WORLD BANK GROUP
Health, Nutrition & Population

2018 SKILLS BUILDING PROGRAM

BIG DATA, ARTIFICIAL INTELLIGENCE AND DECISION SCIENCE IN HEALTH AND NUTRITION

Implementation Cascades & Optimization

Review of Day 1

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Reflections

Review questions

Plan for the Day

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Introduction to the Cascade Analysis Tool

(C6)

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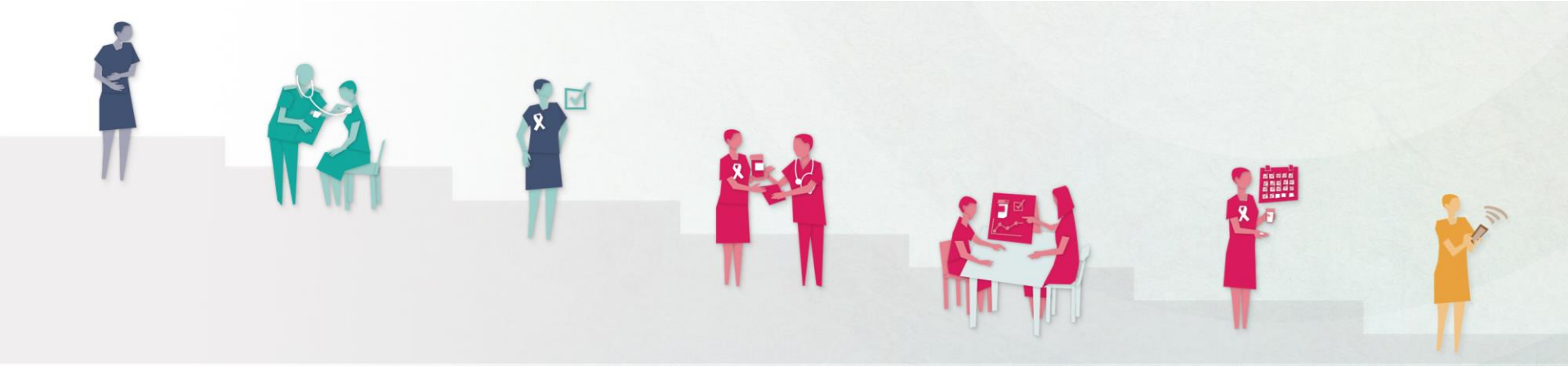
Takeaways from this Session

1. An introduction to the “Cascade Analysis Tool”, software for analyzing cascades

Note: this session will be short: focus will be on practical experience with the tool



Reminder of context: Quantify Programmatic Outcomes

- Multitude of systems in operation to collect/aggregate program results
- In theory, these data are intended to enable organizations to **assess implementation**
  - *which strategies and programs are effective*
  - *identify elements of programs associated with better results*
  - *demonstrate accountability to external stakeholders*
  - *make decisions about allocating further funding*

- In practice, there is **a disconnect between the data being collected and the methods available for analyzing them**

➢ ***The Cascade Analysis Tool aims to bridge this gap***

Key policy questions for the Cascade Analysis Tool

1. Where are the **breakpoints** in the cascade?
   - *Review session C1, P1*

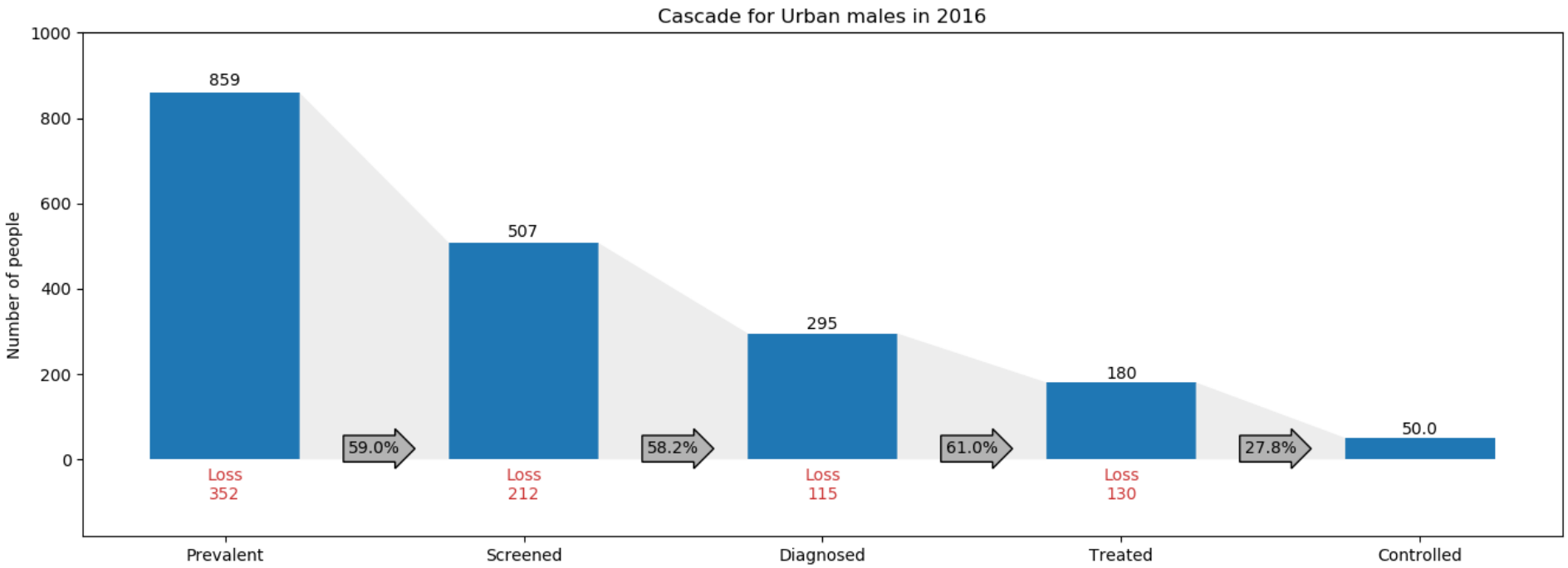
2. How do **interventions** impact the cascade?
   - *Review: sessions C2, C3, P3*

3. How could different **programmatic strategies** lead to different/better cascades?
   - *Review: sessions C3, C5, P4*

4. What would be the **optimal programmatic strategy** to maximize successes along the cascade?
   - *Review: sessions C5, P4*

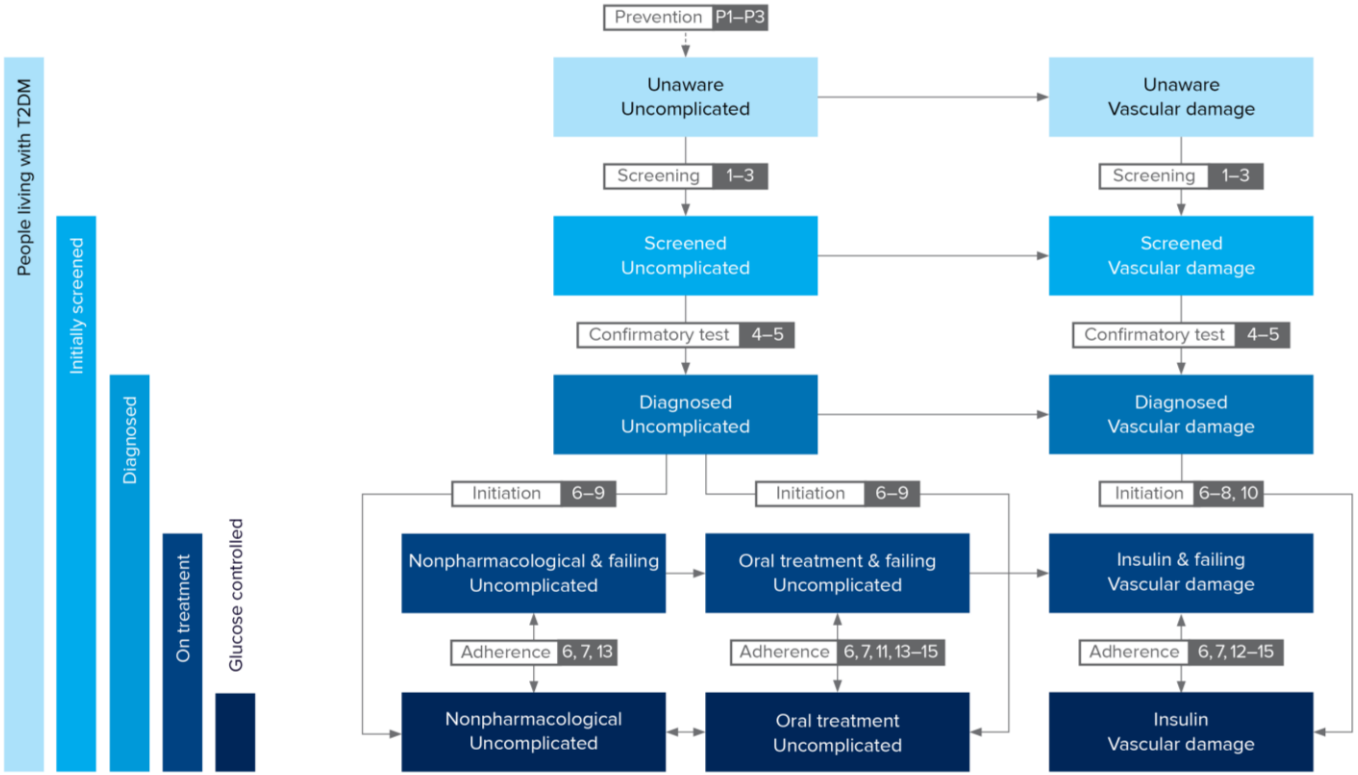
Example results

1. Where are the **breakpoints** in the cascade?
   - *Heterogeneity by population and place…*
   - *Conversion rates and losses*



Example results

2. How do **interventions** impact the cascade?

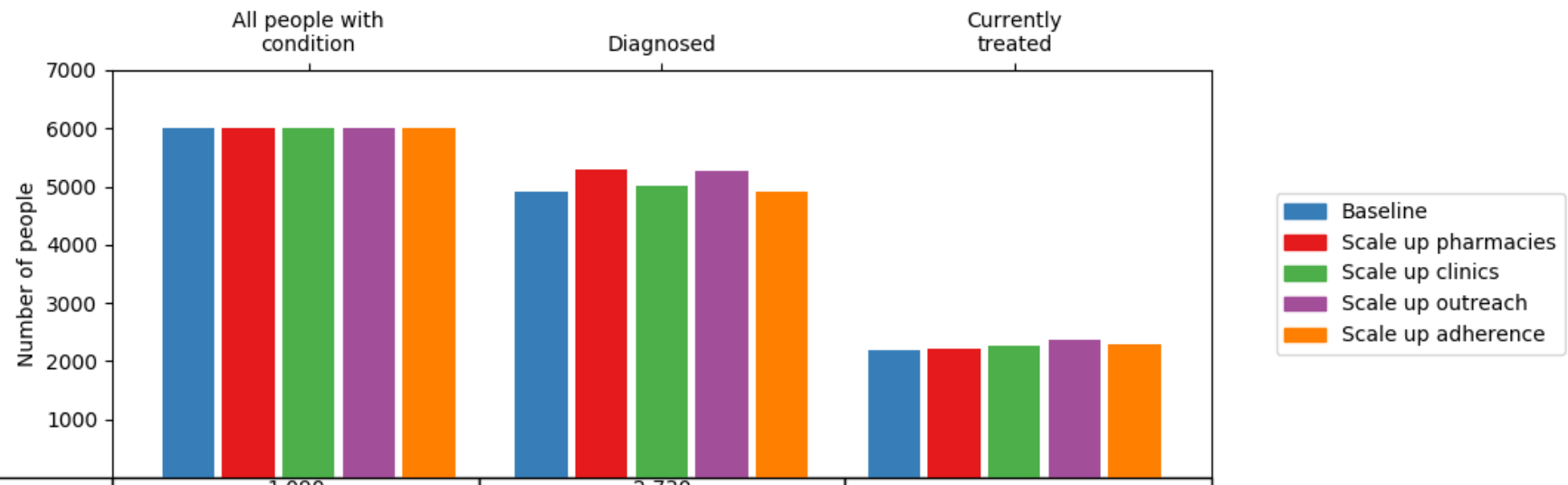


Prevention
P1. Smoking counselling
P2. Health schools
P3. Nutrition/diet counselling

Care and treatment
1. PHC screening
2. Feldsher screening (family nurse)
3. Outreach/community-based screening
4. Confirmatory test - endocrinologist
5. Confirmatory test - family doctor
6. IEC - patient schools
7. IEC - PHC clinic staff
8. Support for self-monitoring
9. Initial clinical exam - simple
10. Initial clinical exam - complex
11. Co-payment scheme - oral
12. Co-payment scheme - insulin
13. Enhanced treatment adherence counselling
14. HbA1C test (public sector)
15. Clinical exam (average package)

Example results

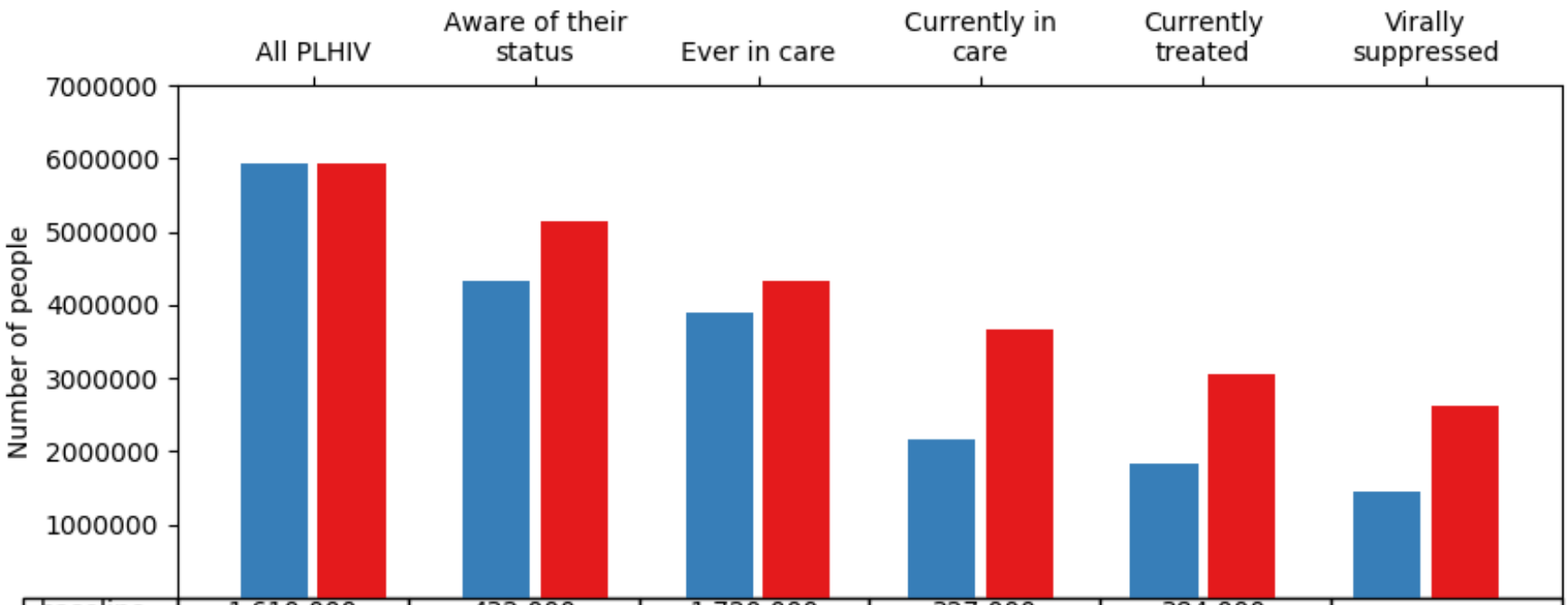
3. How could different **programmatic strategies** lead to different/better cascades?



	All people with condition	Diagnosed	Currently treated
Baseline	1,090	2,730	-
Scale up pharmacies	715	3,060	-
Scale up clinics	995	2,750	-
Scale up outreach	725	2,910	-
Scale up adherence	1,090	2,620	-

Example results

4. What would be the **optimal programmatic strategy** to maximize successes along the cascade?



	All PLHIV	Aware of their status	Ever in care	Currently in care	Currently treated	Virally suppressed
baseline	1,610,000	432,000	1,720,000	327,000	384,000	-
optimized	781,000	811,000	684,000	603,000	436,000	-

Analysis steps and data requirements

1. STEP 1: Design cascade
   A. Identify the "target state" (last bar in cascade).
   B. Identify the "pathways to the target state" – how do people get there? What intermediate stages do they go through? What are the flows/transitions?
   C. Figure out how the pathways translate to a cascade

–> DATA

–> DATA

2. STEP 2: Add interventions
   A. Identify interventions that move people along the pathways
   B. How do these interventions interact? (synergies, complementarities…)
   C. Costing, coverage and constraints

–> DATA

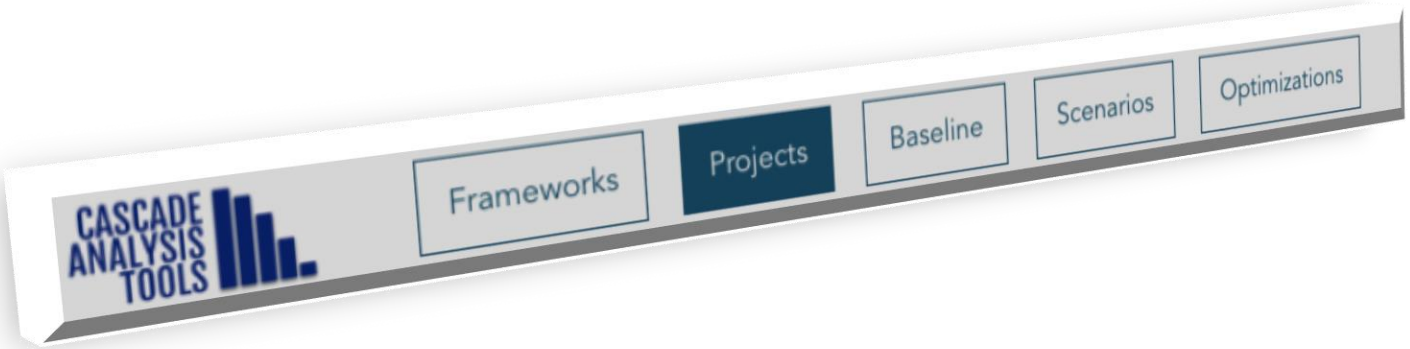
–> DATA

–> DATA

3. STEP 3: Optimize and analyse

Tool overview

- Based around the steps discussed
  - FRAMEWORKS: designing a cascade
  - PROJECTS: populate the cascade with data
  - BASELINE: visualize baseline projections
  - SCENARIOS/OPTIMIZATIONS



- Open access and freely available

Live demo

CASCADE ANALYSIS TOOLS

We go to http://ui.cascade.tools/ for a walk-through…

System requirements:

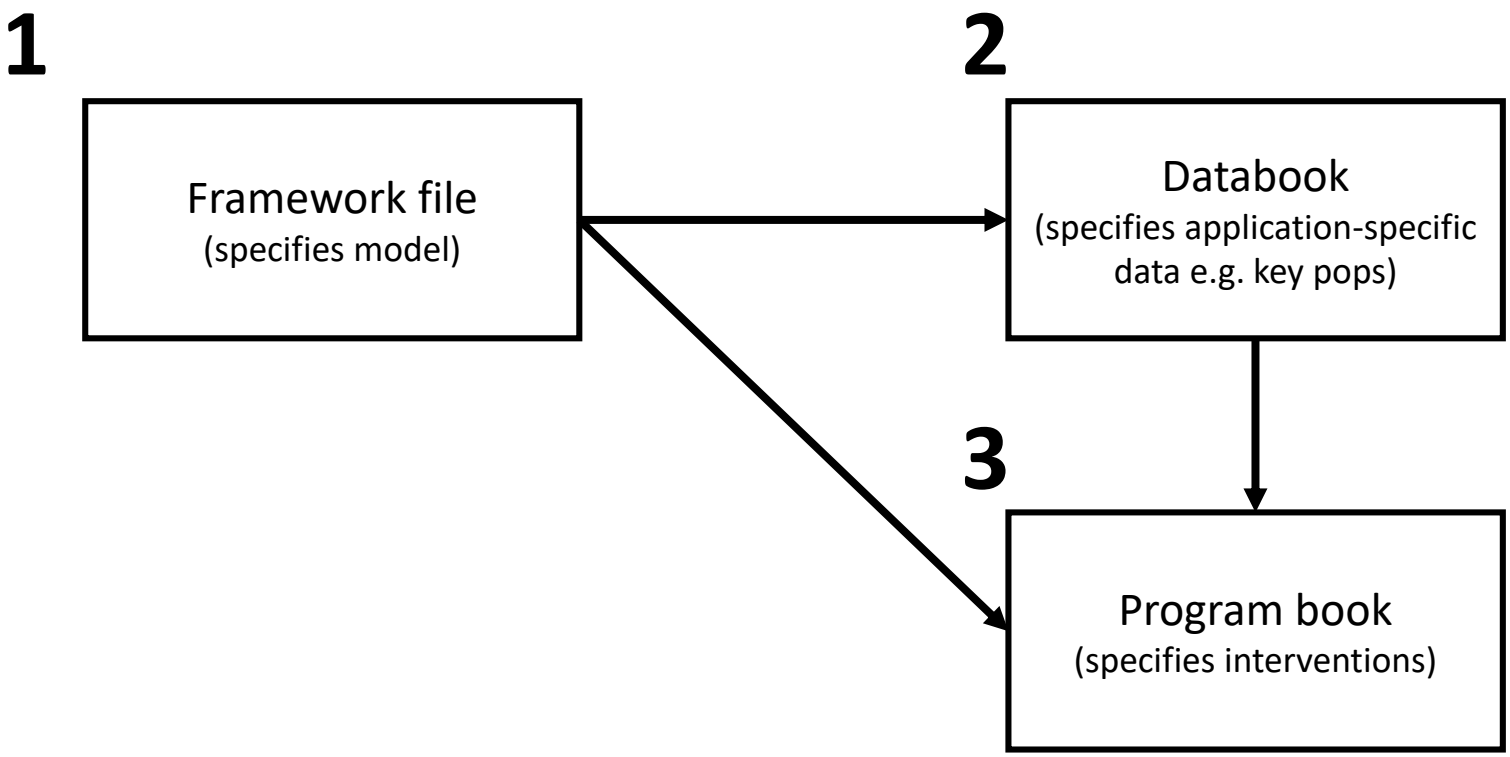
- **Chrome or Firefox**
- **Microsoft Excel 2007 or later (xlsx file compatible)**

Main use-cases for tool

- **I want to get started quickly**:
  - ✓ Using a pre-defined framework means the cascade structure is already set up: **go straight to data entry**
  - ✓ Using a pre-defined project means that data entry is completed: **go straight to analysis**

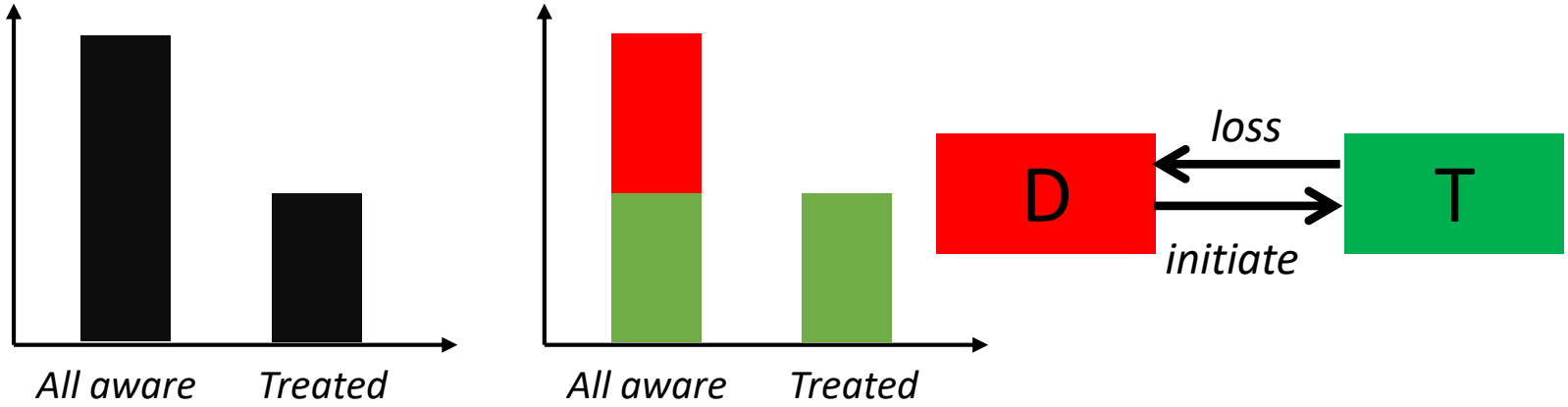
- **I want to create a custom analysis**:
  - In the next **practice session**, we will work on designing a cascade from scratch in the tool
  - Cascade design and data entry are done in Excel for easy file-sharing and familiar interfaces

Data entry spreadsheets



PREPARING FOR GROUP WORK P5: MAKE CASCADE

- The cascade framework template allows you to design your own cascade
- **Live demonstration** with a diagnosed-treated model



- **Compartments**: Diagnosed & not treated, Treated
- **Parameters (flow rates)**: initiation, loss
- **Cascade**: All aware (D+T), treated (T)

GROUP WORK P5

Aims:

- Make a framework
- Fill in framework file
- Upload a framework file

Groups: work in 4-5 groups

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Data requirements for a cascade modeling analysis

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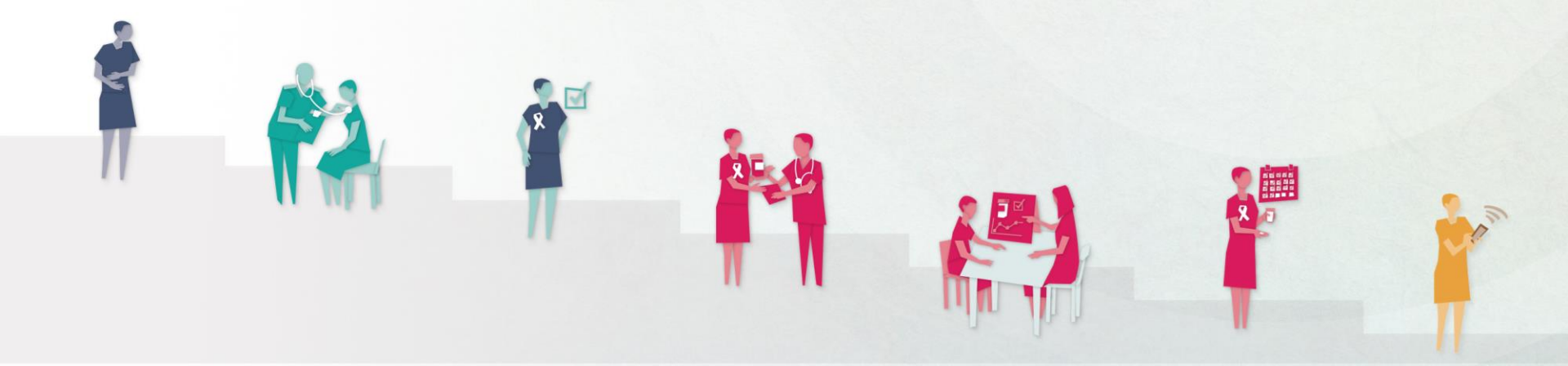
Takeaways from this Session

1. Knowledge of the data requirements to use the cascade analysis tool: what is needed and why

2. How data inputs affect the cascade model outputs

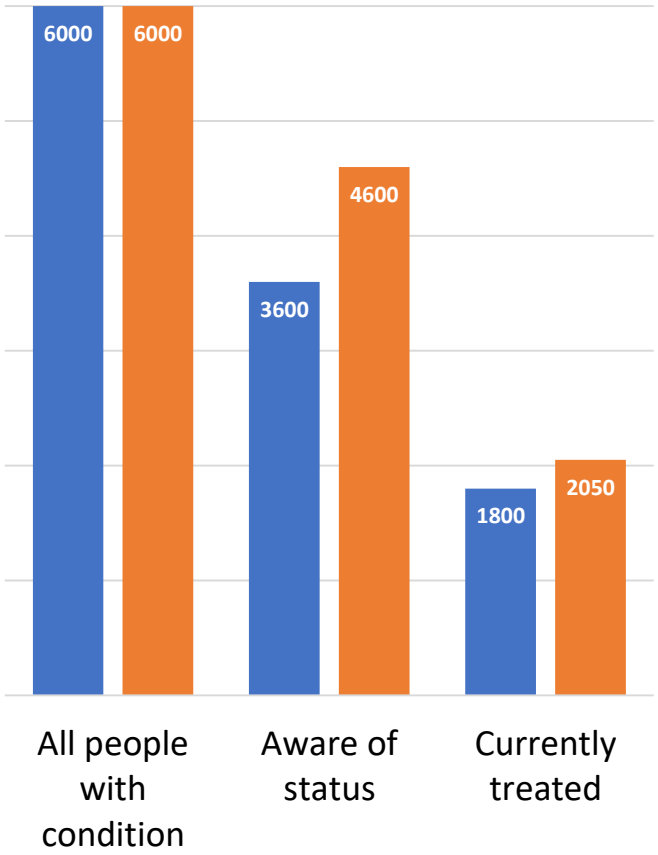
3. How data is organized for a cascade modelling analyses



What data are needed and why?

To create the cascade, we need to know:

- Baseline values, either for the cascade stage or the compartments
- Information about the flow rates (testing, loss, initiation)
  - this will be linked to interventions later…



Revisiting the example from Day 1

Baseline values for cascade

Data on flow rates

All people with condition	Units	Constant		2016	2017
adults	Number		OR	6000	
Diagnosed people	Units	Constant		2016	2017
adults	Number		OR	3600	
Currently treated	Units	Constant		2016	2017
adults	Number		OR	1800	
Annual number of new diagnoses	Units	Constant		2016	2017
adults	Number		OR	1000	
Annual number newly initiated onto treatment	Units	Constant		2016	2017
adults	Number		OR	490	
Annual number lost to follow-up	Units	Constant		2016	2017
adults	Number		OR	240	

Data sources

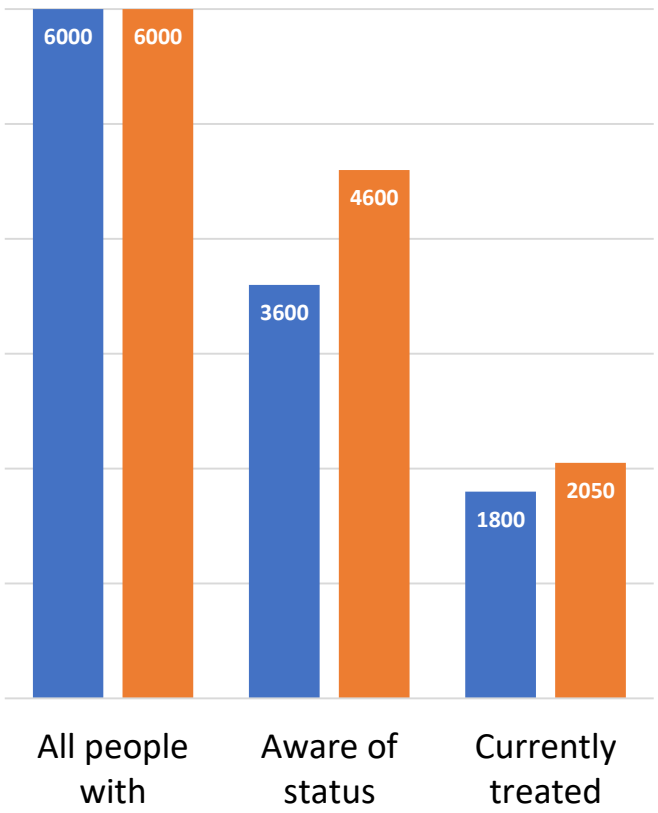
[AUDIENCE PARTICIPATION]

- Where might you get data on the current/baseline cascade?
- Where might you get data to inform flow rates along the cascade?

Different data inputs give different model outputs

[AUDIENCE PARTICIPATION]: What would change if you vary each of these numbers?

All people with condition	2016
adults	6000
Diagnosed people	2016
adults	3600
Currently treated	2016
adults	1800
Annual number of new diagnoses	2016
adults	1000
Annual number newly initiated onto treatment	2016
adults	490
Annual number lost to follow-up	2016
adults	240



Organizing data within the cascade analysis tool

- Within the tool, data are organized in *projects*
- A project is based on a particular framework (see previous session), and has data for a number of population groups

Live demo

1. Click ‘Create new project’
    1. Give the project a name and select a model framework
    2. Choose a number of populations
    3. Choose data entry years
    4. Click ‘Create’ to download an empty data entry book

2. Click ‘Create demo project’ and select a project
    1. In the project table under ‘Databook’ click ‘Download’
    2. Examine the filled-in databook

GROUP WORK P6

Aims:

- Make a project
- Fill in a databook

Groups:

- Group 1- Diabetes
- Group 2 - HIV treatment
- Group 3 - Tuberculosis
- Group 4 – Hypertension

Please do not use the models 'with demography' for this exercise – they are for cross-sectional cascades and are somewhat more complex

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Visualizing the cascade in the cascade analysis tool

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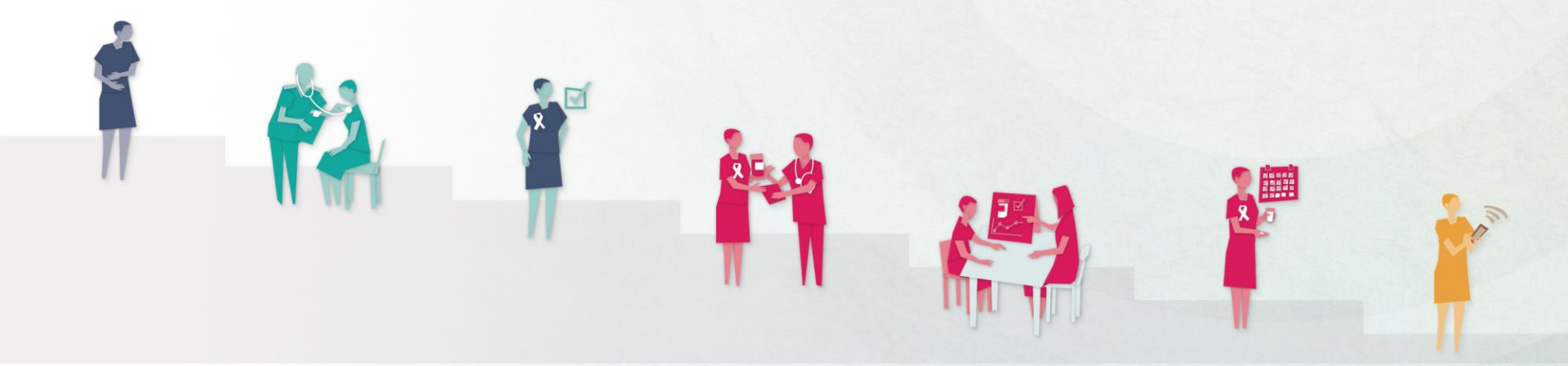
Takeaways from this Session

1. An overview of how to view a cascade within the cascade analysis tool

2. Knowledge of how to upload data and interpret the model outputs



Live demo

1. Ensure that you have one of the demo projects loaded to your account
2. Go to ‘Baseline’
    1. View the cascade for the entire population in 2018
    2. View the cascade for one subpopulation in 2018
    3. View the cascade for 2025
    4. Export the data
    5. Show the parameters

GROUP WORK P7

Aims:

- Upload a databook
- Interpret the model results

Groups:

- Group 1- Diabetes
- Group 2 - HIV treatment
- Group 3 - Tuberculosis
- Group 4 – Hypertension

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Modeling interventions in the cascade analysis tool

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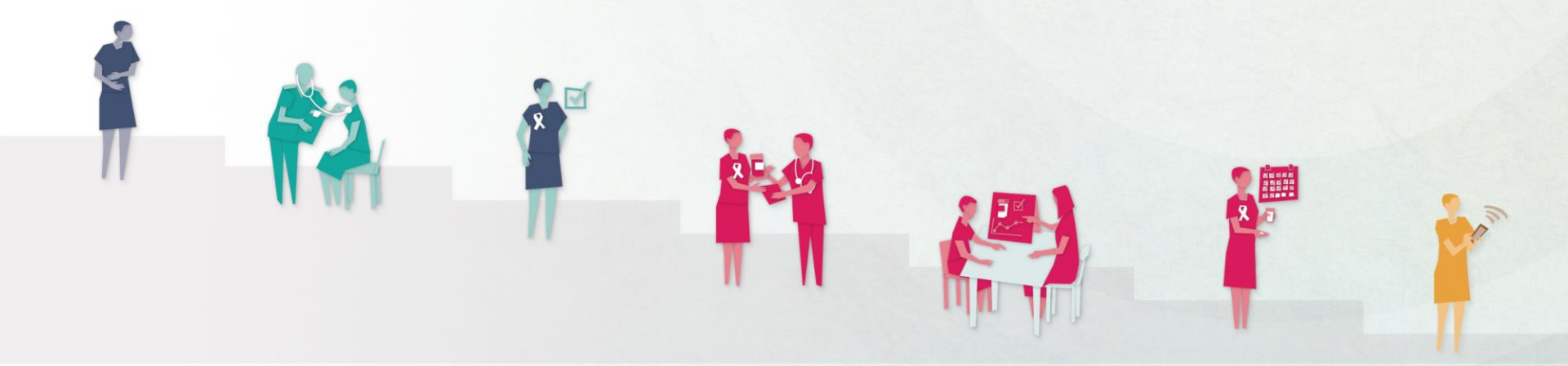
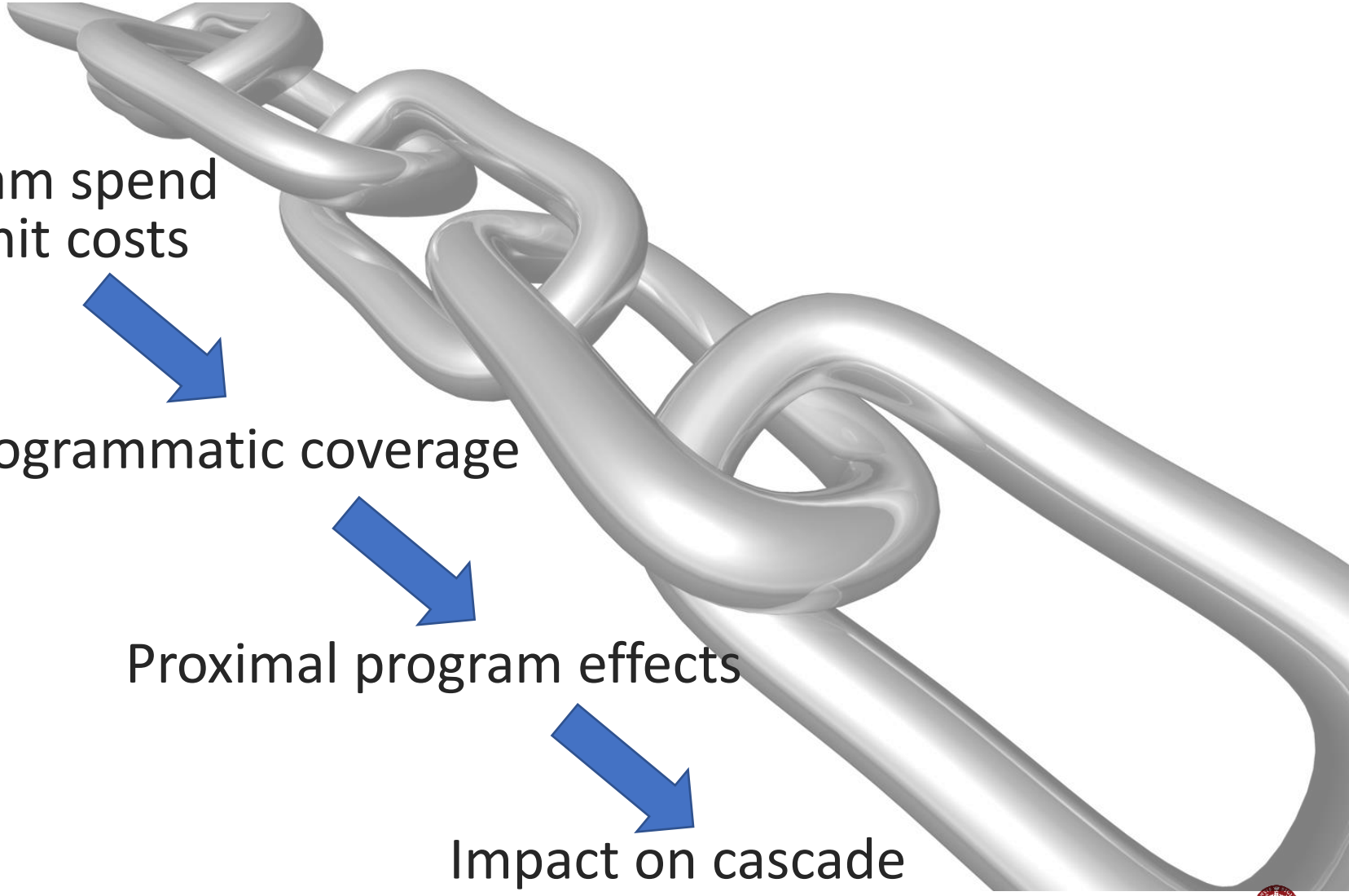
Takeaways from this Session

1. An understanding of how interventions are modelled in the cascade analysis tool

2. Knowledge of how to upload intervention data and interpret the model outputs



How are interventions modelled in the tool?



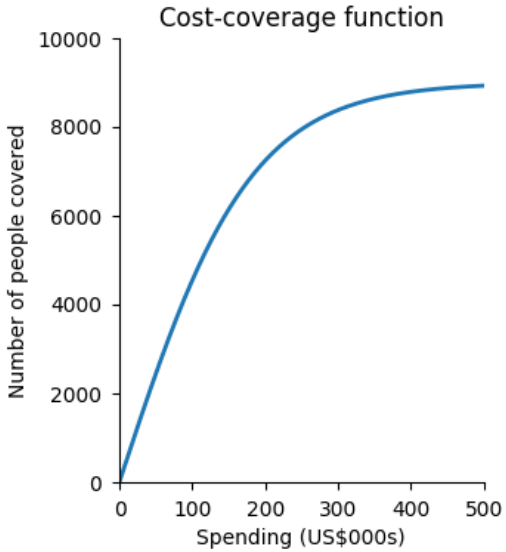
Program spend and unit costs

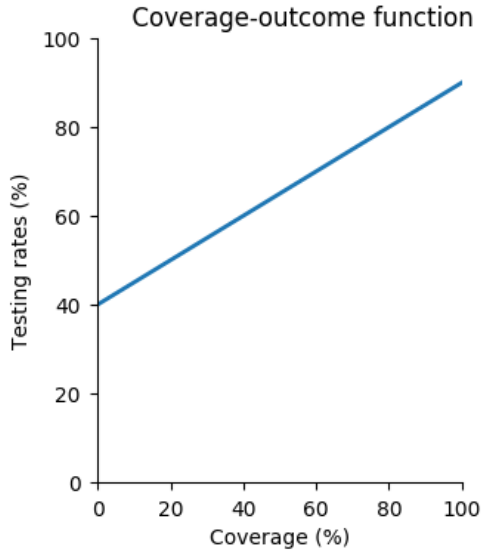
Programmatic coverage

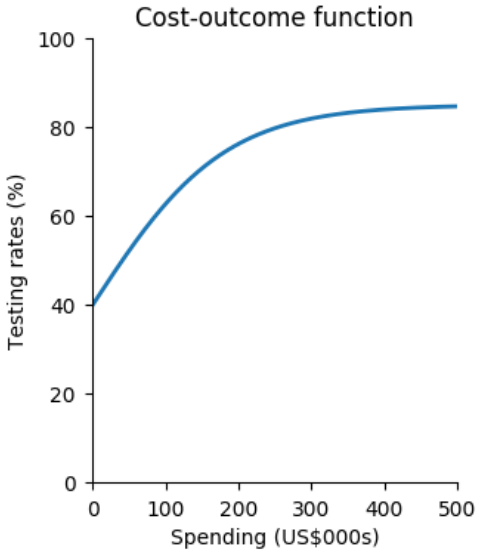
Proximal program effects

Impact on cascade

Program spend → coverage → outcomes





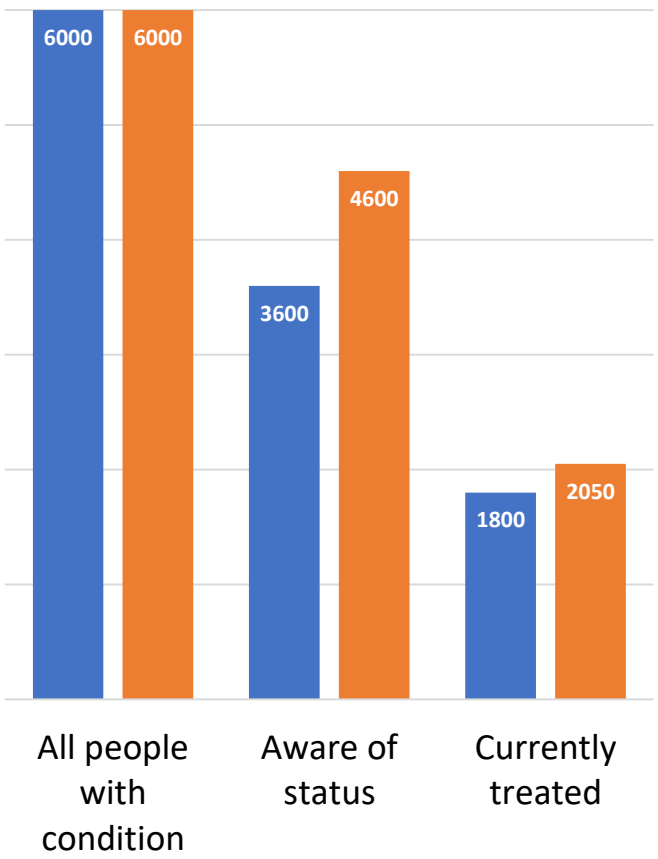


- Cost-coverage function: based on the average cost of program delivery (measured at current coverage levels) and information on capacity constraints
- Coverage-outcome function: based on the outcome under no public investments and an assumed maximal outcome

Revisiting the example from Day 1

Undiagnosed, Diagnosed, Treated

	Unit cost	Spend (000's)	Covered	Impact
Pharmacy test	$5	$50	10,000	• 10,000 tested, 500 diagnosed (5%) • 20% start treatment (100)
Clinic test	$20	$100	5,000	• 5,000 tested, 200 diagnosed (4%) • 90% start treatment (180)
Outreach	$15	$30	2,000	• 2,000 tested, 300 diagnosed (15%) • 70% start treatment (210)
Adherence	$25	$20	800	• 5% loss-to-follow-up vs 20% among those not covered (240)



Revisiting the example from Day 1

		2015	2016	2017	2018
Testing - pharmacies	Total spend		50000		
Testing - pharmacies	Capacity constraints				
Testing - pharmacies	Unit cost		5		
Testing - pharmacies	Coverage		500		
Testing - clinics	Total spend		100000		
Testing - clinics	Capacity constraints				
Testing - clinics	Unit cost		20		
Testing - clinics	Coverage		200		
Testing - outreach	Total spend		30000		
Testing - outreach	Capacity constraints				
Testing - outreach	Unit cost		15		
Testing - outreach	Coverage		300		
Adherence	Total spend		20000		
Adherence	Capacity constraints				
Adherence	Unit cost		25		
Adherence	Coverage		800		

Revisiting the example from Day 1

Diagnosis rate	Baseline value	Coverage interaction	Impact interaction	Uncertainty		Testing - pharmacies	Testing - clinics	Testing - outreach	Adherence
Adults	0	additive	best			1	1	1	
Initiation rate	**Baseline value**	**Coverage interaction**	**Impact interaction**	**Uncertainty**		**Testing - pharmacies**	**Testing - clinics**	**Testing - outreach**	**Adherence**
Adults	0	additive	best			0.2	0.9	0.7	
Loss-to-follow-up rate	**Baseline value**	**Coverage interaction**	**Impact interaction**	**Uncertainty**		**Testing - pharmacies**	**Testing - clinics**	**Testing - outreach**	**Adherence**
Adults	0.2	additive	best						0.05

- 2 data entry tables:
  - one for costing data
  - one for impact data
- Look for the data from the example…

Entering program outcomes

Diagnosis rate	Baseline value	Coverage interaction	Impact interaction	Uncertainty		Testing - pharmacies	Adherence
Adults	0	additive	best			1	
Loss-to-follow-up rate	**Baseline value**	**Coverage interaction**	**Impact interaction**	**Uncertainty**		**Testing - pharmacies**	**Adherence**
Adults	0.2	additive	best				0.05

- For the program outcome, enter the value for the parameter *if that program had 100% coverage*
- Pharmacy tests – if everyone was covered by the test program, then everyone would be diagnosed
- Adherence – if everyone was covered by the adherence program, the overall loss to follow up rate would be 5%
- *If the coverage is less than 100%, the value will be interpolated appropriately* (e.g. with 50% coverage of adherence program, loss to follow up would be 12.5%)

Live demo

1. Ensure that you have one of the demo projects loaded to your account
2. Go to ‘Projects’
3. Under ‘Program book’, click ‘Download’
4. Open the Excel workbook to view the data
   - *Program targeting*: for defining target groups for each modality
   - *Spending data*: for defining total spend, capacity constraints, and unit costs
   - *Program effects*: for defining the impacts of programs

Summary of the session

- The cascade analysis tool requests data on interventions, which are then linked to the flow rates that determine how people move along the cascade
- Data is entered in Excel
- Cost data is transformed to coverage using cost functions
- Coverage is transformed to an impact on flow rates using the random, additive and nested calculations
- The impact on flow rates is translated to an impact on the cascade

GROUP WORK P8

Aims:

- Making a program databook
- Filling out a program databook
- Uploading a program databook and interpreting the results

Groups:

- Group 1- Diabetes
- Group 2 - HIV treatment
- Group 3 - Tuberculosis
- Group 4 – Hypertension

Costing tools

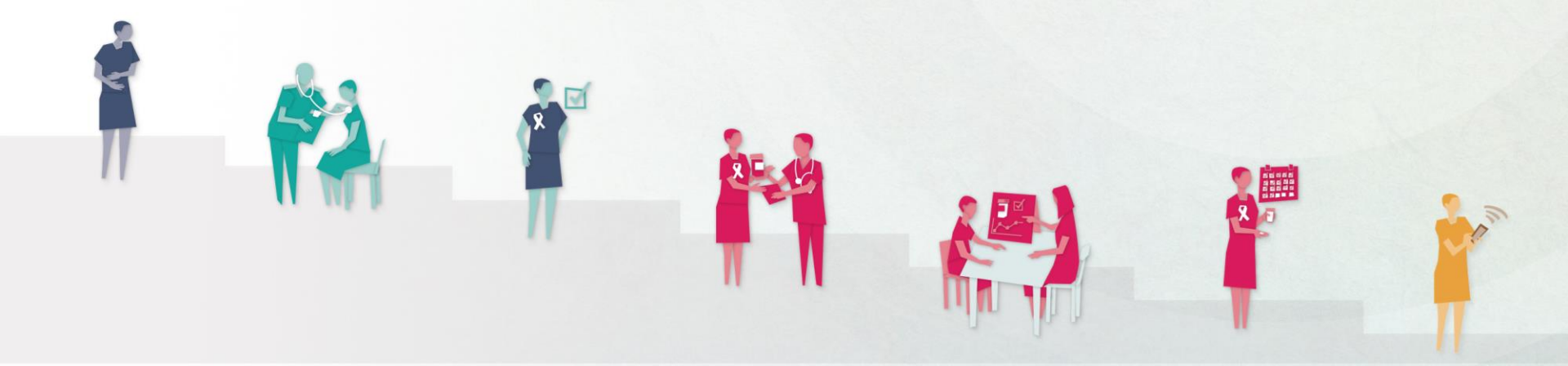
(C10)

Takeaways from this Session

1. An introduction to cost estimation

2. Things to consider in costing - terms and tools

3. How to prepare costs for an analysis



Introduction

What is a cost?

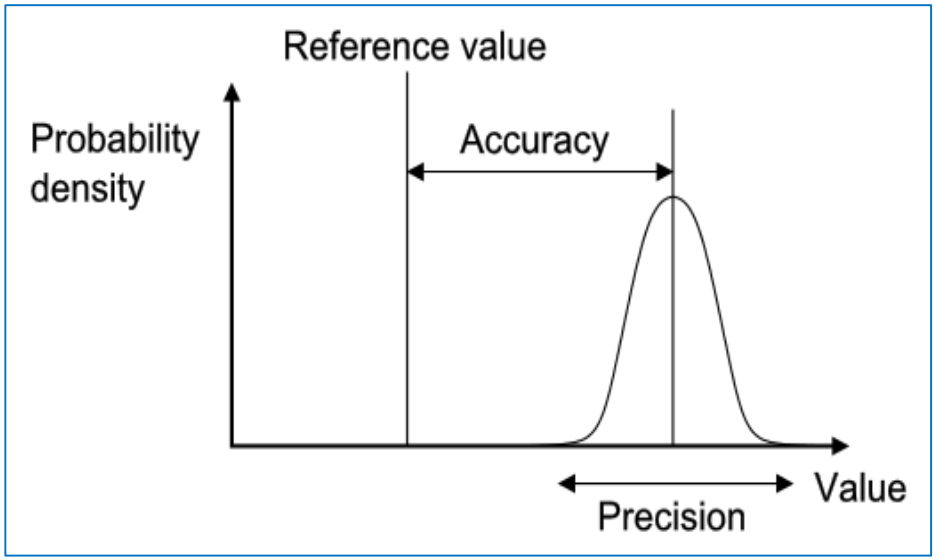
- The value of resources used to produce something

How can costing be used?

- Efficiency analyses
- Input into economic evaluation and priority setting
- Financial Planning:
  - Price Tags
  - Medium term resource requirements/ strategic plans
  - Budgeting - inform decisions on how to expand and replicate activities
  - Assess financial sustainability

Cost Estimation

- Depends on purpose
- No gold standard
- Scarcity of cost data
- Many guides, but lack of standardisation
- Poor reporting
- Transparency and 'transferability'



Source: Vassall, Costing for TB interventions (Presentation TB Conference 2016)

Sources for Cost Data

- Systematic reviews and studies
- Budget or expenditure analysis, financial records
- Ingredients costing
- Expert opinion
- Dearth of empirical cost data
  - Setting
  - Technology
  - Practices
  - Patient populations
  - Scale/ scope
  - Level of health service

Types of Costs

- Gross or ingredients(micro) costs
- Per protocol or real world
- Full or incremental
- Recurrent, once-off
- Financial or economic

Financial versus Economic Costs

Financial costs:

- Estimates the actual monetary flows of the buyer such as the MoH
- Does not include the value of resources already paid for such as personnel time, existing equipment, etc.

Economic costs:

- Includes the value of all resources used in the intervention
- Regardless of the source of funding, i.e. donor funds
- Discounting for capital items
- Differs from actual expenditure when market rate is not paid for resource, or when market price does not accurately reflect value
  - *Think of donated or subsidised goods and/or volunteer time*

What data do you need to estimate economic costs?

The ‘units’ to be Costed

Intervention units

- *Educational session in groups of 2-6*

Episode units

- *Average cost of an inpatient stay*

Service use units / bundled services

- *Annual insulin consumption*
- *Baseline clinical exam (multiple tests)*
- *Annual monitoring costs (bundle consultations, labs, etc.)*

Standardise

- *Health care level*
- *Patient type (uncomplicated vs. complicated, etc.)*

Averaged

- *Information on possible range useful*

The Interventions

Characterize each intervention

- SOPs very useful
- Target population, eligibility
- Ingredients to provide the intervention
  - Consumables, staff time and level, capital costs
- Frequency and health cadre(s)
- Define boundaries of the intervention
- Maturity of intervention
  - Start-up / scale-up / Saturation
- Perspective
  - Provider, but selected patient costs can be useful

Incremental Costs

- Also referred to as “marginal costs”
- Additional costs incurred based on the change in a certain activity
- Useful in scenario analysis
- Helps to keep costing simple, but think of downstream effects!

Can we name examples?

Adjusting and Updating of Costs

1. Can be a useful shortcut

2. Can adjust costs from elsewhere for approximate cost estimates

3. Updating own historical costs must be done carefully
   - *Best if ingredient costs available*
   - *Intervention definition/SOPs/test algorithm/treatment protocol may have changed*
   - *Drug costs – reliable updating (drug costs can reduce over time)*
   - *Labour costs - main cost driver and must be studied in detail*
   - *Real prices (incl. salaries) may not just increase with inflation*

4. Modalities, alternative care models, innovation
   - *Task shifting/decentralization scenarios - careful checking of cost differentials*
   - *Document key costs patients may cover costs (e.g. self-monitoring)*
   - *Public sector subsidy/cost-sharing schemes: understand shifts in costs*

5. Poor quality of cost estimates can invalidate findings
   - *Difference between the real and the inflation-adjusted*
   - *Can bias results*

GROUP WORK P9

Aims:

- Practice in using the costing tools
- Understanding different cost categories and drivers

Groups:

- Group 1- Diabetes
- Group 2 - HIV treatment
- Group 3 - Tuberculosis
- Group 4 – Hypertension

Back to the policy questions

GROUP WORK P10

Aims:

- Reflecting on a quality improvement (QI) initiative to address breakpoints in a continuum of care
- Identifying priority areas for QI and formulating interventions to address major breakpoints
- Formulating policy questions which could be addressed with Implementation Cascade Analysis (scenarios)

Groups:

- Group 1- Diabetes
- Group 2 - HIV treatment
- Group 3 - Tuberculosis
- Group 4 – Hypertension

75 min

Case studies - Breakpoints in the cascade?

a) Large differentials at *screening/testing* stage

Group 1 - Diabetes	Group 2 - HIV tx	Group 3 - TB	Group 4 - HTN
Screening	*Testing*	*Symptom screen (SS)*	*BP screen*
By setting + gender	*By sub-population*	*By HIV status + site*	*By district + age*
Urban 70% screening coverage among eligible, rural 35%, women much more likely to get screened than men. PHC level poorly equipped for DM case finding. Staff lacks confidence in DM control.	Risk factors for low testing coverage: Women who have not had children, men unemployed or in informal jobs. Districts with low HIV prevalence have particularly scarce HIV testing resources.	Known HIV+ 90% SS coverage, others 40%. Large facilities overall much higher (donor TA support) than small clinics. Linkage to lab diagnosis could be improved.	30 districts, of which 6 reach target of universal adult BP screen (80%), lowest performance in 8 districts (<50%). Large problem in under 40 year olds not getting screening attention. Linkage to full diagnosis unknown.

Case studies - Breakpoints in the cascade?

b) Also some large differentials in *treatment adherence*

Group 1 - Diabetes	Group 2 - HIV tx	Group 3 - TB	Group 4 - HTN
Adherence to anti-diabetic treatment, especially low in rural patients who struggle to get to clinics for monitoring, re-scripting and refills. Low treatment literacy, fears of hypoglycaemia and monitoring/drug costs major barriers.	Adherence to ART especially difficult for people who do not have time to queue, cannot go to clinic during work time, or live far away from ART sites. Many still don't want it to be known that they are on ART.	Adherence to MDR/XDR treatment especially poor due to side effects, length of treatment and distance to MDR treatment sites. HIV negative patients who don't get the extra health staff attention via ART struggle most.	Adherence especially low in younger patients who tend to have low risk perception and unhealthy lifestyles. The 8 districts with low screening also face biggest problem due to dispersed populations, poor access to health centres and under-performing health posts.

Some Principles of successful PHC Approaches

1. **SIMPLIFICATION, STANDARDIZATION** and **MONITORING** of healthcare delivery processes
2. **DECENTRALIZATION**
3. **PEER AND COMMUNITY INVOLVEMENT**
4. **TASK-SHIFTING**
5. Support for **SELF-MANAGEMENT**

Some of these elements can be applied in Quality Improvement and PHC Reform, through **innovative service delivery models of care**

Questions in each Group/Case Study

1. Where are the **breakpoints** in the cascade?

- Reflect on a quality improvement initiative to address breakpoints in a continuum of care. Remember the five principles shown on previous slide.
- Identifying priority areas for QI and formulating interventions to address major breakpoints

2. How do **interventions** impact the cascade?

- Consider possible service delivery modalities (”facility-level QI”)
- Consider health system-level interventions (”system-level reform”)

3. How could different **programmatic strategies** lead to different/better cascades?

- Formulate your ideas on change into policy questions for local and national level
- Translate at least one into a scenario analysis question for Implementation Cascade Analysis

4. What would be the **optimal programmatic strategy** to maximize successes along the cascade?

- Consider data system needs to determine the baseline and measure change