



Vaccine Surveillance

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Objectives

- Discuss VPDs
- Describe surveillance related to VPDs

Post Questions in the Chat!

(we will have breaks to answer these during the workshop)

Workshop Schedule

Time	Topics
2:00–2:20 pm	Vaccine Preventable Diseases
2:20–2:45 pm	Surveillance of VPDs
2:45–3:00 pm	Vaccine Safety
3:00–3:10 pm	Break
3:10–4:00 pm	Visualization

Vaccine-Preventable Diseases



Vaccine-Preventable Diseases

- Fortunate to have vaccines available for many diseases
- Target populations and vaccination schedules vary by country and even jurisdiction

Vaccination Schedule – Bangladesh

VPD	Targets	
Diphtheria	General population	Pregnant women ✓
<i>Haemophilus influenzae</i>	General population	
Hepatitis B	General population	
Measles	General population	
Pertussis	General population	
Pneumococcal disease	General population	
Polio	General population	
Rubella	General population	
Tetanus	General population	Pregnant women ✓
Tuberculosis	General population	

Diphtheria

- *Corynebacterium diphtheriae* cause the infection with some strains producing a toxin (diphtheria toxin)
- Respiratory or cutaneous infection, spread person-to-person
- DTwP-Hib-HepB vaccine for children
- Td for pregnant women and recommended for adults



Haemophilus influenzae type b

- *Haemophilus influenzae* cause infection with six capsular types (but only one -type b- causing most disease historically)
- Noncapsular types cause most disease in areas with vaccination
- Bacterial meningitis or mucosal infection (milder)
- DTwP-Hib-HepB vaccine for children

Hepatitis B

- Hepatitis B virus (DNA) causes the infection causing acute or chronic disease
- Affects liver, spread by blood and sexual transmission
- DTwP-Hib-HepB vaccine for children



Measles

- Measles virus causes the infection and is extremely contagious
- Lower respiratory infection with rash, spread through saliva, coughing, and sneezing
- MR vaccine for children

Pertussis

- *Bordatella pertussis* cause the infection and is highly contagious
- Respiratory infection, spread through cough
- DTwP-Hib-HepB vaccine for children



Pneumococcal disease

- *Streptococcus pneumoniae* cause the infection with more than 90 serotypes
- Respiratory (pneumonia), spread by airborne droplets
- PCV-10 vaccine for children

Poliomyelitis

- Poliovirus causes the infection with 3 serotypes
- Affects nerves, spread by fecal-oral routes, respiratory droplets
- OPV or IPCf vaccine for children



Rubella

- Rubivirus causes the infection
- Rash, congenital effects, spread by respiratory droplets and contact
- MR vaccine for children

Tetanus

- *Clostridium tetani* cause the infection which forms dormant spores and also produces a toxin (tetanospasmin)
- Respiratory or cutaneous infection, spread from contaminated soil to wounds
- Td vaccine for pregnant women and adults (recommended)



Tuberculosis

- *Mycobacterium tuberculosis* cause the infection, acute or chronic
- Respiratory infection, spread by coughs, sneezing
- BCG vaccine for children

Non-scheduled VPDs

- Additional VPDs may be included in VPD surveillance programs:
 - diseases that are not on the vaccination schedule but still may be in use
 - Influenza
 - diseases with vaccines in clinical trials
 - RCV
 - diseases with vaccines that are used in outbreak response
 - COVID-19
 - Cholera

need to know baseline

Surveillance Related to Vaccines

Vaccine-preventable Diseases and Vaccine Tracking

Surveillance Interests

- Surveillance of vaccine-preventable disease
- Tracking of vaccination
- Vaccine safety



Purpose of Vaccine-Related Surveillance

- Rapid identification of outbreaks
- Identify under-immunized/unimmunized populations
- Track progress of disease elimination/eradication goals
- Inform the introduction of new/regional vaccines
- Guide choices and development of vaccines
- Monitor vaccine impacts
- Track possible adverse events
- Guide optimal vaccine use

Pre-vaccine

- Understand disease epidemiology, including **burden**, to inform vaccine introduction decision.

Vaccine introduction

- Monitoring changes in disease epidemiology, to quantify vaccine programme **impact** on disease, health systems, and economic factors.

Programme optimization

- Identify communities unreached by vaccines and triangulate surveillance with other data to design and implement **targeted delivery strategies**.

Long-term monitoring

- Understand changes in disease epidemiology to inform **shifts in vaccine or programme strategy**.
- Monitor progress and modify programmes to achieve **control, elimination and eradication goals**.

Across all phases

- Identify **outbreaks** for immediate action to contain and limit spread, including through reactive vaccination campaigns and other control measures
- Monitor **infectious diseases currently without vaccines** using components of comprehensive VPD surveillance

VPD Surveillance


- Countries determine their priority VPDs
- The VPDs may be included in national notifiable disease surveillance
- Otherwise, the priority VPDs can be tracked using:
 - sentinel surveillance
 - regionally notifiable system
 - event-based surveillance



VPD Surveillance

- Comprehensive and integrated
 - laboratory confirmation is important for VPDs
 - high quality data is critical
- Budgetary constraints may limit capacity for surveillance but special support sometimes available
 - Global Polio Eradication Initiative

Determining Priority VPDs

- Global surveillance mandate
 -  • polio, measles, neonatal tetanus
- International Health Regulation targets
 - smallpox, wild-type polio, new subtype influenza, sometimes cholera, yellow fever, Ebola
- Other priorities depend on:
 - epidemic potential
 - prevention, control, and elimination potential
 - disease burden and endemicity
 - severity, case fatality ratio
 - potential for changing pattern of disease
 - social and economic impact
 - public perception of risk
 - logistics

<u>Immunization Analysis and Insights (who.int)</u>	Type of Surveillance			
	National, case-based with laboratory confirmation	National, aggregate with laboratory confirmation of outbreaks	Sentinel, case-based with laboratory confirmation	Other surveillance
All countries	<ul style="list-style-type: none"> • Measles • Polio • Neonatal tetanus 			
Some countries	<ul style="list-style-type: none"> • Diphtheria • Meningococcus • Rubella • Yellow fever 	<ul style="list-style-type: none"> • Hepatitis A • Hepatitis B • Mumps 	<ul style="list-style-type: none"> • Congenital rubella syndrome • <i>Haemophilus influenzae</i> • Influenza • Japanese encephalitis • Pertussis • Pneumococcus • Rotavirus • Typhoid 	<ul style="list-style-type: none"> • Cholera • Human papillomavirus • Non-neonatal tetanus • Varicella

Vaccine Tracking

Coverage & Impact

Vaccine Coverage

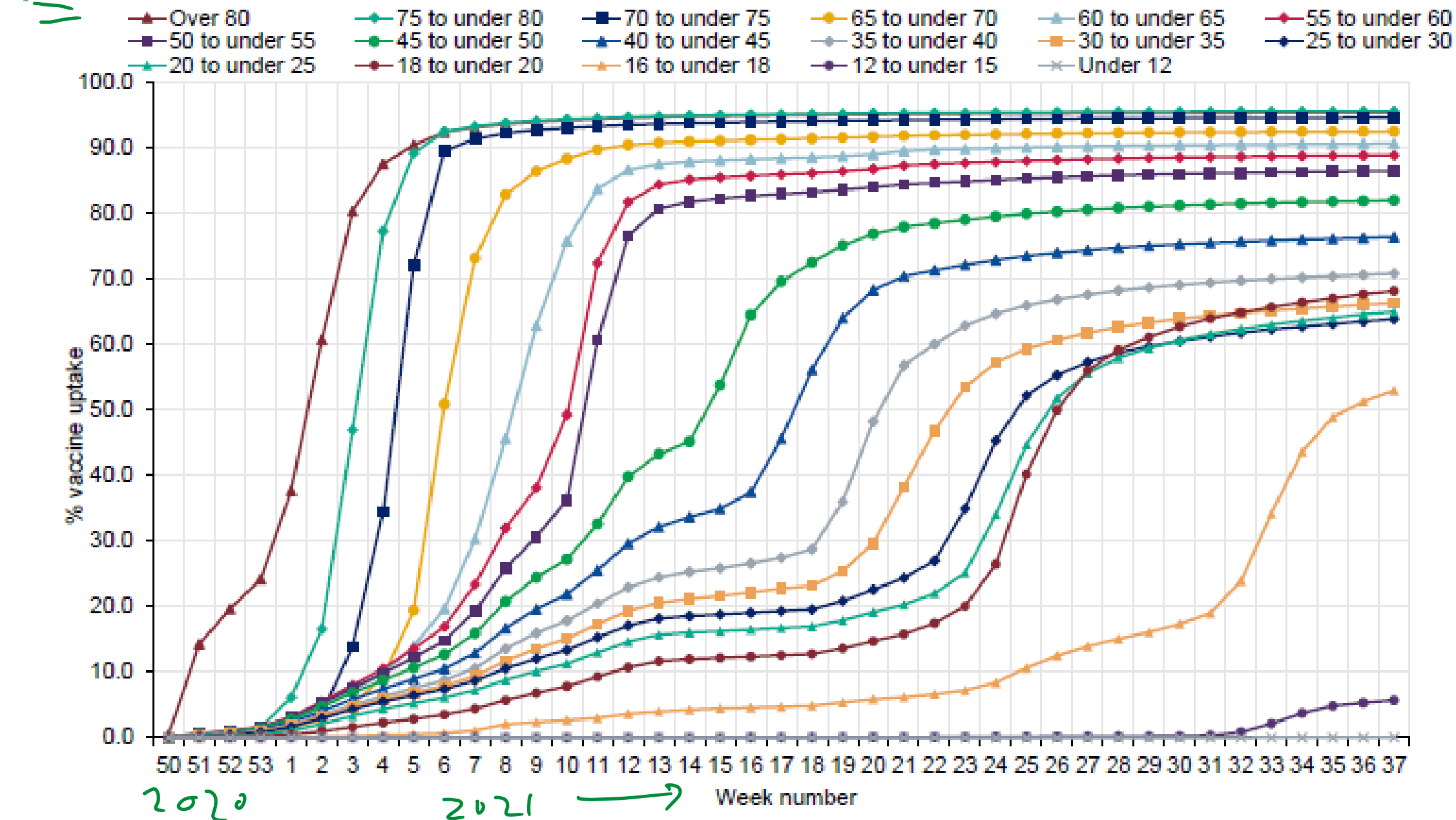
- Coverage
 - proportion of population with vaccine
 - who is unvaccinated
- Used to:
 - adapt vaccine delivery
 - assess effectiveness, impact, and safety



Vaccine Coverage

- Reporting comes from providers of vaccination
 - extraction from health record system
 - child health information systems
 - regular manual reporting
 - vaccine registries
- Information systems
 - automated data extraction
 - identifying vaccine eligibility
 - update individual records

a) Dose 1



Vaccine Impact

- Effectiveness
 - compare disease rates in vaccinated and unvaccinated
 - estimates level of protection in population
 - epidemiologic studies, modeling and serology *→ duration*
- Status
 - for illness, hospitalization, deaths from VPD

Vaccine Impact

- number of cases, hospitalizations, and deaths that were avoided

Vaccine Safety

Goals of Safety Surveillance

- Rapid detection of AEFIs and AESIs
 - adverse events following immunization
 - adverse events of special interest
- Data generation for new vaccines
- Identify and respond to safety issues
- Support public confidence in vaccines

→ manufacturer
• expected
• rare adverse events

→ vaccine enhanced disease
is this caused by vaccine?

AEFIs & AESIs: Passive Surveillance

- voluntary reporting from:
 - healthcare providers, pharmacists, coroners, patients
- required reporting:
 - event in children ✓
 - new vaccines ✓
 - serious events ✓
- information
 - brand and batch ✓
 - nature, timing, severity
 - other factors



AEFIs & AESIs: Active Surveillance

- using protocol
 - visits to facilities
 - discussion with healthcare professionals
 - records review



AEFIs & AESIs: Event Monitoring

- Follow-up of vaccinated
 - phone calls
 - emails
 - home visits



AEFIs & AESIs: Sentinel Surveillance

- Selected reporting units
 - many potential cases
 - good laboratory facilities
 - high quality data collection and reporting



AEFIs & AESIs

- potential safety signals
 - clusters of serious events, immunization errors, *etc.*
- causality assessments
 - review safety signals
 - stay updated on vaccine safety data
 - identify AEFI needing further investigation



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tidyverse data manipulation

- pipe operator

- %>%  %>%

- take the output from left side and put it into the next command or argument

- easy to set up “layers” of commands

pipeline

tidyverse data manipulation

- pipe operator

- %>%
- take the output from left side and put it into the next command or argument
- easy to set up “layers” of commands

```
data <- covid19_df %>%  
  filter(location == "Bangladesh") %>%  
  spread(data_type, value) %>%  
  arrange(date) %>%  
  mutate(deaths = deaths_new)  
  rename
```

subset





4 modification in one action

tidyverse data visualization

- ggplot2 package
- “Grammar of Graphics”
- building plots in layers

plots for
exploratory analysis
plot(...)

ggplot data visualization

- Always start with a  `ggplot(data = mpg) +`   
- plotting commands set up in rows with '+' between each

ggplot data visualization

- Tell ggplot what type of plot to make and which variables to use

ggplot(data = mpg) +

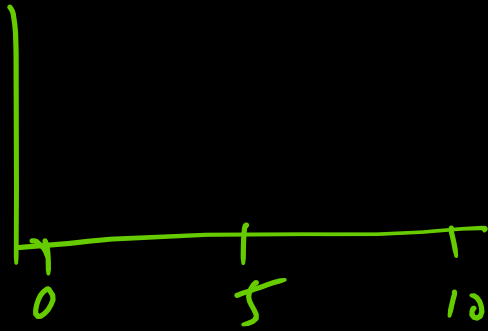
geom_point(mapping = aes(x=displ, y=hwy)) +

scatter plot

ggplot data visualization

- Make adjustments to the scale (optional)

```
ggplot(data = mpg) +  
  geom_point(mapping = aes(x=displ,y=hwy)) +  
  scale_x_continuous(breaks=c(2,4,6))
```

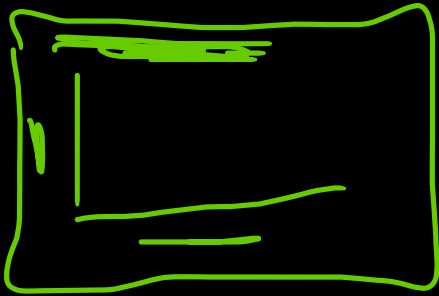


ggplot data visualization

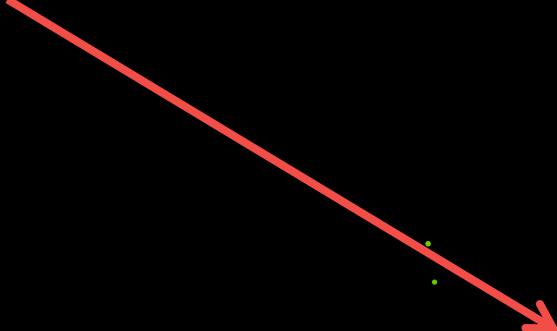
data(mpg)
data(cars)
(Iris) ...

- Add titles and labels (optional)

```
ggplot(data = mpg) +  
  geom_point(mapping = aes(x=displ,y=hwy)) +  
  scale_x_continuous(breaks=c(2,4,6)) +  
  ggtitle("Car Data") +  
  labs(x="Engine Size", y="Fuel Efficiency")
```



ggplot data visualization

- Use ggthemes to set up and standardize visual details
- ```
ggplot(data = mpg) +
 geom_point(mapping = aes(x=displ,y=hwy)) +
 scale_x_continuous(breaks=c(2,4,6)) +
 ggtitle("Car Data") +
 labs(x="Engine Size", y="Fuel Efficiency") +
 theme()
```
- 

default design