Epidemiological Exercises

Shadan Institute of Medical Sciences
Department of SPM

Genezens 2k15

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Horrock's Test

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Finding the bleaching powder demand by Horrocks test

- Horrocks apparatus is devised to find bleaching powder requirement to disinfect 100 gallon (455 litre) of water.

- Contents of Horrocks apparatus.

1 black cup- 240ml

1 pipette

6 white cups of 200ml each

2 metal spoon- 2gm each

7 stirring rods- 1 for each cup

2 droppers

Indicator: starch- iodine solution*

*Starch- iodine solution: 1.5gm starch is added to 100ml distilled water. Boiled and cooled. 7.5gm cadmium iodide or potassium iodide is added.

- **Procedure:**
- With 2gm (1 level spoon) of bleaching powder and little water, thin paste is made in the black cup.

- More water is added to the black cup upto the circular mark, vigorous stirring is done and allowed to settle. This is 'stock solution' or 'mother solution'.

- All 6 white cups are arranged in order. Water to be tested is filled, upto a cm below the brim in all 6 cups.

- With pipette stock solution is added to white cups- 1 drop to first cup, 2 drops to second cup, 3 drops to third cup and so on. One drop represents one part of chlorine in a million part of water.

- Water in all 6 cups is stirred well by using separate glass rod.

- Cups are left undisturbed for half an hour for bleaching powder action, i.e. liberation of free chlorine.
- Three drops of freshly prepared starch-iodine indicator is added to all white cups by dropper and stirred again.
- Development of blue colour indicates the presence of free residual chlorine.
- Note the first cup showing blue colour.
- 5^{th} cup is the first cup showing blue colour, 5 level spoon, i.e. 5 x 2= 10gm of bleaching powder is required to disinfect 100 gallon (455 liter) of water.

- **Principle:**
- Indicator contains potassium iodide + starch + NaCl
- Free chlorine reacts with potassium iodide: iodine is left free which reacts with starch and gives blue colour.

Step 2: Finding the quantity of bleaching powder requirement

- 5^{th} cup is the earliest cup showing blue colour in Horrocks test indicates that 5 level spoon (5 x 2)= 10gm of bleaching powder is required to disinfect 455 liter of water.

455 liter of water requires- 10gm of bleaching powder

For 45,500 liter- how much bleaching powder is required?

= 10/ 455 x 45500

= 455000/455

= 1000gm (1 kg)

1 kg bleaching powder is required to disinfect the tank water.

Question 1

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1. A circular well of 10 meter diameter with 15 meter depth of water is to be chlorinated. Horrock's test shows blue colour in 3rd cup onwards.

- Calculate the quantity of bleaching powder ($CaOCl_2$) required to disinfect the well?
- Explain the procedure of well disinfection?

Step 1: finding the volume of well water

Volume of water in the circular well = $\pi \times r^2 \times h \times 1000$

Where, $\pi = 22/7 = 3.14$

r= radius = 5 mt (half of the diameter)

h= height = 15 mt water column

1000 = volume of water per 1 m^3

$= \pi \times r^2 \times h \times 1000$

$= 3.14 \times 5 \times 5 \times 15 \times 1000$

$= 3.14 \times 25 \times 15 \times 1000 = 1,177,500$

- Volume of water in the well is = 1,177,500 liter

- **Step 2: Finding the amount of bleaching powder requirement**

3rd cup is the earliest cup showing blue colour

3rd cup means – 3 level spoon (3 x 2 gm) = 6 gm of bleaching powder is required to disinfect 455 liter of water.

- 455 liter of water requires – 6 gm of bleaching powder
- For 1177500 liter- how much bleaching powder is required?

= 6/ 455 x 1177500

= 7065000/ 455

= 15,527.5 gm (roughly 15.5 kg)

15 kg 527 gm (to round up 15.5 kg) of bleaching powder is required to disinfect the well water.

- **Step 3: well disinfection procedure**
- Required amount of bleaching powder is mixed with little water in a bucket (not more than 100gm at a time) to make thin paste.
- $3/4^{th}$ of the same bucket is filled with water, stirred well, allowed 10 min for sedimentation.
- Supernatant clear chlorine solution is transferred to another bucket; lime sediment is discarded. Not poured into the well because sediment increases hardness of water.
- Bucket is lowered into the well below the water level.
- Well water is violently agitated by lowering and drawing movements for homogenous mixing of chlorine solution in water.
- This completes chlorination of well.

- Residual chlorine should be tested after half an hour, by orthotolidine arsenite test. It should be atleast 0.5 mg/ liter.
- Subsequent to chlorination, well water is used only after a contact period of 1 hour.
- Wells are best disinfected once in a week at night.
- During epidemics wells should be disinfected every day.

Question 2

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2. A swimming pool having 100 meter length, 60 meter breadth, with 10 meter depth of water is to be disinfected.

- Calculate the amount of bleaching powder required to disinfect the swimming pool. Horrocks test shows blue colour in 4^{th} cup.
- What measures you advice for swimming pool sanitation.

Step 1: Finding the volume of water in the swimming pool

Volume of water in swimming pool= L x b x h x 1000

Where, L = length= 100 mt

b= breadth = 60 mt

h= height = 10 mt

1000 = volume of water per 1 m^3

= 100 x 60 x 10 x 1000 = 60,000,000

Volume of water in the swimming pool is 60,000,000 liter.

Step 2: Finding the amount of bleaching powder requirement

- 4^{th} cup is the earliest cup showing blue colour in Horrocks test indicates that, 4 level spoon (4 x 2) = 8 gm of bleaching powder is required to disinfect 455 liter of water.

455 liter of water requires – 8 gm of bleaching powder

For 60,000,000 liter – how much bleaching powder is required?

= 8/ 455 x 60000000

= 480000000/455

= 1,054,945 gm

- 1054 kg 945 gm (roughly 1055 kg) bleaching powder is required to disinfect the swimming pool.

Step 3: Maintaining swimming pool sanitation

- People suffering from skin disease, sore eye, nasal or ear discharge, upper respiratory, GI infections and any communicable disease should not be allowed to swim.
- Swimmers are instructed to empty the bladder, bowel and to take shower bath before entering the pool.
- They should not spit, blow the nose, urinate or defecate in the pool.
- Surrounding environment of the pool should be maintained well.
- Pool is cleaned once in 15 days. Water is changed frequently or best subjected for continuous purification
- Pool water is frequently tested for any contamination.
- 25 sqft area is provided per swimmer.

Question 3

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3. During the year 2012, Narsingi primary health centre covering 30,000 population had collected 4,000 peripheral smears by house to house visit. Another 400 slides were collected in the OPD. Results of the microscopic examination of these slides are given to you

Plasmodium vivax	positive 41
Plasmodium falciparum	positive 9
	Total positive 50

- Calculate the possible malarial Indices and suggest the remedial measures in brief.

Malarial parameters

Annual parasite incidence (API) = $\frac{\text{confirmed cases in one year}}{\text{Population under surveillance}} \times 1000$

$= \frac{50}{30{,}000} \times 1000$

= 1.6 per thousand population

Annual falciparum incidence(AFI) = $\frac{\text{number of cases due to falciparum}}{\text{Population under surveillance}} \times 1000$

$= \frac{9}{30000} \times 1000$

= 0.3 per 1000 population

Annual blood examination rate (ABER) = number of slides examined X 100

Population Under surveillance

$$= \frac{4400}{30000} \times 100$$

$$= 14.6\ \%$$

Slide positivity rate (SPR) = number of slides positive for malaria X 100

Number of slides examined

$$= \frac{50}{4400} \times 100$$

$$= 1.13\%$$

Slide falciparum rate (SFR) = $\frac{\text{number of slides positive for } \textit{P.falciparum}}{\text{Number of slides examined}} \times 100$

$= \frac{9}{4400} \times 100$

$= 0.20\%$

- **Control Measures**

- Narsingi PHC can be classified as area with API less than 2
- According to modified plan of operation (MPO) measures required are:
- Focal spraying in and around *P. falciparum* detected house.
- Active and passive surveillance (once in 15 days)
- Mass blood survey of people living around patients' home
- Treatment: Prompt treatment is given to all detected cases.
- Follow up: After completion of radical treatment, monthly blood examination should be carried out for 12 months
- Epidemiological investigation: All positive cases are to be investigated.

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4. In the year 2011, API of a tribal district was 3/1000. Falciparum malaria cases had been reported with 10 deaths. How will you strengthen the surveillance and containment of malaria in that area?

- Early diagnosis & radical treatment
- Case based surveillance & rapid response
- Integrated vector management
  - Indoor residual spraying
  - Long lasting insecticidal nets / insecticide treated bed nets
  - Larval source management

- Epidemic preparedness and early response
- Monitoring & evaluation
- Advocacy, coordination & partnerships
- Behaviour change communication and community mobilization.
- Programme planning and management.

Usually malaria surveillance is done by:

- Active case finding
- Passive case finding
- Rapid fever survey
- Mass fever survey

Active case finding:

- Carried out by multipurpose health workers working under PHC.
- Every fortnight periodicity of house to house visits.
- Fortnight visits are done to catch most of secondary cases.
- Search for all fever cases.
- If cases have fever – collect blood films (thick and thin on same slide)
- If cases are positive for malaria, radical treatment is provided.

Passive surveillance :

- All the fever cases attending hospitals are screened for malaria and treated accordingly.
- Medical officer with the help of PHC staff should carry out mapping of private clinics, under guidance of district malaria officer.
- Various malaria clinics are to be established in all health institutions in high risk areas.
- MPHW male should contact all fever treatment dispensaries for drug replacement (fortnightly)

Rapid fever survey:

- House to house visits are undertaken and all fever cases screened by blood smears.
- Blood smears are to be examined at earliest in the temporary field lab at village level

Mass survey:

- Carried out for entire population in suspected epidemic zone.

- As it is high risk area with API> 2 –

1. Vector control :

- Indoor residual spraying
- Use of chemical larvicides like Abate in potable water
- Aerosol spray during day time
- Marathon fogging during outbreaks
- Biologically by – larvivorous fish in ornamental tanks and fountains
- Personal protective measures – bed nets, mosquito repellants

2. Increase community participation
3. Environmental management by source reduction.
4. Entomological assessment – to carryout susceptibility tests and suggest required insecticide
5. Health Education

Question 5

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5. A routine clinical survey for filariasis was carried out in a community health centre, serving 1 lakh population; data collected is as follows:

Night blood smears collected	30000
Persons showing only mf positive	300
Persons showing signs of filariasis	80
Persons showing both mf positive and signs	10

- Calculate the possible filarial indices. And suggest the control measures.

- **Sample size:** For routine filarial survey, sample size recommended is 5 to 7%. In this survey, 30% sample is examined hence the sample is adequate and acceptable.

- **Calculation of filarial indices**

$$\text{Microfilarial rate (mf)} = \frac{\text{number showing mf positivity}}{\text{Number of persons (slides) examined}} \times 100$$

$$= \frac{300}{30000} \times 100$$

$$= 1\%$$

$$\text{Filarial disease rate} = \frac{\text{number showing filarial disease symptoms}}{\text{Number of persons examined}} \times 100$$

$$= \frac{80}{30000} \times 100$$

$$= 0.26\%$$

$$\text{Filarial endemicity rate} = \frac{\text{signs + number of mf positives + Both}}{\text{number of persons examined}} \times 100$$

$$= \frac{80+300+10}{30000} \times 100$$

$$= \frac{390}{30000} \times 100$$

$$= 1.3\%$$

Control Measures

- **Against the Parasite**
- **Mass chemotherapy**
- Given to all in endemic area
- Given only for cases and carriers in low endemic area
- Drug – Diethylcarbamazine (DEC) (Hetrazan)
- Dose – 6 mg/kg/day divided doses after meal
- Duration – 6 day in a week for 2 week, i.e. 12 days
- Total dose: 72 mg/kg

Medicated salt

- Common salt medicated with 1- 4 gm of DEC/kg

Recent schedule

- DEC
- Or Ivermectin
- Or combination of both
- Plus, Albendazole as a supplement
- 0.1% DEC mixed salt and distributed to all

- **Vector control**
- **Antilarval Measure:**
- Chemical: Application of selected insecticides once in a week on all breeding places
- Mosquitoes larvicidal oil (MLO)
- Fenthion 1 ppm
- Organophosphorus – Temephos, fenthion

- **Anti -adult measures**
- Pyrethrum space spray/Insecticidal spray in and around
- Open underground sewage system
- Neighborhood at human dwelling.

- **Environmental measures:** source reduction

- **Integrated vector control**
- **Personal prophylaxis**
- **Other measures**

➢ Maintenance of local hygiene of affected organ (leg)

➢ Primary health care approach

- **Periodic night blood examination**
- **Blood examination:** by taking capillary blood by deep finger prick between 8.30 pm to 12 mid night.
- **Health education:** dynamic health education, campaign is organized to motivate the people, to co-operate in anti- filarial activities and to take complete treatment.
- **Surveillance**

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6. In an antenatal clinic of tertiary care hospital, a primi aged 21 year was found HIV positive. Her husband works as a truck driver, and is repeatedly falling ill for the past few months. What measures do you suggest?

- Referring the woman to integrated counselling and testing center (ICTC) where following help is given

- At counselling center, Post-test counselling is done which:
  - Prepares the woman psychologically to understand the situation
  - Enables her to take appropriate decisions regarding continuing pregnancy.
  - Changing the risk behavior
  - Taking treatment to reduce the risk of transmission to child
  - Encouraging her to tell her spouse
  - Advising her to attend follow up counselling.
  - Advise for CD4 count and lab services
  - Advising about availability of treatment and supportive services for people living with HIV/AIDS (PL – WHA)

- Prevention of parent to child transmission (PPTCT) of HIV/AIDS

- Initiation of lifelong ART medications (tenofovir, lamivudine and efavirenz) irrespective of CD4 cell count.
- Need of institutional delivery should be explained
- ARV prophylaxis to infants from birth to six months.
- Provision of care for associated infections. (STD, TB etc)
- Provision of nutrition, counselling, and psychosocial support.
- Counselling and support for initiation and continuation of breast feeding.
- Integrating follow up of HIV exposed infants into routine health care including immunisation.
- Initiation of cotrimoxazole prophylactic therapy and Early Infant Diagnosis using HIV- DNA PCR at 6 weeks.

- **Advice to Husband**

- Attend integrated counselling and testing centers
- Undergo pre-test and post – test counselling
- Safe sex practices
- Usage of condoms
- Undergo testing and treatment for STD's, RTI, TB if present
- Behaviour change communication.

- **If test is positive**
- CD4 count is done
- Advise to take treatment at ART center
- Good nutrition and exercises
- Healthy life style
- Early health seeking behavior even for minor illnesses

- **If test is negative**
- Undergoing test again after window period

Question 7

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7. A PHC catering 40,000 population has given the data about tuberculosis from January 2016 to December 2016

- **Calculate Incidence and Prevalence of infection**
- **Calculate Incidence and Prevalence of disease**

Particulars	Tuberculin Positive	Sputum Positive
Old Cases	12230	106
New cases	610	34
Total	12840	140

- Incidence = total no. of new cases / population under surveillance * 1000

- Prevalence = total no. of old & new cases / population under surveillance *100

- **Incidence of Infection = total no of new cases who are tuberculin positive / population under surveillance *1000**

= 610/40000 *1000

= 15.25 per 1000 population

- **Prevalence of infection = total no of new and old cases who are tuberculin positive / population under surveillance *100**

= 12230 + 610 /40000 *100

= 32.1 per 100 population

- **Incidence of Disease = total no of new cases who are Sputum positive / population under surveillance *1000**

= 34 / 40000 *1000

= 0.85 per 1000 population

- **Prevalence of Disease = total no of new and old cases who are sputum positive / population under surveillance *100**

= 106+34 /40000 *100

= 140 /40000 *100

= 0.35 per 100 population

Question 8

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8. In a study, out of 60 hypertensives 30 were using OCP. Among 70 non hypertensives, 25 were using oral contraceptives.

- **Draw a 2*2 contingency table.**
- **Calculate Exposure rates among Cases and Controls**
- **Find the odds ratio and Comment**

In a study, out of 60 hypertensives 30 were using OCP. Among 70 non hypertensives, 25 were using oral contraceptives

	Hypertensive	Non Hypertensives	Total
OCP Users	30 (a)	25 (b)	55
Non OCP users	30 (c)	45 (d)	75
Total	60	70	130

Exposure rates among cases (Hypertensives) = a /a+c

= 30/30+30

= 0.5

Exposure rate among controls (Non Hypertensives) = b/ b+d

= 25 /25+45

= 0.35

Odds ratio = ad/bc

= 30*45/30*25

= 1.8

- The odds of OCP users developing hypertension is 1.8 times that of non OCP users

Question 9

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9. Out of 482 Smokers 27 developed Stroke while among 1908 non-smokers, 77 developed Stroke.

- **Draw a 2*2 contingency table.**
- **Calculate incidence rates among Exposed and Non exposed**
- **Find the relative risk and attributable risk and comment**

Out of 482 Smokers 27 developed Stroke while among 1908 non-smokers, 77 developed Stroke.

	Stroke Present	Stroke Absent	Total
Smokers	27 (a)	455 (b)	482
Non Smokers	77 (C)	1831 (d)	1908
Total	104	2286	2390

- Incidence rates among exposed (Smokers) = a /a+b

= 27/27+455

= 50

- Incidence rate among non-exposed (Non Smokers) = c/ c+d

= 77 /77+1831

= 40

- Relative risk = I_E / I_{NE}

= 50 / 40

= 1.25

- Attributable risk = $I_E - I_{NE} / I_E * 100$

= 50 – 40/50 *100

= 20

- The risk of developing stroke is 1.25 times more among smokers when compared to non-smokers
- The risk of developing stroke is 20 times greater among smokers when compared to population in community.

Question 10

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10. A new rapid test has been devised for Leshmaniasis. Following are the results of the rapid test

- **Calculate the Sensitivity of the rapid test**
- **Calculate the Specificity of the rapid test**
- **Calculate the Positive predictive value of the rapid test**
- **Calculate the negative predictive value of the test**

		Disease	
		Yes	No
Rapid test	Positive	148	12
	Negative	2	188
		150	200

Rapid test results	Diagnosis		Total
	Diseased	Not diseased	
Positive	True positive (a) 148	False positive (b) 12	a + b 160
Negative	False negative (c) 2	True negative (d) 188	c + d 190
Total	a + c 150	b + d 200	

Sensitivity = a/(a+c) × 100 = 148/150 × 100 = **98.67%**
Specificity = d/(b+d) × 100 = 188/200 × 100 = **94%**
Positive predictive value = a/(a+b) × 100 = 148/160 × 100 = **92.5%**
Negative predictive value = d/(c+d) × 100 = 188/190 × 100 = **98.95%**