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Calculating Exposure Hours for Contact Investigations

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Abstract

Tuberculosis is a National Notifiable Disease that continues to threaten the health our nation. Epidemiologists and public health professionals work to detect, prevent, and treat TB patients. Tuberculosis (TB) is caused by a bacterium called Mycobacteria tuberculosis. The bacteria usually attack the lungs but can also attack other parts of the body. Not everyone infected with TB bacteria becomes sick but if not treated properly, TB disease can be fatal.

TB control programs utilize contact investigations (CI) to assign priorities to individuals also known as "contacts" of TB cases. "The closeness of a contact has been defined by the amount of time spent in a shared airspace per week with minimal emphasis on specific environmental or social factors." Disease investigators use this information to perform targeted screening on individuals that may have become infected in timely manner.

Introduction

Tuberculosis (TB) is caused by a bacterium called Mycobacteria tuberculosis. The bacteria usually attack the lungs, but TB bacteria can attack any part of the body. Not everyone infected with TB bacteria becomes sick but if not treated properly, TB disease can be fatal.

Take for example, the hypothetical scenario below:

A student was unknowingly exposed to a patient with active Tuberculosis (TB) disease. Initially, the student was asymptomatic but as the school semester progressed, she began coughing and experiencing unusual chest pain, and weight loss. Concerned that her condition was not improving, she visited the health center where they evaluated and diagnosed here with active TB. She was immediately started on treatment and placed in isolation until she was no longer infectious.

The school was notified about her condition and the possibility of exposure to other students she shared classes with. As a result, they reached out to the local health department for assistance with performing a Contact Investigation to identify students who should be screened for potential TB exposure.

One key component in a Contact Investigation is determining the hours of exposure that the index case shared with other students. To perform the analysis, we need to obtain a copy of the student's schedule and the associated class rosters. From the class schedules, calculations can be done to determine the number of days and hours the student may have exposed other students to TB.

Methods

Identify the index case and information about their infectious period.
Obtain class rosters with respect to the index case's schedule.
Determine the days and times that each of the classes took place and consider omitting holidays (Figure 1)
Calculate the cumulative hours of exposure for each student who shared a class with the index case (Figure 2)
Produce a report to help investigators prioritize their screening of contacts.

```
data list_contacts2;
 set list_contacts;

 d_start = '06Sep2018'd;
 d_end = '21Dec2018'd;
 /*Veteran's Day */ d_veteran = '12Nov2018'd;
 /*Thanksgiving Day */ d_thanksgiving = '22Nov2018'd;

 n_Monday = 0;
 n_Tuesday = 0;
 n_Wednesday = 0;
 n_Thursday = 0;
 n_Friday = 0;

 do date1 = d_start to d_end;

 wd = weekday(date1);
 if (wd = 2 and date1 = d_veteran) then n_Monday + 0;
 else if wd = 2 then n_Monday + 1;
 else if wd = 3 then n_Tuesday + 1;
 else if wd = 4 then n_Wednesday + 1;
 else if wd = 5 and (date1 = d_thanksgiving) then n_Thursday + 0;
 else if wd = 5 then n_Thursday + 1;
 else if wd = 6 then n_Friday + 1;
 end;

 if count ne 2 then count = 1;
 format d_start d_end d_veteran d_thanksgiving date1 mmddyy10.;
 run;
```

Figure 1. Consider the number of days a class took place between start and end date of semester and exclude any holidays during the period.

```
data Cumm_Exp_Hours;
 set list_contacts2;

 if Class="Physics" then Cummulative_Minutes_Class1=(sum(n_Tuesday,n_Thursday)*class_time);
 if Class="Chemistry_Lab" then Cummulative_Minutes_Class1=(sum(n_Tuesday,n_Thursday)*class_time);
 if Class="Biology_Lab" then Cummulative_Minutes_Class1=(sum(n_Monday,n_Wednesday)*class_time);
 if Class="Biology" then Cummulative_Minutes_Class1=(sum(n_Monday)*class_time);
 if Class="Chemistry" then Cummulative_Minutes_Class1=(sum(n_Tuesday,n_Thursday)*class_time);

 if Class2="Physics" then Cummulative_Minutes_Class2=(sum(n_Tuesday,n_Thursday)*class_time2);
 if Class2="Chemistry_Lab" then Cummulative_Minutes_Class2=(sum(n_Tuesday,n_Thursday)*class_time2);
 if Class2="Biology_Lab" then Cummulative_Minutes_Class2=(sum(n_Monday,n_Wednesday)*class_time2);
 if Class2="Biology" then Cummulative_Minutes_Class2=(sum(n_Monday)*class_time2);
 if Class2="Chemistry" then Cummulative_Minutes_Class2=(sum(n_Tuesday,n_Thursday)*class_time2);

 Cummulative_Exp_Hrs= round((sum(Cummulative_Minutes_Class1,Cummulative_Minutes_Class2)/60),.1);

 run;
```
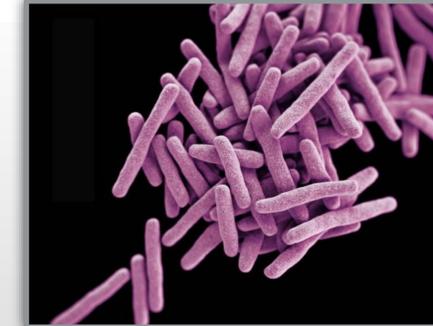
Figure 2. Calculation for the cumulative hours of exposure with respect to class days and times that took place over the infectious period

Conclusion

The decision to initiate a CI is based on several criteria such as the estimated degree of contagiousness of the patient (based on site of disease, clinical and/or radiographic findings, sputum AFB smear and molecular diagnostic results.)

This report allows the TB Controller use data on the exposure hours in combination with other assessments such at site assessment, index case interview to make recommendations for screening. Students who have higher hours of exposure will likely be prioritized for screening. This information can also help calculate projected screening dates for students if their first result is negative just to be safe and make sure they are TB free.

References

Parvaiz, T. "Exclude Holidays from the Count of Days." SAS Communities. 2017. https://communities.sas.com/t5/SAS-Programming/exclude-holidays-from-the-count-of-days/td-p/358369.

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Acknowledgements

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