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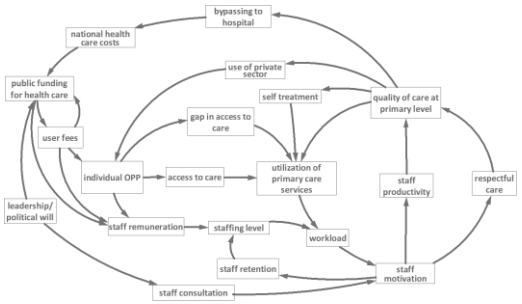
Systems Tools for Complex Health Systems: A Guide to Creating Causal Loop Diagrams



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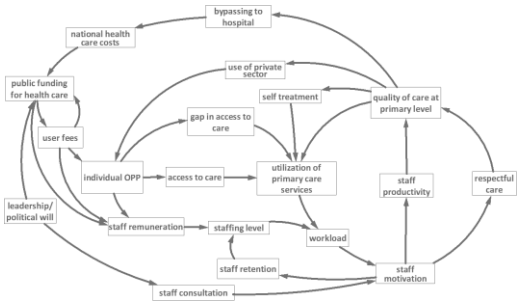
Session Four Causal Loop Diagrams



Session outline

- Identify the causal loop diagram (CLD) seed structure
- Build causal loop diagram
- Identify polarity of variable relationships
- Identify feedback loops
- Identify leverage points

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Determine the CLD seed structure

As you identify your seed structure – think back to boundary issues:

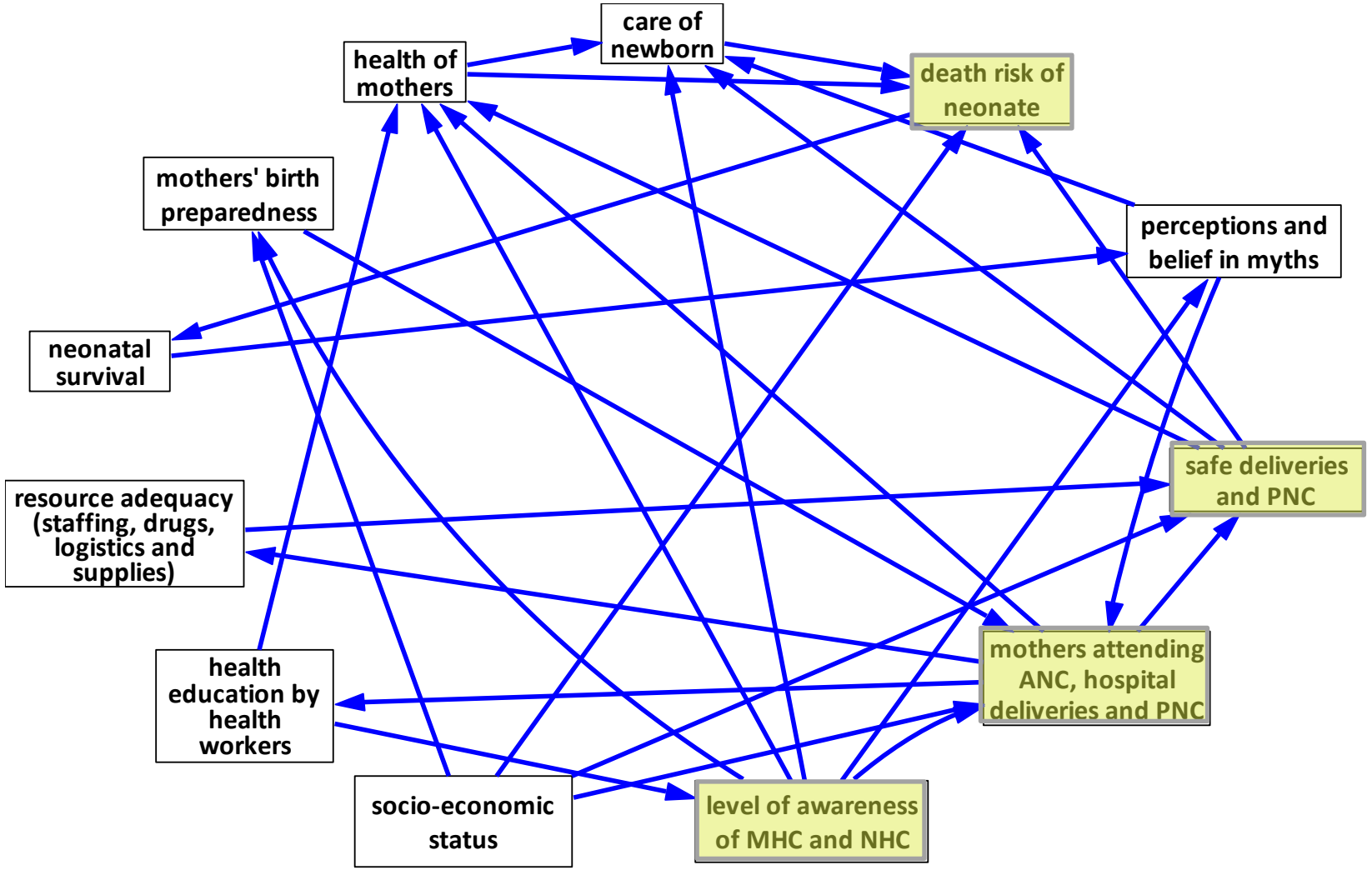
- What is the question or issue that is driving the creation of the causal loop diagram?
- What are the boundaries of your system?
- Think about the level at which you want to intervene?

Determine the CLD seed structure

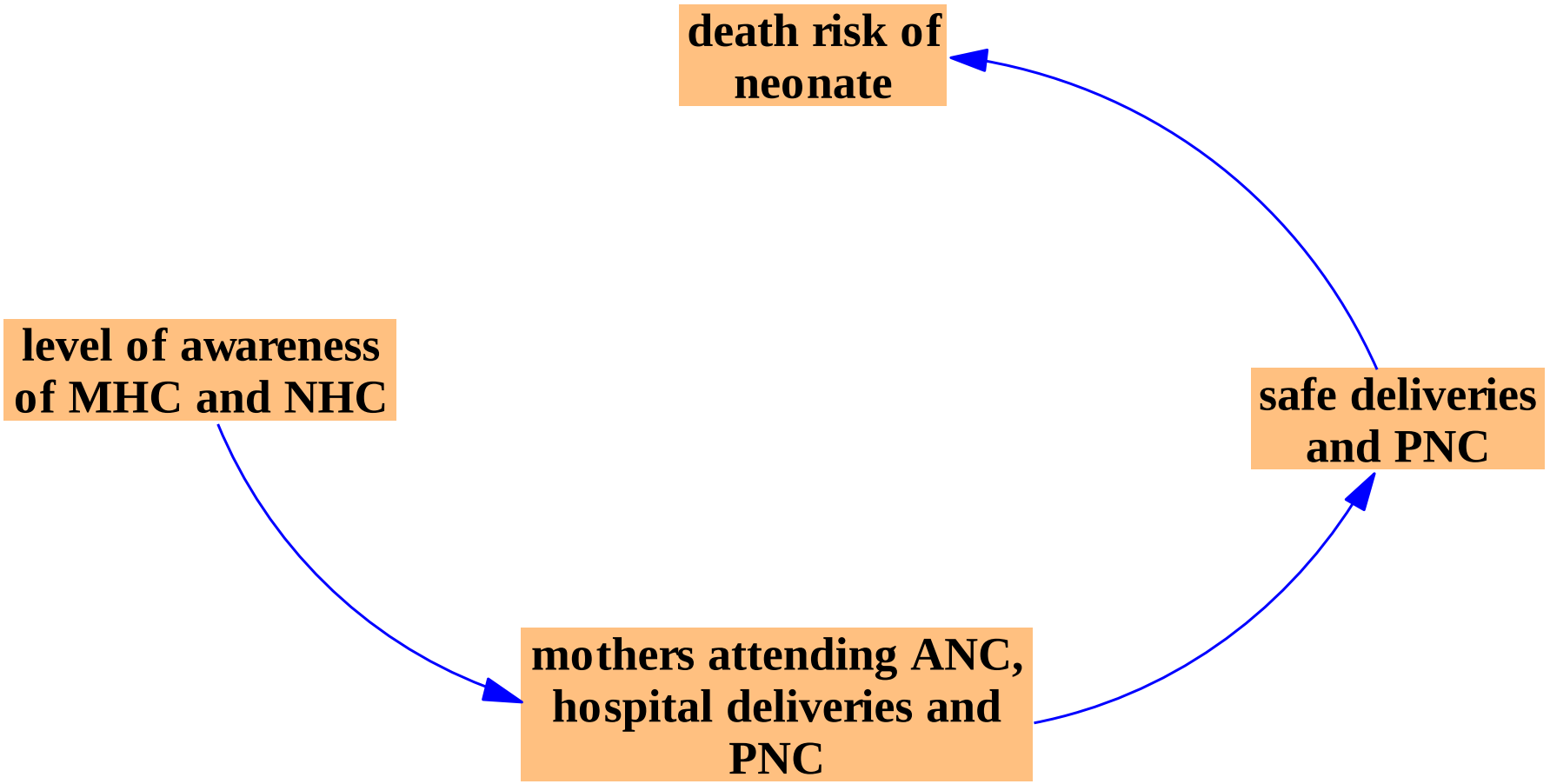
From your interrelationship digraph

- Identify your output or outcome of interest variable
- Identify an intervention/driving variable at your reference level

Surface seed model using drivers and outcomes



Surface seed model using main drivers and outcomes



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- Identify the causal loop diagram (CLD) seed structure
- **Build a causal loop diagram**
- Identify polarity of variable relationships
- Identify feedback loops
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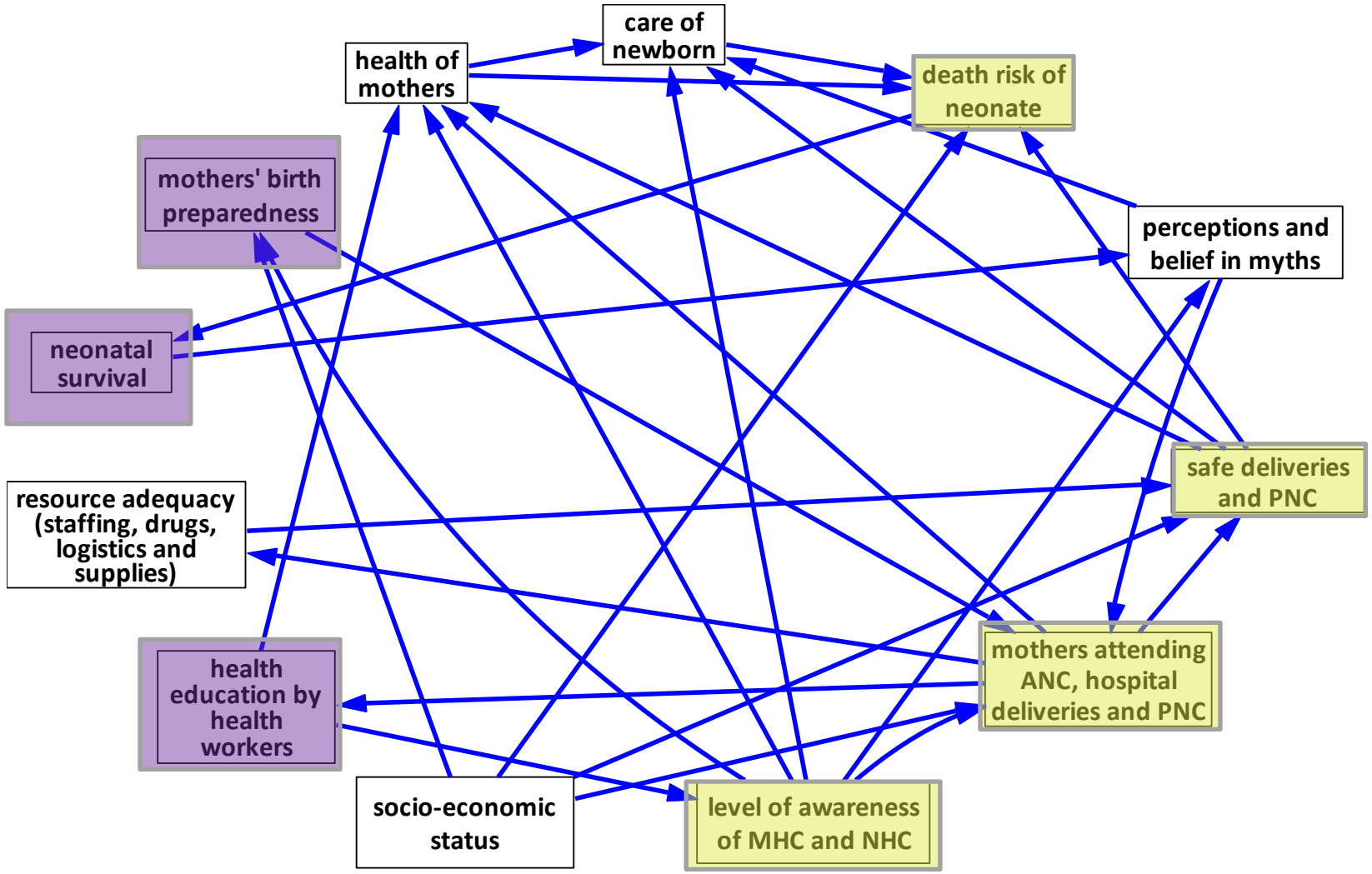
Building your own System Map

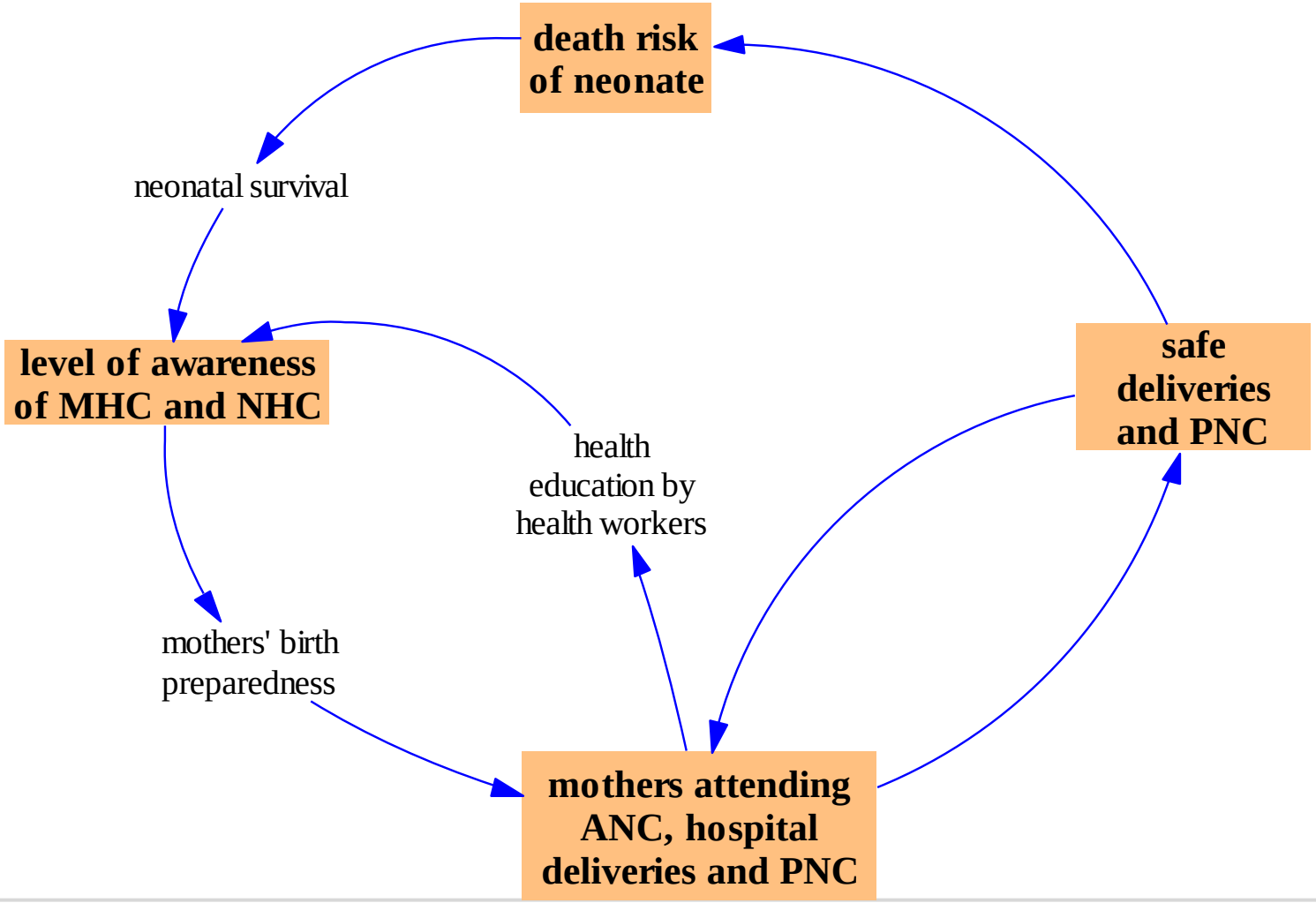
- Determine the "seed structure":
  - Identify your output or outcome of interest variable
  - Identify a intervention variable at your reference level

- **Explore the linkages between these variables and identify intervening variables that explain the situation**

Identify intermediate variables using IRD as a guide



Insert intermediate variables using IRD as a guide



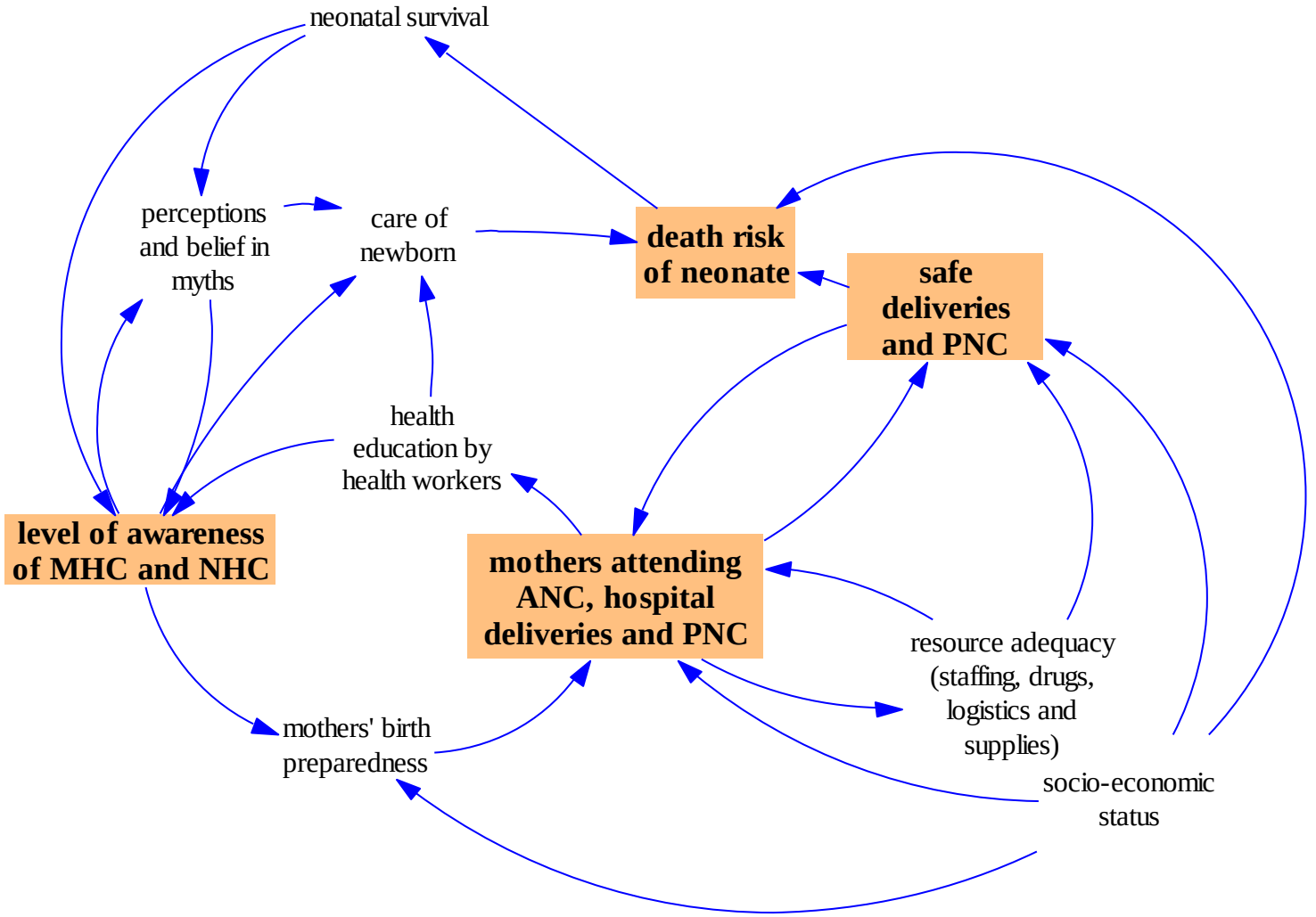
Building your own System Map

- Determine the "seed structure":
  - Identify your output or outcome of interest variable
  - Identify your key intervention variable

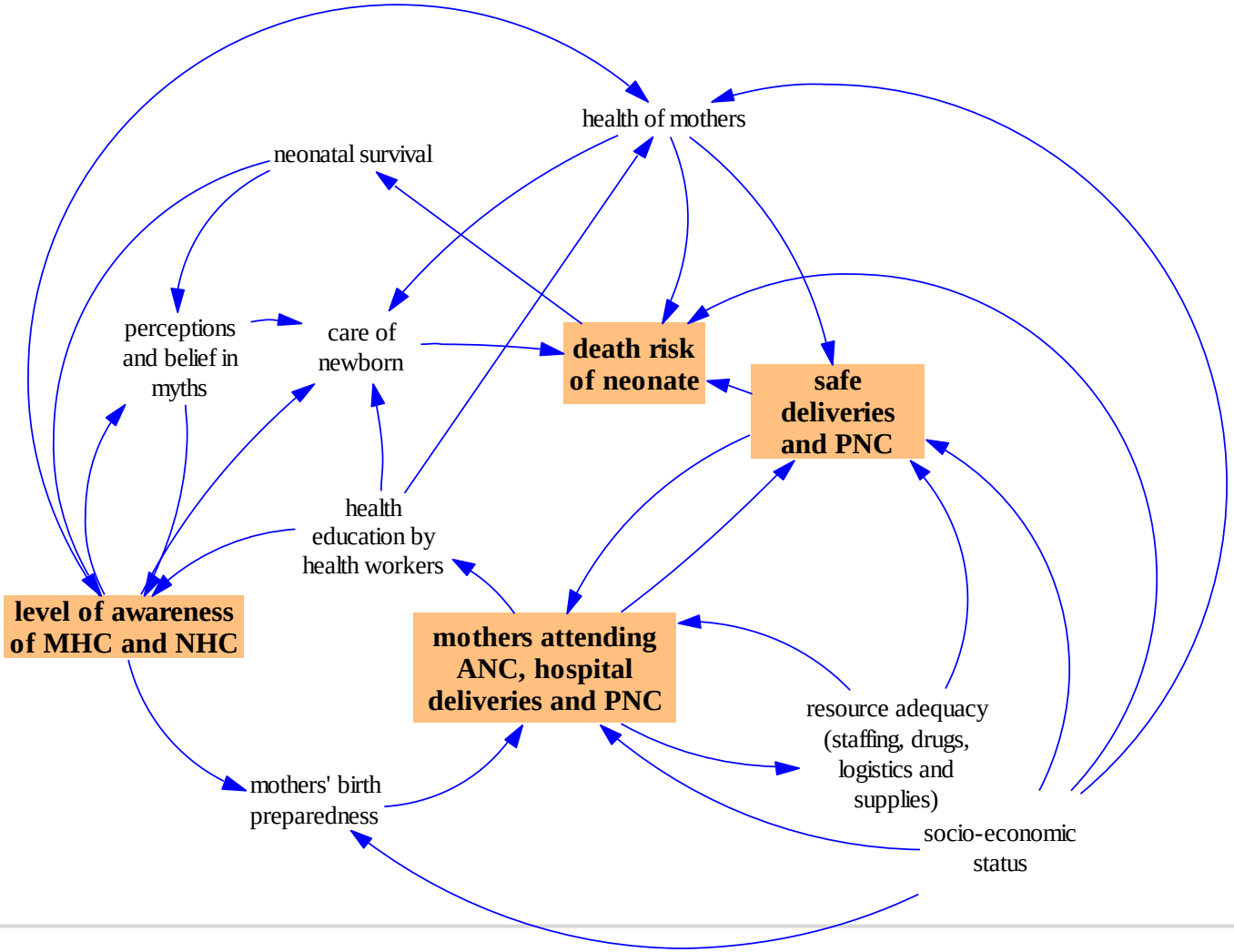
- Explore the linkages between these variables and identify intervening variables that explain the situation

- **Explore linkages amongst the other key variables in your system, looking for feedback loops**

Build CLD – drawing on relationships identified in IRD



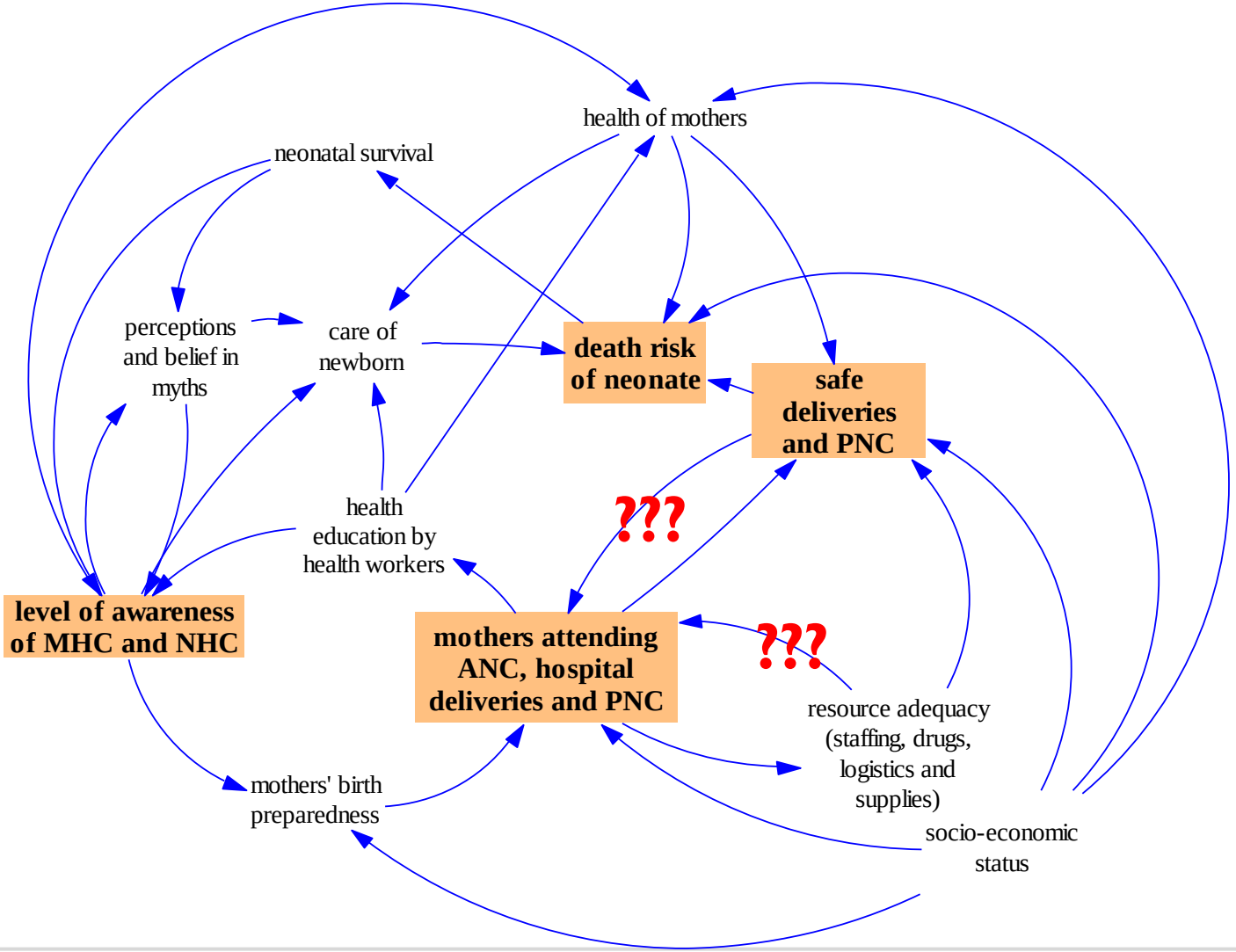
Build CLD – drawing on relationships identified in IRD



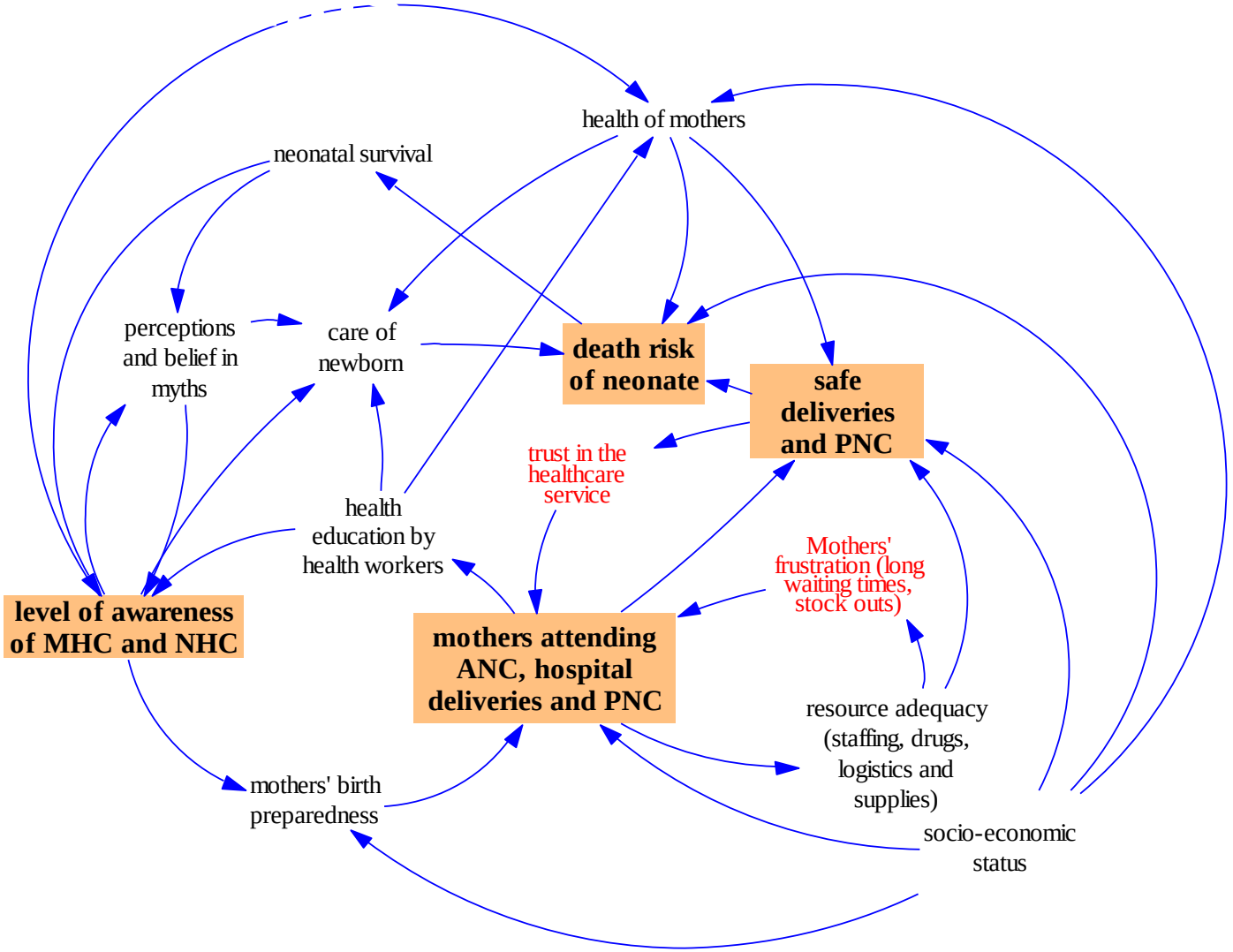
Building your own System Map

- Determine the "seed structure":
  - Identify your output or outcome of interest variable
  - Identify your key intervention variable
- Explore the linkages between these variables and identify intervening variables that explain the situation
- Explore linkages amongst the other key variables in your system, looking for feedback loops
- **Identify additional variables to be added to the system to better explain the relationship between two variables**

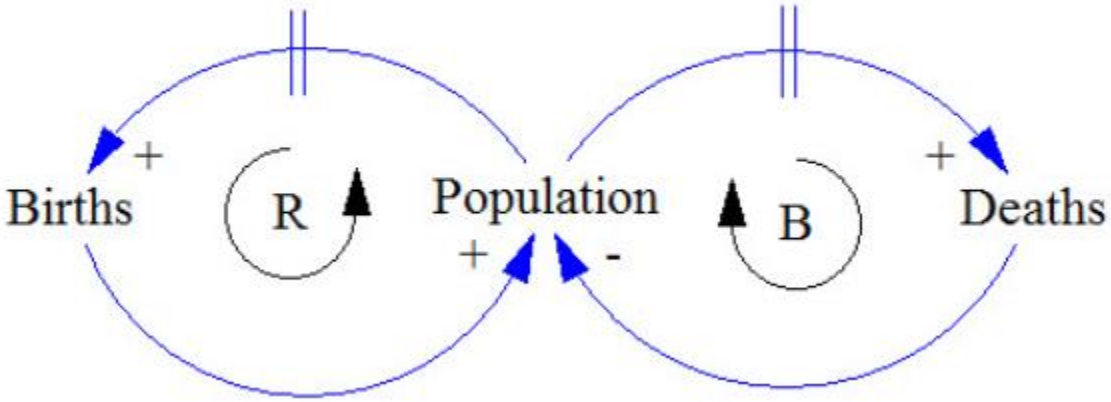
Build CLD – drawing on relationships identified in IRD



Identify and add additional variables to deepen understanding of the relationships



Indicate delays



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- **Identify polarity of variable relationships**
- Identify feedback loops
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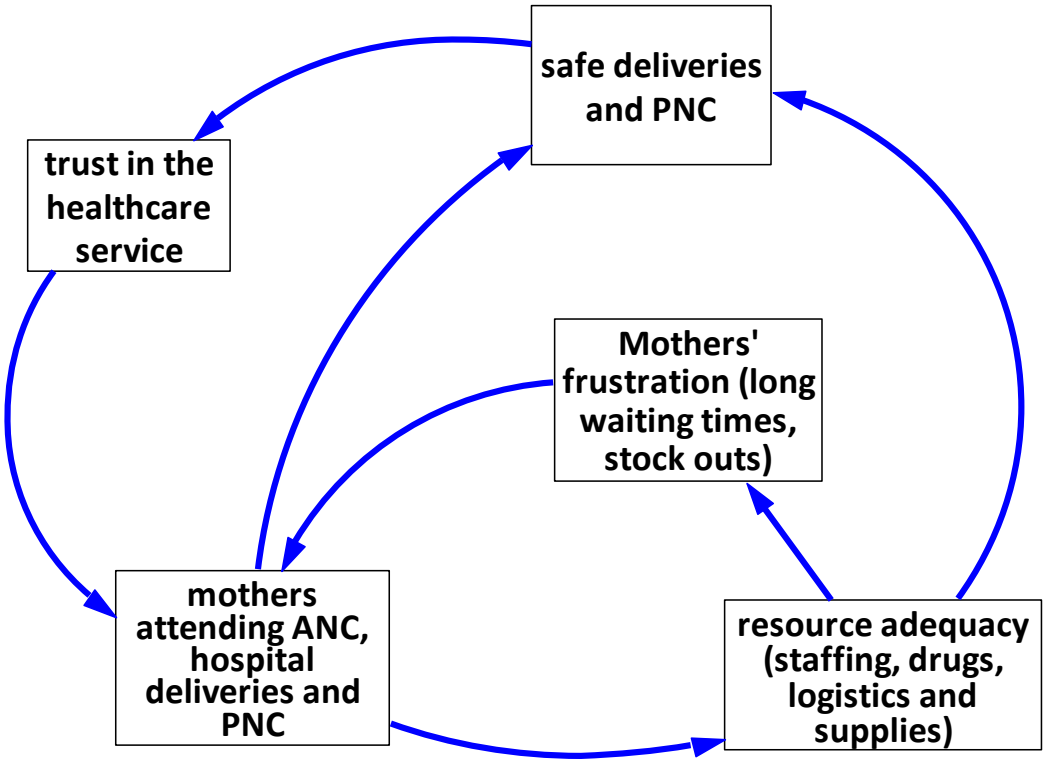
Identifying the polarity of variable relationships

- Pick a starting variable in your CLD
- Assess whether arrows between two variables indicate change in the same or opposite direction
- For each "pair" of variables decide what would happen if variable A changed: would it result in a change in the same direction (+) or opposite direction (-) in variable B?
- Label each arrow to indicate the direction of effect. If change is in the same direction use a "+" sign, and if the change is in opposite directions use a "-" sign

Determine the polarity of the links



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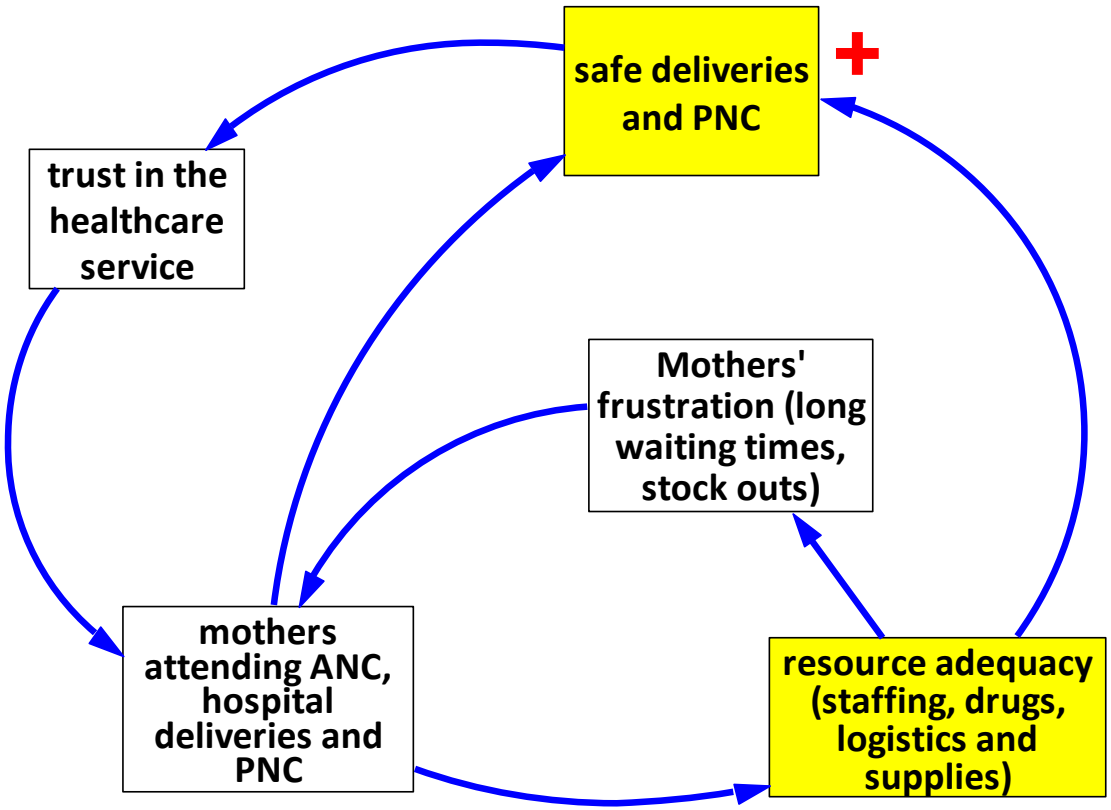

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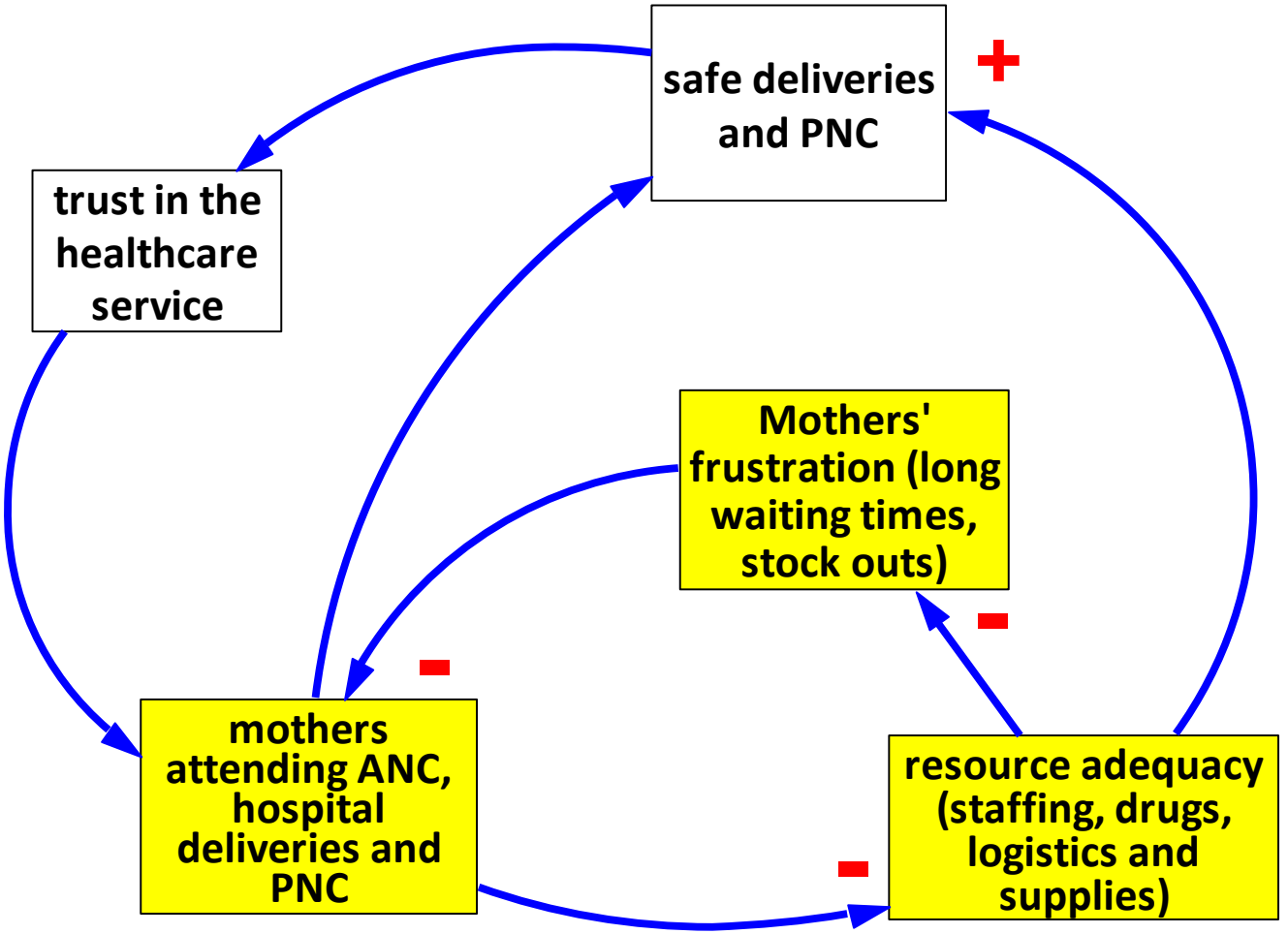

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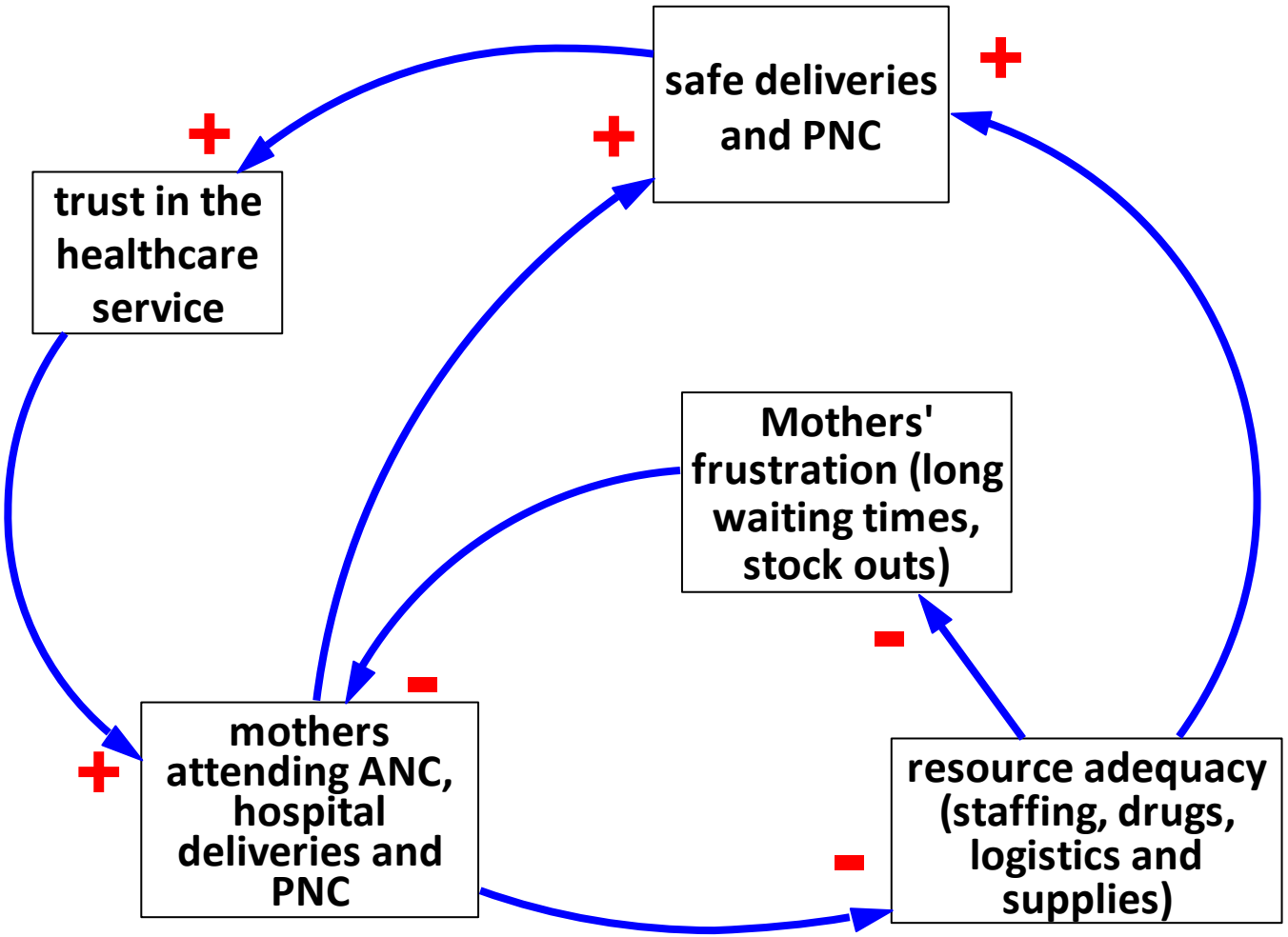

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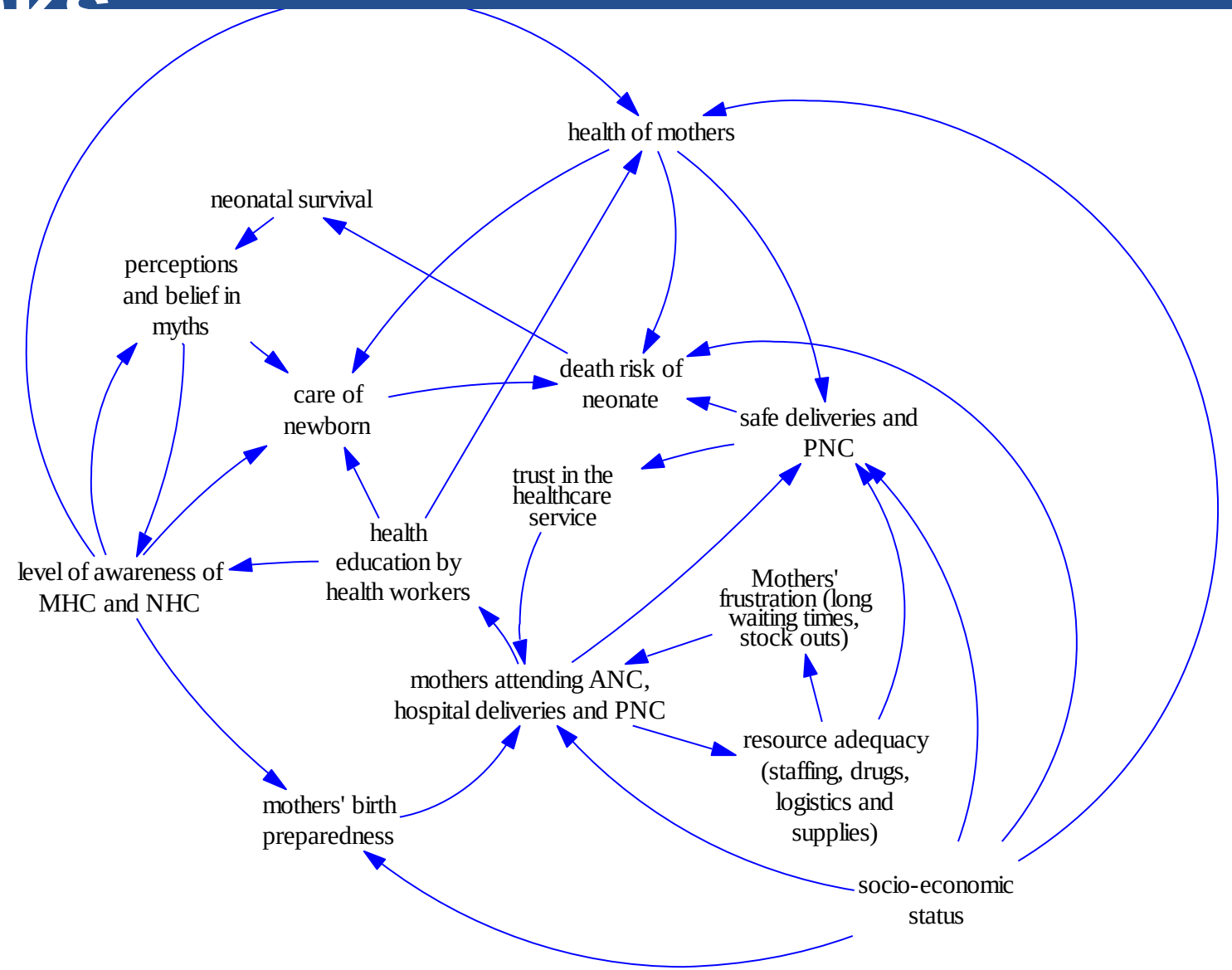

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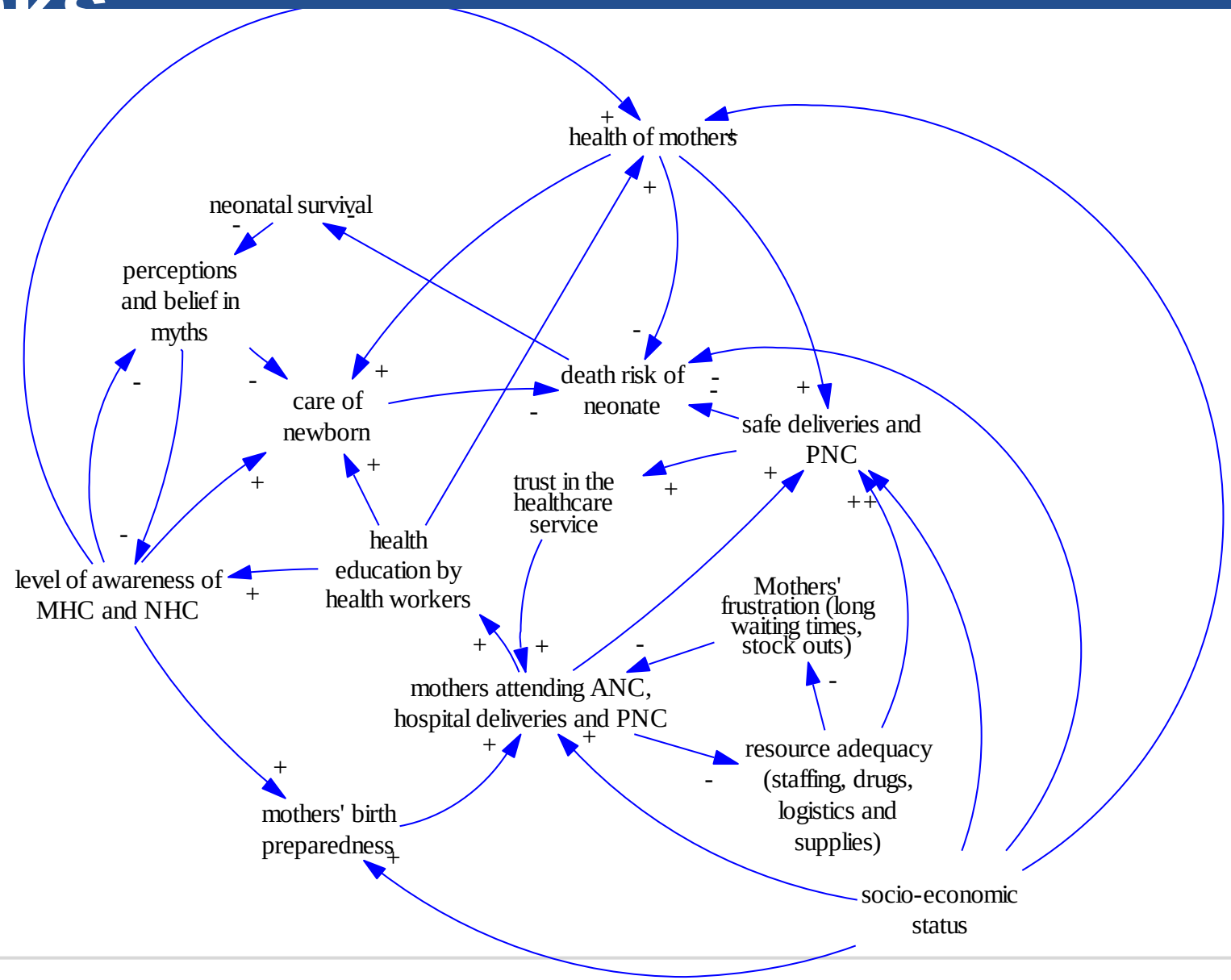

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- **Identify feedback loops**
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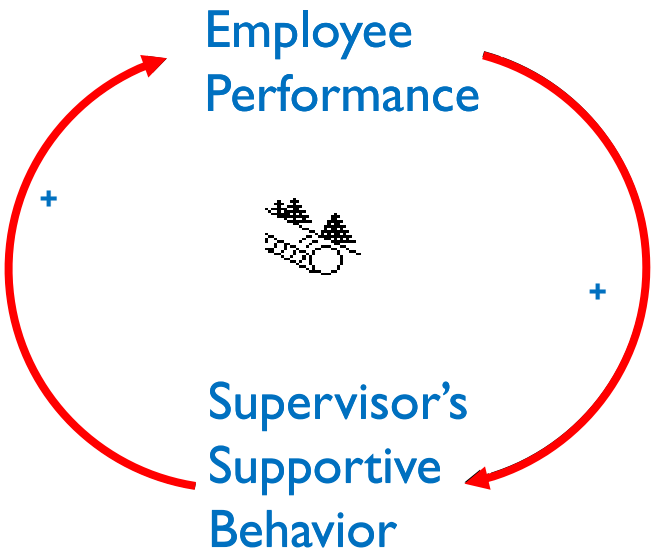
Reinforcing loops

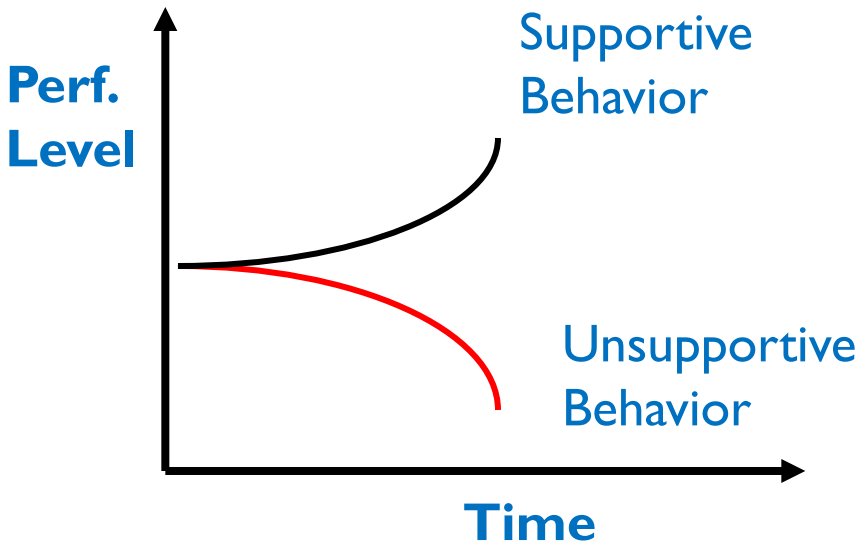
- A reinforcing loop is one in which an action produces a result which influences more of the same action thus resulting in growth or decline at an ever-increasing rate
- Where feedback increases the impact of a change, we call this a Reinforcing Loop.
- Positive reinforcing loops produce **virtuous cycles**
- Negative reinforcing loops produce **vicious cycles.**

Reinforcing loops

Structure



Behavior Over Time



Balancing Loops

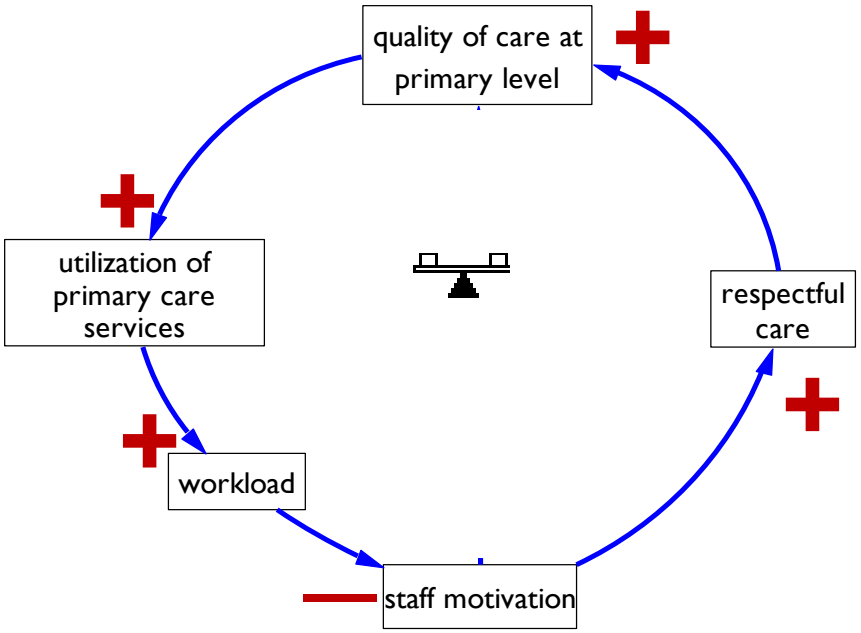
- Balancing processes generate the forces of resistance, which eventually limit growth, maintain stability, and achieve equilibrium

- Balancing loops reduces the impact of a change and are goal seeking

- Shortcut to determining a balancing loop: Count the number of minus signs (-) in the loop: an odd number of minus signs = balancing loop

Balancing Loops

Structure



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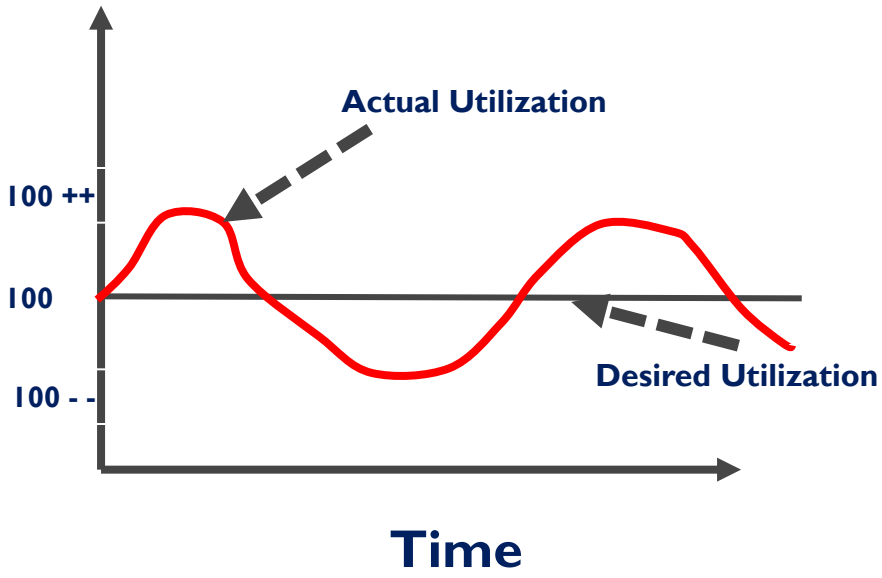
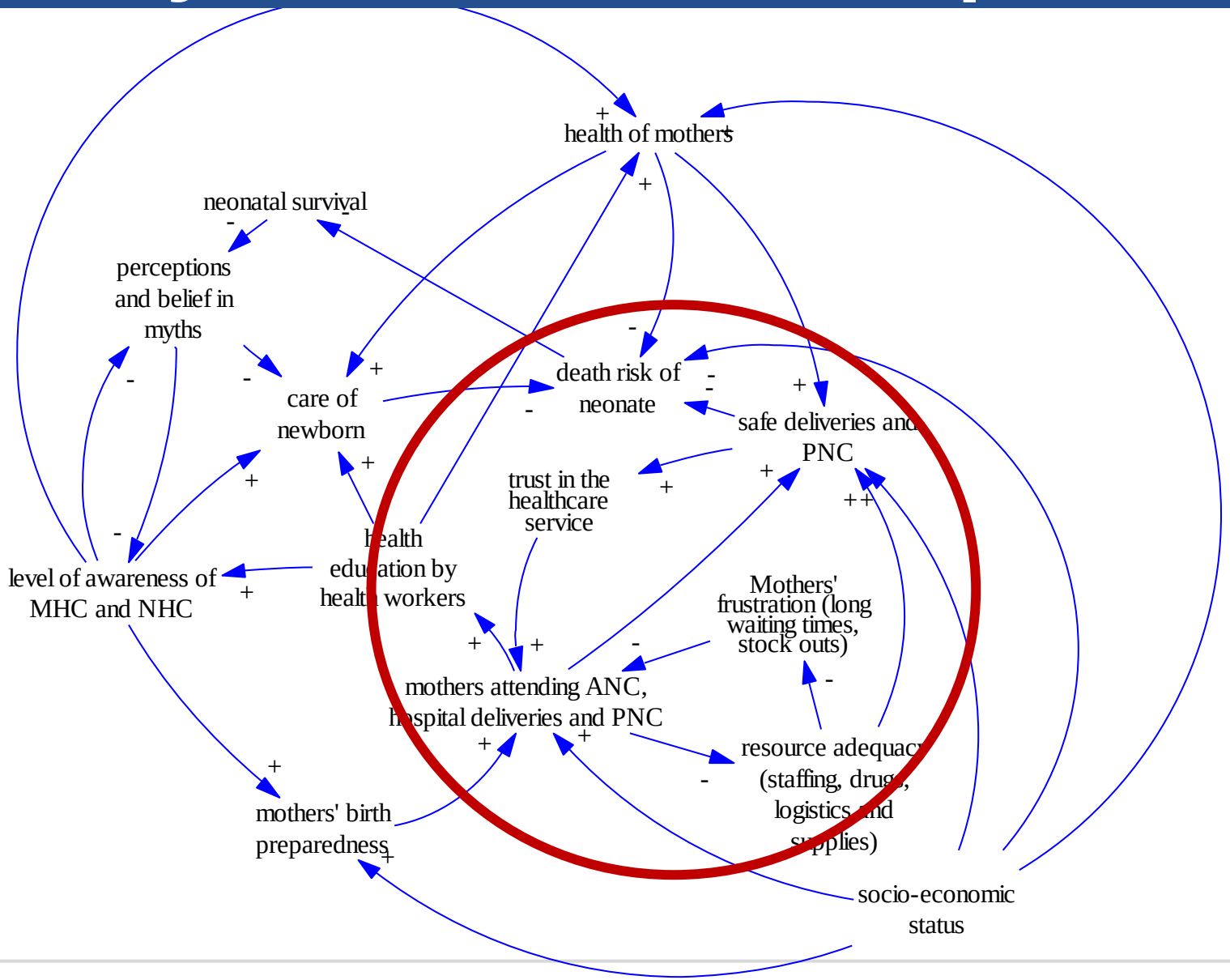


Identify the feedback loops



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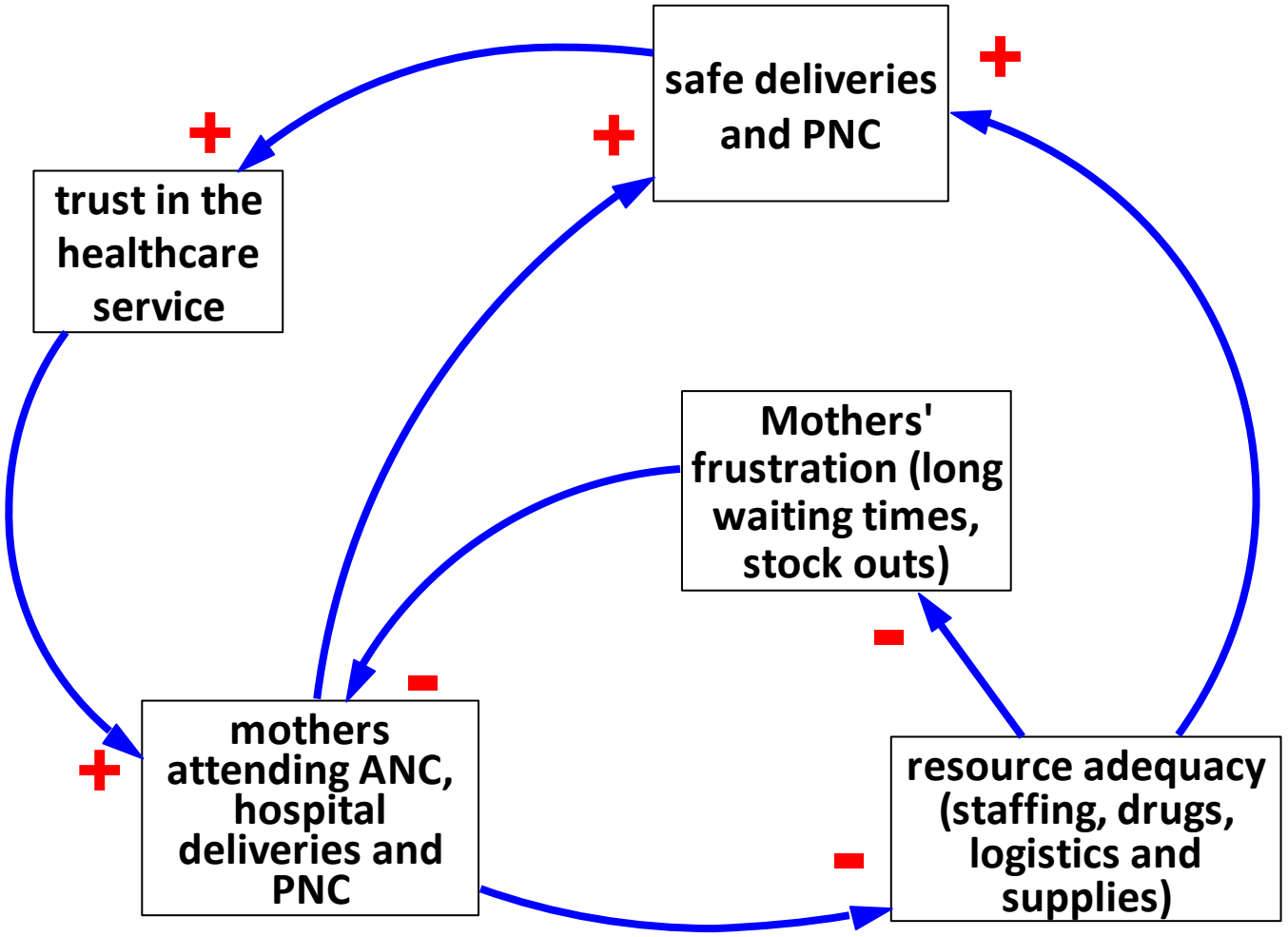
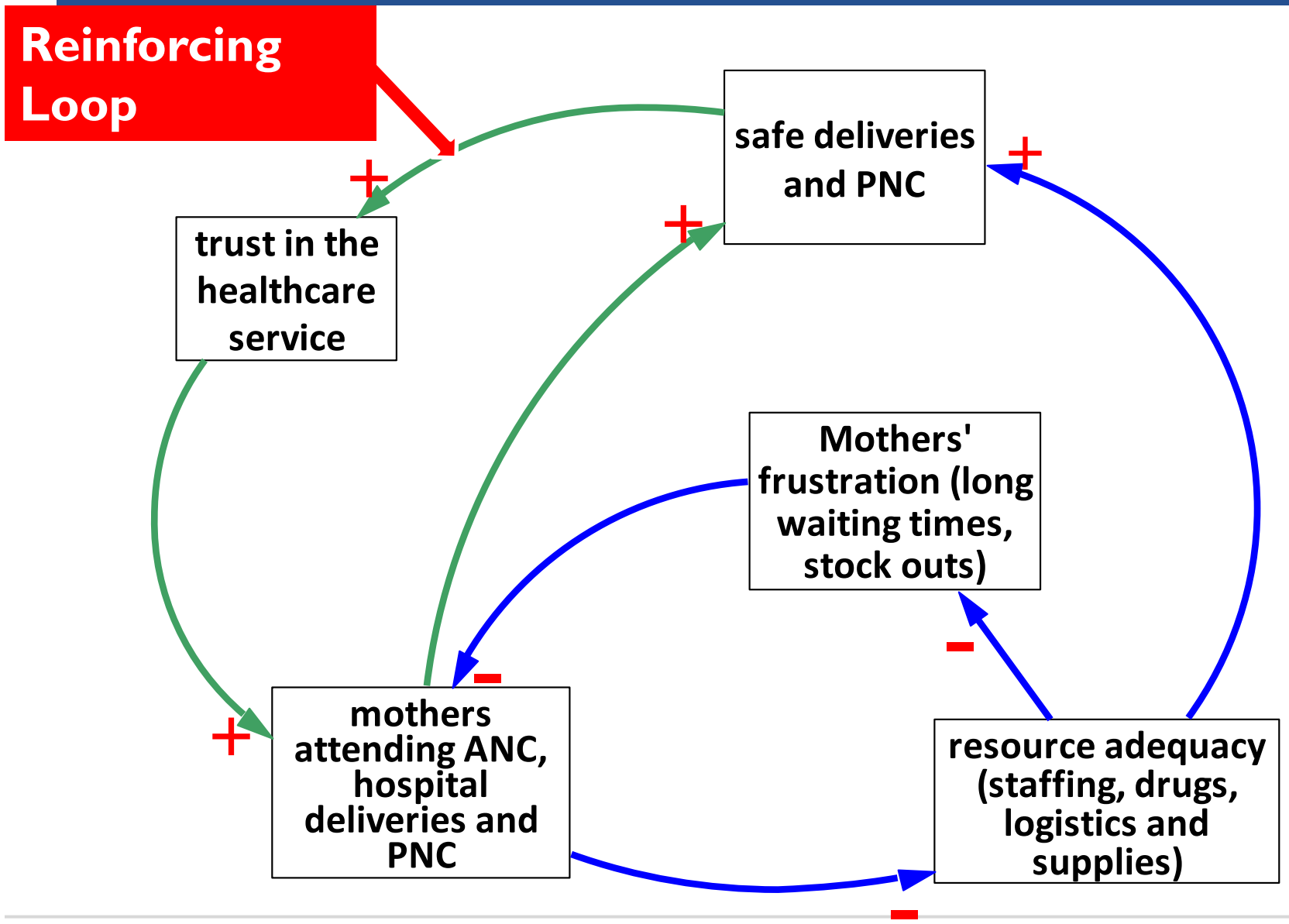


Identify the feedback loops



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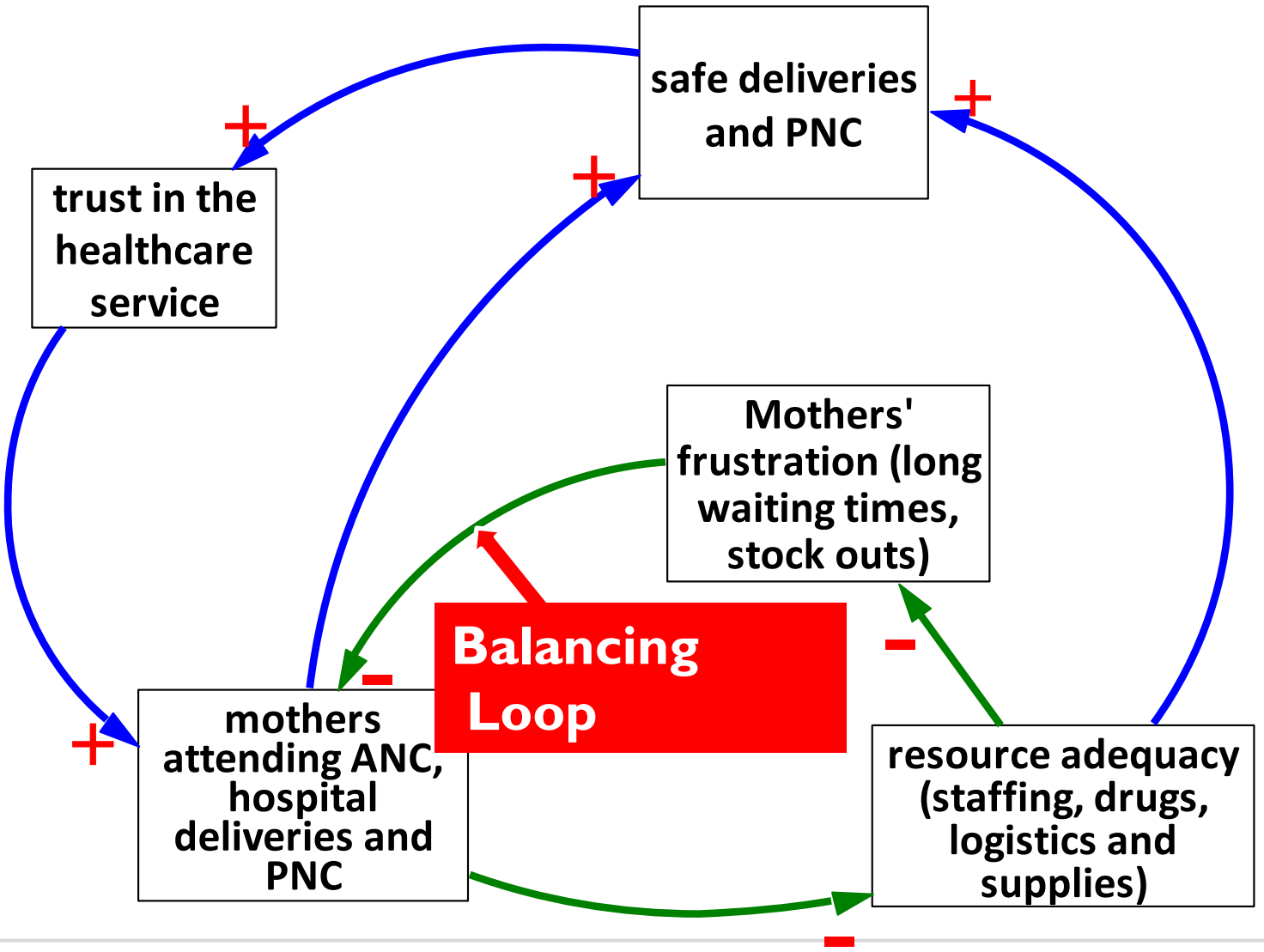

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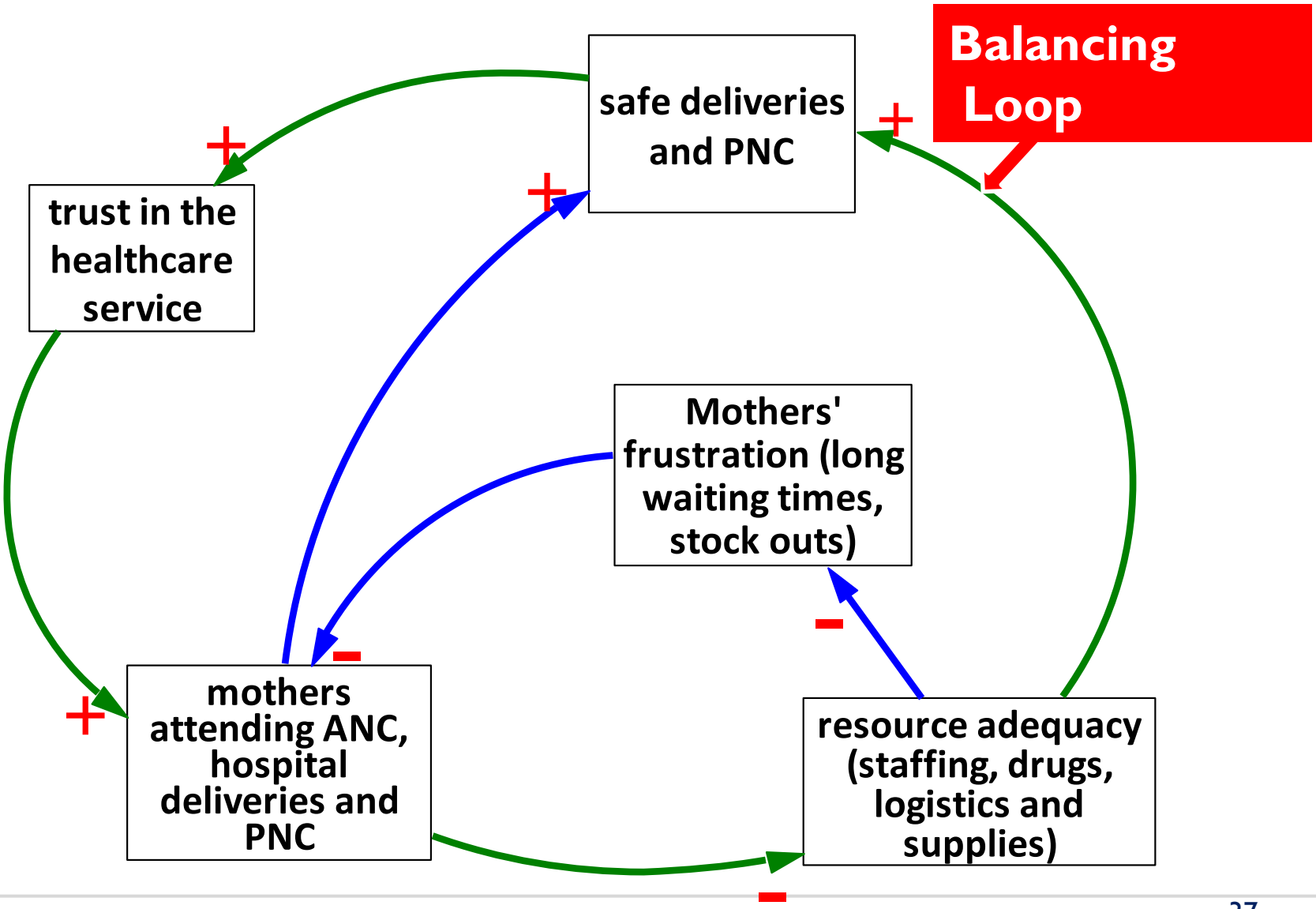

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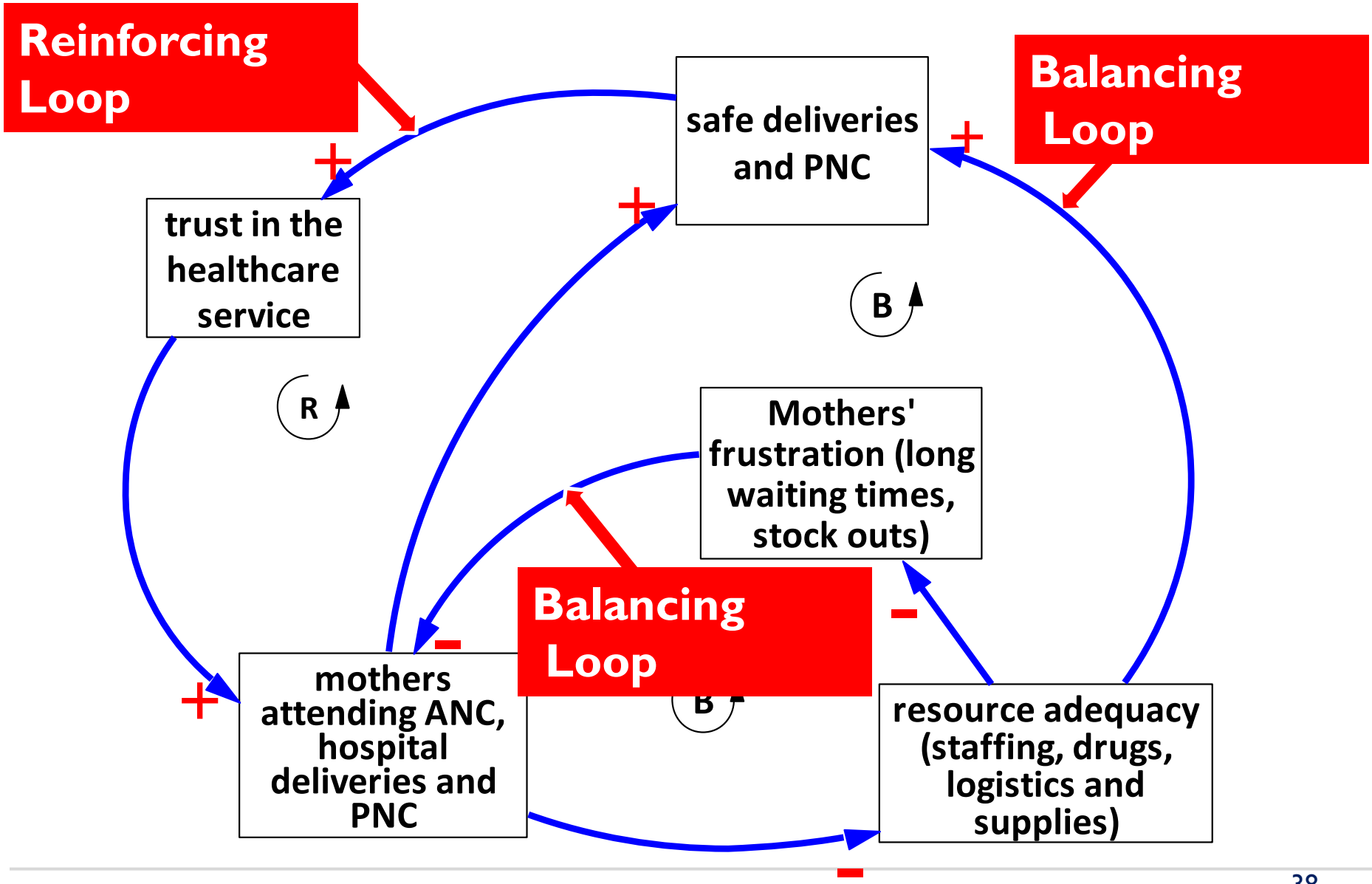
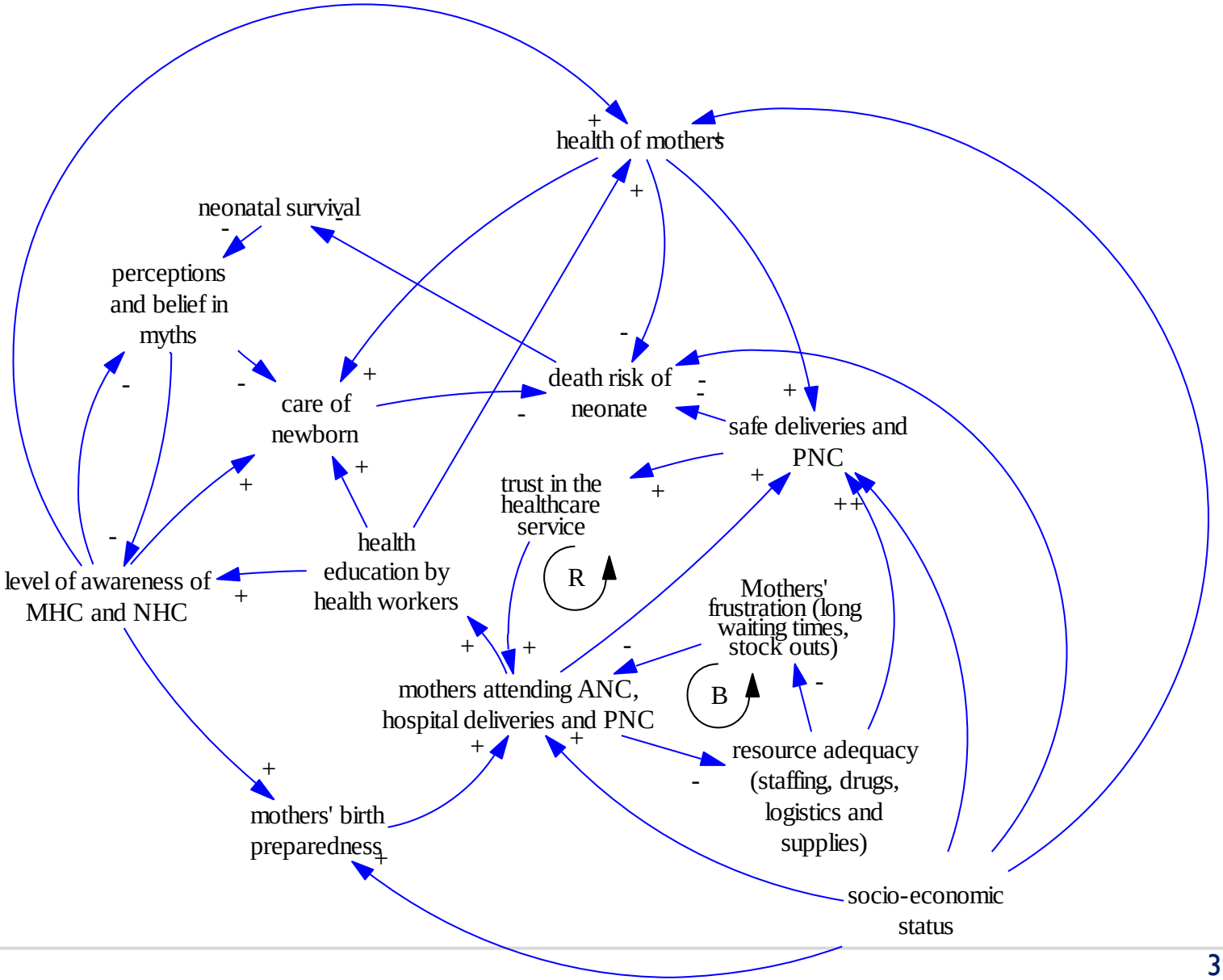


Feedback loops



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Leverage Points

A leverage point is a place in the system's structure:

- where micro changes can result in macro results.
- when an intervention can be applied

A low leverage point—small level of intervention or change force results in a small change in the behavior of the system. Often used to address intermediate causes of a problem

A high leverage point—small level of intervention/change force, causes a large change in the system's behavior. Used to resolve root causes.

Points of leverage: physical and informational

TYPE	LEVER	AIM
Physical	• Change physical amount of elements and stocks • Change structure of physical systems e.g.; staffing structures	• Focus on changing inputs • Focus on more proximal drivers Note: Low leverage potential
Informational	• Change rate of system responses • Manage relationships and timing between feedback loops • Create new loops to connect different system elements	• Reduce system delays • Examine stabilizing/ resisting influence of balancing feedback loops • Reinforce virtuous feedback loops • Explore and alter *who* has access to *what* information

Points of leverage: social and conscious

TYPE	LEVER	AIM
Social	• Alter rules of the system (such as incentives, punishments, constraints) to support desired goals • Alter goals of the system - what a system seeks to achieve	• Understand and change what the rules are and who has power over them • Nurture innovation, flexibility, variation and collaboration Note: High leverage potential
Conscious	• Shift mindset or paradigm out of which the system arises	• View whole system functioning and dynamics • Expose anomalies and failures in old paradigm and challenge assumptions • Work with active change agents Note: Highest leverage potential

Leverage Points and Intervention strategies

System Dynamic	Strategic Intervention
System is stagnant or stalled	Look for constraints
Vicious cycles	Identify "brakes" Examine intervention points to return process to virtuous cycle
Reinforce virtuous feedback cycles	
Find the strongest feedback structure operating then review the implications and generic leverage points.	
Examine each link and consider the consequence of strengthening it or weakening it.	

Overcoming policy resistance

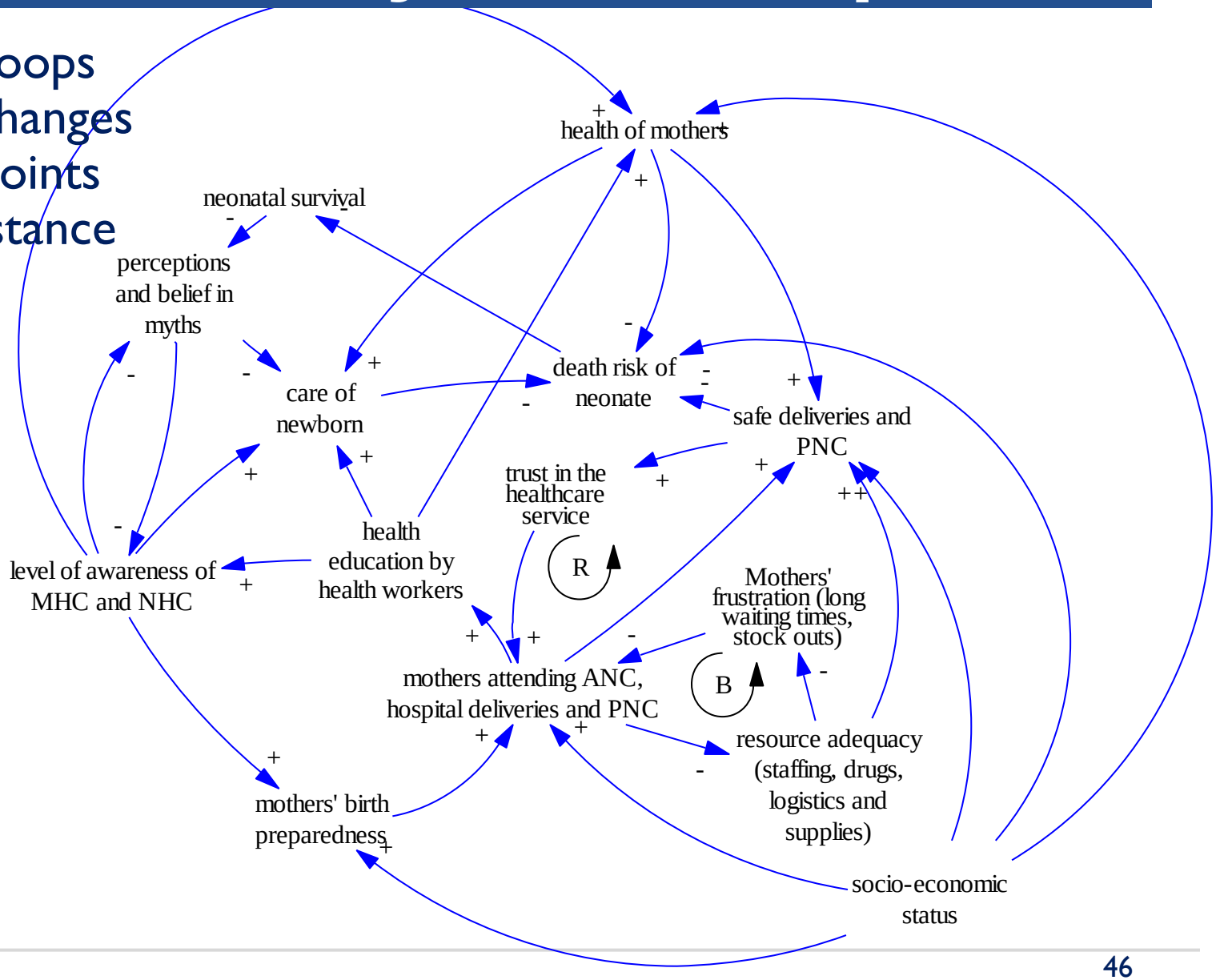
Examine CLD for potential policy resistance following strategy implementation

Develop "what if" alternatives to mitigate policy resistance by:

- **Adding a new link or loop** – can the system start doing something differently or new?
- **Breaking or weakening a link** between two variables – can the system stop doing something or do less of something.
- **Strengthening a link** and hence a loop – can the system do more of something that was working.
- **Alter delays.**
- **Switching an + to a -** (or vice versa) on the link from one variable to another – by getting the system to behave in a different way.

Examine the systems map

- Feedback loops
- Dynamic changes
- Leverage points
- Policy resistance



Exploring causal loop diagrams

Identify the following:

- Underlying issue for which this CLD has been developed
- Reference level informing the CLD
- Source of information used to construct the CLD?
- How people's mental models and assumptions were made explicit
- Key variables of interest/key outcomes in this CLD?
- Main drivers – proximal and distal of outcomes of interest and how they interact
- Major feedback loops in this CLD interacting to give rise to the system behaviour?
- Thinking about intervening in the system
  - What is your scope of influence and how does this impact the level of leverage possible?
  - What are the range of strategic interventions possible and how would these impact the system if successfully implemented.
  - What are possible points of policy resistance and how might those be mitigated given the specific system dynamics
- Finally – consider the boundaries of the system – how were these determined? Whose voices are included in the system and who is left out? What additional elements should be included?

How do we use Systems Thinking Tools?

- Explain root problems, their drivers and feedback mechanisms
- Identify potential leverage points for interventions
- Explore appropriate intermediate and outcome measures
- Model the potential impact of system interventions
- Identify potential policy resistance
- Formulate appropriate research questions
- Make explicit our theory of change

References

- Meadows D. *Leverage Points: Places to Intervene in a System. Donella Meadows Institute.* 1999. http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/

Thank you

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