A Measly Choice

When planning a vacation, no one appreciates complications imposed by illness. In the case of the Marin County College Prep trip, the travelers are faced with the challenge of John's measles exposure and probable infection. To report – or not to report? As the thirteen of them grapple with their next steps, there are several facts to consider.

1. The cruise originated in Auckland, New Zealand.
2. Auckland was the epicenter of a measles epidemic that ravaged New Zealand in 2019 (Turner, 2019).
3. John did not report his measles exposure and symptoms until Day Four of the cruise.
4. John has not been vaccinated for measles and is likely infected.
5. The other eleven students are not certain of their measles vaccination status.
6. Six students visited a port of call on Day Five, potentially exposing the New Zealand population to measles.

In addition, this analysis proceeds on the following assumptions.

1. This trip occurred in June 2020.
2. On this trip, the most vulnerable population to measles is New Zealanders.
3. The COVID-19 pandemic was not a consideration in this scenario.

These facts point to a clear course of action for these travelers. First, Charles should report John's condition to the ship medic. Second, John and the other eleven students should submit to the ship medic's prescribed protocol.

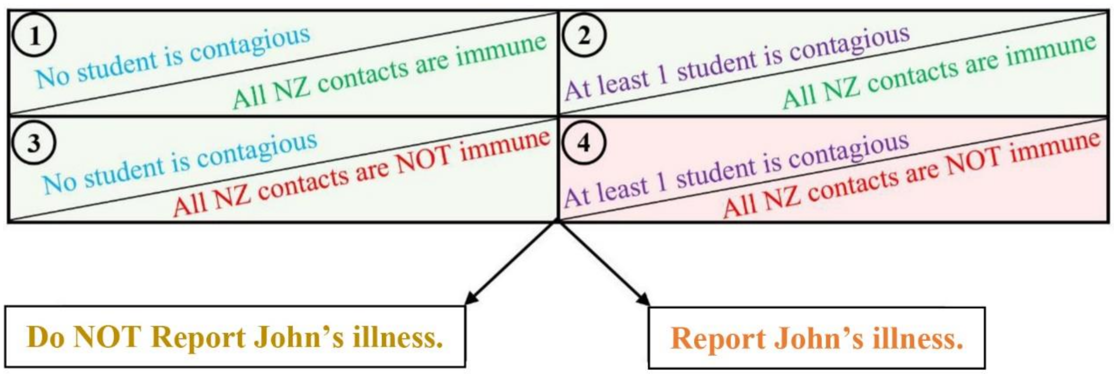
While assessing the facts, these travelers could use the code of the Ethics of Infection as a framework for their decision. The Ethics of Infection is built on the premise of 'do no harm'

(Murphy, 2014). Therefore, these travelers must determine the risk of harm to the New Zealand population. Risk of harm is a function of two factors: probability of harm and severity of harm (Murphy, 2014).

On this trip, the risk of harm arises primarily from the six students who visited a port of call on Day Five. To examine the probability of harm, these travelers could start with the decision matrix in Table 1, which shows the four possible scenarios for Day Five.

Table 1

Decision Matrix for Travelers



One's point-of-view on each of these scenarios is an argument that can be quantified. First, to determine the risk that one of the six students was contagious, the question is the probability the six students were vaccinated. Since John and his friends graduated in 2020, they were likely born between 2001 and 2003, turning 19 – 35 months old in 2002 – 2005. Measles vaccination rates in the U.S. for children 19 – 35 months for 2002 – 2005 (Elfein, 2020) are in Table 2.

Table 2

Measles Vaccination Rates in the United States for Children 19 – 35 months

2002	2003	2004	2005
91.60%	93%	93%	91.5%

The average of these percentages, 92.275%, could estimate the probability that any of the six students on the trip would have measles immunity. Luckily, if a student was vaccinated, he/she cannot be ‘a carrier’ of measles (Utah Department of Health, 2017). Accordingly, the estimated probability that at least one of the six was not vaccinated is

$$1 - (0.92275)^6 = 0.38269,$$

or 38.269%. The second question is the estimated probability that an unvaccinated, exposed student would become infected. According to the Centers for Disease Control and Prevention (C.D.C.), “measles is so contagious that if one person has it, up to 90% of the people close to that person who are not immune will also become infected” (2020, para 4). Therefore, the estimated probability that one of these six students was exposed and infected is

$$0.9 * 0.38269 = 0.344421$$

or 34.4421%. Since the incubation time from infection to rash is seven – twenty-one days for measles (Epidemiology, C.D.C., 2015) and individuals infected with measles can spread measles from four days before the rash appears through four days after the rash appears (C.D.C., 2020), a student traveler could have been contagious as early as Day Three of the cruise. Therefore, a prudent assumption is that the probability that at least one of the six students was unvaccinated, exposed, infected, and contagious is 34.4421%.

The last question is the estimated probability of immunity for a New Zealander who had contact with one of the students at a port of call. Measles vaccination rates for newborns to two-year olds in New Zealand for several years from the last three decades (Turner, 2019) are in Table 3.

Table 3

Vaccination Rates in New Zealand for Birth – Two-years Old

1991	2005	2006	2012
60%	77%	86%	93%

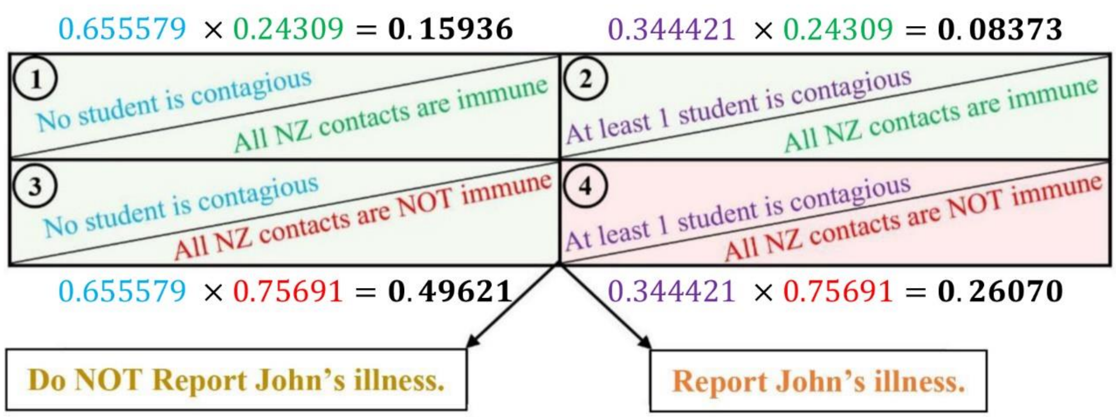
The average of these rates, 79%, could approximate the percent of New Zealanders with measles immunity that the travelers encountered at any port of call. If the six students encountered just six New Zealanders on Day Five, the estimated probability that at least one New Zealander did not have immunity is

$$1 - (0.79)^6 = 0.75691,$$

or 75.691%. Thus, the travelers' decision matrix with probabilities is represented in Table 4.

Table 4

Decision Matrix with Probabilities, Assuming Contact with Six New Zealanders



Thus, the worst-case scenario has an estimated 26.070% chance of occurring.

Next, the travelers must determine the severity of potential harm. Saitta, Chowdhury, Ferro, Nalis, & Polosa (2017) created a risk assessment matrix for public health principles which categorizes ‘impact’ as catastrophic, critical, moderate, minor, or negligible. Since New Zealand is still recovering from their measles epidemic in 2019 (Turner, 2019), the impact, or severity, of new exposures would rightly be classified as ‘critical’ to ‘catastrophic.’ Combining this rating of severity with a probability of 26.070% that qualifies as ‘occasional,’ that is, between ‘seldom’ and ‘likely,’ Saitta, et al.’s matrix in Table 5 can be used to assess the risk the travelers’ actions pose to the New Zealand population.

Table 5

Risk Assessment Matrix for Public Health Principles (Saitta, et al., 2017)

Probability of Occurrences			Impact				
			Catastrophic	Critical	Moderate	Minor	Negligible
Definition	Meaning	Value	(A)	(B)	(C)	(D)	(E)
Frequent	• Occurs frequently • Will be continuously experienced unless action is taken to change events	5	5A	5B	5C	5D	5E
Likely	• Occurs less frequently if corrective action is taken • Documented through surveillance	4	4A	4B	4C	4D	4E
Occasional	• Occurs sporadically • Discovered through surveillance	3	3A	3B	3C	3D	3E
Seldom	• Unlikely to occur • Rarely, if ever, reported	2	2A	2B	2C	2D	2E
Improbable	• Highly unlikely to occur • Never previously reported	1	1A	1B	1C	1D	1E

Risk Levels: Risk is High for codes 5A, 5B, 5C, 4A, 4B, 3A (in red); Risk is Medium High for codes 5D, 5E, 4C, 3B, 3C, 2A, 2B (in orange); Risk is Medium Low for codes 4D, 4E, 3D, 2C, 1A, 1B (in yellow); Risk is Low for codes 3E, 2D, 2E, 1C, 1D, 1E (in blue).

Looking at the intersection of ‘catastrophic’ and ‘critical’ with ‘occasional,’ this risk matrix clearly categorizes the risk of a contagious traveler coming into contact with unvaccinated New Zealanders as ‘Medium’ to ‘High.’ Even though the percentages used to quantify probability of harm are not exact values, they represent a reasonable approximation to assess risk. Therefore, the conditions of the Ethics of Infection (Murphy, 2014) support taking action. It is imperative that the travelers report John’s illness.

References

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