Public health microbiology October 2, 2013

**General water & sewage**

Areas of importance include:-

* Food microbiology: meat, milk inspection, public eating places/institutions
* Sanitation: disposal of sewage, pest/vector control
* Security: bioterrorism prevention/monitoring (e.g. *B. anthracis*)
* STD: STD agents diagnosis, prevention, education
* Water supplies – bacterial testing for public water supplies

Roles of microbiology lab

* Communicable disease surveillance, prevention and control
* Outbreak and emergence response to communicable diseases
* Environmental health and food safety
* Reference testing, specialized screening and diagnostic testing
* Bio-safety, containment, and biohazard response
* Integrated communicable disease data Mx
* Lab quality assurance
* Training and education of health care workers
* Public health related policy development, evaluation and research

**Water & sewage**

* Water sources for domestic use: lakes, rivers, streams, wells, boreholes, piped water

Contamination of water sources

* Surface and shallow ground water
  + Show high degree of bacteriological and chemical pollution due to:-
    - Poor human excreta disposal
    - Agricultural activity
    - Environmental organisms from air, soil, etc.
* Deep wells & springs – low bacterial content due to filtration through soil
  + Boreholes and wells should be at least 30 meters from structurs like pit latrines, septic tanks, refuse dumps: avoids seepage
* lakes and reservoirs: on-going \*\*\*

Water quality parameters

* Microbiological, physical & chemical
* Chemical parameters: residual chlorine, industrial waste pollutants, agricultural chemicals run-off
* \*\*\*
* Microbiological parameters: efficient Rx should yield water free from coliform organisms (organisms found in gut of animals e.g. E. coli)
* Coliforms: G –ve rod-like bacteria normally found in the GIT of man and other warm-blood animals, and have the ability to ferment lactose
* Includes: Enteobacter, Escherichia & Klebsiella

Water-related infxns

* Water borne diseases
* Water hygiene-related diseases
* Vector-borne water habitat diseases

Water borne diseases

* Enteric diseases (Diarrhoea, dysentery) due to pathogens
  + Bacteria: salmonella, shigella, E, Vibrio, etc.
  + Enteroviruses: rotavirus, polio virus, Norwalk
  + \*\*\*

Water hygiene-related diseases

* Inadequate/improper use of water in personal cleanliness
* Inadequate water quantity
* Use of contaminated water in recreation facilities
* Diseases include:-
  + Trachoma (eye
  + Scabies
  + Legionnaire’s

Vector-borne water habitat diseases

* Snail vectors – transmission of schistosomiasis
* Mosquito vectors – malaria, filariasis, arbovirus
* Fly vectors – onchocerciasis (river blindness), trypanosomiasis

Water borne bacterial pathogens

* Intestinal bacterial pathogens known to contaminate drinking water include:
  + Salmonella
  + Shigella
  + E coli
  + Vibrio cholera
  + \*\*\*
* Other organisms that can cause eye, ear, nose, throat infections when present in large quantities in water used for drinking, bathing or medical purposes
  + Pseudomonas
  + Flavobacterium
  + Acinetobacter
  + Klebsiella
  + Serratia

Use of indicator bacterial organisms (coliforms)

* Indicators of excreta pollution of water
* Tests check for presence of organisms normally present in stool of man and other warm blooded animals
* Measures the efficacy of water Rx

Criteria of an indicator organisms

* Abundant in excreta
* Easily isolated
* Easily identified and enumerated
* More resistant to disinfectants such as chlorine

Coliform organisms s.a citrobacter, enterobacter, aeromonas, Klebsiella meet the above criteria

Other supplementary indicators include:-

* Fecal streptococci
* Sulfite reducing clostridia
* Bacteroides
* Bifidobacteria

Total coliform count

* An indicator of Rx efficiency or post-treatment contamination
* Used to simultaneously detect all coliform bacteria in a drinking sample
* They should not be detectable in treated water supplies: no. of coliforms should be zero!

Thermotolerant fecal coliform organisms

* Coliform organisms able to ferment lactose at 44-44.5 deg C (others ferment at 37)
* Comprise E. coli, and to a lesser extent enterobacter, citrobacter & Klebsiella

Disinfenctants used include chlorine

* Water Rx with chlorine kills most microorganisms esp if preceded with organic removal processes

Water disinfection

* Destroy pathogens in water
* Prevent entry of pathogens to water system
* Suppress bacterial growth in pipe environment

Disinfection efficiency

* Colony counts used to:-
  + Assessing efficiency of water Rx processes
  + Assessing cleanliness and integrity of water distribution system
  + Suitability of water for use in manufacturing

Water specimen

* Avoid contamination
* Collect adequate amount 200 ml in sterile bottle
* Wide opened mouth with sterile glass stopper
* Cap released at point of collection

The specimen

* Deliver sample to the lab ASAP, 2-6 hrs, or refrigerate
* Neutralize the chloride ions with 3% sodium thiosulphate
* Mix the sample and pick at different water levels

Determining bacterial counts:

* Quantitative analysis
  + Non-differential test
  + For counts of all viable bacterial
  + Pour onto media plates in duplicates
  + Eliminates the probability of error and is reproducible
* Qualitative analysis: Eijkman test
  + A differential test
  + Specific for coliform bacteria esp E. coli.
  + Uses MAC media (look for lactose fermenters)
  + Incubated at 44 C (thermotolerant E. coli)
  + Also uses Durham’s tube
  + If gas and acid is produced and the media turns yellow at 44 D it is fecal coliform E. coli.
* Membrane filter technique
  + For sampling larger volumes of water
  + Filter a known amount through a pore filter
  + Bacteria grows and forms colonies on the filter
  + Identify the bacteria
  + Quantity can be calculated using colony counts and volume filtered

Sewage rx

* Sewage Rx is a controlled intensification of natural self-purification processes
* Involves primary, secondary and tertiary treatments

**Stool microbiology**

* Acute infective diarrhea and gastroenteritis are major causes of ill-health/death in developing countries
* Highly related to contaminated water supplies and poor sanitation
* Most infections acquired by fecal-oral route (contaminated food & water)
* Loss of water, electrolytes 🡪 severe dehydration 🡪 fatal

Clinical features

* History
* Nature of D: blood, mucous, pus?
* Acute (bacteria, viruses) or chronic (parasitic)?
* Food history?
* Other pple affected; outbreak?
* Recent antibiotic use?
* Travel history?
* Risk factors for immunosuppression
* Patient emaination
* Febrile, shocked
* Wasting: malabsorption, immunosuppression, malignancy
* Rectal examination: blood, mucous, rectal carcinoma
* Gastrointestinal & neurological signs: N, dry mouth, crianl nerve paralysis – C. botulinum
* Differential diagnosis
  + Metal poisoning
  + Perforation
  + Appendicitis
  + Colonic malignancy
  + Irritable bowel syndrome
  + Lactase \*\*\*

Gastrointestinal commensals

* Normal GIT flora influenced greatly by diet
* Include:-
  + Coliform bacilli
  + Proteus spp
  + Pseudomonas spp
  + Clostridium spp
  + Bacteroides spp
  + Enterococcus spp
  + Lactobacilli spp

Invasive diarrhoea (dysentery – blood, mucous)

* Shigella
* Campylobacter
* Some salmonellae
* Enteroinvasive E. coli
* Enterohemorrhagic E. coli
* Y. enterocolitica
* C. difficile
* C. perfringens (pigbel)
* Aeromonas spp

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Note:

* Viral causes – rotavirus, adenoviruses
* Parasitic causes \*\*\*

Outline of investigation of infectious diarrhoea (caused by pathogens)

* Stool
  + Collection and transport of stool specimen
    - Provide patient with suitable container (bedpan or wide mouthed container)
      * Clean & dry
      * Disinfectant free
      * Leak-proof
    - Avoid contamination with urine
    - Transport labelled specimen to lab within 1 hr
    - Otherwise use transport media
      * Cary-Blair
        + Cotton swab of specimen/rectal swabs
        + Salmonella, shigella, vibrio, Yersinia: viable for 48 hrs
        + Campylobacter viable for 6 hrs
      * Alkaline peptone water – enrichment
        + Used when cholera is suspected
        + 1 ml specimen in 10 ml of media
        + Maintains viability for 8 hrs
  + Examine the specimen microscopically
    - Saline wet prep\*\*\*
    - Basic fuchsin smear: campylobacter
    - Motility smear and gram stained smear
      * When cholera is suspected
      * Specimen from alkaline peptone water
      * \*\*\*
  + Culture the specimen
    - Enrichment media
      * Alkaline peptone water: vibrio
      * Selenite F broth: salmonella, shigella
    - Selective media
      * Xylose lysine deoxycholate agar: salmonella, shigella
  + Examine and report the cultures
  + Biochemical tests
    - On XLD, SS, DCA, MAC plates
      * Exclude proteus using urease
      * Set indole, motility, TSI/KIA tests
      * Identify serologically
    - On TCBS
      * G stain colonies
      * Subcultures to Na
  + Serotyping
    - This is done using commercially prepared antisera for identification of specific bacteria serotypes from pure cultures
    - The tests done \*\*\*

Other investigations

* Blood tests
* Sigmodoscopy: view colonic mucosa
* Biopsies
* Abdominal CT scans

Management

* Mild cases: oral rehydration
* Severe dehydration: IV replacement of fluids, electrolytes
* Antibiotics: specific to pathogen
* Antispasmodic agents: useful in mild diarrhea without blood