

Problem Chosen

A

**2020
MCM/ICM
Summary Sheet**

Team Control Number

Hello

**Novel Coronavirus Pneumonia: Aloha and to Say
Aloha**

Summary

Begin Abstract...

Keywords: Begin Keywords...

Novel Coronavirus Pneumonia: Aloha and to Say Aloha

February 14, 2020

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1 Introduction

1.1 Problem Background

The ocean is covering approximately 1.3 billion cubic kilometers on Earth, which is the equivalent of 97 percent of total water. Playing a vital role on oxygen producing, carbon sequestering and food providing for billions of people, the ocean's abilities are being eroded by plenty of stressors.

Since the 1950s, the oceans has absorbed more than 93 percent of all the heat that produced by human, which is beginning to show its drawbacks at a price. Marine organisms, as an important part in the ocean, can be affected when there are changes in their natural habitat as well as changes in ocean chemistry. As a primary producer of the food chain in the ocean, phytoplankton, a kind of marine plants, is facing a slowly decrease if the water becomes warmer, which results in the reduction of the amount of nutrients in the ocean. The scarcity of nutrients will limit the growth of marine organisms in the food chain. In addition, temperature plays an important role on controlling biological rhythm of marine plants and animals involving birth, growth, feeding, production and death. The changes in ocean temperature will cause a disruption of biological rhythm making marine organisms become vulnerable to illness. Moreover, sequenced lowering of the pH of seawater is unfavorable to the hatching of eggs and the growth of fry of some sea fish.

The anticipated increase in ocean temperature is predicted to stimulate the migration of marine organisms based on their temperature tolerance, with heat-tolerant species expanding their range northward and those less tolerant species retreating. Just as the lobster of Maine, USA, thousands of aquatic species are forced to migrating north to find a better habitat. As an impact, relative companies need to move their base to survive.

1.2 Our Work

The major logic flow is depicted as follows, in Figure 1:

Figure 1: Major Logic Flow of our Model - ALOHA

2 Assumptions and Justifications

We make some general assumptions to simplify our model. We will list all of the assumptions together with corresponding justification below:

- 1) **All of human beings are susceptible to NCP.** NCP was recently discovered and has gene specificity, which make it difficult to be immunized by the body. Thus, we can infer that human beings are susceptible to this virus without previous contact.
- 2) **People will not get susceptible to secondary infection of NCP.** Depending on the nature of the body's immune system, after recovery most people will have better immune reaction to

virus. We ignore the possibility of secondary infection to simplify our model.

- 3) **Assume that incubation period to different individuals are the same.** Since incubation period of different host individual is different and also hard to predict, we assume that incubation periods are the same.
- 4) **NCP will only complete the process of human-to-human transmission via close contact such as talking face-to-face.** We simplify our model here since people suffer a rather low level of risk if they do not have close contact with the infected when it comes to NCP.
- 5) **The number of infected people around the world is almost the number of infected people in China.** Although countries except China accounts for 71.57% of the world population (till August 28th, 2019, by United Nations [?]), only less than 0.77% of confirmed cases occurred outside China (till February 3rd, 2020, by various organizations [?][?][?][?]; with detailed information listed in Appendix). Meanwhile, after NCP was discovered in China, all the other countries took immediate action against the spread. Therefore, what deserves our attention is more the circumstances in China.

3 Notations and Definitions

For convenience, we define a series of notations for mathematical usage, which are listed in Table 1 to describe our model.

Table 1: Notations mentioned in this paper

Symbol	Definition
$S(t)$	Number of susceptible person at time t
$E(t)$	Number of enfective person at time t
$I(t)$	Number of infectious person at time t
$R(t)$	Number of removed person at time t
t	Time
N	Gross population in this model
α	Morbidity of NCP
β	Infection rate
γ	Removal rate
d	Mortality of NCP
h	Recovery rate of NCP
k	Average number of people exposed to infections every day
b	Probability of infection by contact
R_0	Basic reproduction number
m_i	Affecting parameters of ith measure by government
ND	Number of death
NR	Number of recovery
NSP	Number of suspected people
NDP	Number of diagnosed people

4 Modified SEIR Model Based on Differential Equation

4.1 Introduce our SEIR Model

4.2 Determination of Unknown Parameters

5 title

5.1 Background Illustration

5.2 subsection1

5.3 subsection2

6 S6

6.1 Simulation Results

7 Model Analysis

7.1 Sensitivity Analysis

7.2 Strengths and Weaknesses

7.2.1 Strengths

- Our model achieves a good simulation in fitting the current infections.
- Our model takes into account the effects of the change of pedestrian flow during the Spring Festival travel rush as well as virus mutations
- The model is a well-organized epidemic model which can be widely applied to other virus disease.

7.2.2 Weaknesses

- The prediction simulation result can't be verified due to the unknown data in future.
- A large number of assumptions reduce the accuracy of the models simulation results.

8 Conclusion

References

Brief Assessment Report

Appendices

Appendix A Solve and Plot Ordinary Differential Equation Systems