

APPENDIX F: ANALYSIS OF USS THEODORE ROOSEVELT (CVN 71)

BINNACLE LIST

Introduction

Concerns about crew members displaying symptoms prior to the confirmed cases of Novel Coronavirus 19 (COVID-19) aboard USS Theodore Roosevelt (CVN 71) (TR) led to an analysis of the ship's sick call logs, specifically studying the symptoms potentially indicating early undetected COVID-19 infections, as well as an examination of trends of respiratory disease. Using International Classification of Diseases 9 (ICD-9) codes, and the Navy and Marine Corps Public Health Center (NMCPHC) criteria for disease outbreaks, a trend of increasing acute upper respiratory infections was observed between March 9th and March 23rd, which may represent early cases of COVID-19. A parallel epidemiological study, staffed and funded by NMCPHC, is currently being conducted in the wake of the coronavirus outbreak on the TR. Using more comprehensive data-sets, and with the visibility provided by Centers for Disease Control and Prevention (CDC) serology testing on the first 400 TR patients, their preliminary findings are consistent with those of the command investigation team.

Background Information

Though COVID-19 information is rapidly evolving, well-established symptoms of fever, non-productive cough, and shortness of breath were among the initial screening criteria based on data from the initial outbreak location in Wuhan, China. Additionally, travel to high risk areas (initially China and Korea) or exposure to a person diagnosed with COVID-19 were both given equal weight in the screening process. On April 27, 2020, the World Health Organization (WHO) added anosmia and alterations to the sense of taste to the list of symptoms indicating possible COVID-19 disease.¹ CDC guidance as of May 13, 2020 lists the following symptoms for screening for COVID-19:²

- Cough
- Shortness of breath or difficulty breathing
- Fever
- Chills
- Muscle pain
- Sore throat
- New loss of taste or smell

¹ <https://www.washingtonpost.com/health/2020/04/27/six-new-coronavirus-symptoms/>

² <https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>

In contrast, as of May 15, 2020 Up-to Date (a well-trusted resource for clinical practice) ranks the prevalence of the following symptoms as the hallmarks of COVID-19:³

- Fever – 99 percent
- Fatigue – 70 percent
- Dry Cough – 59 percent
- Anorexia – 40 percent
- Myalgia (body aches) – 35 percent
- Dyspnea – 31 percent
- Sputum production – 27 percent

The differences between these lists illustrates the challenges in screening for this disease based solely on clinical presentation. A wide array of symptoms has been described, especially in the early stages of COVID-19 disease. Anecdotal evidence for loss of smell and taste was present in several surveys from Italy on COVID-19 survivors and these symptoms ranged from 34-64 percent depending on the study.⁴ Another European study puts loss of smell and loss of taste as an early symptom at 85 percent and 88 percent of COVID-19 cases respectively.⁵

In an interview with the TR Physician Assistant on May 9th, it was mentioned that two to three days prior to the first patients testing positive for coronavirus on the TR, the Carrier Air Wing Eleven (CVW-11) Flight Surgeon had inquired about several members who reported a decrease in taste or smell (anosmia). Subsequent to this report, the sick call log was examined as a part of the investigation. Of note, no reports of anosmia were discovered from the sick call data retrieved. Further analysis looking at the outbreak of illness affecting the respiratory tract was conducted.

Binnacle List Analysis by Command Investigation Team

Sick call logs from January 2, 2020 until April 7, 2020 were transcribed from PDF files to Excel. A total of 385 entries were retrieved and evaluated. Of these, 33 ICD-9 codes were blank, 43 exhibited influenza-like illness (ILI) symptoms, 78 respiratory issues, and 78 diarrhea. Due to only three data points in April (the last week examined), rates were based on 14 weeks. Acute Upper Respiratory Infection (AURI) and ILI-type symptoms mimic those of COVID-19 and were chosen as potential indicators of outbreak on the ship. Due to a known outbreak of norovirus aboard TR in February, diarrheal illness was also examined to provide a convenient contrast. The ILI-type symptoms occurred

³ https://www.uptodate.com/contents/coronavirus-disease-2019-covid-19-epidemiology-virology-clinical-features-diagnosis-and-prevention?search=coronavirus-disease-2019-covid-19&source=search_result&selectedTitle=8~150&usage_type=default&display_rank=8

⁴ https://www.uptodate.com/contents/coronavirus-disease-2019-covid-19-epidemiology-virology-clinical-features-diagnosis-and-prevention?search=coronavirus-disease-2019-covid-19&source=search_result&selectedTitle=8~150&usage_type=default&display_rank=8

⁵ https://www.entnet.org/sites/default/files/uploads/lechien_et_al_-_covid19_-_eur_arch_otorhinolaryngol_.pdf

at a 3.1-patients per week average, while acute upper respiratory infection and diarrhea occurred at a rate of 5.6-patients per week.

Significant increases in ILI and AURI symptoms were noted from the week beginning January 19th until February 16th. Cases of ILI-type symptoms peaked during the week of January 19th, at 18 cases, and respiratory symptoms peaked during the week of January 26th with 17 cases; both exceeding the outbreak threshold for aircraft carriers (CVNs) of 15 cases or 0.3 percent. As this corresponds to the timeframe reported by the ship of an outbreak of norovirus, cases of diarrhea peaked during the week of February 9th at 28 cases. Beginning on the week of March 8th, AURI cases again rose, but did not reach 15 cases before March 22nd. The increase in reported respiratory symptoms and diarrhea (March 8th to March 22nd) corresponds with the transit period from Vietnam to Guam. However, the numbers reported do not meet the threshold for outbreak declaration in accordance with the Navy and Marine Corps Public Health Center (NMCPHC) Guidance for Underway Evaluation and Management of Suspected Persons under Investigation (PUI) for 2019 Novel Coronavirus (COVID-19) for CVNs. The Binnacle Log data after March 22nd is unreliable due to parallel reporting methods for COVID-19, which were initiated on or around March 23rd by the ship's Medical Department.

A linear regression analysis was conducted on these three symptoms. Little correlation was discovered between diarrhea and respiratory issues and diarrhea and ILI. For this reason, multi-linear regression was not conducted. Correlation was found between the cases of ILI and respiratory issues, but only 41 percent of the variation could be explained by the model.

A secondary analysis of the combined rate for AURI and ILI was conducted. As previously stated, COVID-19 symptoms vary widely and span from mild, cold-like symptoms to pneumonia and respiratory failure. For this reason, combined ILI and AURI symptoms were considered an accurate proxy for this spectrum of disease. Reports of ILI and respiratory illness were compared to total numbers on the ship. This revealed that there was a peak of respiratory illness by February 22nd, prior to VN. There was another peak in AURI by March 22nd after Vietnam which did not reach outbreak levels. This potentially represents an early rise in COVID-19 symptoms prior to the first positive tests. Even with careful surveillance, if the data is accurate, the trend would not have triggered concern for an outbreak of respiratory illness as the rate failed to exceed the guidance baseline of 0.3 percent of ship's crew.⁶

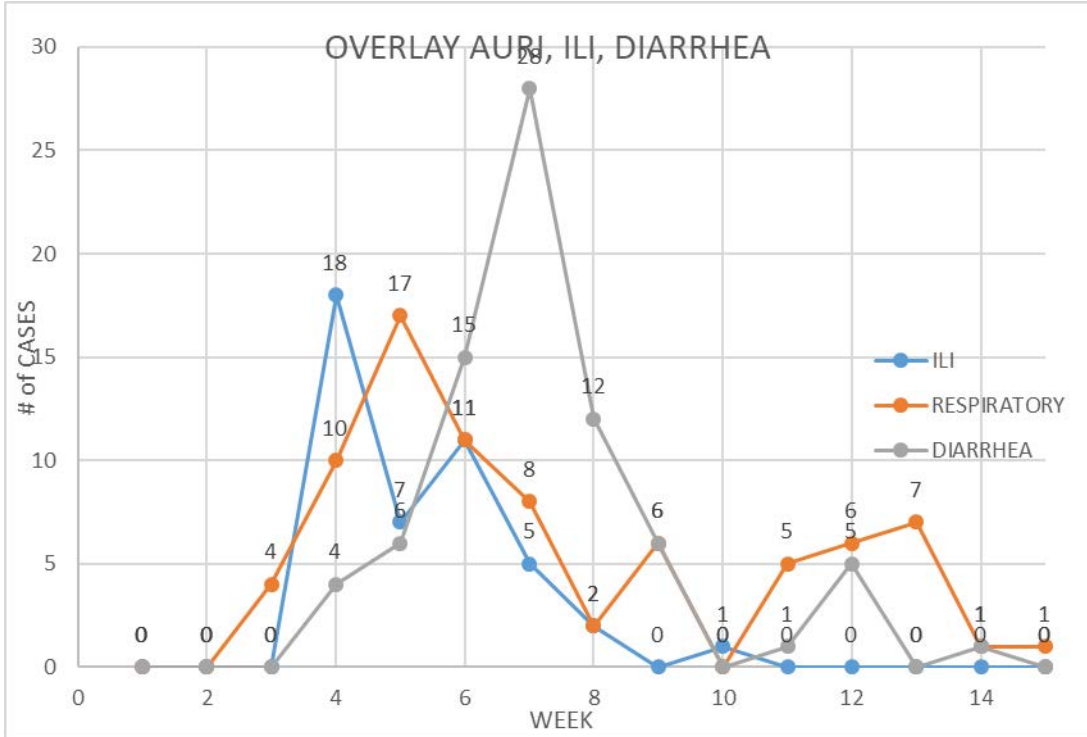
⁶ Guidance for Underway Evaluation and Management of Suspected Persons Under Investigation for 2019 Novel Coronavirus, April, 2020 Navy and Marine Corps Public Health Center

Row Labels	Sum of ILI/PNEU	Sum of RESPIRATORY	Sum of DIARRHEA
1	0	0	0
2	0	0	0
3	0	4	0
4	18	10	4
5	7	17	6
6	11	11	15
7	5	8	28
8	2	2	12
9	0	6	6
10	1	0	0
11	0	5	1
12	0	6	5
13	0	7	0
14	0	1	1
15	0	1	0
Grand Total	44	78	78

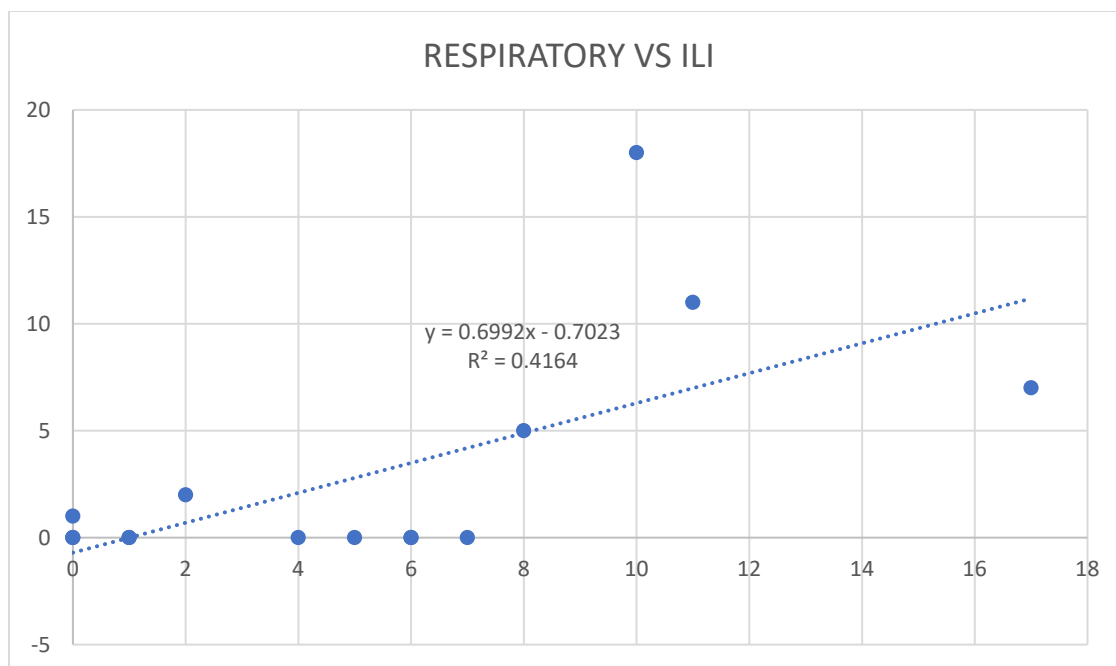
Table 1: Binnacle List Analysis

Week of	ILI	RESP ILL	DIARRHEA
2-Jan	0.00%	0.00%	0.00%
5-Jan	0.00%	0.00%	0.00%
12-Jan	0.00%	0.08%	0.00%
19-Jan	0.36%	0.20%	0.08%
26-Jan	0.14%	0.34%	0.12%
2-Feb	0.22%	0.22%	0.30%
9-Feb	0.10%	0.16%	0.56%
16-Feb	0.04%	0.04%	0.24%
23-Feb	0.00%	0.12%	0.12%
1-Mar	0.02%	0.00%	0.00%
8-Mar	0.00%	0.10%	0.02%
15-Mar	0.00%	0.12%	0.10%
22-Mar	0.00%	0.14%	0.00%
29-Mar	0.00%	0.02%	0.02%
5-Apr	0.00%	0.02%	0.00%

Table 2: CI Binnacle List Analysis



Binnacle List Analysis Graph 1



Binnacle List Analysis Graph 2

NMCPHC Epidemiologic Analysis⁷

As stated previously, evaluation of an outbreak based on a spectrum of common signs and symptoms risks the possibility of over- or understating the prevalence of cases. Preliminary data from the NMCPHC epidemiological analysis of the first 400 TR cases, isolation logs from Guam, and backed by serology testing through the CDC provides a more detailed examination of the coronavirus outbreak on the ship, likely origins of the outbreak, and provides an epidemiologic curve as support. Of particular interest is that both the findings from the NMCPHC epidemiological analysis and the Command Investigation TR Binnacle List Analysis reveal an early rise in COVID-19 symptoms prior to the first positive test result on TR.

The NMCPHC epidemiologic curve provides a temporal illustration of coronavirus transmission, and allows sub-analysis of populations within the crew. (NMCPHC Epi-data study Graph 1)

Key preliminary findings of the NMCPHC epi-data study are as follows:

- COVID-19 illness appears to have occurred on the ship prior to the first Carrier Onboard Delivery (COD) arrival after the Da Nang port visit, and the growth in cases by

⁷ NMCPHC "USS Theodore Roosevelt Outbreak Investigation: Epidemiologic Analysis Update #2" 13 May 2020

March 30th is not consistent with the limited potential introduction of the disease via COD. This is illustrated in Graph 2 which is an overlay of the COD arrivals with the epidemiologic curve. (NMCPHC Epi-data study Graph 2)

- Sub-analysis of populations (males and females, and work space) indicates simultaneous exposure of a group potentially at a mass gathering consistent with the Vietnam port visit. (NMCPHC Epi-data study Graph 3)

- TR Reactor Department, and two embarked squadrons (HSM-75 and VFA-154) had early cases, but there was a lag of several incubation periods prior to the next case indicating transmitters may be asymptomatic or display very mild disease. (NMCPHC Epi-data study Graph 4)

- Careful use of the correct personal protective equipment (PPE) and hygiene protocols prevents spread of COVID-19 within the medical department. The medical department had one symptomatic case despite presumably high contact rates while caring for ill patients.

- Follow-on analysis looking at rates instead of case counts will be conducted in order to attempt to identify trends with respect to age, and rank.

Summary

Though conducted in parallel, the TR Binnacle List Analysis and the NMCPHC USS Theodore Roosevelt (CVN 71) Outbreak Investigation: Epidemiologic Analysis came to the following similar conclusions:

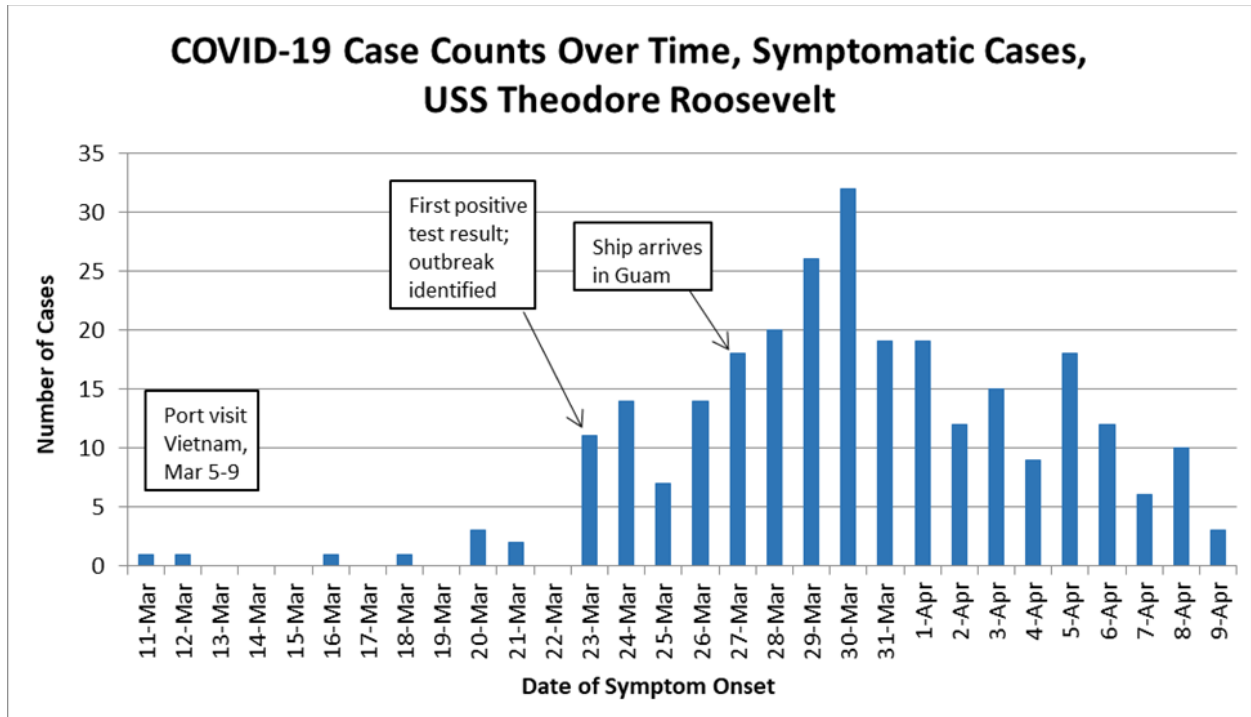
- There is no indication that coronavirus came aboard the ship via COD
- There are indications that there were early cases of COVID-19 shortly after the Vietnam port visit
- The ILI outbreak prior to the Vietnam port visit died out spontaneously and does not appear to have been COVID-19

In the TR Binnacle List Analysis attempts to identify and interview the Sailors who cited experiencing loss of taste or smell as a primary symptom were unsuccessful based on information available in the sick call logs. It is likely that a Sailor reporting to sick call for early COVID-19 disease and the medical personnel caring for them would not focus on these symptoms given these symptoms were not known to be early indicators of COVID-19 at the time. If a Sailor later remembered those symptoms, recall bias makes it difficult to discern the accuracy of their remarks due to the prominence of these symptoms in the media.⁸

If several Sailors had displayed anosmia two to three days prior to the first positive COVID-19 test, it would provide support for the illness coming aboard after the port visit in Vietnam. We did not find evidence to support that, but an increase in AURI symptoms after Vietnam, up to March 22nd may be an early indication of the COVID-19 outbreak in personnel who had early or mild symptoms.

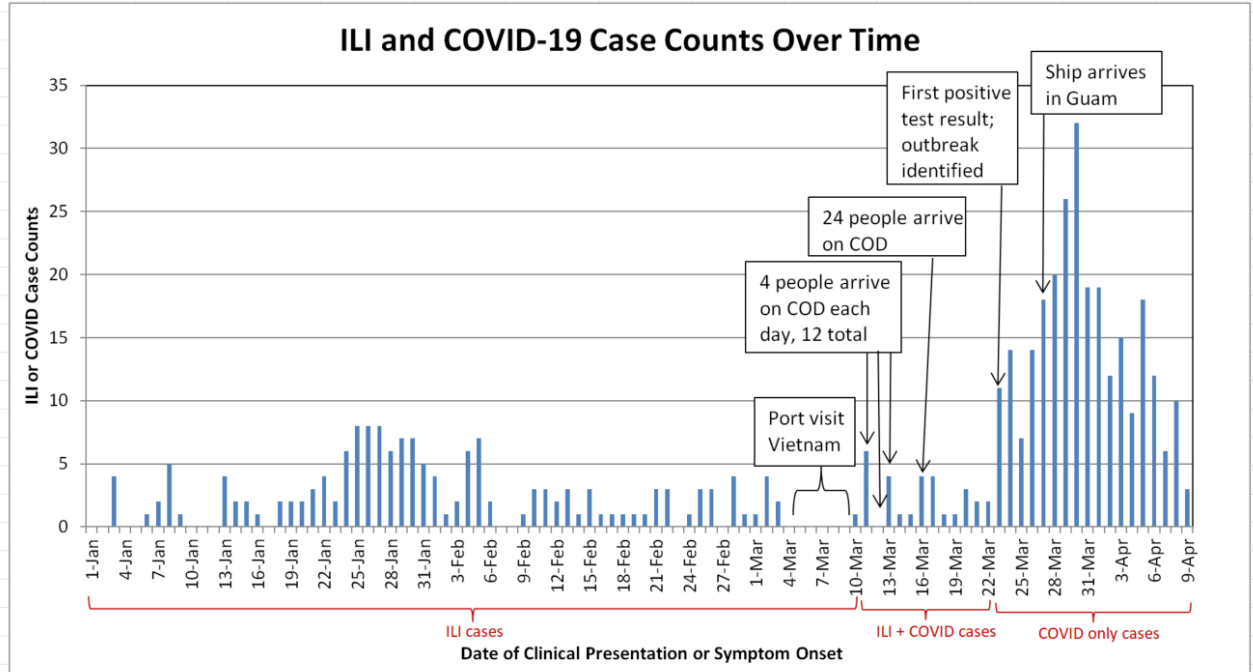
The NMCPHC study's findings support our findings in regards to coronavirus occurring onboard soon after visiting Vietnam. Additional study by their team focusing on disease rates will continue to inform on patterns of coronavirus spread among crewmembers and be of high value in prevention of this disease aboard naval vessels.

⁸ <https://www.nytimes.com/2020/03/22/health/coronavirus-symptoms-smell-taste.html>



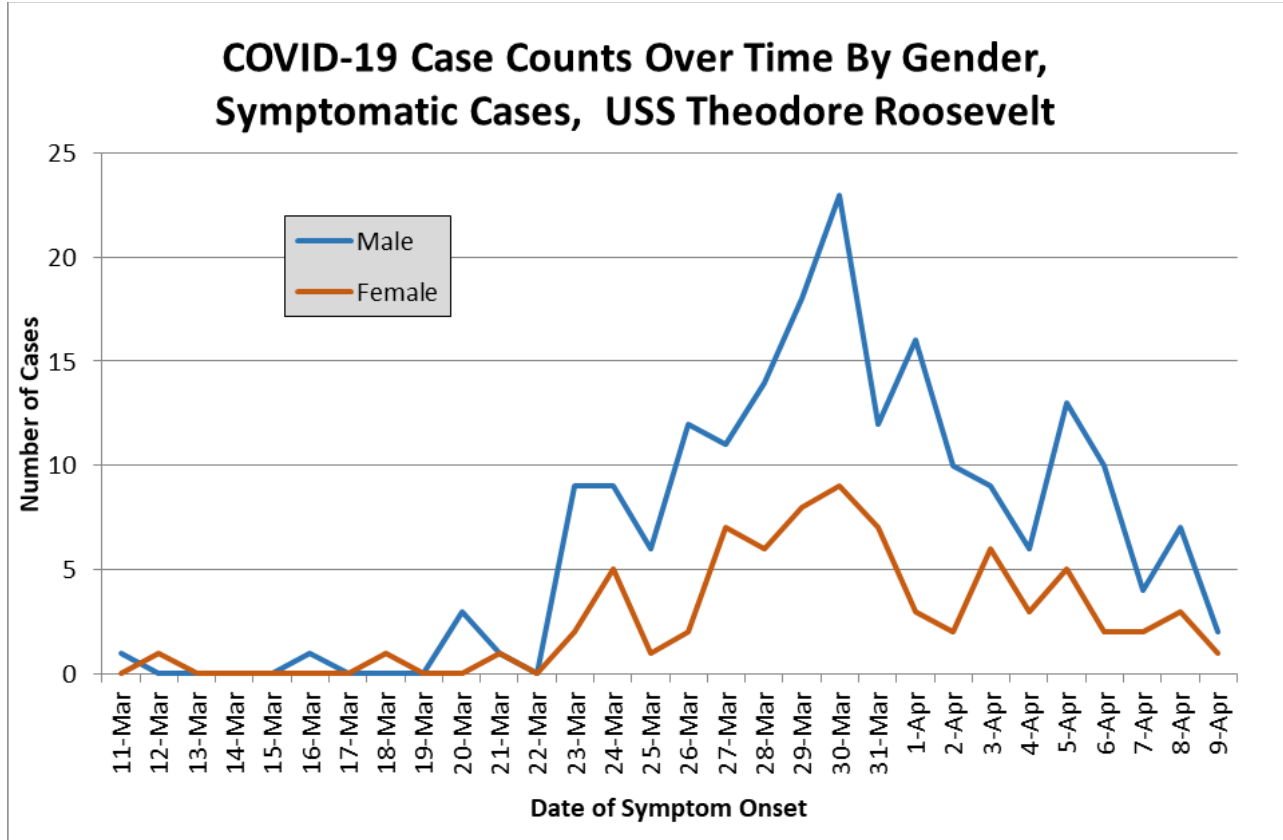
NMCPHC Epi-data Study Graph 1⁹

⁹ NMCPHC "ATTACHMENT #1 to: USS Theodore Roosevelt Outbreak Investigation for Epidemiologic Analysis Update #2" 13 May 2020, from "USS Theodore Roosevelt Outbreak Investigation: Epidemiologic Analysis Update #2" 13 May 2020



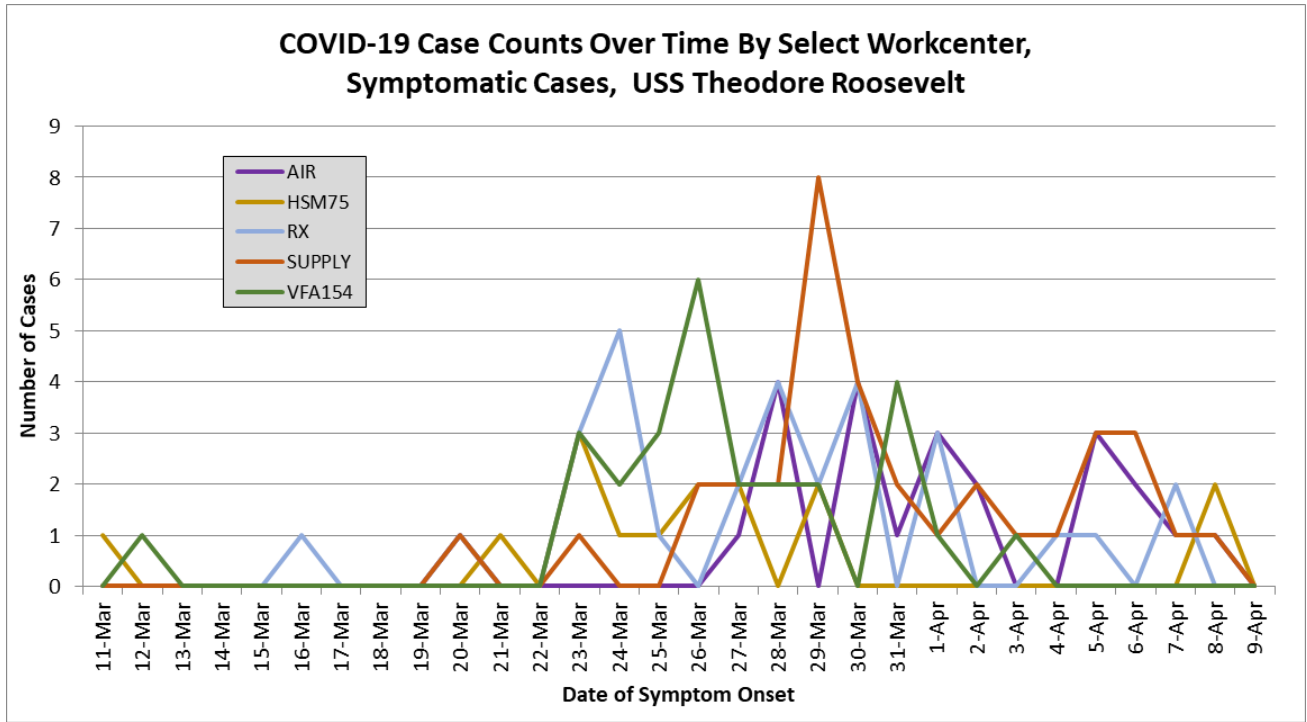
NMCPHC Epi-data study Graph 2¹⁰

¹⁰ NMCPHC "ATTACHMENT #1 to: USS Theodore Roosevelt Outbreak Investigation for Epidemiologic Analysis Update #2" 13 May 2020, from "USS Theodore Roosevelt Outbreak Investigation: Epidemiologic Analysis Update #2" 13 May 2020



NMCPHC Epi-data study Graph 3¹¹

¹¹ NMCPHC "ATTACHMENT #1 to: USS Theodore Roosevelt Outbreak Investigation for Epidemiologic Analysis Update #2" 13 May 2020, from "USS Theodore Roosevelt Outbreak Investigation: Epidemiologic Analysis Update #2" 13 May 2020



NMCPHC Epi-data study Graph 4¹²

¹² NMCPHC "ATTACHMENT #1 to: USS Theodore Roosevelt Outbreak Investigation for Epidemiologic Analysis Update #2" 13 May 2020, from "USS Theodore Roosevelt Outbreak Investigation: Epidemiologic Analysis Update #2" 13 May 2020