

# Designing and Implementing Health Information Systems

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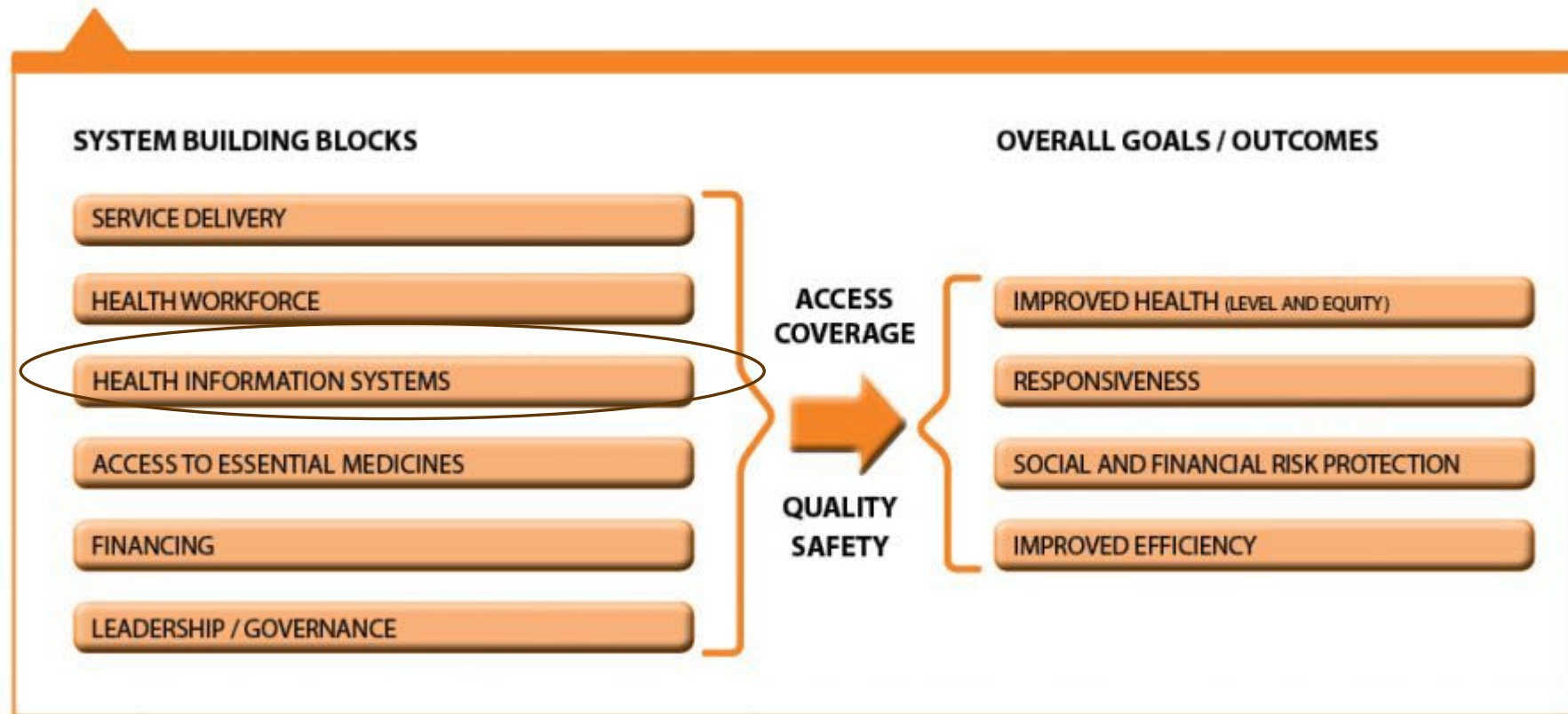
28 AUG 2024



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# What is a Health Information System?

**Figure 1. The WHO Health Systems Framework**



Source: Reference c

The organisations, institutions, people and resources whose primary purpose is to promote, restore or maintain health.

## Box 2. Selected definitions of HISs

HISs are systems providing information support to decision-making at all levels of the health system, which incorporate information generated by both population-based and institution-based data sources (8).

HISs can be defined as infrastructures for the monitoring of health activities, population health outcomes, and policies with a significant impact on health. They encompass the people, institutions, legislation, interinstitutional relationships, values, technologies, and standards that contribute to the different stages of data processing. These stages include the collection, analysis, storage, transmission, display, dissemination, and further utilization of data and information from various sources. The goal of health information systems is to allow all professional and lay users within and outside the health sector to use, interpret, and share information and to transform it into knowledge (9).

An HIS refers to a system involving producers, users, and other factors contributing to the production and use of health information. Health information generated by an HIS supports evidence-informed decision-making at every level of a health system (10).

The HIS provides the underpinnings for decision-making and has four key functions: (i) data generation, (ii) compilation, (iii) analysis and synthesis, and (iv) communication and use. The HIS collects data from health and other relevant sectors, analyses the data and ensures their overall quality, relevance and timeliness, and converts the data into information for health-related decision-making (11).

An HIS is the total of resources, stakeholders, activities and outputs enabling evidence-informed health policy-making (12).

# Health Information System - Definitions

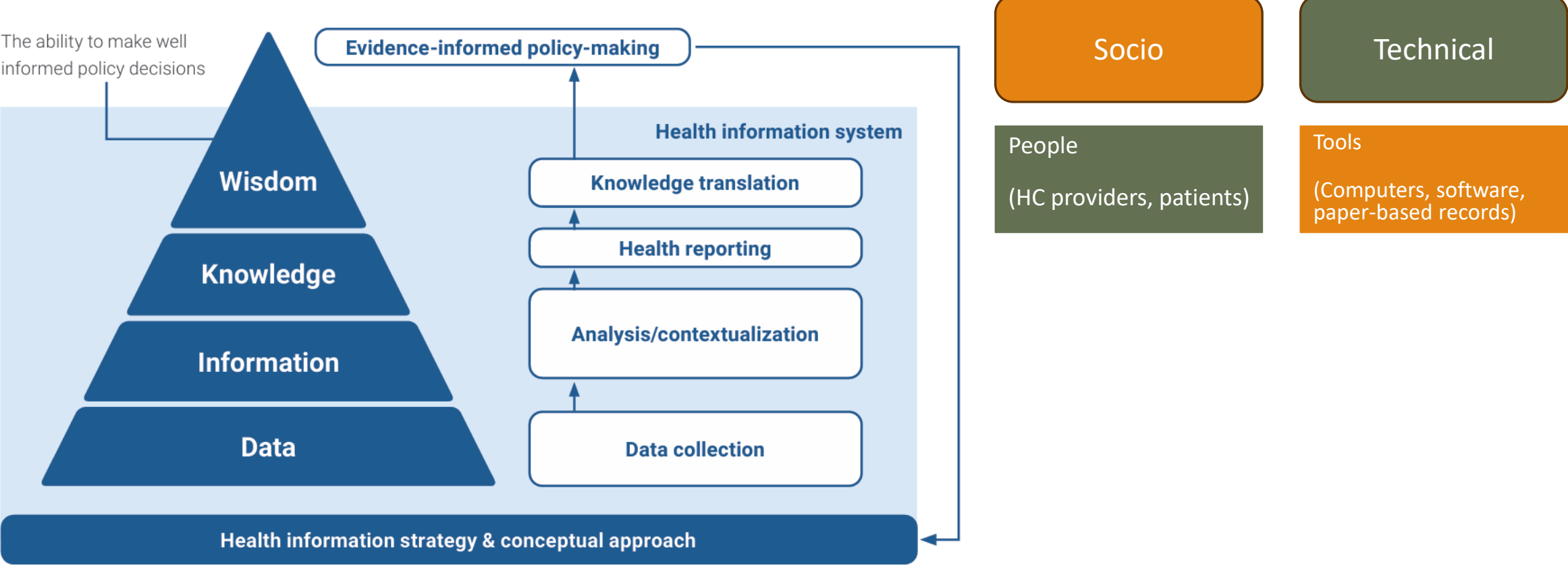
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“integrated effort to collect, process, report and use health information and knowledge to influence policy-making, programme action and research”.

“a set of interrelated components that collect, process, store and distribute information to support the decision-making process and assist in the control of health organizations”

“a system of interrelated constituents that collect, process, store and distribute data and information to support the decision-making process, assist in the control of health organizations and enhance healthcare applications”.

**Fig. 2. Population health monitoring model combining health information system outputs and activities**



*Note:* The levels in the data, information, knowledge and wisdom hierarchy, also known as the knowledge hierarchy or information pyramid, can be seen as the outputs an HIS generates by performing the activities depicted on the right side of the figure. Thus, when these HIS activities are performed, the information pyramid can be climbed to reach evidence-informed policy-making at the top.

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What is a Health Information System  
Used for?

# What is a Health Information System Used for?

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Individual-Level	Clinical decision-making
Health Facility-Level	Resource needs, purchasing drugs, equipment, outreach planning
Population-level	Information about those who use services AND those who don't (household surveys)
Public Health Surveillance	Epidemics, timely basis for action

# What are the main functions of the HIS?

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Data Generation

Compilation

Analysis and Synthesis

Communication and Use

Four key functions of HIS  
Underpinnings of decision-  
making

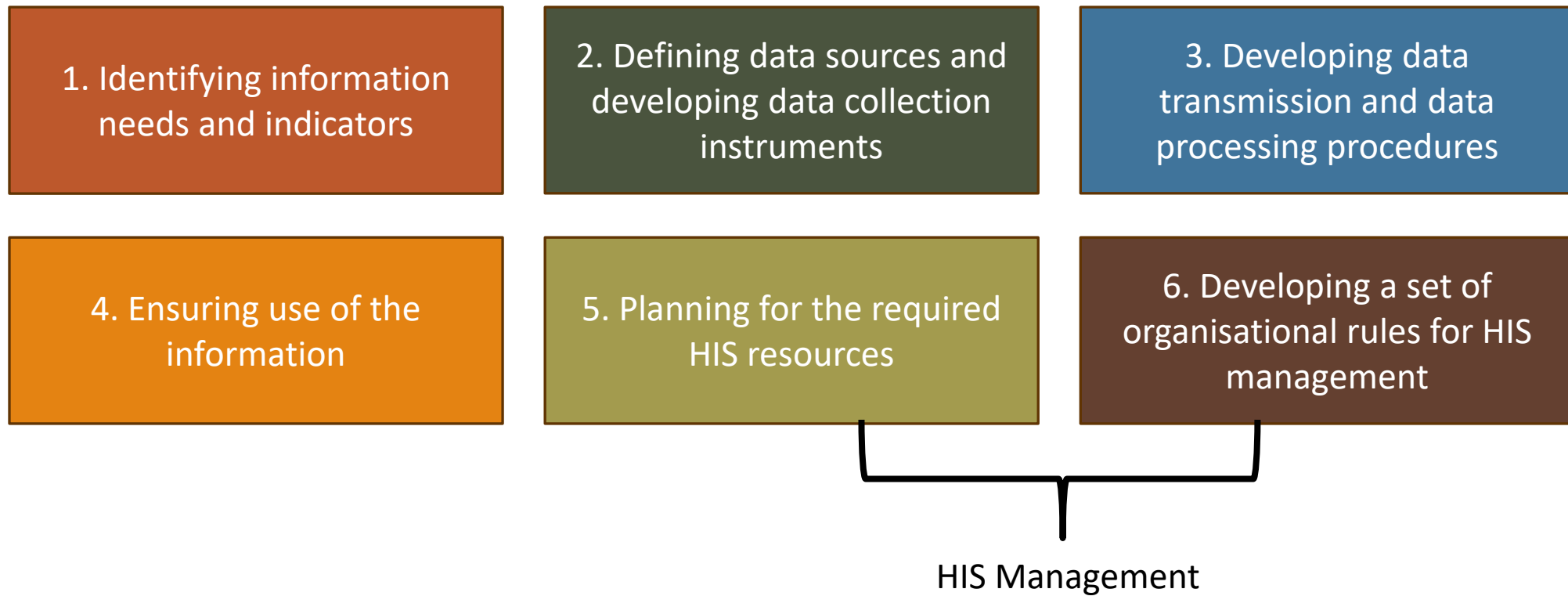


# HIS Design

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# HIS Design

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# HIS Design:

Identifying information needs and indicators

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# HIS Design: Identifying information needs

What information is needed to take decisions at each of these levels?

Individual-Level

Clinical decision-making

Health Facility-Level

Resource needs, purchasing drugs, equipment, outreach planning

Population-level

Information about those who use services AND those who don't  
(household surveys)

Public Health  
Surveillance

Epidemics, timely basis for action

# ESSENTIAL DATASET FOR A HEALTH FACILITY

- **Priority setting**
- **Limited number of feasible indicators**

## Special Program Activities

- Maternal & reproductive health
- Child health & nutrition
- Chronic illness
- HIV/AIDS, STI and TB

## Routine Service Activities

- Minor ailments
- Non-priority activities

## Epidemiological Surveillance

- Notifiable diseases
- Environmental health

## Administrative Systems

- Infrastructure, equipment
- Human resources
- Drugs, transport, laboratories, finances, budget, staff

## Population

- Census: age, sex, place
- Births & deaths registration

Figure 11: Information collected at PHC facilities

# DATA ELEMENT GROUPS



Adolescent Health



ART Baseline



ART Monthly



ART Outcome



Central Chronic Medicines  
Dispensing and Distribution



Child and Nutrition



Chronic



Communicable Diseases



Emergency Medical Services



Environmental Health



Expanded Programme on  
Immunisation



Eye Care



HIV



Malaria



Management Inpatients



Management PHC



Maternal and Neonatal



Mental Health



Oral Health



PHC Ward Based  
Outreach Teams



Quality



Rehabilitation



School Health



Sexually Transmitted  
Infections



TB Monthly



TB Quarterly



Women's Health

NIDS Data Elements 2016 NDoH

# DATA ELEMENTS - NIDS

[Home](#)[Organisational Units](#)[Indicators](#)[Data Elements](#)[Validation Rules](#)[Submissions](#)

## DATA ELEMENTS

**Data File : NIDS Integrated**

Version: NIDS 2020

Search: Groups: Download: 

UID	Data Element Name	Y	Short Name
X8j2Z6m4O8d	<a href="#">All DS-TB client death</a>		All DS-TB death
T2uU41Q5SCd	<a href="#">All DS-TB client in treatment outcome cohort</a>		All DS-TB outcome cohort
TxU0Yvaz8VC	<a href="#">All DS-TB client lost to follow-up</a>		All DS-TB LTF
qEI5I93Lq0l	<a href="#">All DS-TB clients treatment failure</a>		DS-TB failure
Q4m0E3c8D7p	<a href="#">All DS-TB client successfully completed treatment</a>		All DS-TB success
SZriUtR2k7z	<a href="#">All DS-TB treatment start</a>		All DS-TB start Rx
N2m4W6w3N4r	<a href="#">Antenatal 1st visit 20 weeks or later</a>		ANC 1st visit >=20w
CI4D9i5T6j2	<a href="#">Antenatal 1st visit before 20 weeks</a>		ANC 1st visit <20w
Afp9c3hcKx9	<a href="#">Antenatal already on ART at 1st visit</a>		ANC already ART 1st visit
K2j3J8b4H6c	<a href="#">Antenatal client HIV re-test</a>		ANC HIV re-test
cx6F4m5U5v2	<a href="#">Antenatal HIV 1st test</a>		ANC HIV 1st test
Cb3X7x9P7b2	<a href="#">Antenatal HIV 1st test positive</a>		ANC HIV 1st test pos
J1a6l8c1G2k	<a href="#">Antenatal HIV re-test positive</a>		ANC HIV re-test pos
cq3K6v5R5e3	<a href="#">Antenatal known HIV positive but NOT on ART at 1st visit</a>		ANC known HIV pos not ART
X1d4L2l6W1k	<a href="#">Antenatal start on ART</a>		ANC start ART

# DATA DEFINITIONS

Data Field	Definitions
PHC headcount under 5 years	All individual patients not yet reached five years (60 months) of age attending the facility during the period.
PHC headcount 5 years and older	All individual patients five years (60 months) and older attending the facility during the period.
DOTS visit – Facility	Directly Observed Treatment System visit (usually daily) by a diagnosed tuberculosis patient to receive medication.
Nurse clinical work days (PHC)	The number of actual work days by nurses, irrespective of rank, used to perform Primary Health Care services in the month.
First antenatal visit	A first visit by a pregnant woman to a health facility for the primary purpose of receiving antenatal care.
Follow-up antenatal visit	Any antenatal visit other than a first antenatal visit.
Tet Tox 3 <sup>rd</sup> /booster dose to pregnant woman	The final Tet Tox dose given to a pregnant woman. Women who have proof of being fully immunised during a previous pregnancy need only a single booster.
Oral pill cycle	A packet (cycle) of oral contraceptives issued to a woman.
Nuristerate injection	Any Nuristerate (Norethisterone enantate) injection given into a woman between 15 and 45 years.
Depo-provera/Petogen injection	Depo-provera/Petogen (Medroxyprogesterone acetate) injection given to a woman between 15 and 45 years.
Condoms distributed	Condom that has been given out or taken from distribution points in facilities or elsewhere (including campaigns).
Referred for Termination of Pregnancy	A client referred to a facility that provides Termination of Pregnancy Services.

**Table 3: Partial list of the DHIS data definitions**



# DATA DEFINITIONS

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DE Group	TB monthly
Data element name	DS-TB <b>Bacteriologically</b> confirmed under 5 years
Bulleted definition	Children under 5 years who were bacteriologically confirmed with GeneXpert, or culture and DST as Rifampicin-Susceptible TB (RS-TB)
Extended Definition	None
Use and Context	Monitors trends in early identification of clients with DS-TB in health care facilities
Inclusions	INCLUDE All children with confirmed Drug-Susceptible TB, including pulmonary and extra-pulmonary TB;
Exclusions	EXCLUDE children diagnosed with Rifampicin Resistant (RR) TB; EXCLUDE children clinically diagnosed only
Collected by	Clinician
Collection points	Clinics, CHCs, Hospitals
Frequency	Monthly
Tools	TB Identification register

# DATA ELEMENTS VS INDICATORS IN DHIS

Indicator

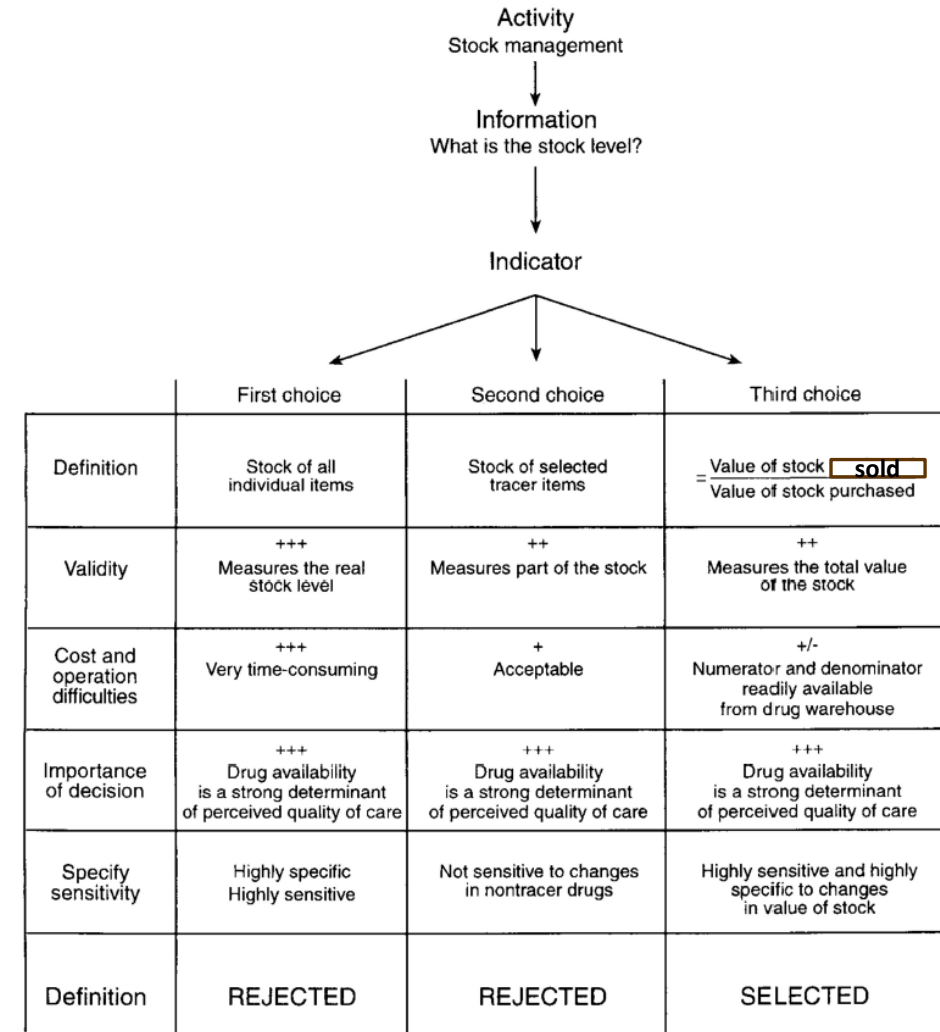
Indicator	Formula	Numerator	Denominator	Factor
Maternal Mortality Rate	Maternal deaths/Live births x 100 000	Maternal deaths	Live births	100 000 (MMR is measured per 100 000)

Element

**Fig. 10** Selection process of an indicator for stock management

## Selecting Indicators

- What is the indicator supposed to measure (validity?)
- What will be the cost of measuring the data?
- What is the relative importance of the subject matter and decision to be made based on the indicator? (relevance)
- Does the indicator actually capture changes that occur in the situation under study (specificity)?
- Is the change shown by the indicator a true change in the situation under study? (sensitivity)?



# HIS Design:

Defining data sources and  
developing data collection  
instruments

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# HIS Design: Defining data sources

What source of information can we use at each of these levels?

Individual-Level

Clinical decision-making (patient files: paper/electronic)

Health Facility-Level

Resource needs, purchasing drugs, equipment, outreach planning

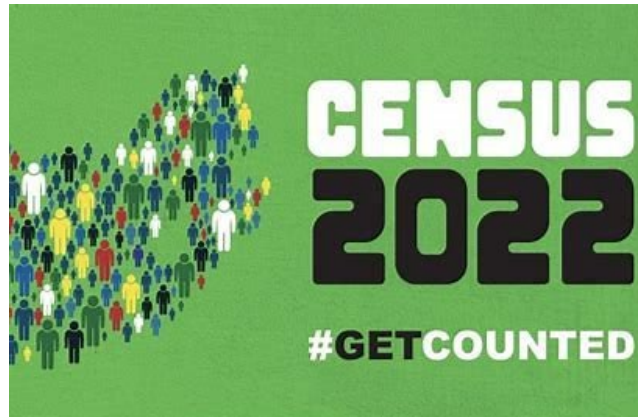
Population-level

Information about those who use services (service delivery – RHIS)  
AND those who don't (household surveys)

Public Health  
Surveillance

Epidemics, timely basis for action

Data sources may be routine or non-routine



# PATIENT-HELD RECORDS

**COVID-19 Vaccination Record Card**

Please keep this record card, which includes medical information about the vaccines you have received.  
Por favor, guarde esta tarjeta de registro, que incluye información médica sobre las vacunas que ha recibido.

Last Name \_\_\_\_\_ First Name \_\_\_\_\_ Patient number (medical record or IIS number) \_\_\_\_\_

Date of birth \_\_\_\_\_

**Vaccine** **Product Name/Manufacturer** **Date** **Healthcare Professional or Clinic Site**

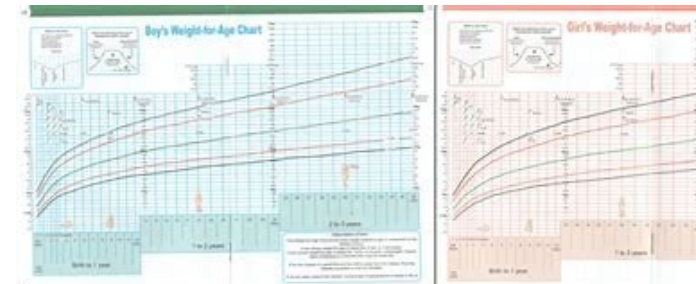
1 <sup>st</sup> Dose COVID-19	PEIZER EKLIT6	15/21	Allina CR
2 <sup>nd</sup> Dose COVID-19			

**ROAD TO HEALTH GIRLS**

**ROAD TO HEALTH BOYS**

IMPORTANT: Always bring this booklet when you visit any health clinic, doctor or hospital.

health



**IMMUNISATIONS**

Name and surname: \_\_\_\_\_ ID number: \_\_\_\_\_

Age group	Batch no.	Vaccine	Site	Date given (dd/mm/yy)	Signature
Birth		BCG	Right arm		
		OPV0	Oral		
		OPV1	Oral		
6 weeks		RV1	Oral		
		DTaP-IPV-Heb1	Left thigh		
		Hep B1	Right thigh		
10 weeks		PCV 1	Right thigh		
		DTaP-IPV-Heb2	Left thigh		
		Hep B2	Right thigh		
14 weeks		DTaP-IPV-Heb3	Left thigh		
		Hep B3	Right thigh		
		PCV2	Right thigh		
9 months		RV2	Oral		
		Measles1	Left thigh		
		PCV3	Right thigh		
18 months		DTaP-IPV-Heb4	Left arm		
		Measles2	Right arm		
		Td	Left arm		
6 years		Td	Left arm		
		Td	Left arm		

**HEAD CIRCUMFERENCE AT 14 WEEKS AND AT 12 MONTHS**

14 Weeks: \_\_\_\_\_ (Range: 37 - 42 cm) 12 Months: \_\_\_\_\_ (Range: 42 - 47.5)

REFER if head circumference is outside range

ROAD TO HEALTH



# HIS Design: Data Collection Instruments

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- **Layout:** Is the flow logical? Is there enough space to fill out the required information?
- **Clarity:** Are the instructions clear and helpful?
- **Burden:** How much time and effort does it take to complete the form?
- **Feasible:** Is it possible to collect the information from this setting?  
e.g. if lab-information is required
- **Duplication:** Is this information collected elsewhere?



# HIS Design:

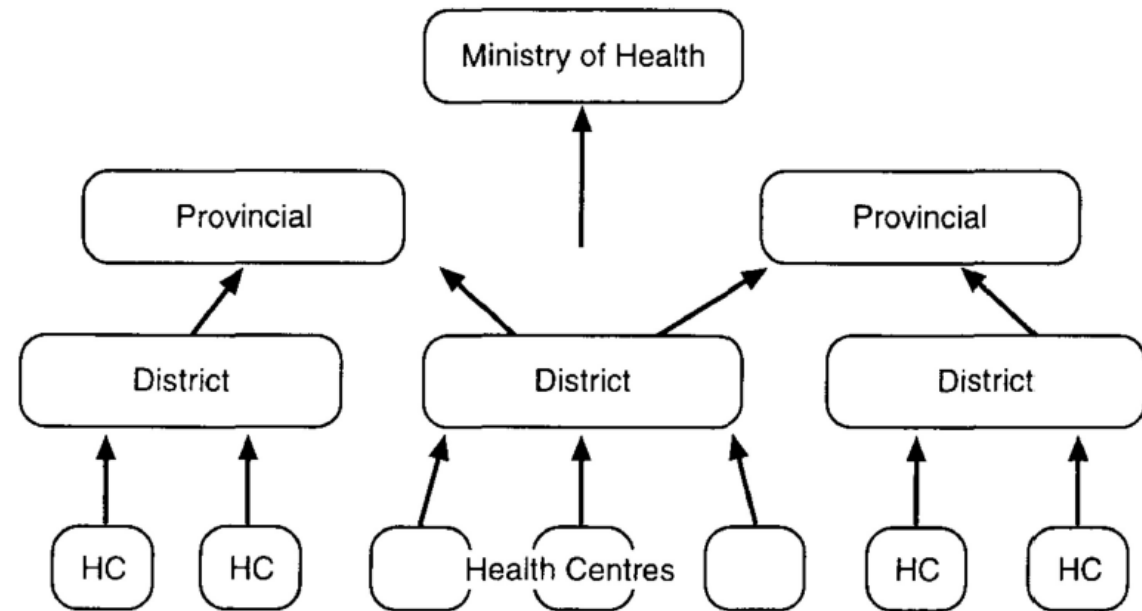
Defining data transmission and data processing procedures

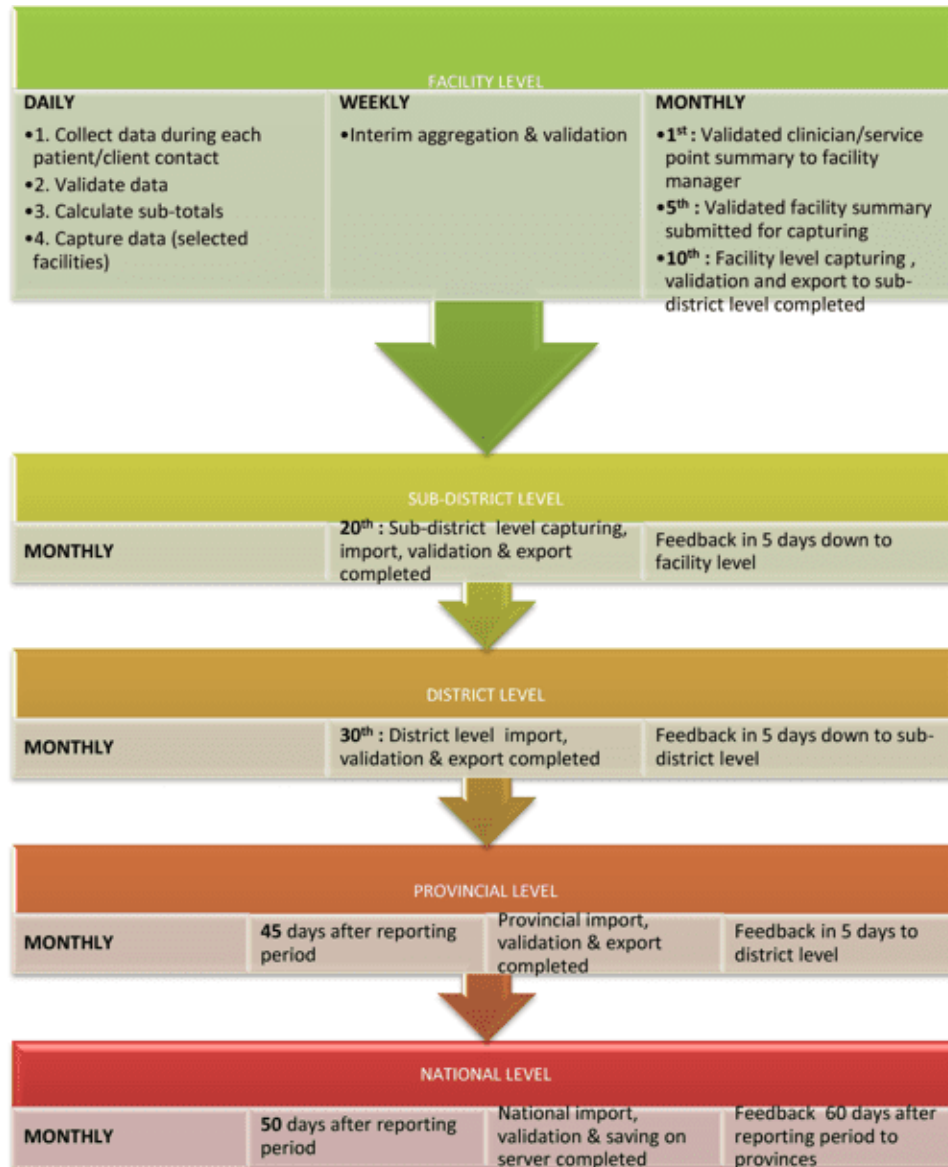
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# Data Transmission

Transfer of raw data from the lowest level to higher levels of a health system for the purpose of data processing.

Recognition that raw data collected at the lower level may not be in a form or of sufficient quality to be useful for decision-making.





# DHMIS POLICY

# Data Processing

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## DATA CLEANING

- Missing Records
- Duplicated Records
- Implausible values
- Contradicting values
- Inconsistency with other known information

## RE-ARRANGE THE DATA TO FORM A SUMMARY SET OF VARIABLES

- Tabulations
- Statistical analyses

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What are the characteristics of good quality data?

# Data Quality

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Characteristic	How it's measured
Accuracy	Is the information correct in every detail?
Completeness	How comprehensive is the information?
Reliability	Does the information contradict other trusted resources?
Relevance	Do you really need this information?
Timeliness	How up- to-date is information? Can it be used for real-time reporting?

# Data Quality

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## Inappropriate data collection instruments and procedures

e.g. adapting a DCI from a different setting without making changes for the context

Poorly defined indicators

Illegible forms - photocopying

## Poor recording and reporting

e.g. non-submission of data from a health facility (no personnel)

Poor understanding of indicator

Purposeful reporting of false data

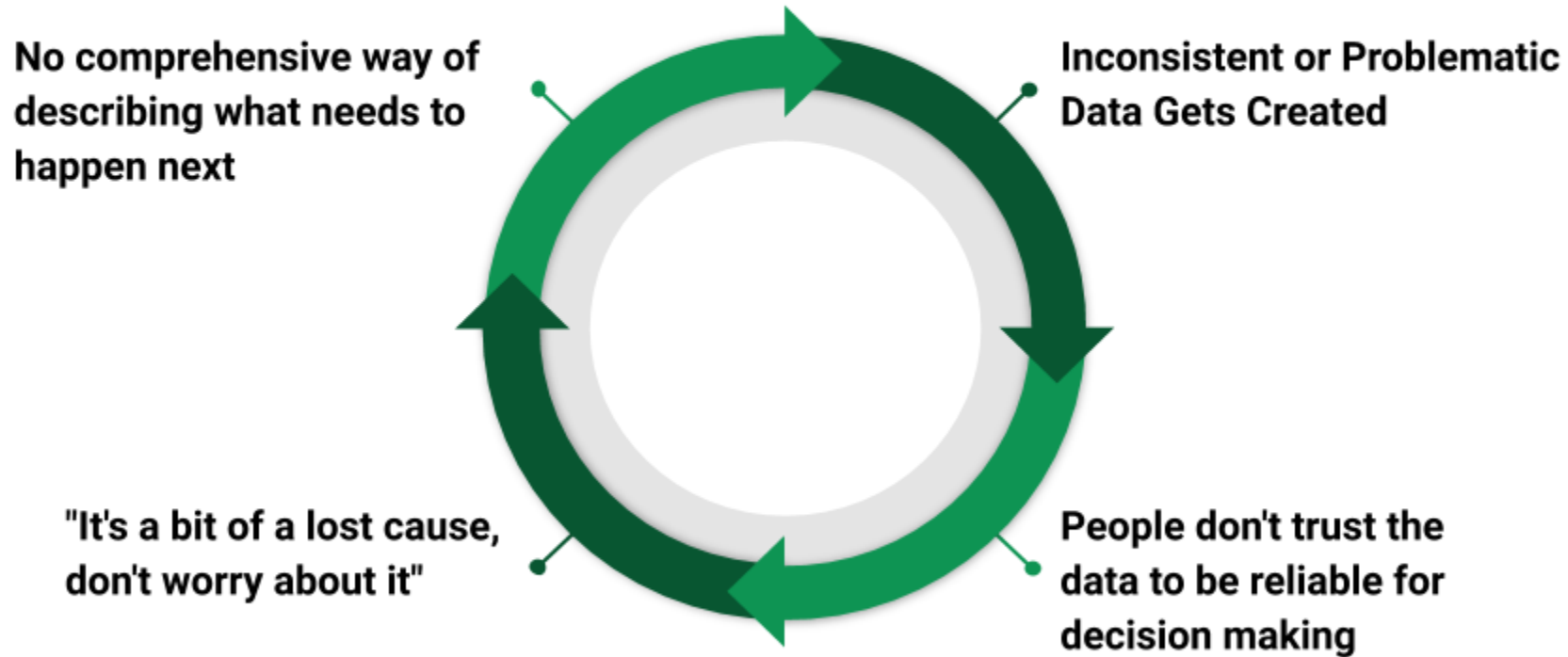
## Errors in data processing

e.g. coding errors – ICD10

Tabulation error

Linkage error

# The Data Quality Vicious Cycle



**DataKind**



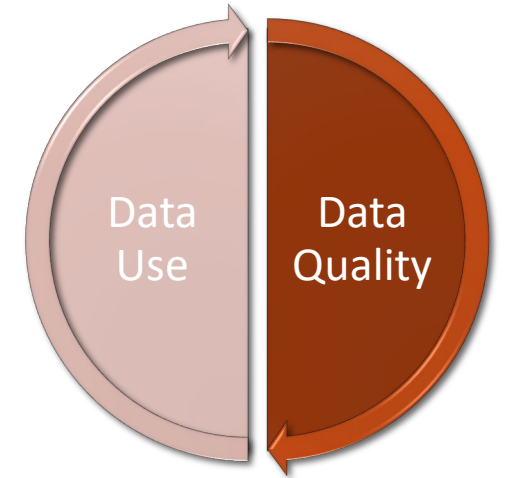
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What are some ways you can think of to improve data quality?

# Data Quality

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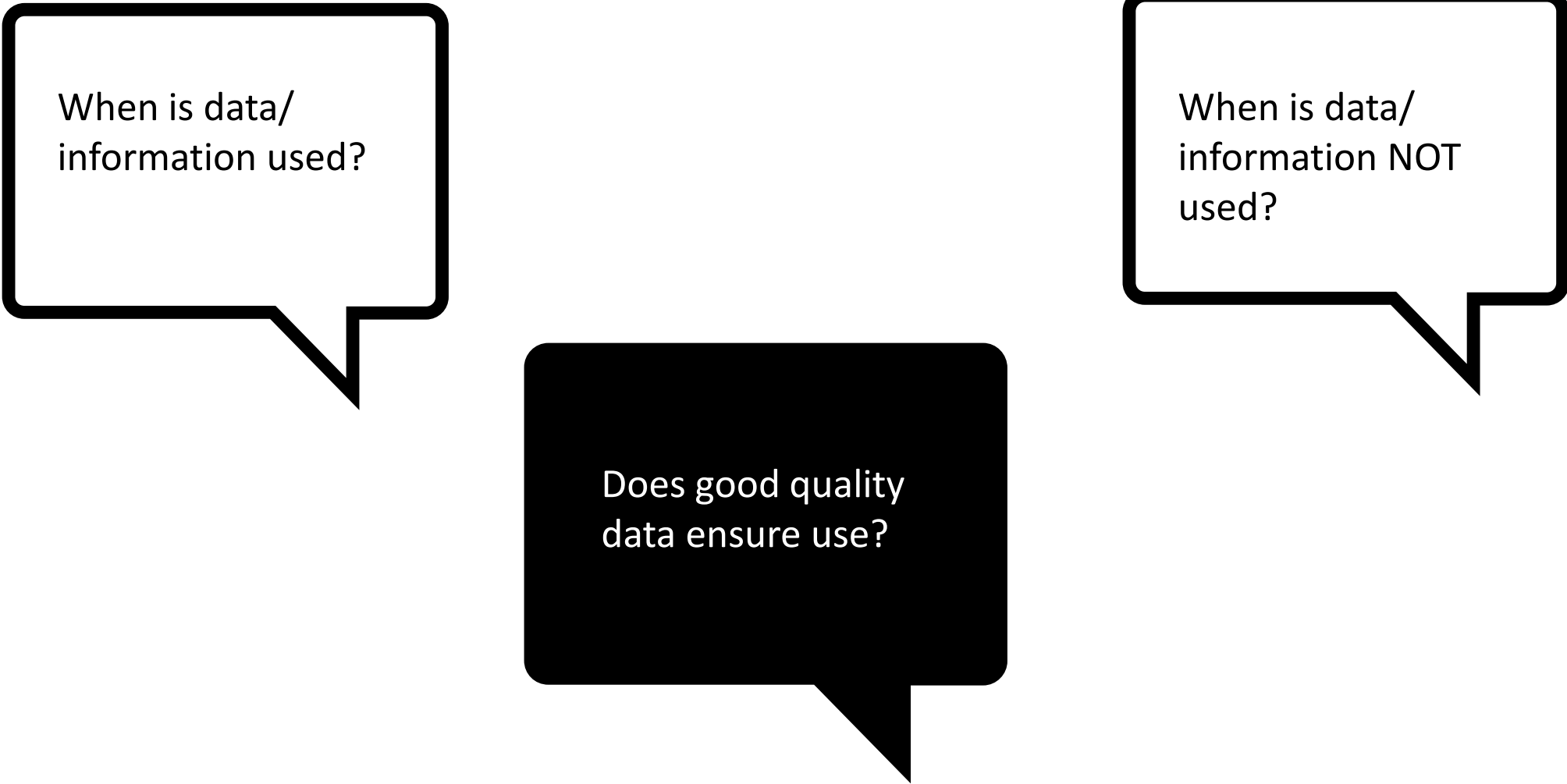
- Simple design – less room for error
- Standardise procedures and definitions - e.g. NIDS/ DHMIS policy/ SOPs
- User involvement in design
- Testing/ piloting data collection instruments
- Training and refresher training
- Incentive structure
- Monitoring – data quality audits/ comparison with other data sources/flag potential errors – e.g. data validation reports
- Feedback



# HIS Design:

Ensuring use of the information

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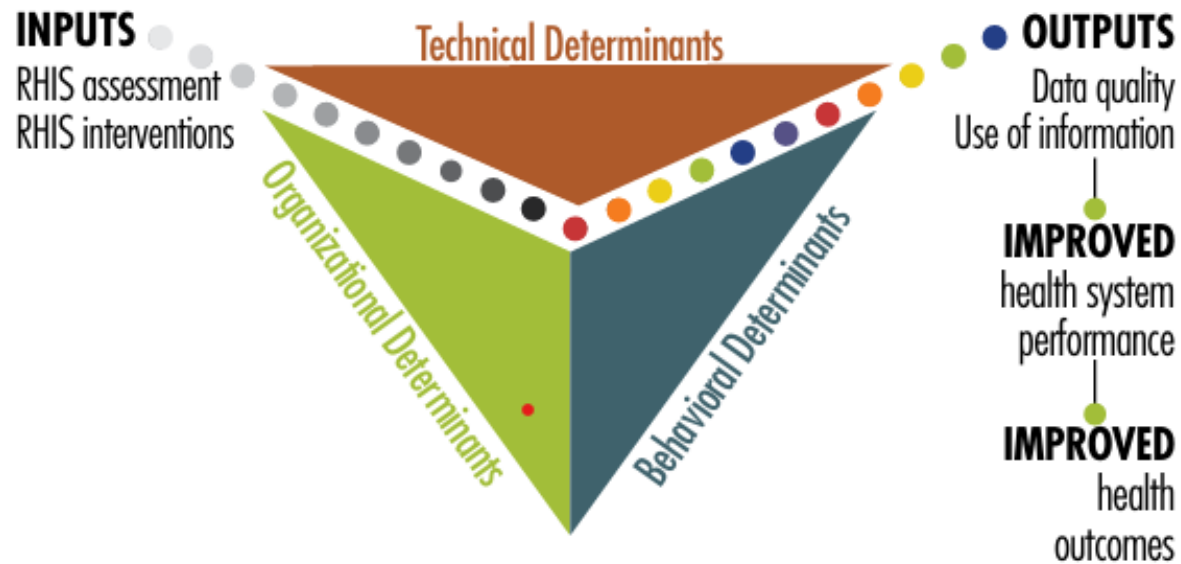
When is data/  
information used?

When is data/  
information NOT  
used?

Does good quality  
data ensure use?

# Ensuring use of information

**Figure 1. PRISM Framework**



## **Behavioural Determinants:**

The knowledge, skills, attitudes, values, and motivation of the people who collect, analyze, and use health data

## **Technical Determinants:**

The RHIS design, data collection forms, processes, systems, and methods

## **Organisational Determinants:**

Information culture, structure, resources, roles, and responsibilities of key contributors at each level of the health system

PRISM : Performance of Routine Information System  
Management

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What are some ways you can think of to improve data use in decision-making?

# Improving use of data for decision making

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- Ownership and relevance of the data
  - Users involved in data needs assessment, indicator selection, DCI development, etc.
- Validity and reliability
  - In design phase and in implementation (monitoring)
- Data at the level required
  - Aggregation or disaggregation of data – user needs
- Data Visualisation
  - Easily interpreted
- Timeliness
  - Complement the health system planning cycle
- Understanding when/where decisions are made
  - E.g. How to structure programme review meetings

# HIS Design:

# HIS Management -Resources and Organisational Rules

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## *Elements of health information system (HIS) management*



**Equipment:** requirements for different settings/facilities

**Staff:** What HIS responsibilities do staff have? Clinical staff vs non-clinical staff?

**Training:** What are the training requirements

**Financial:** How do we fund HIS implementation - programme-specific/ system-wide

**Governance:** Who has the responsibility to manage the HIS?

**Steering committee:** Multidisciplinary team, oversee the strategic direction, address user needs

**Data collection standards** (e.g. ICD 10), NIDS

**Data transmission schedules/timelines** (e.g. DHMIS policy)

**Privacy/confidentiality/access rights**

**Standards** for training/equipment

**M&E systems** – data quality – audit/intervention/ improvement

# Other relevant terms

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## Electronic Health Record (EHR)/EMR

Have you heard of an EHR?

- What is it?
- How is it different to what we have been talking about?

# Electronic Health Record

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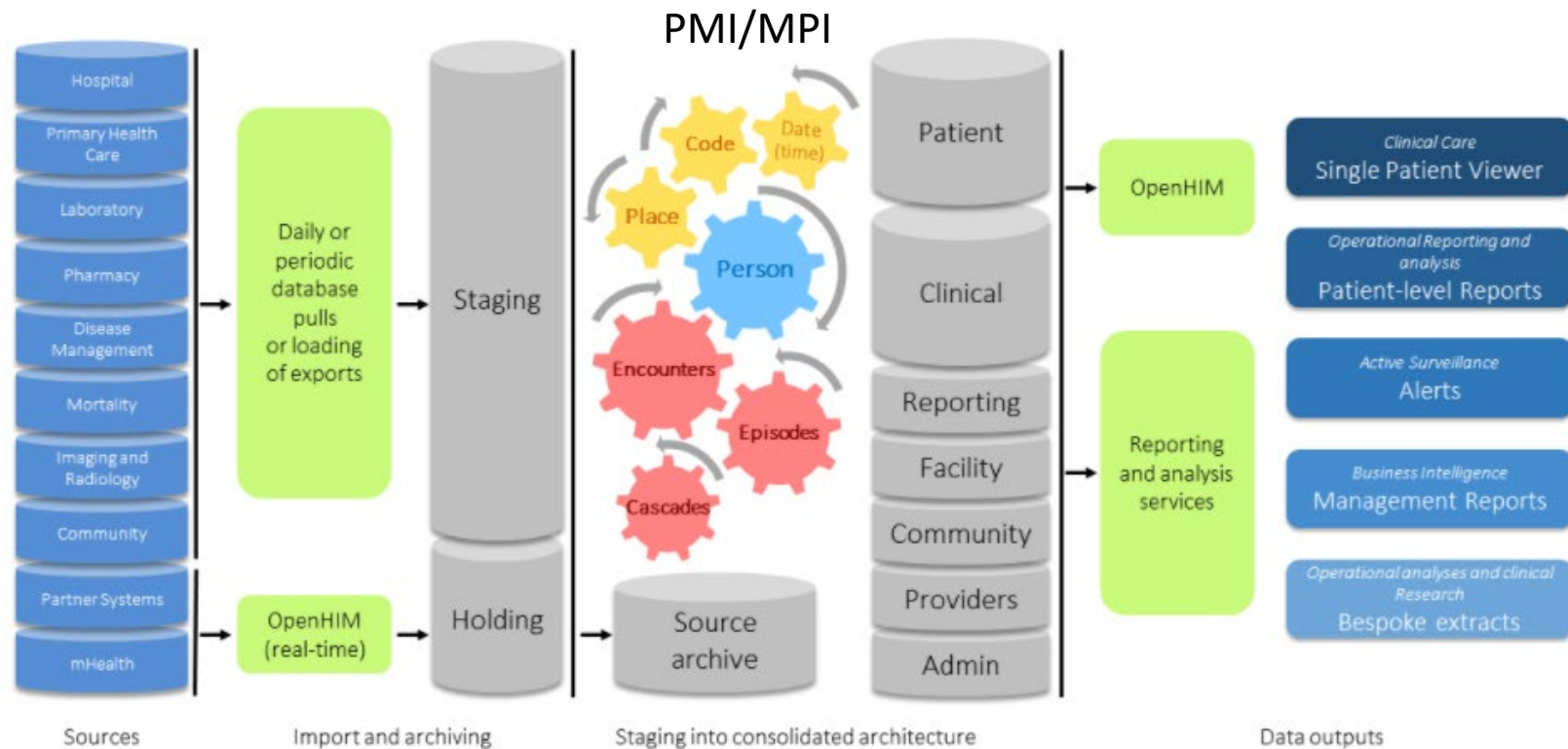
- Sometimes referred to as EMR
- Collects health and demographic information about an individual
- Longitudinal
- Ideally contains data across health delivery sites
  - Electronic Patient Record (EPR) usually used to refer to information at 1 site only
- Some allow for patients to access their own records

# Health Information Exchange (HIE)

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- Health information exchange (HIE), involves the electronic transfer of health information between health care organizations according to nationally recognized standards
- Concept– the idea that all health data should be readily available to the patient and clinicians at the point of care, regardless of where that data was generated.
- Potential use cases:
  - Access to more comprehensive clinical information – better decision making for clinicians
  - More accurate information about disease burden and can be aggregated/ disaggregated as needed
  - Clinical governance – ability to “audit” service delivery easily and design targeted interventions
  - Better understanding of health-seeking behaviour and service utilisation
  - Datasets for health research – simplifies the research process

# Health Information Exchange (HIE)



# Resources

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- Design and Implementation of Health Information Systems. Edited by Theo Lippeveld, Rainer Sauerborn, Claude Bodart. WHO 2000
- The benefits of health information exchange: an updated systematic review. Nir Menachemi, Saurabh Rahurkar, Christopher A Harle, Joshua R Vest. Journal of the American Medical Informatics Association
- Health Information Systems: Technological and Management Perspectives. Winter A, Ammenwerth E, Haux R, et al.
- Health Information Systems in South Africa. Rene English, Thulani Masilela, Peter Barron, Anzel Schonfeldt. SAHR 2011
- A Systematic Literature Review of Health Information Systems for Healthcare. Ayogeboh Epizitone, Smangele Pretty Moyane, Israel Edem Agbehadji, Healthcare 2023
- Support tool to strengthen health information systems: guidance for health information system assessment and strategy development. Copenhagen: WHO Regional Office for Europe; 2021