

RETHINKING TRADITIONAL EMERGENCY DEPARTMENT CARE MODELS IN A POST-CORONAVIRUS DISEASE-2019 WORLD

Authors: Ali Pourmand, MD, MPH, RDMS, Amy Caggiula, MD, Jeremy Barnett, BS, Mateen Ghassemi, BS, and Robert Shesser, MD, MPH, Washington, DC

Contribution to Emergency Nursing Practice

- Emergency nursing workforce shortages are not a new phenomenon, but they have become more serious in the coronavirus disease-2019 era. There is an extensive body of literature regarding emergency nursing burnout, stress, fatigue, and workplace violence, but there is not much literature about how to support emergency nurses.
- We offer a clarion call for hospitals to view their ED technicians as strategic resources which, if properly managed, can significantly mitigate the adverse effects of the nursing shortage on ED patient flow and satisfaction.
- Emergency department leadership should identify and implement strategies to expand the role of the ED-extenders when sufficient numbers of nurses are not available. This expansion will require additional training and an ongoing process of skills development and competence measurement.

Ali Pourmand is Professor, Department of Emergency Medicine, The George Washington University School of Medicine and Health Sciences, Washington, DC. **Twitter:** @AliPourmand.

Amy Caggiula is Assistant Professor, Department of Emergency Medicine, The George Washington University School of Medicine and Health Sciences, Washington, DC.

Jeremy Barnett is a Medical Student, Department of Emergency Medicine, The George Washington University School of Medicine and Health Sciences, Washington, DC.

Mateen Ghassemi is Health Policy MPH Candidate, Department of Emergency Medicine, The George Washington University School of Medicine and Health Sciences, Washington, DC.

Robert Shesser is Professor, Department of Emergency Medicine, The George Washington University School of Medicine and Health Sciences, Washington, DC.

For correspondence, write: Ali Pourmand, MD, MPH, RDMS, Department of Emergency Medicine, George Washington University School of Medicine and Health Sciences, 2120 L Street, Washington, DC 20037; E-mail: Pourmand@gwu.edu.

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Abstract

As the nursing shortage in United States emergency departments has drastically worsened since the coronavirus disease-2019 (COVID-19) pandemic, emergency departments have experienced increased rates of inpatient onboarding, higher rates of patients leaving without being seen, and declining patient satisfaction scores. This paper reviews the impacts of the coronavirus disease-2019 pandemic on the current nursing shortage and considers how various medical personnel (emergency nurse-extenders) can ameliorate operational challenges by redesigning emergency department systems. During the height of the coronavirus disease-2019 pandemic, the psychological effects of increased demand for emergency nurses coupled with the fear of coronavirus infection exacerbated nursing turnover rates. Health care workers who can be trained to augment the existing emergency department workforce include paramedics, Emergency Medical Technicians, emergency department technicians, ancillary staff, scribes, and motivated health sciences students. Utilizing non-nurse providers to fulfill tasks traditionally assigned to emergency nurses can improve emergency department flow and care delivery in a post-coronavirus disease-2019 world.

Key words: Nursing; Shortage; Emergency department; Pandemic

Introduction

While United States emergency department utilization increased by 28% between 2000 to 2019, emergency departments experienced episodic operational difficulties due to intermittent registered nurse (RN) shortages. During the coronavirus disease-2019 (COVID-19) pandemic, most emergency departments saw acute drops in patient volume with variable recovery patterns while simultaneously experiencing uneven, location-dependent staffing and systems challenges.¹⁻³ In recent years, operational difficulties have worsened and now include record levels of inpatient

boarding in the emergency department, widespread nursing shortages, higher rates of patients leaving without being seen by a provider, and declining patient satisfaction scores.⁴⁻⁷

One of the more significant issues affecting care delivery post-COVID-19 is the dramatic shift in workforce availability. Undoubtedly some of the emergency department and hospital nursing shortages are due to COVID-19-related stress, coupled with significant economic incentives for nurses to “travel” rather than becoming “permanent” or “staff” employees. One survey found that 66% of critical care nurses were considering leaving the profession entirely due to COVID-19-related burnout and concerns over personal safety during the pandemic.⁸

The future of the US nursing workforce is uncertain, and its recovery is not guaranteed. As such, there must be a focus on restructuring care models to mitigate the effects of the nursing shortage. ED managers and hospital administrators should think creatively about effective care delivery in the absence of a “traditional, RN-heavy” care team. The purpose of this literature review is to explore how different medical personnel (emergency nurse-extenders) can augment existing workforces in redesigned ED systems by alleviating some of the task burden historically relegated to RN staff.

Methods

To explore the literature and evaluate new roles for specific emergency nurse-extenderns, the following databases were searched: PubMed, SCOPUS, and Cumulative Index to Nursing and Allied Health Literature. Studies published as of October 30, 2022, were included in this review. PubMed and SCOPUS searches were conducted using a combination of the keywords, including: “nurse shortage,” “COVID-19 workforce burnout,” “ED Paramedics,” “EMT,” “EDT,” “emergency department ancillary staff,” and “triage tiered system.” Studies were included in the review if they addressed ED patients’ triage, screening, response, or education; focused on the emergency nursing workforce; and were published in the English language. We included letters, perspectives, clinical guidelines, retrospective studies, cohort studies, and editorials due to the novelty of some ideas and lack of evidence. Studies that addressed settings outside of the emergency department were excluded. We used the web-based Covidence system to manage our literature review (www.covidence.org, Melbourne, Victoria, Australia).

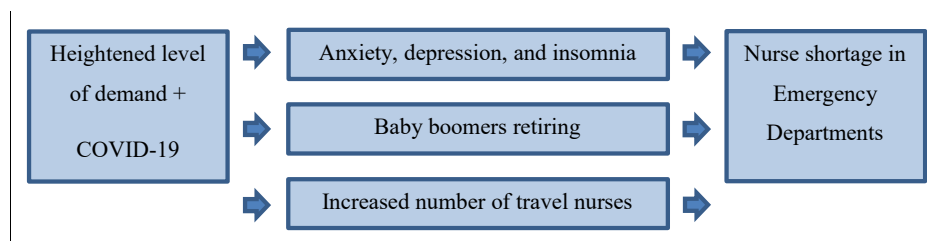
References of the included citations were also reviewed to identify additional sources. The initial literature search identified 150 articles, of which 34 articles were included in this review. We enclosed our search strategy in [Supplementary Appendix 1](#) and [2](#).

Results

The ED nursing shortage is not a new phenomenon, and it has affected care delivery in emergency departments for most of the 21st century.⁹ The COVID-19 pandemic, however, has dramatically increased nursing turnover rates.⁶ Multiple studies have demonstrated an increased prevalence of anxiety, depression, and insomnia during the pandemic, and nursing burnout can be traced to “occupational psychological trauma” resulting from consistently working at a heightened level of stress for a prolonged period and fearing the possibility of being infected and infecting others.^{10,11} Many nurses report the emergence of new sleep disturbances and decreased quality of life.^{11,12} Psychological trauma combined with the current pressures of working through the pandemic have contributed significantly to workforce shortages as nurses leave the emergency department and/or field altogether.^{4,13,14} In addition, a large cohort of aging “baby boomer” nurses are now retiring, thus adding to the problem.¹⁵ [Figure 1](#) outlines the impacts of the COVID-19 pandemic on the nursing shortage.

Emergency Medical Service call volume decreased during the first wave of the pandemic in early 2020 for a variety of reasons, including fear of infection in the emergency department and mandated restrictions that reduced out-of-home activities.^{16,17} As a result, patients delayed care, worsening their medical conditions and skewing the triage scales toward life-threatening emergencies.^{17,18} High overall acuity, patient load, and excessive inpatient boarding in the emergency department contributed significantly to both workforce stress and the breakdown of the standard ED operating paradigm.^{4,19}

The current/standard ED patient flow system and care delivery model are built around the RN. Registered nurses are the largest provider group in the emergency department and lack of optimal nurse staffing has a significant adverse effect on patient care.²⁰ Studies have demonstrated an association between inadequate nurse staffing and increased patient morbidity and mortality.²¹ Additionally, nursing shortages are not strictly limited to the emergency department, as a shortage of medical, surgical, and intensive care



FIGURE

Impacts of the COVID-19 pandemic on the current nursing shortage. COVID-19, coronavirus disease-2019.

unit staff contributes to ED boarding at many institutions.¹²⁻¹⁴

There is little evidence to suggest that nurse staffing woes will improve as the pandemic wanes, and ED managers must consider restructuring ED flow systems to account for continued RN shortages. The following sections will discuss how other categories of health care professionals, including paramedics, Emergency Medical Technicians (EMTs), ED technicians, ancillary staff, scribes, and health sciences students, can be utilized to improve ED flow and care delivery in a post-COVID-19 world.

PARAMEDICS

Paramedics have significant autonomy and decision-making capacity in the prehospital setting. Their scope of practice includes the administration of medications (orally or intravenously), interpreting electrocardiograms (ECGs), and using cardiac monitors and complex equipment. Wake Forest University Baptist Medical, a level-one trauma center, launched a pilot program utilizing paramedics as emergency nurse-extendors in times of workforce shortages.²² Participants underwent a 12-week intensive course, during which they trained alongside newly graduated emergency nurses (further indicating that the groups had comparable baseline knowledge). The paramedics were subsequently able to assist with traditional nursing tasks like obtaining ECGs, placement of intravenous (IV) lines, triage, and medication administration.²² Campbell et al²³ conducted a study that examined ED flow when paramedics were used to treat patients with a triage emergency severity index of 4 or 5 rather than ED RNs. The results demonstrated a decrease in wait time from 5.63 hours to 3.17 hours in the area managed by an advanced care paramedic, thus decreasing workload for ED RNs who could then manage patients with more serious injuries or illnesses.

A survey of paramedics in Britain, where paramedics have traditionally been used within the hospital health care system, determined that many participants felt their

ambulance-developed diagnostic reasoning skills transferred well to the emergency department. However, some paramedics believed that their role in the emergency department was limited and that they lost the autonomy they had in the prehospital setting.²⁴ Whalen et al²⁵ conducted a survey on veteran paramedics transitioning to emergency department roles in Nova Scotia, demonstrating that paramedics developed advanced teamwork skills while addressing patient needs alongside emergency nurses. The participants in this survey felt that working in the emergency department allowed them to continue to use the skills they learned in the field and that it was beneficial for both their careers and patient care.²⁶

EMERGENCY MEDICAL TECHNICIANS AND EMERGENCY DEPARTMENT TECHNICIANS

There are fewer studies examining Emergency Medical Technicians (EMTs) in the emergency department, possibly because EMT certification is often a prerequisite for becoming an ED technician. EMTs provide important assistance to paramedics in the prehospital setting. Patient care duties traditionally performed in the emergency department by a nurse that could be performed by an EMT include cardiopulmonary resuscitation, providing oxygen and glucose, and administration of certain treatments such as nebulizers and medications for allergic reactions.¹⁵ With additional training, EMTs can serve as valuable members of the emergency department care team. In 2021, the Mississippi Department of Health authorized the use of both paramedics and EMTs in their emergency departments due to the nursing shortage.²⁷

Nurses and ED technicians also work together and often divide patient care responsibilities in order to improve patient flow and enhance health care quality. Functions of Emergency Department Technicians (EDTs) vary widely between hospital systems and states but can include measuring and monitoring vital signs, specimen collection, venipuncture, peripheral and ultrasound-guided IV access,

splinting a limb or immobilization of a joint, wound care, ECG acquisition, point-of-care testing, patient transport, cardiopulmonary resuscitation, and some communication with the patient/family.²⁸ With additional training, they are able to provide further interventions such as urinary catheterization, patient discharge, and help with activities of daily living, all of which will substantially lessen the burden on emergency nurses. Studies show that EDT scope of practice can be successfully and efficiently expanded to include more advanced skills such as suturing, ultrasound-guided venous cannulation, and monitoring of low acuity patients.²⁹⁻³²

ANCILLARY STAFF

There are several additional categories of hospital staff that can be trained to perform patient care tasks historically assigned to emergency nurses. Respiratory therapists, radiology and ultrasound technicians, ECG technicians, wound care specialists, monitoring technicians, psychiatry technicians, and phlebotomists are potential untapped resources to consider when nursing shortages affect care delivery. By cross-training ancillary staff to perform roles that actively support the ED medical team—such as ultrasound-guided IV access, ECG acquisition, splinting, patient triage, or discharge protocols—they could alleviate the mounting pressure on nurses, freeing them to focus on other critical duties. For example, the ED phlebotomist can manage point-of-care testing and ensure compliance with Clinical Laboratory Improvement Amendments standards.³³

In smaller hospitals, some of these technicians cover the floor and outpatient clinics in addition to the emergency department. Tasks are allocated differently in large emergency departments, and nurses have traditionally assumed virtually all responsibilities related to venipuncture, ECG acquisition, nebulizer treatments, and wound care, with occasional input from respiratory therapy for some complex needs. Although cross-training ancillary staff to perform nursing tasks may alleviate the pressure of widespread nursing shortages, many of these technician jobs are seeing a similar scarcity of staff. As such, there is potentially little or no benefit that can be achieved from off-loading nursing work onto this group.³⁴

EMERGENCY DEPARTMENT SCRIBES

Scribes in the emergency department can offer a multitude of benefits, including faster patient throughput, increased revenue, and improved provider and patient satisfaction. Unlike most of the ED staff, scribes are generally hired by

the physician group and are often employed by a third-party vendor. The main duty of scribes in the emergency department is documentation of the physician encounter, allowing providers to see more patients and improving the quality of documentation.³⁵ Hospital systems should consider allocating scribe resources to aid in nursing documentation in a similar manner to how this resource is utilized for physicians.

During periods of high boarding, ED nursing shortages, and overcrowding in the emergency department, physicians are often asked to evaluate patients in atypical locations such as triage (as in a “provider-in-triage” program) or a rapid assessment area (like in the split flow model).³⁶ Physicians engaging in these evaluations frequently have minimal support from ED staff, and scribes can be utilized as a resource to support the front-end providers in order to increase flow and maximize the number of patients seen. Scribes can also be trained to aid in triage documentation, thus freeing up RNs to participate in bedside patient care.³⁷

HEALTH SCIENCES STUDENTS

Since prehealth undergraduate and graduate students often need practical clinical experience before applying to medical, physician assistant, or nursing school, offering courses that train students to perform noncritical nursing tasks can also ease the pressure caused by limited staffing. This has substantial benefits for both departments and students. Students will gain valuable clinical skills, affirm their commitment to medicine, and demonstrate a working knowledge of health care systems on their resumes.³⁸ In turn, their clinical responsibilities can offload a substantial work burden from nurses. Effective training of students is necessary to ensure operational efficiency and high-quality patient care. Current programs that train students to become EDTs can be replicated and modified to include other task-oriented activities such as wound care, splinting, obtaining ECGs, venipuncture, IV placement, and triage. Because these programs may lead to efficient task-shifting, further research and investigation are needed to study their impact.³⁸

STANDARD PATIENT TRIAGE

Patient triage and assigning emergency severity index levels have historically been RN-specific tasks. However, health care systems can train other staff, such as paramedics, EDTs, or prehealth students, to perform triage functions in order to increase the number of nurses available for

bedside clinical care. Several studies have examined the concordance between triage assessments of other providers compared to evaluations by RNs. Ghanbarzahi et al³⁹ conducted a study on triage proficiency between RNs and EMTs in a 2-day training workshop. The study demonstrated that EMTs had a 0.20 concordance with nurses before training and a 0.71 concordance level after.³⁹ This, in turn, led to a 57.75% accuracy level between EMTs and triage nurses.³⁹ Additionally, Sarikaya et al⁴⁰ measured the consistency between emergency physicians and paramedics after a training session on triage decisions, the accuracy of which increased slightly for paramedics after the education.

PATIENT DISCHARGE

The majority of ED patients (67.5%) are discharged after initial evaluation and workup.⁴¹ These patients require a set of written instructions that are usually reviewed verbally with the patient by both a physician or Advanced Practice Provider and an RN. Studies have demonstrated that direct verbal communication of discharge information and instructions from a medical professional is superior to paper discharge instructions alone due to literacy concerns or loss of paperwork.⁴² Emergency nurses often bear the brunt of the responsibility regarding patient communication and education upon discharge. Ramsey et al⁴³ conducted a retrospective chart review that examined throughput data at a Chicago hospital, comparing total nursing hours to discharge time and patients who left without being seen. The results demonstrated that when nursing hours decreased during periods of limited staffing, emergency departments experienced an overall increase in patient discharge time and total number of patients leaving without being seen.⁴³

The National Health Care Workers Association endorses that discharge from the emergency department is a duty that falls within the capabilities of a certified EDT.⁴⁴ Several hospital systems are already utilizing this tactic to offload nursing duties related to patient communication to EDTs, such as the University of Wisconsin, and the University of Louisville.^{45,46}

Discussion

The ED nursing pool was inadequate before the onset of the COVID-19 pandemic, and the hardships associated with the last several years have led nurses to leave the emergency department and the profession entirely at historic

rates.^{8,9,12,14,47} Many emergency department processes have evolved to require nurses for normal operations, and thus many departments are failing in the provision of their core capabilities due to nursing staff limitations.^{20,21,24} There has been no indication that the nursing shortage is temporary or recovering, so emergency department processes must be redesigned to utilize non-RN providers to fulfill some core responsibilities traditionally assigned to RNs.

Paramedics currently serve as autonomous providers during prehospital care and transport. The pilot study conducted at Wake Forest University Baptist Medical found that both nurse and paramedic participants felt that the utilization of paramedics in the emergency department improved patient care and decreased the workload burden on emergency nurses.²² Therefore, the program demonstrated that the clinical skills paramedics already had could be transferred to in-hospital settings. Campbell et al²³ used in-hospital paramedics to treat higher-acuity patients and demonstrated a significant decrease in wait time for clinical care. In both studies, care was directed by a veteran triage nurse, with paramedics utilized in assisting roles.^{22,23} The successful addition of paramedics to the ED workforce will require a comprehensive and well-rounded clinical orientation course and the ability to foster effective teamwork between emergency nurses and paramedics.^{22,23,25} Paramedics will also expect to experience some degree of autonomy during prehospital care in order to feel adequately fulfilled in their new role.^{24,26} These studies indicate that paramedics in a supportive role can reduce the burden on emergency nurses by assuming responsibility for many tasks historically assigned to nurses and freeing nurses to lead other patient care duties.

Furthermore, the triage quality of paramedics in the emergency department could be strengthened by displaying discrete guidelines for reference to improve consistency.⁴⁰ However, more research needs to be performed to assess patient care outcomes from a shift in standard triage protocols.

EMTs working clinically in the emergency department are less studied, and this is a potential topic for future research.²¹ Like paramedics, EMTs possess valuable clinical skills that would be useful in an emergency department. Additionally, EMTs are already accustomed to a hierarchy of emergency care, as they provide assistance to paramedics in the prehospital setting.¹⁵

EDTs have varying responsibilities based on their clinical skills and the customs and norms of the hospital system within which they are employed.²⁸ Studies have shown that they are a valuable resource and able to develop additional skills through physician and nurse-led educational initiatives.^{30,31} EDT job duties vary greatly geographically and between hospital systems, but the foundational clinical

TABLE

Areas that various medical personnel could be trained to alleviate the stress on emergency nurses

Task	Paramedic	EMT	EDT	Ancillary staff	Emergency nurse
Electrocardiogram	✓		✓		✓
Intravenous lines	✓		✓		✓
Triaging			✓		✓
Medicine administration	✓				✓
Cardiopulmonary resuscitation	✓	✓	✓		✓
Oxygen administration	✓	✓	✓		✓
Glucose administration	✓	✓	✓		✓
Vitals monitoring	✓	✓	✓		✓
Specimen collection			✓		✓
Venipuncture	✓		✓		✓
Splinting			✓		✓
Wound dressing			✓	✓	✓
Point-of-care testing			✓		✓

continued

TABLE
Continued

Task	Paramedic	EMT	EDT	Ancillary staff	Emergency nurse
Patient transport	✓	✓	✓		✓
Urinary catheterization			✓		✓
Discharge			✓		✓
Ultrasound-guided venous cannulation			✓		✓
Patient monitoring	✓	✓	✓	✓	✓
Personal care	✓	✓	✓	✓	✓

EDT, emergency department technician; EMT, emergency medical technician.
The ✓ icon indicates tasks that these personnel already are trained to perform.

knowledge to understand discharge communication and procedure is well within the capabilities of EDTs. Discharge protocols are important tasks that can easily and effectively be relegated to EDTs and other clinical staff, allowing nurses to focus their efforts elsewhere. Furthermore, in states where venipuncture, ECG acquisition, splinting, and patient transport are within the scope of practice of an EDT, redistributing these tasks to techs can significantly offload responsibility from an already overstretched nursing staff. Comprehensive on-the-job training and continuous clinical education will be paramount to ensuring delivery of high-quality care.

Emergency department leadership should consider hiring additional non-nursing patient care personnel to meet the challenges of the post-COVID-19 health care workforce. For this to happen, RNs must be trained in a more “managerial” approach to patient care, including task delegation, supervision, and evaluation and feedback. This role is similar to the ways in which the attending physician(s) provide care in academic institutions, working in a supervisory capacity over several residents and Advanced Practice Providers.

While some in the nursing profession may feel that assigning tasks to other staff equates to giving away their responsibilities and undermining their influence as health care professionals, these recommendations are intended to address the critical shortage of experienced nurses. The nursing shortage is affecting every facet of health care quality and delivery, and accepting the status quo is unsustainable and will exacerbate the resultant inefficiencies. Elevating nurses to more managerial positions may assuage the sentiment that nurses are “being replaced” by other health care professionals.

With additional training, nurse-extendors can meaningfully improve ED flow and care by performing a wider range of tasks. Table 1 outlines areas of training for various medical personnel in order to reduce the burden on emergency nurses, allowing them to focus on more complex diagnostic and therapeutic responsibilities. Hospital nurse educators can provide additional training during the onboarding process, and outcomes should be measured and compared to regional norms. It is important to note that the potential roles of nurse-extendors vary based on local and regional regulations and scope of practice restrictions.

Implications for Emergency Nurses

The emergency nursing task force shortage is significantly affected by COVID-19. Emergency nurses can use this information to explore the potential for using nurse-extendors to promote optimal patient outcomes during the current staffing crisis. ED-extendors, who are discussed in this paper, could help emergency nurses to provide safe care during periods of short staffing. Future studies may offer additional insight into emergency nurse-extendors and discuss the implementation and integration of these personnel in order to augment the existing ED workforce, as well as their effects on ED flow and care delivery.

Conclusion

The continuing nursing shortage in US emergency departments, exacerbated by the COVID-19 pandemic, demands innovation in care delivery models. One strategy is directing non-nurse providers, called nurse-extendors, to perform a variety of tasks otherwise carried out by emergency nurses. By delegating responsibilities such as ECG acquisition, venipuncture, discharge protocols, triage, and medication administration to non-nurse health care professionals, the patient care processes are streamlined and less reliant on an already over-burdened workforce. Nurse-extendors not only can alleviate the responsibilities shouldered by emergency nurses, but they also allow nurses to concentrate on higher-level operations, thus improving acute care delivery in the emergency department. This restructuring will hopefully generate an increase in patient satisfaction, decrease wait times, and lead to fewer patients who leave without being seen and evaluated by a provider. Additional training is required to build capacity for nurse-extendors to ultimately help improve ED flow and care delivery. The recommendations outlined are intended to support nurses and to ensure sustainability and efficiency while continuing to deliver the highest quality care. Roles and scope of practice for emergency nurse-extendors must be considered as laws and regulations vary by geographic region.

Author Disclosure

Conflicts of interest: none to report.

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Supplementary Data

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Supplementary Appendix 1

SEARCH STRATEGY

Search: **Nursing shortage** Sort by: **Most Recent**

("nursing"[MeSH Terms] OR "nursing"[All Fields] OR "nursings"[All Fields] OR "nursing"[MeSH Subheading] OR "nursing s"[All Fields]) AND ("shortage"[All Fields] OR "shortages"[All Fields])

TRANSLATIONS

Nursing: "nursing"[MeSH Terms] OR "nursing"[All Fields] OR "nursings"[All Fields] OR "nursing"[Subheading] OR "nursing's"[All Fields]

shortage: "shortage"[All Fields] OR "shortages"[All Fields]

Search: **emergency department** Sort by: **Most Recent**

"emergency service, hospital"[MeSH Terms] OR ("emergency"[All Fields] AND "service"[All Fields] AND "hospital"[All Fields]) OR "hospital emergency service"[All Fields] OR ("emergency"[All Fields] AND "department"[All Fields]) OR "emergency department"[All Fields]

Translations

emergency department: "emergency service, hospital"[MeSH Terms] OR ("emergency"[All Fields] AND "service"[All Fields] AND "hospital"[All Fields]) OR "hospital emergency service"[All Fields] OR ("emergency"[All Fields] AND "department"[All Fields]) OR "emergency department"[All Fields]

Search: **covid 19** Sort by: **Most Recent**

"covid 19"[All Fields] OR "covid 19"[MeSH Terms] OR "covid 19 vaccines"[All Fields] OR "covid 19 vaccines"[MeSH Terms] OR "covid 19 serotherapy"[All Fields] OR "covid 19 serotherapy"[Supplementary Concept] OR "covid 19 nucleic acid testing"[All Fields] OR "covid 19 nucleic acid testing"[MeSH Terms] OR "covid 19 serological testing"[All Fields] OR "covid 19 serological testing"[MeSH Terms] OR "covid 19 testing"[All Fields] OR "covid 19 testing"[MeSH Terms] OR "sars cov 2"[All Fields] OR "sars cov 2"[MeSH Terms] OR "severe acute respiratory syndrome coronavirus 2"[All Fields] OR "ncov"[All Fields] OR "2019 ncov"[All Fields] OR (("coronavirus"[MeSH Terms] OR "coronavirus"[All Fields] OR "cov"[All Fields]) AND 2019/11/01:3000/12/31[Date - Publication])

Translations

covid 19: ("COVID-19" OR "COVID-19"[MeSH Terms] OR "COVID-19 Vaccines" OR "COVID-19 Vaccines"[MeSH Terms] OR "COVID-19 serotherapy" OR "COVID-19 serotherapy"[Supplementary Concept] OR "COVID-19 Nucleic Acid Testing" OR "covid-19 nucleic acid testing"[MeSH Terms] OR "COVID-19 Serological Testing" OR "covid-19 serological testing"[MeSH Terms] OR "COVID-19 Testing" OR "covid-19 testing"[MeSH Terms] OR "SARS-CoV-2" OR "sars-cov-2"[MeSH Terms] OR "Severe Acute Respiratory Syndrome Coronavirus 2" OR "NCOV" OR "2019 NCOV" OR (("coronavirus"[MeSH Terms] OR "coronavirus" OR "COV") AND 2019/11/01[PDAT] : 3000/12/31[PDAT]))

Supplementary Appendix 2

Flow chart of selected articles

