Screening Test

Introduction:

This is the second epidemiology practical under the Medicine & Society Module II (FF2613).

The focus of this practical is to introduce the students to the concept of screening test, sensitivity, specificity and predictive values.

Problem Overview:

- **You are the State Medical Officer for AIDS/HIV of Negeri Sembilan and you are expected to conduct a sentinel surveillance for HIV amongst;**
    - **Pregnant mothers (Antenatal Screening)**
    - **STD clinic patients**
- **Therefore you are required to choose an appropriate screening method for the sentinel surveillance.**
- **Calculate the sensitivity, specificity and predictive values of the following tests.**
- **Explain which test is the best one for the sentinel surveillance.**

Learning Outcome:

At the end of this 1-session, the student will be able to:

- Define sensitivity, specificity and predictive values.
- Explain what is a good screening test.

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Trigger:

You are the State Medical Officer for AIDS/HIV of Negeri Sembilan and you are expected to conduct a sentinel surveillance for HIV amongst;

- **Pregnant mothers (Antenatal Screening)**
- **STD clinic patients**

1. Define sentinel surveillance
2. How are the specimens collected for sentinel surveillance?
3. What is the ethical way of conducting HIV testing?
4. What are the screening and confirmatory tests for HIV?

Data Information Sheet-1 – Choosing the Appropriate Screening Test

To select the appropriate screening test, you did a literature review and collated the following tables. Calculate the sensitivity, specificity, PPV and NPV of each test to help you decide.

	Disease Present	Disease Absent	Total
Positive	TP	FP	TP + FP
Negative	FN	TN	FN + TN
Total	**TP + FN**	**FP + TN**	N

TP = True Positive
FP = False Positive
FN = False Negative
TN = True Negative

Sensitivity = TP/(TP+FN) x 100%

Specificity = TN/(TN+FP) x 100%

PPV = TP/(TP+FP) x 100%

NPV = TN/(TN+FN) x 100%

HIV Enzyme Immuno Assay (EIA)

		Gold Standard		
		+	-	total
EIA (blood)	+	1000	9	1009
	-	0	8991	8991
	total	1000	9000	10,000

HIV Particle Agglutination Test

		Gold Standard		
		+	-	total
PA	+	999	270	1269
	-	1	8730	8731
	total	1000	9000	10,000

HIV Rapid Test Kit

		Gold Standard		
		+	-	total
Rapid Test	+	998	180	1178
	-	2	8820	8822
	total	1000	9000	10000

Oral Rapid Test Kit

		Gold Standard		
		+	-	total
Oral Test Kit	+	930	180	1110
	-	70	8820	8890
	total	1000	9000	10000

4. Define True Positive, False Positive, True Negative & False Negative.

5. Define sensitivity, specificity and predictive values.

	EIA	PA	Rapid	Oral
Sensitivity				
Specificity				
PPV				
NPV				

Which is the best screening test?

Data Information Sheet-2 – Effect of Prevalence on Sensitivity & Specificity

Based on the earlier analysis, HIV EIA, a test with sensitivity of 100.0% and specificity of 99.9% was selected to be used for the sentinel surveillance in Negeri Sembilan. You decided to include the inmates of Pusat Serenti Tampin and Pusat Serenti Jelebu in the sentinel surveillance. Each study population consisted of 10,000 people. Calculate the PPV, NPV and prevalence rate of HIV for each study population.

Antenatal mothers

	Disease Present	Disease Absent	Total
Positive	3	10	**13**
Negative	0	9987	**9987**
Total	**3**	**9997**	**10000**

PPV =

NPV =

STD Patients

	Disease Present	Disease Absent	Total
Positive	9	10	**19**
Negative	0	9981	**9981**
Total	**9**	**9991**	**10000**

PPV =

NPV =

IVDU

	Disease Present	Disease Absent	Total
Positive	2000	8	**2008**
Negative	0	7992	**7992**
Total	**2000**	**8000**	**10000**

PPV =

NPV =

Population	Population with HIV	Population without HIV	TOTAL	Prevalence rate
Antenatal mothers	3	9987	10,000	
STD Patients	9	9991	10,000	
IVDUs	2000	8000	10,000	

6. Discuss how PPV & NPV is affected by prevalence rate of the disease.

Since the sensitivity and specificity is the same for all three study populations, please discuss how PPV and NPV are affected by the prevalence of the disease in each study population.

PPV and NPV can also be calculated using the following formulas;

$$PPV = \frac{\text{Prevalence} \times \text{Sensitivity}}{(\text{Prev} \times \text{Sen}) + (1 - \text{Prev}) \times (1 - \text{Sp})}$$

$$NPV = \frac{(1\text{-Prevalence}) \times \text{Specificity}}{(1\text{-Prev}) \times \text{Sp} + \text{Prev} \times (1 - \text{Sen})}$$

Data Information Sheet-3 – Effect of Prevalence on Sensitivity & Specificity

Hypothetical Illustration of Screening Programme with Test Kit

			+	-				
Population	**10,000**	+	**a**	**b**	**a+b**			
Sensitivity	**100.00%**	-	**c**	**d**	**c+d**			
Specificity	**99.90%**		**a+c**	**b+d**	**a+b+c+d**			
	TP	**FP**	**FN**	**TN**			**PPV**	NPV	
Prevalence	**a**	**b**	**c**	**d**	**a+c**	**b+d**	a/a+b	**d/c+d**	
0.01%	**1**	**10**	**0**	**9,989**	**1**	**9,999**	9.09%	100.00%	
0.02%	**2**	**10**	**0**	**9,988**	**2**	**9,998**	16.67%	100.00%	
0.03%	**3**	**10**	**0**	**9,987**	**3**	**9,997**	23.08%	100.00%	**<- Antenatal**
0.05%	**5**	**10**	**0**	**9,985**	**5**	**9,995**	33.34%	100.00%	
0.09%	**9**	**10**	**0**	**9,981**	**9**	**9,991**	47.39%	100.00%	**<- Blood Donors**
1.00%	**100**	**10**	**0**	**9,890**	**100**	**9,900**	90.99%	100.00%	
5.00%	**500**	**10**	**0**	**9,491**	**500**	**9,500**	98.14%	100.00%	
10.00%	**1000**	**9**	**0**	**8991**	**1000**	**9,000**	99.11%	100.00%	
20.00%	**2000**	**8**	**0**	**7992**	**2000**	**8,000**	99.60%	100.00%	**<- Pusat Serenti**
30.00%	**3000**	**7**	**0**	**6993**	**3000**	**7,000**	99.77%	100.00%	

PPV based on Prevalence, Sensitivity & Specificity

	sensitivity %			
	specificity %			
prevalence	99%	95%	90%	80%
	99%	95%	90%	80%
20.0%	96.1%	82.6%	69.2%	50.0%
10.0%	91.7%	67.9%	50.0%	30.8%
5.0%	83.9%	50.0%	32.1%	17.4%
1.0%	50.0%	16.1%	8.3%	3.9%
0.1%	9.0%	1.9%	0.9%	0.4%

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