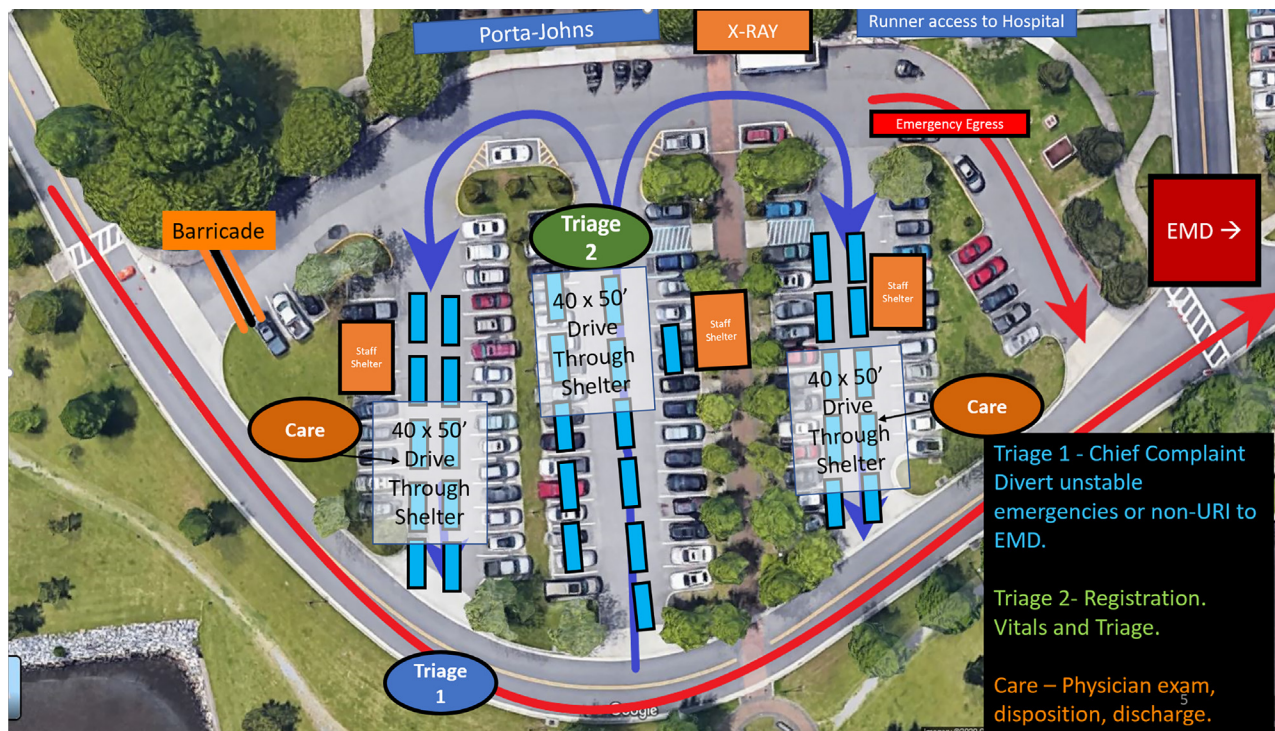
### Facility Components

The DMF was located in a large parking lot adjacent to, and within 100 yards of, the ED. The system consisted of a central registration and triage area and two medical treatment areas. Each of these areas was housed within 40' × 50' event tents, which afforded environmental protection for staff and accommodated two parallel lanes allowing patients to drive their vehicles through. This allowed the entire visit to be conducted while the patients remained in their vehicles. Smaller support areas included two staff shelters housing equipment and supplies, and a portable x-ray truck (Figure 1). Power and ethernet cables were routed from the main hospital to the command center to achieve access to the hospital’s electronic health records and refrigeration for specimen collection and testing.

### Flow of Medical Care

The DMF was set up along the main road leading to the ED. All cars on the road were met by a hospital corpsman (the military equivalent of a medical technician) who performed an initial quick screen with the aid of a question card. This “Triage 1” location was designed to identify both drivers who were not intending to visit the ED, and patients in distress who required immediate diversion. Both were allowed to bypass the DMF via a bypass lane that was maintained for emergency vehicles such as emergency medical services (EMS). Additionally, signs were placed along the road instructing patients to engage hazard lights if they felt they were experiencing a medical emergency. Cars with engaged hazard lights were immediately assessed by the “Triage 1” corpsman.

All patients who did not meet immediate diversion criteria and intended to visit the ED for potential COVID-like/influenza-like symptoms were directed into the DMF. These patients were given a pamphlet that described what



**Figure 1.** Diagram of the drive-through medical facility organization and flow of traffic. EMD = Emergency Medicine Department.

to expect from the process. Each patient had their vital signs and chief complaint documented on a paper medical record, which was placed under the vehicle's windshield wipers.

At the Triage 2 checkpoint, patients were sorted by a seasoned ED nurse with triage training and experience. A specially developed screening tool was used to help identify patients that met exclusion criteria for the DMF and obtain initial clinical information, as shown in Figure 2. As before, patients who were thought to require an extensive workup, hospitalization, or to be at risk for decompensation were diverted from the DMF to the adjacent main ED. All other vehicles were then directed by security to one of the two treatment areas.

The two treatment areas were designed to accommodate two independent treatment teams each, though we did not exercise it to its full capacity. Each team consisted of a physician or advanced practice practitioner and a hospital corpsman; the teams shared a registered nurse. The team would perform a standard focused history, physical examination, and review of systems. Physical examinations were performed through vehicle windows, opened doors, or with the patient standing outside the vehicle, as required. Ancillary diagnostic tools included point-of-care testing for COVID-19, influenza, and group B strep, as well as a portable x-ray machine. Once dispositions were decided, standard discussion to include follow-up plans occurred using preprinted discharge forms. Select medications including antipyretics and common “cold medica-

tions” formulations (e.g., guaifenesin, dextromethorphan) were available to immediately dispense. Traditional paper prescriptions were used for other indicated medications. After receiving medications and discharge instructions, the vehicles were directed to exit the DMF. If at any time during the course of care it was determined that the patient required an ED visit, they were rapidly diverted. An evacuation litter and resuscitation equipment were kept in the care areas for emergent use.

#### Data Analysis

To access disposition decisions, patient charts were reviewed to identify downstream diagnostics, dispositions, and outcomes. Throughput metrics from the study periods were compared with those from the preceding 2 months, as well as from the same time interval from the preceding year. Patients diverted to the main ED that received additional diagnostic testing or were admitted, were coded as true positives, whereas those dispositioned home without further diagnostic testing were coded as “Clinically Discharged” and viewed as a false positive. False negatives were defined as those patients discharged home from the DMF that, within the following 14 days, returned to the ED and who underwent additional diagnostic testing or hospital admission. Lengths of stay were recorded as medians and interquartile ranges; time savings was calculated as the difference between median patient lengths of stay between DMF and ED patients, multiplied by



**MEDICAL RECORD - SUPPLEMENTAL MEDICAL DATA**

For use of this form, see requiring document. Form is not valid without Requiring Document, Issuance date, local Form Number and Edition Date.

REQUIRING DOCUMENT ( <i>Title and Number</i> )		ISSUANCE DATE	
NAVMEDCENPTSVAINST 3440.6		March 2020	
LOCAL FORM TITLE ( <i>Optional</i> )			
Rapid Respiratory and Contagion Assessment 6220/1			
Triage Date _____ Time _____ ESI *1 *2 3 4 5	<b>HIGH RISK - IMMEDIATE DIVERT TO EMD</b>		
Historian Patient Family	Altered mental Status Confusion Lethargy		
Arrival Mode Car Other _____	Disorientation Wheezing Hemoptysis		
Vitals Ht _____ in Wt _____ lbs (Pt report)	*Shortness of Breath *Difficulty Breathing Pregnant		
Temp _____ HR _____ BP _____ RR _____ SpO <sub>2</sub> _____ Pain _____	*HR>110 RR >20 SpO <sub>2</sub> <92% SBP<90 Age> 65/<5yo		
Chief Complaint: _____	History of Chronic Lung Ds (COPD, Asthma) Syncope		
Onset/ Duration: _____	CAD CHF Immunocompromised Chest Pain		
Travel / Exposure Hx: Country: _____	Sickle Cell Ds ESRD on Dialysis O <sub>2</sub> Requirement		
Relative Co-worker Patient Other (Write in)	Resident of chronic care facility (nursing home)		
Duration of Exposure: _____	Feel Safe at Home Y / N Thoughts of HI/ SI: Y / N		
<b>Time at Aid Station: _____</b>		<b>ROS</b>	
Symptoms:		CONST Weakness CVS Palpitations	
Fever Sweating Fatigue Chills	LYMPH Swollen Glands GU Hematuria/Dysuria		
Cough (Dry / Productive) Muscle Aches Earache	EYES Redness Itching LNMP Preg		
Sore Throat Runny Nose Sinus Pain/ Drainage	MS Joint pain PSYCH Anxiety Depsn		
Headache Nausea Vomiting Diarrhea	OTHER _____		
Other: _____	_____		
<b>MEDICAL HISTORY</b>			
Allergies: NKDA PCN Sulfa Latex Other: _____			
Past Med HX: HTN DM DVT/PE Cancer			
Surge: None or List			
Soc Hx: Smoker _____ppd/past/quit _____yr/mon ago			
EtOH Recent / Heavy / Occasional			
Drug Use Y/N _____			
Circle positives / One-line negatives			
<b>PHYSICAL EXAM</b>		Gen: NAD Alert Mod / Sev Distress Anxious	
EENT: Eyes Nml PERRLA Ears Nml		TM Erythema (R / L) Pharyngeal Erythema	
Conjunctival Injection (R / L) Rhinorrhea		TM Dullness (R / L) Cerumen Impaction	
Oral Lesions Tonsillar swelling		_____	
<b>NECK:</b> Nml Inspection Supple		Lymphadenopathy Meningismus	

Patient Contact Number: \_\_\_\_\_

\* See protocol regarding Triage Nurse Role

PRACTITIONER'S NAME See page 2	PRACTITIONER'S NAME See page 2	DATE See page 2
PATIENT'S IDENTIFICATION: ( <i>For typed or written entries, give: Name - last, first, middle; SSN; Sex; Date of Birth; Rank/Grade.</i> )		HOSPITAL OR MEDICAL FACILITY
DEPARTMENT / SERVICE		RECORDS MAINTAINED AT:
SPONSOR'S NAME		SSN
RELATIONSHIP TO SPONSOR		

NAVMEDCENPTSVA 6220/1(03-2020), Exception to NAVMED 6000/5 (09-2008)

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Figure 2. Triage and evaluation form for patients presenting to the drive-through medical facility.

the number of patients encounters. Data were descriptively analyzed in Excel (Microsoft Corporation, Redmond, Washington). Disposition accuracy, sensitivity, and

specificity were calculated via MedCalc (MedCalc Software Ltd., Ostend, Belgium).

	<u>Value</u>	<u>95% Confidence Interval</u>
<b>Accuracy</b>	92.4 %	91.2% - 93.5%
<b>Sensitivity</b>	83.3 %	65.3% - 94.4%
<b>Specificity</b>	92.8 %	91.7% - 93.9%
<b>Positive Predictive Value</b>	32.5 %	27.8% - 37.5%
<b>Negative Predictive Value</b>	99.3%	98.4% - 99.7%

**Figure 3. Screening performance metrics.**

## Results

A total of 2164 patients, with a mean age of 32 (18–87) years and a slight male predominance (65% vs. 45%), were evaluated through the DMF between May 1 and July 1, 2020.

Overall accuracy for patient classification was 92.4% (95% confidence interval [CI] 91.2–93.5%) (Figure 3). Screening criteria resulted in a 14-day unscheduled return visit rate of 1.8% and a return with need for extensive workup or admission rate of 0.25%. This yielded a sensitivity of 83.3% (95% CI 68–96%), and a negative predictive value of 99.3% (95% CI 98.4–99.66%).

Of those presenting to the DMF, 179 patients (8.3%) were diverted to the main ED for further evaluation (Figure 4). Diversion decisions were made by the triage nurse or clinician 82% and 18% of the time, respectively. Of those diverted to the ED, 25 patients (14%) required further diagnostic workup, with 9 (5%) of those requiring subsequent admission to an inpatient service, yielding a specificity of 92.8% (95% CI 91.7–93.9%) and a positive predictive value of 32.5% (95% CI 27.8–37.5%).

ED performance metrics are summarized in Figure 5. During the study period the average daily patient volume presenting to the ED was 145, with 109 being seen in the ED and 36 by the DMF. This compared with 184 during the same time period the previous year and 176 during the previous 2 months. In the ED, the number of patients “left without being seen” decreased to an average of 6 per month compared with the previous year ( $n = 41$ ) and previous 2 months ( $n = 89$ ). “Door-to-Physician” and “Length of Stay” times also decreased to an average 40.3 and 157.7 min, respectively, during the study period vs. the previous year (64.6 and 169.7 min, respectively) and previous 2 months (69.2 and 171 min, respectively).

For patients evaluated through the DMF, the median time from arrival to departure was 38 min (interquartile

range 24–41 min). During this same time interval and operating hours, the median length of stay for patients evaluated for potential COVID symptoms to the main ED was 149 min (interquartile range 104–214 min). This yielded a mean difference of 111 min per encounter and a total time savings of 3762 h.

## Discussion

Our study evaluated the effectiveness and efficiency of medical care delivered to potential COVID-19 patients via a drive-through system. Here we found that such a system can effectively manage these patients, detecting those requiring ED referral with a high degree of accuracy. Furthermore, our system significantly increased patient throughput, while creating an environment that may reduce nosocomial transmission. Overall, our study supports the viability of a DMF in the setting of a respiratory pandemic.

Alteration in health care delivery models must place a premium on ensuring quality patient care. Since the 1990s, the number of ED unscheduled return visits (URV), or “bounce-backs,” has been used as a quality-of-care measurement (9). In our cohort we found a 14-day URV rate of only 1.8%. Although our population was inherently more limited in presenting chief complaints, our calculated URV rate compares favorably with the 3–9% national rates for EDs.

However, the reasons for the URVs are not inherent in the delivery model and include patient-related, physician-related, disease-related, and system-related factors (10). In fact, studies indicate that only 5–20% of return visits are related to inadequate medical care at the primary visit (9). Therefore, URV overestimates inadequacy of medical care. To determine a more clinically relevant outcome, we also assessed the rate of URV deemed to require additional diagnostic evaluation or admission. Although

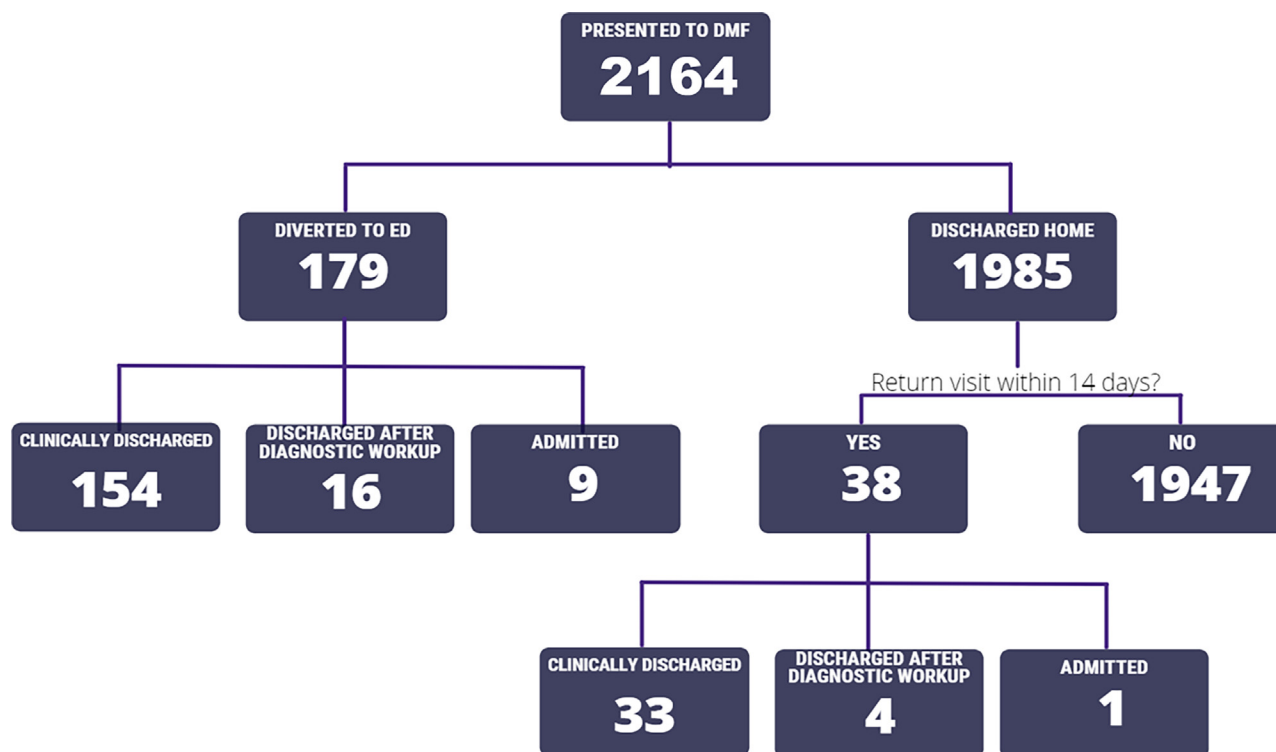


Figure 4. Summary of dispositions of patients presenting to the drive-through medical facility (DMF). “Clinically discharged” refers to disposition based on history and physical alone, without additional diagnostic tests except for a COVID-19 nasal swab.

	Daily Patient Volume	Monthly LWBS	Door to Physician time (min)	Length of Stay (min)
Study Period	109 (145)	6	40.3	157.7
Previous Year (Same 2-month interval)	184	41	64.6	169.7
Delta	-40.7% (-21.4%)	-85.2%	-37.0%	-7.1%
Previous 2 months	176	89	69.2	171.0
Delta	-38.1% (17.9%)	-93.3%	-41.5%	-7.8%

Figure 5. Emergency department performance metrics. All values are averages. Values in () represent inclusion of patients seen in the Drive-through Medical Facility. LWBS = left without being seen.

returns for scenarios such as expected progression of disease may adversely affect sensitivity, we still found a rate of only 0.25%, yielding a negative predictive value of 99%, which we feel is well within an acceptable margin.

Although the safe and effective delivery of care are paramount concerns, the efficiency of health care systems must be considered, and is especially critical during surging patient volumes. During our study period, 2164 patients were seen, which, when accounting for a diversion rate to the ED of 8.3%, amounts to 1985 patients that were decompressed from the ED. Additionally, the DMF patient encounters saw a 73% reduction in visit time compared with a matched cohort seen in our main ED. Although we do not know the precise reason for this re-

duction in visit time, a combination of decreased transfer time between areas, faster documentation, and removing the need for sanitizing and resetting rooms between patients likely contributed. The resultant 3700 h in estimated savings in just 2 months demonstrates the potential to massively increase patient throughput and be a critical mitigation strategy during high-volume periods such as pandemics and influenza seasons.

The decompression of patient volumes by the DMF also was accompanied by improvement in the ED’s metrics. Commonly cited metrics such as “Door to physician,” “Length of stay,” and “Left without being seen” all decreased during the study period. Given the decreased patient census and other public health determinates, it

is difficult to parse out the extent the DMF contributed. However, these metrics are interrelated, and given that the DMF accounted for half of the decrease in ED volume, it is reasonable to attribute some contribution. Finally, of note, this is not lost revenue, as these patients were evaluated and treated under the care of an emergency physician, charts were able to be coded and billed as ED visits.

Staff safety is critical in all scenarios and we feel the DMF represented a breakthrough in exposure reduction for our ED. After implementation of the DMF, we had only one work-related COVID-19-positive staff member requiring removal from the schedule. Although this strongly reflected our adherence to personal protective equipment and best practices, the significant reduction in patient exposure-hours in the department most certainly factored into our successful retention of staff during the initial surges of the pandemic. In the DMF itself, patients were seen in an open-air environment and care was provided either through the window of, or standing next to, their vehicle, significantly reducing contact exposure levels while still allowing for complete patient evaluation. Additionally, although we are unable to objectively assess it, removing these patients from our waiting rooms can reasonably be expected to decrease the odds of nosocomial infection.

### Limitations

Although our study provides valuable initial insight, our outcomes may not be generalizable, and the utilization of a DMF-type facility not feasible, to all institutions. Our facility is a federal, academic institution with several associated branch clinics and a slightly lower acuity reflected by an annual admission rate of ~9% compared with a national average of 12.7% (11). Most importantly, however effective, there are numerous logistical factors that must be evaluated on a per-institution basis. This includes: implementation into the current health system, staffing resources, ancillary services, layout of hospital facilities and adjacent roadways, and constraints involving the physical setting, to include location and weather variations. These factors may be highly variable between institutions and ultimately, cost analysis outcomes would need to be evaluated in determining if a DMF-type asset would be a value-add proposition within a health care system. Finally, the DMF was designed exclusively in the setting of the COVID-19 pandemic, and although it can be reasonably extrapolated to conditions such as influenza, it may not be appropriate for all medical conditions.

### Conclusion

Our study demonstrated that a drive-through medical treatment facility can provide effective and efficient care

in the setting of a respiratory pandemic. Although a dramatic change in the delivery model of medical care, DMFs represent a viable option for sustained operations during the surge of a pandemic.

### Acknowledgments

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### ARTICLE SUMMARY

#### **1. Why is this topic important?**

Emergency department overcrowding negatively effects patient care, is a persistent, systemic issue at baseline, and is a particular vulnerability in health care delivery during surge events.

#### **2. What does this study attempt to show?**

The aim of our study was to evaluate the effectiveness and efficiency of a drive-through medical treatment system in the setting of the COVID-19 pandemic.

#### **3. What are the key findings?**

Here we found that such a system can effectively manage these patients, detecting those requiring emergency department referral with a high degree of accuracy. Furthermore, our system resulted in a significant reduction in patient length-of-stay times.

#### **4. How is patient care impacted?**

Novel health care delivery mechanisms can allow more appropriate allocation of resources to patients, while decreasing patient waiting times and potentially decreasing rates of nosocomial infection during respiratory pandemics.