

## Exercise 2: Variability in serial smear results

At the end of this exercise you should be able to:

- Create a subset of 'suspects' from the working dataset
- Create a string variable that combines the three results for each examinee
- Test the given hypothesis on variation in the serial pattern of the results
- Reject or accept a study hypothesis for each country

The diligence of technicians may suffer if they are over-burdened with work. Decreasing diligence in sputum smear examinations may result in copying a first result.

This exercise examines a bit more closely the variability of serial smear grading among those with at least one positive result (it cannot be ascertained among the majority without any positive result).

In a given laboratory A we might find among suspects the following patterns:

### Laboratory A Register

<b>Examinee</b>	<b>Other variables</b>	<b>Res 1</b>	<b>Res 2</b>	<b>Res 3</b>
Examinee 1		1+	1+	1+
Examinee 2		neg	neg	neg
Examinee 3		2+	2+	
Examinee 4		neg	neg	neg
Examinee 5		2+	2+	
Examinee 6		neg	1+	1+
Examinee 7		3+	3+	
Examinee 8		neg	neg	neg
Etc				

In a given laboratory B we might find among suspects the following patterns:

### Laboratory B Register

<b>Examinee</b>	<b>Other variables</b>	<b>Res 1</b>	<b>Res 2</b>	<b>Res 3</b>
Examinee 1		1+	neg	1+
Examinee 2		neg		
Examinee 3		2+	1+	
Examinee 4		neg	neg	neg
Examinee 5		2+	3+	
Examinee 6		neg	1+	1+
Examinee 7		3+	1+	2+
Examinee 8		neg		
Etc				

If we compare the patterns found in laboratory A with those in laboratory B, we notice that there is much more variation in laboratory B than in laboratory A. In fact, there is virtually no variation in laboratory A for the series of smears for a given suspect.

The amount of tubercle bacilli is, however, not constant in a series of specimens. Most conspicuously, we see this phenomenon when we compare the number of bacilli found in an early morning specimen with an on-the-spot specimen from the same patient. But even if we took a series of 5 on-the-spot specimens from a patient, e.g., in two-hour intervals (as done in “front-loading”), it is likely that the grading of each of the smears made from these specimens will vary to some extent. This may be because the number of bacilli in the secretions varies and / or because the quality of the produced specimen varies and / or the laboratory technician takes by chance particles that differ in content: fresh sputum is not homogenous.

It is thus highly unlikely that all the results from a given examinee recorded in laboratory A reflect the true content of the series of smears. One becomes suspicious that once the technician in laboratory A found a slide to be positive with grade 2+, the subsequent specimen was not properly examined or perhaps even not examined at all, and the result of the first positive specimen was simply copied into the next column. Such observations can be made in seriously overworked laboratories which are forced to examine three smears until they can declare an examinee not to be a case, and if one specimen is positive, to examine additional specimens until the first positive is confirmed by a second positive smear.

By definition, we cannot examine variation among suspects with a series of three negative smears, which is regrettable because this is precisely the group in which this type of problem is most likely to occur. To assess the quality of examination among negative slides, a system of external quality assessment is required. Nevertheless, the results among suspects with at least one positive result may show the extent of variability between such results that might nevertheless be a useful indicator.

We do not know how much variation there must be to make the results look credible (and even if they vary, the technician could in fact have recorded a fictitious variation). What we can do, however, is to compare the extent of variation between laboratories, or in the data set available here, between the four countries, but we can only assess variations among suspects who are cases in the definition of this course.

In other words, the differences in variation are a crude tool to identify laboratories which pay more and which pay less attention to careful and recommended procedures for the examination of serial smears. This exercise should accomplish this.

### ***Tasks:***

Exercise hypothesis:

H<sub>0</sub>: In each study country, at least 60% of cases found among suspects with a complete diagnostic series show a variation in the serial pattern

- ***Determine with a program C\_EX02.PGM the proportions of smears with and without variation in serial smears by country***
- ***Interpret the findings***