

Brief Report

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Infectious Disease Hospital Preparedness: Lessons Learned From the 2019 Measles Outbreak

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Abstract

Objective: This paper: (1) explores the real and perceived threats to Emergency Departments (EDs) in addressing infectious disease cases in the US, like measles, and (2) identifies priorities for protecting employees, patients, and others stakeholders through hospital preparedness while streamlining processes and managing costs.

Methods: A case study approach was used to describe the events that triggered an infectious disease emergency response in 1 ED in the southeast. Development of the case study was informed by emergency preparedness literature on Homeland Security Exercise and Evaluation Program processes.

Results: Hospital staff and administrators identified a number of factors that either positively contributed to disease containment or exacerbated conditions for disease transmission. Successes included early recognition of the potential threat, development of a multidisciplinary taskforce, and implementation of a pre-incident response plan. Challenges comprised of patient flow in crisis response, lab turnaround time, and employee records.

Conclusions: The threat of exposure challenged daily operations and raised situational awareness among administrators and providers to issues that might arise during an infectious disease exposure. Recording emergency preparedness successes, remediating challenges, and sharing information with others may help minimize the threat of communicable diseases within hospital settings in the future.

The public health threat posed by emerging infectious diseases has been well described in the research literature, including, most recently, the 2019 Novel Coronavirus (SARS-CoV-2).^{1,2} Increasing interconnectedness through international travel has made all nations susceptible to infectious disease pathogens that ignore geographic boundaries.³ These epidemics have required multidisciplinary teams to implement infection prevention strategies to mitigate the risk of spread of infection, particularly in healthcare systems.⁴

This Brief Report: (1) explores the real and perceived threats to Emergency Departments (EDs) in addressing infectious disease cases in the US, and (2) identifies priorities for protecting employees, patients, and others stakeholders through hospital preparedness while streamlining processes and managing costs. We highlight program successes and challenges, implications for practice, and recommendations to minimize the threat of communicable diseases within hospital settings. This case study focuses on the 2019 measles outbreak in the US; however, lessons learned can be broadly applied to emergency responses to infectious disease exposures regardless of type or place.

Background

Measles, caused by the rubeola virus, is a highly-contagious virus that infects individuals through airborne transmission. Despite the highly communicable nature of the disease, the spread of measles has been effectively managed in the US through immunizations. In the year 2000, the Center for Disease Control and Prevention (CDC) declared measles eliminated in the US, based on an absence of continuous disease transmission for greater than 12 months. However, as of December 31, 2019, the CDC had confirmed 1282 individual cases of measles in 31 states.⁵ This figure is approximately 344% higher than the total number of cases reported in 2018 (n = 372) and nearly 200% higher than the number of cases for 2016 (n = 667), the highest reported total since 2010.

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Since measles is common in many parts of the world, outbreaks of the disease can occur, due primarily to travelers returning to the US and spreading the virus to groups where immunization rates are low.⁶ The re-emergence of measles, a highly infectious, yet vaccine preventable disease in the US highlights efforts for prevention of spread both in the community and in hospitals. Estimates of economic burden associated with containment are high, with a median cost of \$152000 per outbreak.⁷ As the CDC continues to monitor cases of measles in the US, organizational leaders and health providers should closely examine policies and procedures for addressing a disease outbreak that many of them had not trained for, nor, in many cases, even seen in their hospitals.

Methods

Our team used a case study approach to describe the events that triggered an infectious disease emergency response in 1 ED in the southeast. Authors 1 and 4 conducted a series of 60-minute, semi-structured key informant interviews with authors 2 and 3, both of whom had decision-making authority before, during, and after the emergency response. In addition to participating in interviews, authors 2 and 3 drafted sections of the manuscript and reviewed it for accuracy and context. Moreover, they helped authors 1 and 4 identify implications for practice and make recommendations. Development of the case study was informed by emergency preparedness literature on Homeland Security Exercise and Evaluation Program (HSEEP) processes including conducting hot washes, and completing after-action reports and improvement plans.^{8,9} Under the Common Rule, this work was considered non-human subject research by the University of Alabama at Birmingham Institutional Review Board.

The Case

During the summer of 2019, at a time of increasing numbers of measles cases in the US, a 55-year old female presented to the triage area of the ED of a large academic medical center in the southeastern US complaining of a rash, fever, and malaise. Additionally, the patient reported recent international travel. An ED physician was notified and the patient was immediately evaluated. The patient's initial presentation was concerning measles; however, there were several factors that did not favor measles as a primary diagnosis. First, the patient reported a childhood history of measles vaccination. Second, in anticipation of international travel as well as an expressed concern about a measles outbreak in the US, the patient received a second measles vaccination 5 days before travel and 16 days before her presentation in the ED.

Initially, the patient reported that her rash onset was greater than 5 days before presentation, which would also place her outside of the infectious window for measles. The patient was given a surgical mask to wear while waiting for bed placement in the ED waiting room as is standard practice in this facility for patients with fever and respiratory illness. Later, the patient was taken to the treatment area and evaluated by a second ED physician when it was noted that there were some inconsistencies in her history. The patient now stated that she had had a measles infection as a child and her current rash had only begun 3 days before presentation. The second physician became more concerned and decided to treat this as a possible measles case, thereby triggering a large emergency response.

The Response

Despite the original impression that this patient's symptoms were incongruous with the timeline for infection, the infectious disease team's response was both swift and substantial due to the potential impact of an acute measles case in the ED. Consistent with hospital policy, the first step in the response was to notify the healthcare epidemiologist and the county health department of a potential disease outbreak. Physicians and administrators were also concerned about identifying other patients and visitors who were in the waiting room at the same time and may have been exposed. Those patients and visitors were identified and monitored while awaiting diagnostic test results.

In addition to treating patients, administrators audited employee records for physician and staff vaccinations. The Advisory Committee on Immunization Practices (ACIP) recommends that healthcare providers have proof of immunity to measles by vaccination or titers, and this documentation is recorded at the time of provider onboarding. However, because the hospital had recently transitioned to a new record-keeping system and the older system had incomplete records, administrators could not locate documentation of proof of immunity for all employees. Therefore, serologic testing and/or post-exposure prophylaxis with vaccination within 72 hours or an intramuscular dose of immune globulin within 6 days of exposure was required for providers whose records could not be confirmed.

Finally, the response to this potential exposure to measles led to a large and expensive environmental cleanup. The hospital closed part of the ED and waiting room for approximately 8 hours and conducted a terminal cleaning of these spaces. Furthermore, based on the design and flow of the air handling system, hospital administrators expressed initial concern regarding exposure for people on 3 different floors and the potential for a large number of employees to require screening. However, clarification of airflow with engineers ensured that there was no possibility of exposure through the air handling system. Ultimately, extensive follow-up and exposure tracking occurred.

Results

In the wake of this emergency response, hospital staff and administrators identified a number of factors that either positively contributed to disease containment or exacerbated conditions for disease transmission. We broadly group these factors into successes and challenges and describe how they shaped this specific case.

Successes

Early Recognition

Before the 2019 measles outbreak, the CDC performed extensive education efforts for clinicians to recognize symptoms, act quickly, and report exposure to authorities.¹⁰ Additionally, the hospital presented targeted education for healthcare providers, which directly contributed to early recognition of this potential case of measles. Before this event, the state Department of Public Health released a health advisory of a possible measles case, prompting early education of frontline staff and additional screening questions for all patients presenting to the hospital's inpatient and outpatient settings.

Multidisciplinary Taskforce

In advance of the outbreak, the hospital created a multidisciplinary measles taskforce to drive preparedness efforts. Stakeholders from

infectious diseases, emergency medicine, critical care, employee health, environmental services, respiratory therapy, public health, and patient flow were all involved in the formulation of a system-wide, pre-incident response plan which outlined roles and responsibilities, triage protocol, and emergency contact information. This plan was based on an all-hazard approach to emergency management, which combines preparation and flexibility, rather than a narrowly defined, disease-specific protocol.¹¹

Pre-incident Planning

The hospital's pre-incident response plan guided actions taken during this incident. Of the most notable successes of this plan, 1 was an algorithm that was developed by the taskforce before the incident and utilized to assess employees who were potentially exposed (see [Figure 1](#)). This visual map facilitated rapid response from Employee Health, offering unequivocal steps in the case of employee exposure to a patient with a suspected or confirmed diagnosis of measles. Moreover, it ensured timely post-exposure prophylaxis where indicated.

Challenges

Patient Flow in Crisis Response

Among the challenges to managing this incident was a lack of understanding of the air handling system and measles virus epidemiology. Consultation between hospital administrators and engineers about airflow eliminated the need to adjust patient flow or shut down large sections of the hospital for environmental decontamination. However, this information would have been valuable as part of the pre-incident response plan.

Lab Turnaround Time

Due to low numbers of measles cases, this hospital did not offer any onsite diagnostics for measles due to cost, which required send-out labs. Typically, send-out labs are available within 5 days, but often are delayed due to weekends, holidays, or other barriers. Delays could have placed additional burdens and costs on the hospital for treatment and care, employee paid time off, decontamination, and epidemiologic investigations.

Employee Records / System Issue

As previously noted, the hospital was transitioning to a new record keeping system, and the older system had incomplete records. Early recognition of potential challenges arising from incomplete records led to a hospital-wide audit of records for high-risk staff including the ED, which streamlined the response to this potential exposure. Nevertheless, incomplete employee records delayed the response.

Discussion

The efforts of the hospital to prepare staff, limit exposure, and overcome challenges contain important lessons for future disease outbreaks. We suggest that implementation of the following recommendations can minimize the threat of communicable diseases within hospital settings.

Recommendations

Among the strengths of this specific disease response was the hospital's pre-incident response plan. Before this measles outbreak, administrators had developed a plan of action with input from stakeholders. Pre-incident plans should include a patient flow plan,

notification guidance, environmental decontamination guidance, and post-exposure prophylaxis and isolation guidance. These plans should be monitored and updated periodically. Moreover, use of algorithms incorporating current guidelines can be helpful in preparing for the response effort. A robust pre-incident plan that is drilled regularly can lead to a well-coordinated response that minimizes over-reaction, cost, and additional exposures.⁸

Hospital administrators and providers should take advantage of existing training opportunities through CDC and other accredited agencies to educate all staff members about disease symptomatology and appropriate protocols for containing the threat. Representatives from Employee Health and Infectious Disease may also want to develop internal trainings to address specific employee concerns. Administrators should also be aware of potential challenges to disease control. Inadequate records for proof of immunity can lead to duplicate testing and over-treatment with duplicate vaccination and administration of immune globulin. Ultimately, it could also lead to the necessity to place employees on paid leave. Fragmented, non-existent, or inaccessible records are a barrier to rapid response and recovery during an infectious disease exposure.

Finally, this article demonstrates that even a single case of measles can lead to the need for post-exposure prophylaxis for many individuals, including healthcare workers, other patients, visitors to healthcare facilities, and other contacts of the patient. Treatment can be costly and difficult to implement. To mitigate the threat of disease spread, providers should intermittently check on the availability of vaccines and immune globulin.

Limitations

Despite the successes of this emergency response and subsequent recommendations, there were limitations to this study. First, the article documented the experiences of an individual patient and her providers at 1 academic medical center in the southeastern United States. Due to the qualitative nature of this study, results cannot be generalized beyond the context in which the research was conducted. Second, this case study recounted experiences related to an outbreak of measles in 2019. While recommendations are intended to inform all infectious disease response efforts, there may be disease-specific characteristics of this case study that make it unique. Finally, these data were collected and analyzed before the global pandemic. Emerging literature on hospital preparedness for COVID-19 highlights aspects of emergency response that were beyond the scope of this case study, such as surge capacity, technology to limit staff exposure, family engagement, and physician readiness (Goniewicz, *et al.*, 2020; Griffin, *et al.*, 2020; Wurmb, *et al.*, 2020).¹³⁻¹⁵

Conclusions

The 2019 measles outbreak posed very real consequences for employees, patients, and others stakeholders at 1 ED in the southeast. The threat of exposure raised situational awareness among administrators and providers to issues that might arise during an emergency response to any infectious disease exposure. As demonstrated by this case and, more recently, the emergence of COVID-19, transmission of infectious diseases is endemic to the world in which we live due to globalization and extreme mobility.^{6,12} Recording emergency preparedness successes, remediating challenges, and sharing information with others may help minimize the threat of communicable diseases within hospital settings in the future.

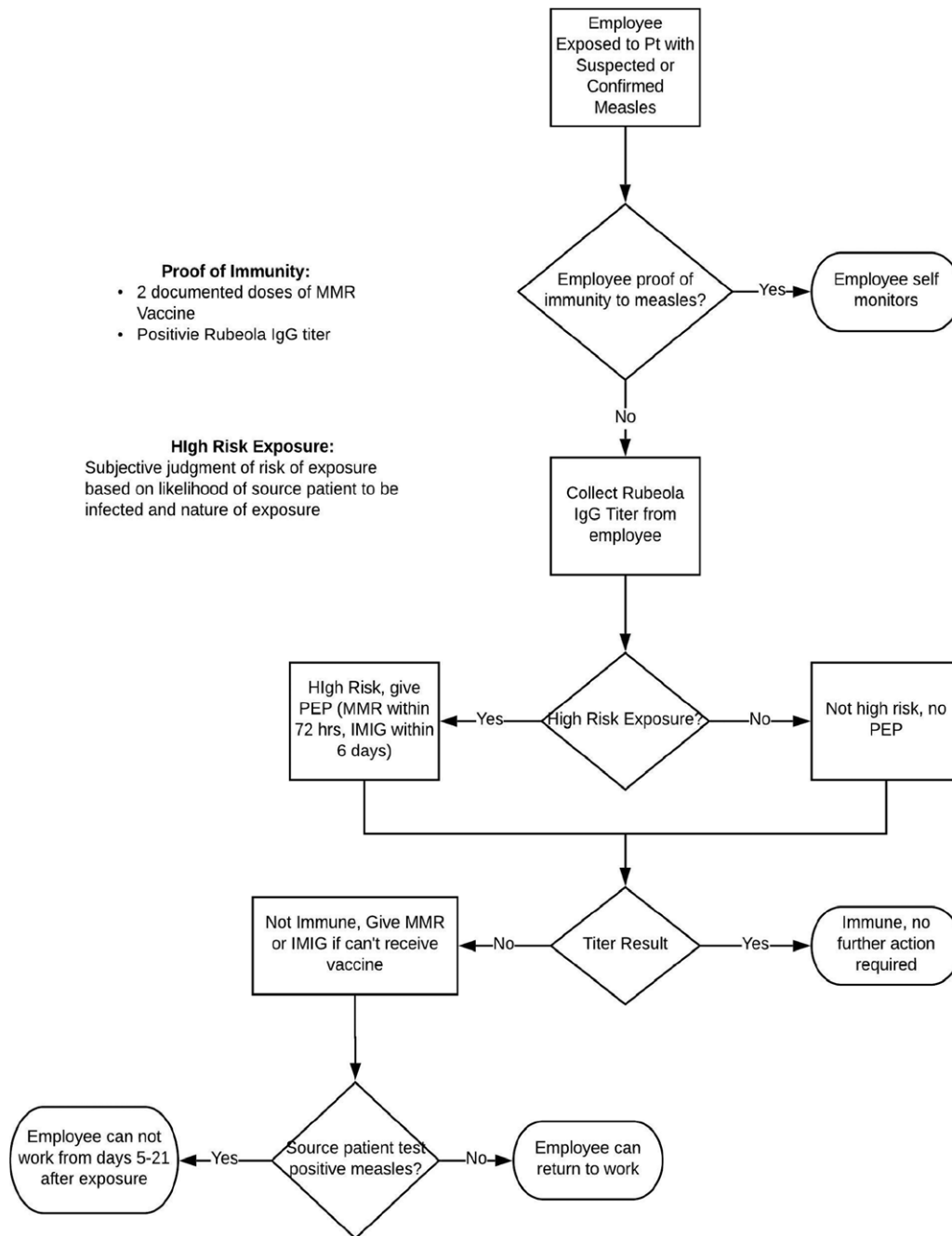


Figure 1. Algorithm for prevention of measles and management of employees exposed to measles.

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