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# UNIT 3 EPIDEMIOLOGICAL AND STATISTICAL EXERCISES

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## 3.0 OBJECTIVES

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By the end of this unit you should be able to:

- respond rationally to a report of AFP case in your area;
- assess the community needs of RCH services;
- make suitable statistical charts from tabular data;
- compute basic risk estimates; protective efficacy of a vaccine; and validity as well as predictive accuracy of a screening procedure; and
- perform ABC-VED analysis for a medicine store.

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## 3.1 INTRODUCTION

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In the preceding two units we have dealt with the practical aspects of immunization and health education and counselling.

In the present unit we will create some important epidemiological and statistical situations related to RCH and try to address them. While dealing with them, you will realize that these situations are as nearer to the reality as possible. This will enable you to apply your knowledge/skills in solving practical problems. In the course of this unit, you will cover a broad area of practical epidemiology that shall include AFP surveillance, community need assessment, statistical charts, basic risk estimates, protective efficacy; validity and predictive accuracy, and ABC-VED analysis. Read the concerned theory material in MME-101. If you still can not solve the exercises given in this unit, your counsellors at the PSC will help to increase your practicability.

## 3.2 AFP SURVEILLANCE

### Exercise 1

You are a private practitioner in Saharanpur. There is a slum in the vicinity of your clinic. A suspected case of acute flaccid paralysis (AFP) has been reported to you by one of your patients from this area. Considering its significance, you visit the locality and examine the case. The case of AFP is confirmed. You notify the district immunization officer (DIO) or surveillance medical officer (SMO) at the earliest.

- a) You will also start arranging for?
  - 1) .....
  - 2) .....
  - 3) .....
- b)
  - 1) Stool specimens are to be collected within how many days of the onset of paralysis?
  - 2) How many stool specimens are to be collected?
  - 3) What should be the time gap between the collection of the two specimens?
  - 4) What amount of stool should be collected for each specimen?
  - 5) How do you sterilize the specimen container?
  - 6) What preservative/transport media is used for stool specimen?

### Exercise 2

In a state 'X', there were a total of 132 cases of AFP in 2001. The lab results of adequate stool specimens are available for 121 AFP cases. Wild polio virus could be isolated from 2 of them. Of the rest of the 11 AFP cases with inadequate stool specimens: 3 were lost to follow-up; 1 died during follow-up; 2 had residual weakness; and 5 had no residual weakness after 60 days. Finally, the expert group at national level discarded 3 cases after reviewing the referred cases.

Fill the following table on the basis of above information:

Confirmed polio cases	
Cases referred to Expert Group at national level for the review	
Polio Compatible AFP	
Non-Polio AFP	

## 3.3 COMMUNITY NEED ASSESSMENT

### Exercise 3

You are MO I/c of PHC Ramnagar. The population of the sub-centre Balaghat in your area is 6400. Health Worker (F) of the area has just started her annual community need assessment for RCH services, through household survey and consultative process. The Birth Rate and Infant Mortality Rate of your district are not available but at the state level they are 22 and 68 respectively. Compute the following estimates for this sub-centre for making comparison with the assessment of the health worker:

Sl.No.	Expected RCH related events in the area	Probable number
1.	Pregnancies	
2.	Deliveries/live births	
3.	Ante-natal registration (for requirement of ANC visits, IFA & TT doses)	
4.	High risk ante-natal cases (for preparedness at PHC & FRU)	
5.	Pregnant women suffering with anemia	
6.	High risk neonates (for preparedness at PHC & FRU)	
7.	Number of infants alive at 1 yr (for immunization activities)	
8.	Number of children below 3 yr (for requirement of Vit. A doses)	
9.	Number of children below 5 yr (for requirement of DT doses)	

### 3.4 BIRTH RATE AND GENERAL FERTILITY RATE

#### Exercise 4

The Birth Rate of state-‘X’ and state-‘Y’ are 22 and 33 respectively, for the year 2001. Compute their approximate General Fertility Rates.

### 3.5 STATISTICAL CHARTS

#### Exercise 1

In a state of over 100 million people, a total of 10608 maternal deaths were reported in 2001. Following table categorizes this mortality according to the cause of death.

Cause of Maternal Death	Number
Abortion	1453
Toxemia of pregnancy	1337
Bleeding of pregnancy and puerperium	2673
Malposition of child	902
Puerperal sepsis	1220
Anemia	2079
Not classifiable symptoms	944
<b>Total</b>	<b>10608</b>

Make a statistical chart that suitably represents this data.

#### Exercise 6

In your district, child immunization coverage of 2000 and 2001 is given in the following table:

	Coverage in %	
	2000	2001
BCG	72	66
HBV3	42	53
OPV3	63	72
DPT3	55	67
Measles	51	64

Illustrate this information through a suitable statistical chart.

### 3.6 BASIC RISK ESTIMATES

#### Exercise 7

To study the strength of association between ‘heavy work during ante-natal period’ and ‘low birth weight of baby’, a cohort of 515 heavy worker ANCs was followed up. A duly matched control cohort of 515 sedantary-moderate worker ANCs were also followed up. Complete follow up till the measurement of birth weight could be done in 506 and 511 subjects of the study and control cohort respectively. Following results were obtained:

	Baby’s birth weight: below 2500 g	Baby’s birth weight: 2500 g or more	Total
Heavy worker ANCs	a: 189	b: 317	506
Sedantary-moderate worker ANCs	c: 95	d: 416	511
<b>Total</b>	284	733	1017

Compute the following on the basis of above data:

- a) Relative Risk
  - b) Attributable Risk
  - c) Population Attributable Risk
- } of heavy work during ante-natal period

### 3.7 PROTECTIVE EFFICACY OF A VACCINE

#### Exercise 8

Suppose, following are the results of a field trial of an inhalation (aerosol-based) measles vaccine:

	Had measles during follow-up		Total
	Yes	No	
Vaccinated Group	42	558	600
Unvaccinated Group	128	272	400

- a) Can the prevalence in vaccinated and unvaccinated groups be compared by a test of significance? If yes, suggest a suitable test.
- b) Calculate the Protective Efficacy of the vaccine.

### 3.8 VALIDITY AND PREDICTIVE ACCURACY OF A SCREENING PROCEDURE

#### Exercise 9

A group of health workers, after being duly trained, were asked to:

- give home visit to all cases of “fever in under 5 children” occurring in a community; and
- report suspect measles cases.

Serum measles antibody titers were also done in all these fever cases to confirm the diagnosis (4 fold or greater rise). Following results were obtained:

Health workers report on Suspect Measles	4 Fold or greater rise in Serum Measles Antibody Titers		Total
	Positive	Negative	
Positive	26	18	44
Negative	2	114	116
Total	28	132	160

Considering that ‘4 fold or greater rise in Serum Measles Antibody Titers’ is the gold test for the disease, furnish the following on the basis of above data:

- a) Number of false positive and false negative cases of measles in health workers report.
- b) 1) Sensitivity;  
2) Specificity;  
3) Predictive value of a positive result;  
4) Predictive value of a negative result;
- } of the health workers’ screening of measles.

### 3.9 ABC-VED ANALYSIS FOR A MEDICINE STORE

#### Exercise 10

You visit a PHC and collect some inventory management data from the medicine store. Following is the initial table of data collected by you:

Item No.	VED category	% of annual investment
1	D	1
2	E	0.5
3	D	2
4	E	0.5
5	V	16
6	D	0.5
7	E	4
8	D	1
9	E	3

Item No.	VED category	% of annual investment
10	D	0.5
11	E	19
12	D	1
13	E	0.5
14	D	2
15	E	0.5
16	D	0.5
17	V	0.5
18	D	1
19	D	0.5
20	D	1
21	D	0.5
22	E	0.5
23	V	22
24	D	0.5
25	D	0.5
26	D	2
27	E	0.5
28	D	1
29	D	15
30	E	2
<b>Total</b>		<b>100</b>

Subject above data to ABC-VED analysis and present your findings.

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### 3.10 LET US SUM UP

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In this unit we have tested our knowledge and skills in dealing with some RCH related epidemiological and statistical situations. While doing so, we have covered some practical aspects of AFP surveillance and community need assessment. We have also learnt how to convert tabular data into statistical charts. Computation of basic risk estimates; protective efficacy of a vaccine; and validity and predictive accuracy of a screening procedure has also been covered. We have also performed ABC-VED analysis on medicine store data.

In the next unit we will cover the practical aspects of family and clinico-social case study before going the final unit of practical manual that deals with the field visits.

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### 3.11 ANSWERS TO THE EXERCISES\*

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*\*Some of the answers given here may not necessarily be the best possible answers to the questions asked. They are to facilitate you. You may differ with them.*

**Exercise 1**

- a) 1) Stool specimen collection  
2) Outbreak response immunization  
3) Active case search in the community
- b) 1) Within 14 days of the onset of paralysis  
2) Two  
3) 24 hours or more  
4) 8-10 grams (roughly of the size of adult's thumb)  
5) The container need not be sterile  
6) No preservative/transport media is used

**Exercise 2**

Confirmed polio cases	Wild polio virus could be isolated = 2
Cases referred to Expert Group at national level for the review	Cases with inadequate stool specimen AND (having residual weakness or died or lost to follow-up = 6
Polio Compatible AFP	Referred to – Discarded by Expert Group = 3
Non-Polio AFP	AFP – (Confirmed+Compatible Polio) = 127

**Exercise 3**

Sl. No.	Expected RCH related events in the area	Statistical relationship with available information	Probable number
1.	Pregnancies	Population of area × Birth rate of district/state	140.8 = 141
2.	Deliveries/live births	Probable number of pregnancies	141
3.	Ante-natal registration (for requirement of ANC visits, IFA & TT doses)	110% of probable number of pregnancies = Probable number of pregnancies × 1.1	155.1 = 155
4.	High risk ante-natal cases (for preparedness at PHC & FRU)	15% of ante-natal registration = Ante-natal registration × 0.15	23.25 = 23
5.	Pregnant women suffering with anaemia	50% of ante-natal registration = Ante-natal registration × 0.5	77.5 = 78
6.	High risk neonates (for preparedness at PHC & FRU)	10% of estimated births/deliveries = Estimated births/deliveries × 0.10	14.1 = 14
7.	Number of infants alive at 1 yr (for immunization activities)	Live births – estimated infant deaths	73
8.	Number of children below 3 yr (for requirement of Vit. A doses)	8% of the population of area = Population of area × 0.08	512
9.	Number of children below 5 yr (for requirement of DT doses)	13% of the population of area = Population of area × 0.13	832

**Exercise 4**

Basic considerations:

- 1) Birth Rate is (**Live births** in an area during a yr.) / (Midyear **population** in same area and yr.)
- 2) GFR is (**Live births** in an area during a yr.) / (Midyr **15-44 female population** in same area and yr.)  
 OR- (**Live births** in an area during a yr.) / (approx. **22% of midyear population** in same area and yr.)
- 3) The denominator in GFR is 22% or (22/100) of the denominator used in BR. Therefore, GFR is mathematically related to BR.
- 4) The approximate GFR will be:  $BR \times (100/22)$

In the present case it will be:

$$22 \times (100/22) = 100 \text{ for state-‘X’}$$

and

$$33 \times (100/22) = 150 \text{ for state-‘Y’}$$

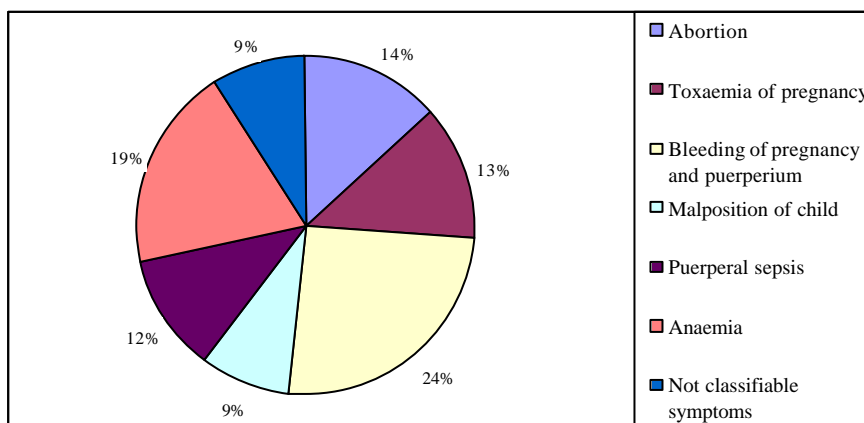
**Exercise 5**

Step 1. Computation of proportionate share of each cause of death:

Case of Maternal Death	Number	Proportion
Abortion	1453	13.7
Toxaemia of pregnancy	1337	12.6
Bleeding of pregnancy and puerperium	2673	25.2
Malposition of child	902	8.5
Puerperal sepsis	1220	11.5
Anaemia	2079	19.6
Not classifiable symptoms	944	8.9
<b>Total</b>	<b>10608</b>	<b>100</b>

Step 2. Making a suitable chart to represent this data:

**Maternal mortality in the state according to cause of death**

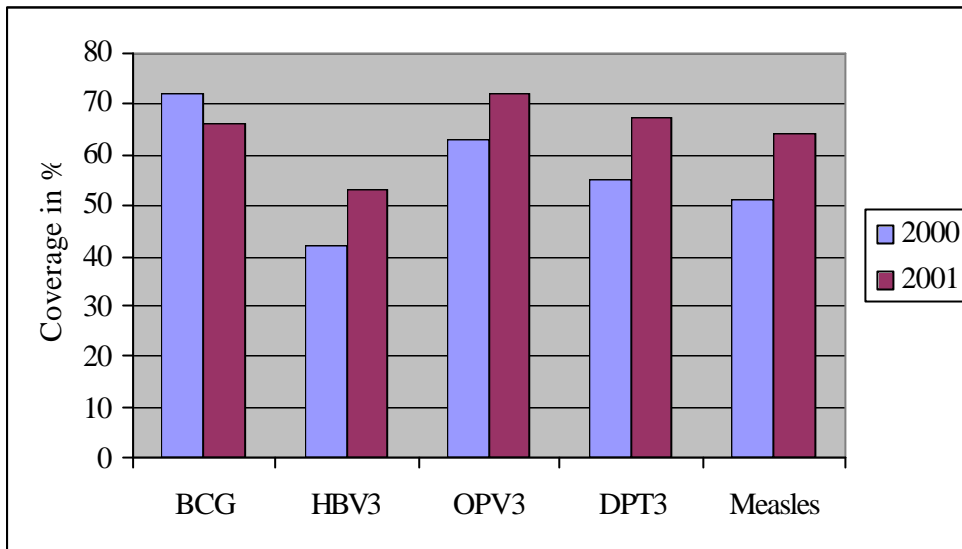




### Exercise 6

Suitable chart to illustrate this information:

Child immunization coverage in the district in 2000 and 2001



### Exercise 7

a) Relative Risk =

Incidence among exposed / Incidence among non-exposed =

$$(a/a+b) / (c/c+d) = (189/506) / (95/511) = 2.01$$

b) Attributable Risk =

(Incidence among exposed – Incidence among non-exposed) / Incidence among exposed)  $\times$  100 =

$$[(a/a+b) - (c/c+d)] / (a/a+b) = [(189/506) - (95/511)] / (189/506) = 0.5 \text{ or } 50\%$$

c) Population Attributable Risk =

(Incidence in population – Incidence among non-exposed) / Incidence in population =

$$[P - (c/c+d)] / P = [0.33 - (125/511)] / 0.33 = 0.3 \text{ or } 30\%$$

### Exercise 8

a) Yes. They can be compared by 'z' test, using standard error of difference between two proportions.

b) Protective Efficacy of a vaccine is calculated by the formula -

$$[(\text{Prevalence in Unvaccinated} - \text{Prevalence in Vaccinated}) / (\text{Prevalence in Unvaccinated})] \times 100$$

$$\text{In this data PE of the vaccine will be: } [(32 - 7) / (32)] \times 100 = 78.12$$

### Exercise 9

a) False positive: 18; false negative: 2.

b) 1) Sensitivity = (True positive / Total disease positive)  $\times$  100 = (26/28)  $\times$  100 = 92.8

2) Specificity = (True negative / Total disease negative)  $\times$  100 = (114/132)  $\times$  100 = 86.4

3) Predictive value (+) = (True positive/Total test positive) × 100 = (26/44) × 100 = 59.1

4) Predictive value (-) = (True negative/Total test negative) × 100 = (114/116) × 100 = 98.3

**Exercise 10**

Step 1. Arranging the medicines in descending order of expenditure incurred.

Item No.	VED category	% of annual investment
23	V	22
11	E	19
5	V	16
29	D	15
7	E	4
9	E	3
3	D	2
14	D	2
26	D	2
30	E	2
1	D	1
8	D	1
12	D	1
18	D	1
20	D	1
28	D	1
2	E	0.5
4	E	0.5
6	D	0.5
10	D	0.5
13	E	0.5
15	E	0.5
16	D	0.5
17	V	0.5
19	D	0.5
21	D	0.5
22	E	0.5
24	D	0.5
25	D	0.5
27	E	0.5
<b>Total</b>		<b>100</b>

Step 2. Do the ABC-VED analysis and present the results as follows:

	<b>V</b>	<b>E</b>	<b>D</b>	<b>Total items</b>	<b>% of items</b>	<b>% of annual investment</b>
<b>A</b>	<b>AV:</b> 23, 5	<b>AE:</b> 11	<b>AD:</b> 29	4	13	72
<b>B</b>	<b>BV:</b> Nil	<b>BE:</b> 7, 9, 30	<b>BD:</b> 3, 14, 26	6	20	15
<b>C</b>	<b>CB:</b> 17	<b>CE:</b> 2, 4, 13, 15, 22, 27	<b>CD:</b> 1, 6, 8, 10, 16, 18, 19,20,21,24,25,28	20	67	13
<b>Total items</b>	3	10	17	30	100	100

\* Numbers listed in boxes are item numbers.

Category I	5 (17%) items	Most important
Category II	12 (40%) items	Important
Category III	13 (43%) items	Least important