Assignment #4

WASH Diploma Course

Strategia Netherlands

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* 1. **Explain what municipal solid waste (MSW) means.**

Municipal Solid Waste (MSW), also called garbage and trash, is nonhazardous refuse generated by households, institutions, commercials, industries, agriculture, and sewage. It is made up of wastes, compostables, and recyclable materials, with the municipality overseeing its disposal. Typically, this refuse is collected, separated and sent to either a landfill or a municipal recycling center for processing. In some cases, what is defined by a community as municipal solid waste will vary by jurisdiction.

MSW has changed alongside with society. In the past, refuse from communal refuse was mostly made up of ash, wood, bone, and vegetable waste. Dumps were mainly filled with pottery or tools that could no longer be repaired as early humans would feed most biodegradables to their livestock or leave it to decompose. As humanity continued to develop, the refuse created by communities became more complicated with the introduction of metals like copper, aluminum, and steel; new materials like plastic; and the introduction of hazardous substances.

Fortunately, humanity has been able to answer to this shift for the most part with programs that combat the various types of litter through recycling, compost, and developing landfills that will protect the environment from pollution. (Resource Center, June14, 2016)

* 1. **Explain the importance of the following MSW properties in solid waste management or treatment.**

The Importance of the Following MSW Properties in solid Waste Management or treatment is detailed below:

A technological approach to solid-waste management began to develop in the latter part of the 19th century. Watertight garbage cans were first introduced in the United States, and sturdier vehicles were used to collect and transport wastes. A significant development in solid-waste treatment and disposal practices was marked by the construction of the first refuse [incinerator](https://www.britannica.com/technology/incinerator) in [England](https://www.britannica.com/place/England) in 1874. By the beginning of the 20th century, 15 percent of major American cities were incinerating solid waste. Even then, however, most of the largest cities were still using primitive disposal methods such as open dumping on land or in water.

Technological advances continued during the first half of the 20th century, including the development of garbage grinders, compaction trucks, and pneumatic collection systems. By mid-century, however, it had become evident that open dumping and improper incineration of solid waste were causing problems of pollution and jeopardizing [public health](https://www.britannica.com/topic/public-health). As a result, [sanitary landfills](https://www.britannica.com/technology/sanitary-landfill) were developed to replace the practice of open dumping and to reduce the reliance on waste incineration. In many countries waste was divided into two categories, hazardous and nonhazardous, and separate regulations were developed for their disposal. Landfills were designed and operated in a manner that minimized risks to public health and the environment. New refuse incinerators were designed to recover heat energy from the waste and were provided with extensive [air pollution control](https://www.britannica.com/technology/air-pollution-control) devices to satisfy stringent standards of air quality. Modern solid-waste management plants in most developed countries now emphasize the practice of [recycling](https://www.britannica.com/science/recycling) and waste reduction at the source rather than incineration and land disposal.

**Solid-waste characteristics, Composition and properties**

The sources of solid waste include residential, commercial, institutional, and industrial activities. Certain types of wastes that cause immediate danger to exposed individuals or [environments](https://www.merriam-webster.com/dictionary/environments) are classified as hazardous; these are discussed in the article [hazardous-waste management](https://www.britannica.com/technology/hazardous-waste-management). All nonhazardous solid waste from a [community](https://www.merriam-webster.com/dictionary/community) that requires collection and transport to a processing or disposal site is called [refuse](https://www.britannica.com/technology/refuse-disposal-system) or municipal solid waste (MSW). Refuse includes garbage and rubbish. Garbage is mostly decomposable food waste; rubbish is mostly dry material such as glass, paper, cloth, or wood. Garbage is highly putrescible or decomposable, whereas rubbish is not. Trash is rubbish that includes bulky items such as old refrigerators, couches, or large tree stumps. Trash requires special collection and handling.

[Construction and demolition (C&D) waste](https://www.britannica.com/topic/construction-and-demolition-waste) (or debris) is a significant component of total solid waste quantities (about 20 percent in the United States), although it is not considered to be part of the MSW stream. However, because C&D waste is inert and nonhazardous, it is usually disposed of in municipal sanitary landfills.

Another type of solid waste, perhaps the fastest-growing component in many developed countries, is [electronic waste](https://www.britannica.com/technology/electronic-waste), or e-waste, which includes discarded computer equipment, televisions, telephones, and a variety of other electronic devices. In 2006 e-waste made up 5 percent of the total solid waste stream, and the [United Nations Environment Programme](https://www.britannica.com/topic/United-Nations-Environment-Programme) estimated that developed countries would triple their output of e-waste by 2010. Concern over this type of waste is escalating. [Lead](https://www.britannica.com/science/lead-chemical-element), [mercury](https://www.britannica.com/science/mercury-chemical-element), and [cadmium](https://www.britannica.com/science/cadmium) are among the materials of concern in electronic devices, and governmental policies may be required to regulate their recycling and disposal.

Solid-waste characteristics vary considerably among [communities](https://www.merriam-webster.com/dictionary/communities) and nations. American refuse is usually lighter, for example, than European or Japanese refuse. In the United States paper and paperboard products make up close to 40 percent of the total weight of MSW; food waste accounts for less than 10 percent. The rest is a mixture of yard trimmings, wood, glass, metal, plastic, leather, cloth, and other miscellaneous materials. In a loose or uncompacted state, MSW of this type weighs approximately 120 kg per cubic metre (200 pounds per cubic yard). These figures vary with geographic location, economic conditions, season of the year, and many other factors. Waste characteristics from each community must be studied carefully before any treatment or disposal facility is designed and built.

**Generation and storage**

Rates of solid-waste generation vary widely. In the [United States](https://www.britannica.com/place/United-States), for example, municipal refuse is generated at an average rate of approximately 2 kg (4.4 pounds) per person per day. Japan generates roughly half this amount, yet in Canada the rate is 3 kg (almost 7 pounds) per person per day. In some developing countries (e.g., India) the average rate can be lower than 0.5 kg (1 pound) per person per day. These data include refuse from commercial, institutional, and industrial as well as residential sources. The actual rates of refuse generation must be carefully determined when a community plans a solid-waste management project.

Most communities require household refuse to be stored in durable, easily cleaned containers with tight-fitting covers in order to minimize rodent or insect infestation and offensive odours. [Galvanized](https://www.merriam-webster.com/dictionary/Galvanized)metal or plastic containers of about 115-litre (30-gallon) capacity are commonly used, although some communities employ larger containers that can be mechanically lifted and emptied into collection trucks. Plastic bags are frequently used as liners or as disposable containers for curbside collection. Where large quantities of refuse are generated—such as at shopping centres, hotels, or apartment buildings—dumpsters may be used for temporary storage until the waste is collected. Some office and commercial buildings use on-site compactors to reduce the waste volume.

**Solid-waste collection (Collecting and transporting):**

Proper solid-waste collection is important for the protection of public health, safety, and environmental quality. It is a labour-intensive activity, accounting for approximately three-quarters of the total cost of solid-waste management. Public employees are often assigned to the task, but sometimes it is more economical for private companies to do the work under contract to the municipality or for private collectors to be paid by individual home owners. A driver and one or two loaders serve each collection vehicle. These are typically trucks of the enclosed, compacting type, with capacities up to 30 cubic metres (40 cubic yards). Loading can be done from the front, rear, or side. Compaction reduces the volume of refuse in the truck to less than half of its loose volume.

The task of selecting an optimal collection route is a complex problem, especially for large and densely populated cities. An optimal route is one that results in the most efficient use of labour and equipment, and selecting such a route requires the application of computer analyses that account for all the many design variables in a large and complex network. Variables include frequency of collection, haulage distance, type of service, and climate. Collection of refuse in rural areas can present a special problem, since the population densities are low, leading to high unit costs.

Refuse collection usually occurs at least once per week because of the rapid decomposition of food waste. The amount of garbage in the refuse of an individual home can be reduced by garbage grinders, or garbage disposals. Ground garbage puts an extra load on sewerage systems, but this can usually be accommodated. Many communities now conduct source separation and recycling programs, in which homeowners and businesses separate recyclable materials from garbage and place them in separate containers for collection. In addition, some communities have drop-off centres where residents can bring recyclables.

**Transfer stations:**

If the final destination of the refuse is not near the community in which it is generated, one or more transfer stations may be necessary. A transfer station is a central facility where refuse from many collection vehicles is combined into a larger vehicle, such as a tractor-trailer unit. Open-top trailers are designed to carry about 76 cubic metres (100 cubic yards) of uncompacted waste to a regional processing or disposal location. Closed compactor-type trailers are also available, but they must be equipped with ejector mechanisms. In a direct discharge type of station, several collection trucks empty directly into the transport vehicle. In a storage discharge type of station, refuse is first emptied into a storage pit or onto a platform, and then machinery is used to hoist or push the solid waste into the transport vehicle. Large transfer stations can handle more than 500 tons of refuse per day.

**Solid-waste treatment and disposal**

Once collected, municipal solid waste may be treated in order to reduce the total volume and weight of material that requires final disposal. Treatment changes the form of the waste and makes it easier to handle. It can also serve to recover certain materials, as well as heat energy, for recycling or reuse.

[**Incineration**](https://www.britannica.com/technology/incineration) **and Furnace operation:**

Burning is a very effective method of reducing the volume and weight of solid waste. In modern incinerators the waste is burned inside a properly designed furnace under very carefully controlled conditions. The combustible portion of the waste combines with oxygen, releasing mostly [carbon dioxide](https://www.britannica.com/science/carbon-dioxide), water vapour, and heat. Incineration can reduce the volume of uncompacted waste by more than 90 percent, leaving an inert residue of ash, glass, metal, and other solid materials called bottom ash. The gaseous by-products of incomplete combustion, along with finely divided particulate material called [fly ash](https://www.britannica.com/science/fly-ash), are carried along in the incinerator airstream. Fly ash includes cinders, dust, and soot. In order to remove fly ash and gaseous by-products before they are exhausted into the atmosphere, modern incinerators must be equipped with extensive emission control devices. Such devices include fabric baghouse filters, acid gas scrubbers, and electrostatic precipitators. Bottom ash and fly ash are usually combined and disposed of in a landfill. If the ash is found to contain toxic metals, it must be managed as a hazardous waste.

Municipal solid-waste incinerators are designed to receive and burn a continuous supply of refuse. A deep refuse storage pit, or tipping area, provides enough space for about one day of waste storage. The refuse is lifted from the pit by a crane equipped with a bucket or grapple device. It is then deposited into a hopper and chute above the furnace and released onto a charging grate or stoker. The grate shakes and moves waste through the furnace, allowing air to circulate around the burning material. Modern incinerators are usually built with a rectangular furnace, although rotary kiln furnaces and vertical circular furnaces are available. Furnaces are constructed of refractory bricks that can withstand the high combustion temperatures.

Combustion in a furnace occurs in two stages: primary and secondary. In primary combustion, moisture is driven off, and the waste is ignited and volatilized. In secondary combustion, the remaining unburned gases and particulates are oxidized, eliminating odours and reducing the amount of fly ash in the exhaust. When the refuse is very moist, [auxiliary](https://www.merriam-webster.com/dictionary/auxiliary) gas or [fuel oil](https://www.britannica.com/technology/fuel-oil) is sometimes burned to start the primary combustion.

In order to provide enough oxygen for both primary and secondary combustion, air must be thoroughly mixed with the burning refuse. Air is supplied from openings beneath the grates or is admitted to the area above. The relative amounts of this underfire air and overfire air must be determined by the plant operator to achieve good combustion [efficiency](https://www.merriam-webster.com/dictionary/efficiency). A continuous flow of air can be maintained by a natural draft in a tall chimney or by mechanical forced-draft fans.

**Energy recovery:**

The energy value of refuse can be as much as one-third that of coal, depending on the paper content, and the heat given off during incineration can be recovered by the use of a refractory-lined furnace coupled to a boiler. Boilers convert the heat of combustion into steam or hot water, thus allowing the energy content of the refuse to be recycled. Incinerators that recycle heat energy in this way are called waste-to-energy plants. Instead of a separate furnace and boiler, a water-tube wall furnace may also be used for energy recovery. Such a furnace is lined with vertical steel tubes spaced closely enough to form continuous sections of wall. The walls are insulated on the outside in order to reduce heat loss. Water circulating through the tubes absorbs heat to produce steam, and it also helps to control combustion temperatures without the need for excessive air, thus lowering air pollution control costs.

Waste-to-energy plants operate as either mass burn or refuse-derived fuel systems. A mass burn system uses all the refuse, without prior treatment or preparation. A refuse-derived fuel system separates combustible wastes from noncombustibles such as glass and metal before burning. If a turbine is installed at the plant, both steam and electricity can be produced in a process called [cogeneration](https://www.britannica.com/technology/cogeneration).

Waste-to-energy systems are more expensive to build and operate than plain incinerators because of the need for special equipment and controls, highly skilled technical personnel, and auxiliary fuel systems.

[**Composting**](https://www.britannica.com/topic/composting):

Another method of treating municipal solid waste is composting, a biological process in which the organic portion of refuse is allowed to decompose under carefully controlled conditions. Microbes metabolize the organic waste material and reduce its volume by as much as 50 percent. The stabilized product is called [compost](https://www.britannica.com/topic/compost) or [humus](https://www.britannica.com/science/humus-soil-component). It resembles potting soil in texture and odour and may be used as a soil conditioner or mulch.

Composting offers a method of processing and recycling both garbage and sewage [sludge](https://www.britannica.com/topic/sludge) in one operation. As more stringent environmental rules and siting constraints limit the use of solid-waste incineration and landfill options, the application of composting is likely to increase. The steps involved in the process include sorting and separating, size reduction, and digestion of the refuse.

**Sorting and shredding:**

The decomposable materials in refuse are isolated from glass, metal, and other inorganic items through sorting and separating operations. These are carried out mechanically, using differences in such physical characteristics of the refuse as size, density, and magnetic properties. Shredding or pulverizing reduces the size of the waste articles, resulting in a uniform mass of material. It is accomplished with hammer mills and rotary shredders.

**Digesting and processing:**

Pulverized waste is ready for composting either by the open windrow method or in an enclosed mechanical facility. Windrows are long, low mounds of refuse. They are turned or mixed every few days to provide air for the microbes digesting the organics. Depending on moisture conditions, it may take five to eight weeks for complete digestion of the waste. Because of the metabolic action of aerobic bacteria, temperatures in an active compost pile reach about 65 °C (150 °F), killing pathogenic organisms that may be in the waste material.

Open windrow composting requires relatively large land areas. Enclosed mechanical composting facilities can reduce land requirements by about 85 percent. Mechanical composting systems employ one or more closed tanks or digesters equipped with rotating vanes that mix and aerate the shredded waste. Complete digestion of the waste takes about one week.

Digested compost must be processed before it can be used as a mulch or soil conditioner. Processing includes drying, screening, and granulating or pelletizing.

[**Sanitary landfill**](https://www.britannica.com/technology/sanitary-landfill):

Land disposal is the most common management strategy for municipal solid waste. Refuse can be safely deposited in a sanitary landfill, a disposal site that is carefully selected, designed, constructed, and operated to protect the environment and public health. One of the most important factors relating to landfilling is that the buried waste never comes in contact with surface water or [groundwater](https://www.britannica.com/science/groundwater). Engineering design requirements include a minimum distance between the bottom of the landfill and the seasonally high [groundwater table](https://www.britannica.com/science/water-table). Most new landfills are required to have an impermeable liner or barrier at the bottom, as well as a system of groundwater-monitoring wells. Completed landfill sections must be capped with an impermeable cover to keep precipitation or [surface runoff](https://www.britannica.com/science/runoff) away from the buried waste. Bottom and cap liners may be made of flexible [plastic](https://www.britannica.com/science/plastic) membranes, layers of [clay](https://www.britannica.com/science/clay-mineral) soil, or a combination of both.

**Constructing the landfill**

The basic element of a sanitary landfill is the refuse cell. This is a confined portion of the site in which refuse is spread and compacted in thin layers. Several layers may be compacted on top of one another to a maximum depth of about 3 metres (10 feet). The compacted refuse occupies about one-quarter of its original loose volume. At the end of each day’s operation, the refuse is covered with a layer of soil to eliminate windblown litter, odours, and insect or rodent problems. One refuse cell thus contains the daily volume of compacted refuse and soil cover. Several [adjacent](https://www.merriam-webster.com/dictionary/adjacent) refuse cells make up a lift, and eventually a landfill may [comprise](https://www.merriam-webster.com/dictionary/comprise) two or more lifts stacked one on top of the other. The final cap for a completed landfill may also be covered with a layer of topsoil that can support vegetative growth.

Daily cover soil may be available on-site, or it may be hauled in and stockpiled from off-site sources. Various types of heavy machinery, such as crawler tractors or rubber-tired dozers, are used to spread and compact the refuse and soil. Heavy steel-wheeled compactors may also be employed to achieve high-density compaction of the refuse.

The area and depth of a new landfill are carefully staked out, and the base is prepared for construction of any required liner and leachate-collection system. Where a plastic liner is used, at least 30 cm (12 inches) of sand is carefully spread over it to provide protection from landfill vehicles. At sites where excavations can be made below grade, the trench method of construction may be followed. Where this is not [feasible](https://www.merriam-webster.com/dictionary/feasible) because of [topography](https://www.merriam-webster.com/dictionary/topography) or groundwater conditions, the area method may be practiced, resulting in a mound or hill rising above the original ground. Since no ground is excavated in the area method, soil usually must be hauled to the site from some other location. Variations of the area method may be employed where a landfill site is located on sloping ground, in a valley, or in a ravine. The completed landfill eventually blends in with the landscape.

**Controlling by-products**

Organic material buried in a landfill decomposes by anaerobic microbial action. Complete decomposition usually takes more than 20 years. One of the by-products of this decomposition is [methane](https://www.britannica.com/science/methane)gas. Methane is poisonous and explosive when diluted in the air, and it can flow long distances through porous layers of soil. If it is allowed to collect in basements or other confined areas, dangerous conditions may arise. In modern landfills, methane movement is controlled by impermeable barriers and by gas-venting systems. In some landfills the methane gas is collected and recovered for use as a fuel.

A highly contaminated liquid called [leachate](https://www.britannica.com/topic/leachate) is another by-product of decomposition in sanitary landfills. Most leachate is the result of runoff that infiltrates the refuse cells and comes in contact with decomposing garbage. If leachate reaches the groundwater or seeps out onto the ground surface, serious environmental pollution problems can occur, including the possible contamination of drinking-water supplies. Methods of controlling leachate include the interception of surface water in order to prevent it from entering the landfill and the use of impermeable liners or barriers between the waste and the groundwater. New landfill sites should also be provided with groundwater-monitoring wells and leachate-collection and treatment systems.

**Importance in waste management**

In communities where appropriate sites are available, sanitary landfills usually provide the most economical option for disposal of nonrecyclable refuse. However, it is becoming increasingly difficult to find sites that offer adequate capacity, accessibility, and environmental conditions. Nevertheless, landfills will always play a key role in solid-waste management. It is not possible to recycle all components of solid waste, and there will always be residues from incineration and other treatment processes that will eventually require disposal underground. In addition, landfills can actually improve poor-quality land. In some communities properly completed landfills are converted into recreational parks, playgrounds, or golf courses.

[**Recycling**](https://www.britannica.com/science/recycling)

Separating, recovering, and reusing components of solid waste that may still have economic value is called recycling. One type of recycling is the recovery and reuse of heat energy, a practice discussed separately in [Incineration](https://www.britannica.com/technology/solid-waste-management#ref72384). Composting can also be considered a recycling process, since it reclaims the organic parts of solid waste for reuse as mulch or soil conditioner. Still other waste materials have potential for reuse. These include paper, metal, glass, plastic, and rubber, and their recovery is discussed here.

**Separation**

Before any material can be recycled, it must be separated from the raw waste and sorted. Separation can be accomplished at the source of the waste or at a central processing facility. Source separation, also called curbside separation, is done by individual citizens who collect newspapers, bottles, cans, and garbage separately and place them at the curb for collection. Many communities allow “commingling” of nonpaper recyclables (glass, metal, and plastic). In either case, municipal collection of source-separated refuse is more expensive than ordinary refuse collection.

In lieu of source separation, recyclable materials can be separated from garbage at centralized mechanical processing plants. Experience has shown that the quality of recyclables recovered from such facilities is lowered by contamination with moist garbage and broken glass. The best practice, as now recognized, is to have citizens separate refuse into a limited number of categories, including newspaper; magazines and other wastepaper; commingled metals, glass, and plastics; and garbage and other nonrecyclables. The newspaper, other paper wastes, and commingled recyclables are collected separately from the other refuse and are processed at a centralized [material recycling facility](https://www.britannica.com/technology/materials-recovery-facility), or [MRF](https://www.britannica.com/technology/materials-recovery-facility) (pronounced “murf” in waste-management jargon). A modern MRF can process about 300 tons of recyclable wastes per day.

At a typical MRF, commingled recyclables are loaded onto a conveyor. Steel cans (“tin” cans are actually steel with only a thin coating of [tin](https://www.britannica.com/science/tin)) are removed by an electromagnetic separator, and the remaining material passes over a vibrating screen in order to remove broken glass. Next, the conveyor passes through an air classifier, which separates aluminum and plastic containers from heavier glass containers. Glass is manually sorted by colour, and aluminum cans are separated from plastics by an eddy-current separator, which repels the [aluminum](https://www.britannica.com/science/aluminum) from the conveyor belt.

**Reuse**

Recovered broken [glass](https://www.britannica.com/topic/glass-properties-composition-and-industrial-production-234890) can be crushed and used in asphalt pavement. Colour-sorted glass is crushed and sold to glass manufacturers as cullet, an essential ingredient in glassmaking. [Steel](https://www.britannica.com/technology/steel) cans are baled and shipped to steel mills as scrap, and [aluminum](https://www.britannica.com/technology/aluminum-processing) is baled or compacted for reuse by smelters. Aluminum is one of the smallest components of municipal solid waste, but it has the highest value as a recyclable material. Recycling of [plastic](https://www.britannica.com/science/plastic) is a challenge, mostly because of the many different polymeric materials used in its production. Mixed thermoplastics can be used only to make lower-quality products, such as “plastic lumber.”

In the [paper](https://www.britannica.com/technology/papermaking) stream, old newspapers are sorted by hand on a conveyor belt in order to remove corrugated materials and mixed papers. They are then baled or loose-loaded into trailers for shipment to paper mills, where they are reused in the making of more newspaper. Mixed paper is separated from corrugated paper for sale to tissue mills. Although the processes of pulping, de-inking, and screening wastepaper are generally more expensive than making paper from virgin wood fibres, the market for recycled paper should improve as more processing plants are established.

[Rubber](https://www.britannica.com/science/elastomer) is sometimes reclaimed from solid waste and shredded, reformed, and remolded in a process called revulcanization, but it is usually not as strong as the original material. Shredded rubber can be used as an additive in [asphalt](https://www.britannica.com/science/asphalt-material) pavements, and discarded tires may be employed as swings and other recreational structures for use by children in “tire playgrounds.” In general, the most difficult problem associated with the recycling of any solid-waste material is finding applications and suitable markets. Recycling by itself will not solve the growing problem of solid-waste management and disposal. There will always be some unusable and completely valueless solid residue requiring final disposal. (Jerry A. Nathanson, June 26, 2018)

* 1. **Outline the advantages and disadvantages of source separation of MSW**

Source separation requires the consumer to separate all materials by type at the point of discard so they can be recycled. It may also be referred to as dual or sorted stream recycling. Source separation may mean separating all recyclables by type- meaning metal, glass, paper, and plastic, and the like.

Alternatively, source separation can mean separating paper from other recyclable materials  (bottles and cans) at the point of discard for further separation later. Dual stream protects paper, a valuable commodity, from becoming contaminated by food waste clinging to the inside of jars and cans.

We have to note that the Source Separation of MSW has its advantages and disadvantages, which are:

**Advantages (Pros):**

1. Lower levels of contamination
2. Higher quality and more valuable material
3. Does not rely on expensive sorting technology, leading to lower costs

## Disadvantages (Cons):

1. Requires more consumer effort
2. Consuming time
3. Can result in low participation rates, especially in areas with low recycling ethics

(BETTER WORLD BETTY, CVILLE'S GREEN RESOURCE, n.d).

4. **Discuss the challenges faced in disease surveillance.**

The Challenges faced in disease surveillance are as follows, though they are not limited to:-

a) Data Management ;

b) Early Detection of Emerging Diseases;

C) Inadequate Computing Resources; and

d) Shortage of Skilled Staff;

#### a) Data Management:

Effective data management is critical to the public health surveillance mission; however, appreciation of the quality of data needed for appropriate inferences and interpretation is often lacking. Data management is the development, implementation, and maintenance of plans, policies, and programs that control, protect, and enhance the value of data. Cleaning and manipulation are not intended to alter data to reach a desired conclusion, but to ensure that data accurately reflect the true nature of what has been measured. Preparing high-quality data for public health analysis requires transformation from the data collection system for use in different formats to conduct quality checks and to prepare it for the analysts who need the analytic "flat" file. The analytic data management work function serves as a crosswalk across domains.

#### b) Early Detection of Emerging Diseases:

The need for enhancing detection of emerging diseases faster and enhancing public health emergency response and recovery capabilities introduce new analytic challenges. Signal (or aberration) detection algorithms, applied to real-time processing of electronic medical records data, generate syndromic surveillance capacity to monitor for disease outbreaks and to support situation awareness and recovery monitoring. These new methodologies, developed during the smallpox vaccination activities and the anthrax attack of the early 2000s, also are useful for detecting emerging infectious diseases (e.g., severe acute respiratory syndrome), extending analytic capabilities for chronic diseases, and developing approaches to support health-care reform. Prudent application of new analytic surveillance methods and interpretation of results from novel data sources used for public health (e.g., patient health encounter records) might require interdisciplinary collaboration across public health and health-care domains, epidemiologic and statistical science domains, and public health jurisdictions.

#### c) Inadequate Computing Resources:

With the increase in number of sources and volume of data available for analysis, insufficient resources in the computing environment might be a limiting factor on timely processing of data and communication of results. This is particularly true for observational data such as those collected from longitudinal studies or various surveys or surveillance systems. When an emphasis is placed on real-time analysis and dissemination of the processed results from data, visual displays of data might be important. For example, displaying trends or clusters might provide information of potential bioterrorist activity, and maps of disease incidence/mortality might help target epidemiologic investigations. Because information needed to respond to an acute event needs a rapid response and simple, understandable display of complex data, a proactive approach would be to anticipate a need for sophisticated graphics display technology and plan for study of the cognitive aspects of such technology and how it will be used. Improved graphic displays of data is an area that requires further study.

#### d) Shortage of Skilled Staff:

Human resources to accomplish analytic data management, statistical analysis, methods for performing geographic and other information displays, visualization of data and effectively communicating uncertainty in health-data evidence are needed in public health surveillance. However, persons and teams with the required skills and experience are in short supply. Furthermore, while core competencies have been developed for some public health professions (e.g., epidemiologists) to ensure staff have the skills needed to successfully perform this work, none have been developed for public health data managers and analysts. Leaders and managers and decision-makers who allocate staffing resources but have not worked directly in analytic data management must trust subordinates to accurately characterize resource requirements that may on the surface, appear inflated. The challenge of recruitment and retention of analytic staff is amplified in public health surveillance because of low pay grades compared with other industries. Within operational programs, analytical knowledge, procedures, and operations are frequently the most complex and detailed areas. Public health curricula have not been able to keep pace with new data management and analytic requirements. Courses that relate specifically to public health analytic data management with administrative data, a large part of where public health surveillance now resides are few.

* 1. **Explain 5 diseases that can be prevented by observing proper sanitation.**

Five diseases that can be prevented by observing proper sanitation are: Diarrheal diseases, Trachoma, Acute Respiratory Infections, under-nutrition and Malaria.

### 1. Diarrheal Diseases:

Diarrhoeal diseases are the most important of the faeco-oral diseases globally, causing around 1.6–2.5 million deaths annually, many of them among children under 5 years old living in developing countries. In 2008, for example, diarrhoea was the leading cause of death among children under 5 years in sub-Saharan Africa, resulting in 19% of all deaths in this age group.

Systematic reviews suggest that improved sanitation can reduce rates of diarrhoeal diseases by 32%–37%. While many of the studies included in those reviews could not rigorously disaggregate the specific effects of sanitation from the overall effects of wider water, sanitation, and hygiene interventions, a longitudinal cohort study in Salvador, Brazil, found that an increase in sewerage coverage from 26% to 80% of the target population resulted in a 22% reduction of diarrhoea prevalence in children under 3 years of age; in those areas where the baseline diarrhoea prevalence had been highest and safe sanitation coverage lowest, the prevalence rate fell by 43% . Similarly, a recent meta-analysis that explored the impact of the provision of sewerage on diarrhoea prevalence reported a pooled estimate of a 30% reduction in diarrhoea prevalence and up to 60% reduction in areas with especially poor baseline sanitation conditions. Another longitudinal study in urban Brazil found that the major risk factors for diarrhoea in the first three years of life were low socioeconomic status, poor sanitation conditions, presence of intestinal parasites, and absence of prenatal examination. The study concluded that diarrhoeal disease rates could be substantially decreased by interventions designed to improve the sanitary and general living conditions of households.

Further, it is not just the provision and adult use of sanitation that is important. A meta-analysis of observational studies of infants' faeces disposal practices found that unsafe disposal increased the risk of diarrhoea by 23%, highlighting the importance of the safe management of both adults' and infants' faeces.

### 2. Neglected Tropical Diseases (e.g. Trachoma)

Neglected tropical diseases, while resulting in little mortality, cause substantial disability-adjusted life year (DALY) losses in developing countries . Many of these diseases have a faeco-oral transmission pathway. Thus, improved sanitation could contribute significantly to a sustained reduction in the prevalence of many of them, including trachoma, soil-transmitted helminthiases, and schistosomiasis. Unfortunately, the current policy focus in most parts of the world is on treatment by medication, which, unlike good sanitation, is not a preferred solution because, in part, it is much more expensive.

Trachoma is endemic in many of the world's poorest countries. It is caused by the bacterium Chlamydia trachomatis and is the world's leading cause of preventable blindness. Trachoma control is predominantly antibiotic-based despite the existence of the SAFE control strategy (surgery, antibiotics, face-washing, and environmental measures, namely sanitation promotion).

### 3. Acute Respiratory Infections:

With 4.2 million deaths each year (1.6 million among children under 5 years), acute respiratory infections are the leading cause of mortality in developing countries. Although sanitation is not directly linked to all acute respiratory infections, a recent study reported that 26% of acute lower respiratory infections among malnourished children in rural Ghana may have been due to recent episodes of diarrhoea. Thus, sanitation could be a powerful intervention against acute respiratory infections.

### 4. Under-nutrition

Poor sanitation, hygiene, and water are responsible for about 50% of the consequences of childhood and maternal underweight, primarily through the synergy between diarrhoeal diseases and under-nutrition, whereby exposure to one increases vulnerability to the other. (Plos Med.Nov.16, 210)

**5. Malaria:**

It is caused by Water-related insect vector (Mosquito) that breed in water or bite near water. Malaria can occur if a mosquito infected with the *Plasmodium* parasite bites you. There are four kinds of malaria parasites that can infect humans: *Plasmodium vivax*, *P. ovale*, *P. malariae*, and *P. falciparum*.

*P. falciparum* causes a more severe form of the disease and those who contract this form of malaria have a higher risk of death. An infected mother can also pass the disease to her baby at birth. This is known as congenital malaria.(StrategiaNetherlands WASH Course, Module 4, pp.54-56)

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