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