

# Water, sanitation, hygiene & environmental health

**Sanitation** is the hygienic means of promoting health through prevention of human contact with the hazards of wastes as well as the treatment and proper disposal of sewage or wastewater. Hazards can be physical, microbiological, biological or chemical agents of disease. Wastes that can cause health problems include human and animal excreta, solid



# Definition and purposes (continued)

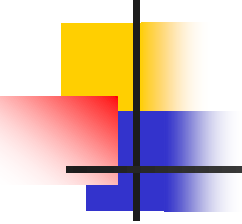
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- **Definition and purposes**

The [World Health Organization](#) explains sanitation as follows:

"Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and feces. The word 'sanitation' also refers to the maintenance of hygienic conditions, through services such as garbage collection and wastewater disposal."

Sanitation includes all four of these engineering infrastructure items (even though often only the first one is strongly associated with the term "sanitation"): Excreta management systems, wastewater management systems (included here are [wastewater treatment plants](#)), solid waste management systems, drainage systems for rainwater, also called storm water drainage.



# Some water, sanitation and health numbers

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- Faecal-oral (focus of this presentation)
  - Diarrhoeal disease
    - **2 million deaths/year from diarrhoea, mostly under 5**
      - **Jumbo jet crash every hour and a half...**
    - **One billion cases/year**
    - **4.3% of Burden of Disease DALYs**
    - **88% (?) attributable to inadequate WSH**
  - 1/3 of developing world pop'n carry intestinal worms
  - 200 million infected by schistosomiasis (bilharzia)
- 6-9 million blind from trachoma (1/4 reduced by adequate water supply)



# Natural chemical hazards

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- Arsenic
  - Skin lesions, various cancers
  - “20 to 60” million exposed in Bangladesh
  - Major problem other parts of S. Asia, also Argentina, Chile, China, Hungary, Mexico, Peru
- Fluorosis
  - Dental damage, crippling bone damage
  - “affects millions” (WHO) but often of mild form



# COMPONENTS OF ENVIRONMENTAL SANITATION

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- WATER SANITATION
- FOOD AND MILK SANITATION
- EXCRETA DISPOSAL
- SEWAGE DISPOSAL
- REFUSE DISPOSAL
- VECTOR AND VERMIN CONTROL
- HOUSING
- AIR SANITATION



# WATER SANITATION

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## **WATER ANALYSIS CONSISTS OF:**

- PHYSICAL
- CHEMICAL
- RADIOLOGICAL
- BIOLOGICAL
- BACTERIOLOGICAL



# WATER Quality

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**The relationship between water and health has been extensively studied. Drinking water should:**

- 1. Be free from pathogenic (disease-causing) organisms.**
- 2. Fairly clear (with low turbidity and little color).**
- 3. Not be saline (salty).**
- 4. Not contain compounds that cause an offensive taste or smell.**
- 5. Not contain chemicals, metals or radioactive compounds in concentrations that may have an adverse effect on human health.**



# Microbiological Quality of water

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- The most important aspect of drinking water quality is its microbiological quality. Indicator bacteria of fecal contamination are thermotolerant (fecal) coliforms (E.coli), and fecal streptococci.

When these bacteria are present in water, fecal contamination is indicated, and there is therefore a possibility that pathogenic bacteria and viruses are also present.





# WATER SANITATION -CHEMICAL QUALITY

## CHEMICAL CONCENTRATION [mg/L]

Arsenic 0.2

Barium 1.0

Cadmium 0.01

Chromium 0.05

Cyanide 0.01

Lead 0.1

Selenium 0.05

Silver 0.05



# WATER SANITATION

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- **HOUSEHOLD TREATMENT OF WATER**

- BOILING, i.e., beyond 2 minutes
- CHLORINATION- 1-5ppm
- IODINE TREATMENT- 10 drops per gallon
- FILTRATION
- AERATION



# Sanitary Definitions

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- Clean: Free of visible soil.
- Sanitize: Reduce the number of bacteria to a safe level.
- Sterilize: to make free of bacteria.
- Contamination: the presence of harmful substance in food.



# Sanitation in the Food Industry

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- **Sanitary (hygienic) practices in the food industry involve systematic control of environmental conditions during production, processing, storage, distribution, preparation, and consumption of foods and beverages. Such control includes ways to prevent contamination of products by microorganisms, insects, rodents, other animal pests, or foreign objects or chemicals. Hence, sanitary practices begin when raw materials are produced and continue until foods or beverages are consumed. Sanitary practices are**

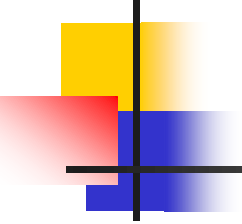


# FOOD AND MILK SANITATION

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- The GOLDEN RULE of food sanitation is:

**“Keep it cold or hot, and keep it covered”**



# Factors Affecting the presence and concentration of pathogens in food

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- Temperature
- Moisture
- Nutrients
- PH
- Competitive flora



# Why is it important to have a sanitary facility?

- To control pathogens and prevent food-borne illness:
  1. *Listeria monocytogenes*
  2. *Salmonella*
  3. *Staphylococcus aureus*
- To control normal spoilage bacteria:
  1. Yeast
  2. Molds
  3. Others that can cause economic spoilage and decrease shelf life



# **Factors that contribute to a sanitary facility**

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- Facility design
- Equipment design
- Good cleaning and sanitizing procedures
- Good written sanitation programs and monitoring procedures





# Historical evolution: water quality and health

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- John Snow      **Cholera**  
Broad Street Pump 1854  
Water Companies' Studies
- William Budd      **Typhoid** in 1850's-60's
- Koch      **Cholera**  
vs. Pettenkoffer      Hamburg/Altona 1892
- 1937 Croydon      **Typhoid**
- And many more...

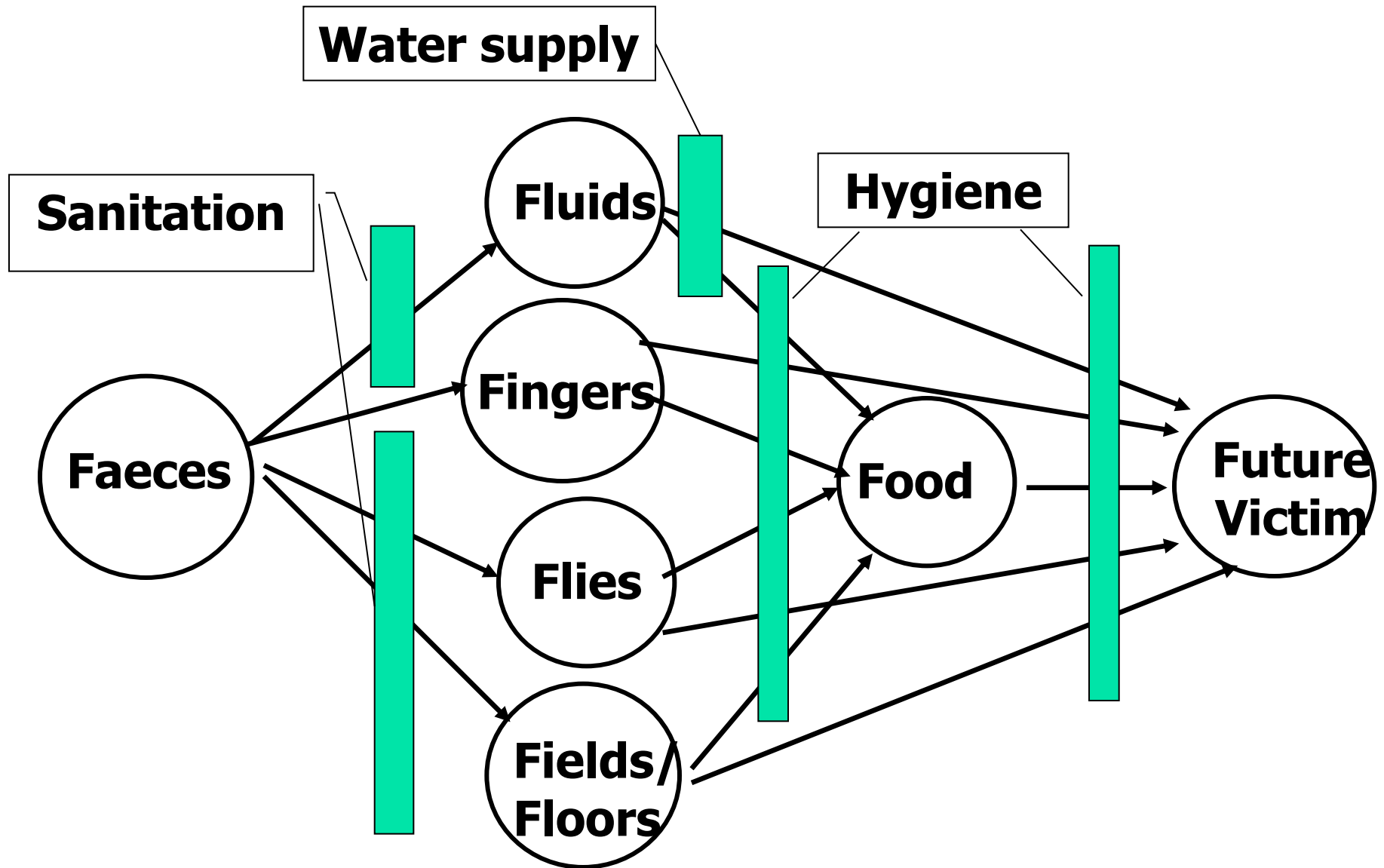


# Classifications of disease

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- Classification usually by organism (viral, bacterial, etc) or organ (diseases of head, heart, liver etc.)
- Classification by transmission route
  - Bradley's great innovation in 1970s
  - If you know how it's spread, you know how to stop it...
  - ...so engineers loved it!

# The F-Diagramme





# HOUSING SANITATION

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- CHARACTERISTICS OF AN ACCEPTABLE HOUSE...[cont]...
  - NOISE: SHOULD NOT BE MORE THAN 30 DECIBELS
  - ADEQUATE HEAT AND VENTILATION
  - EQUIPPED WITH SANITARY TOILET, FOOD STORAGE AND PROPER REFUSE DISPOSAL



# SANITATION REQUIREMENTS IN EMERGENCY SITUATIONS

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- WATER

- 1. **MINIMUM DEMAND PER PERSON PER DAY**

- A. 2 LTS FOR DRINKING
- B. 10 LTS FOR FOOD PREPARATION AND COOKING
- C. 15 LTS FOR BATHING
- D. 15 LTS FOR LAUNDRY
- E. 10 LTS FOR SANITATION AND HYGEINE

...CONT...



# IN EMERGENCY SITUATIONS

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- WATER

- 1. MINIMUM REQUIREMENTS [..CONT..]**

- HOSPITALS AND CLINICS

- A. OUT-PATIENT: 5 LTS / PATIENT/  
DAY.

- B. IN-PATIENT: 40-60 LTS/ PATIENT/  
DAY

- FEEDING CENTERS: 20-30  
LTS/PERSON/DAY



# ENVIRONMENTAL SANITATION

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- THE MOST COMMON AND MOST PRACTICAL DISINFECTING AGENT FOR DRINKING WATER:
  - A. OZONE
  - B. SILVER
  - C. UV RAYS
  - D. CHLORINE



# Results from Esrey, 1985

Type of Intervention	No of Results	Median Reduction	Range
All interventions	53	22	0-100
Water quality	9	16	0-90
Water availability	17	25	0-100
Water quality and availability	8	37	0-82
Excreta disposal	10	22	0-48

(Esrey, S.A. et al., **WHO Bull**, 63(4): 757-772, 1985)





# Esrey (1985) by disease

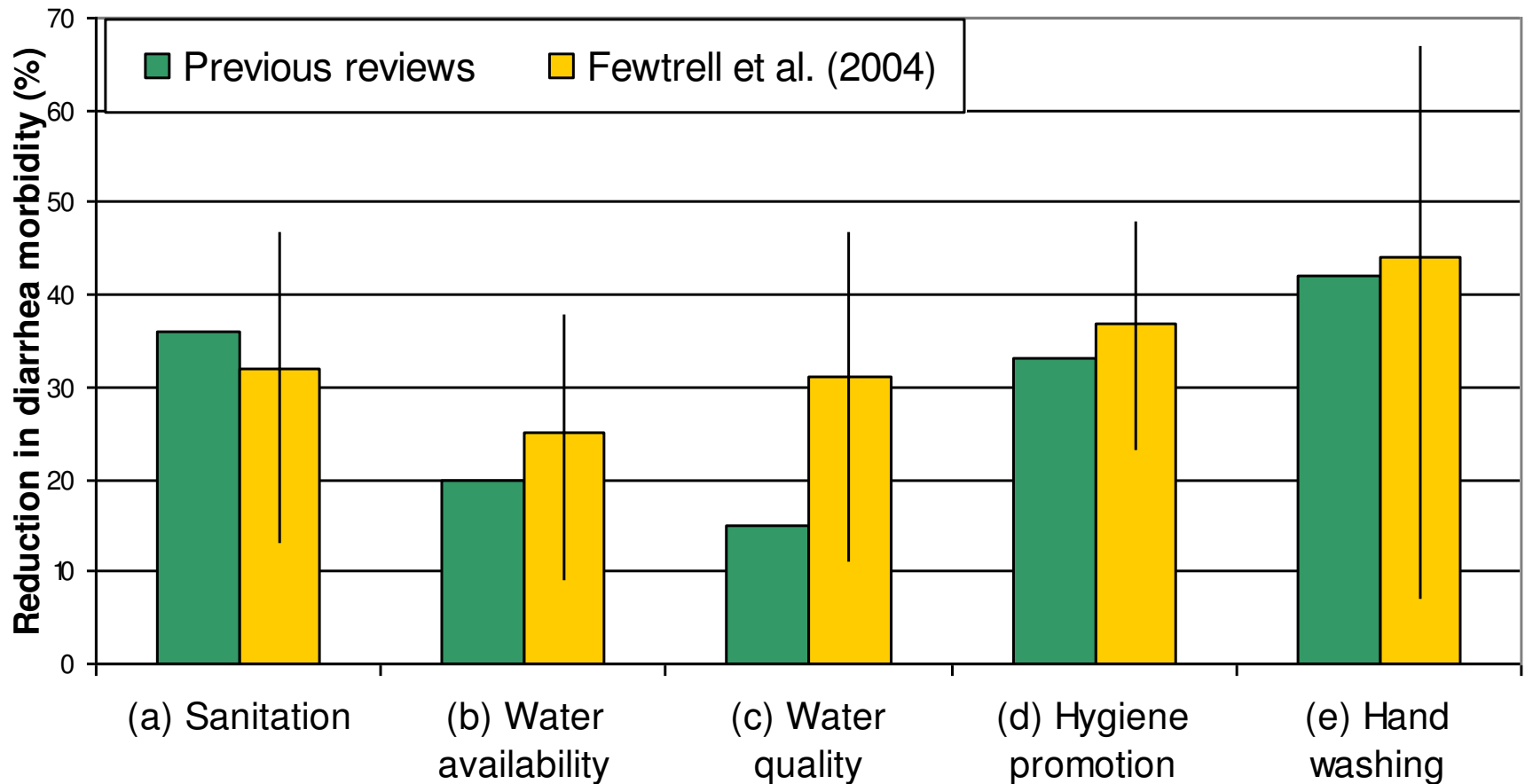
Disease or infection	No of results	Median reduction	Range
<b>Cholera</b>	11	41	0-91
<b>Shigella</b>	27	48	0-81
<b>Entamoeba histolytica</b>	17	2	0-80
<b>Giardia lamblia</b>	10	0	0-20



# Esrey's update in 1991

All Studies      Rigorous Studies

Intervention	No	Med % reduct	No	Med % reduct
<b>Water &amp; San</b>	7	20	2	30
<b>Sanitation</b>	11	22	5	36
<b>Water Quality and Quantity</b>	22	16	2	17
<b>Water Quality</b>	7	17	4	15
<b>Water Quantity</b>	7	27	5	20
<b>Hygiene</b>	6	33	6	33



**Previous reviews:**

a – d Esrey SA et al. (1991) Bull WHO 69 (5): 609-621

e Curtis V, Cairncross S (2003) Lancet Inf Dis 3: 275-281.

**Taken from S. Cairncross RWSSTG BBL “ The Health Impact of Sanitation”, Aug 2004.**

# The F-diagramme revisited

