

Understanding the effects of payment for performance on health systems in low-and-middle income countries- a reflection on empirical findings and research methods

Josephine Borghi
17th May 2022

LONDON
SCHOOL of
HYGIENE
& TROPICAL
MEDICINE



- Background to P4P
- Evaluation of P4P in Tanzania
- Understanding 'health system' mechanisms
 - Causal mediation analysis
 - Systems thinking
- The role of context
- Importance of scheme design
- Closing reflections

Payment for Performance

- A payment mechanism
- Use of performance pay in health originated in the US
- Payments linked to some measure of performance of the health provider
- “Performance” usually means quality of care but can include utilisation and cost (savings)
- Rewards can be directed at health workers or healthcare organisations
- Always used alongside other payment methods (e.g. capitation)



Theoretical foundations and concerns

- Align incentives of different actors in provision of health care (P-A)
- Diverts effort away from non-targeted services
 - So-called “multitasking”
- Single mindedness
 - “You get what you pay for, and nothing more”
- Measurement problems
 - Some measures can be gamed or manipulated
- Cream-skimming of patients
- Erosion of intrinsic motivation

P4P in Low and Middle Income Countries (LMIC)

Implemented in over 40 countries, with funding from international donors (>1.5 billion USD in loans from WB).



P4P in LMIC: a package of interventions

- Individual financial incentives
 - Facility payments
 - Improved HMIS
 - Performance monitoring / supervision
 - Financial autonomy
-
- Aimed at 'transforming' the health system to deliver better care



Evaluation of P4P in Tanzania

Social Science & Medicine 179 (2017) 61–73



ELSEVIER

Contents lists available at [ScienceDirect](#)

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed



Effects of Payment for Performance on accountability mechanisms:
Evidence from Pwani, Tanzania



Iddy Mayumana^a, Jo Borghi^b, Laura Anselmi^c, Masuma Mamdani^a, Siri Lange^{d,*}

LONDON
SCHOOL of
HYGIENE
& TROPICAL
MEDICINE



PLOS ONE

RESEARCH ARTICLE

Effect of Paying for Performance on
Utilisation, Quality, and User Costs of Health
Services in Tanzania: A Controlled Before and
After Study

Peter Binyaruka¹, Edith Patouillard², Timothy Powell-Jackson², Giulia Greco²,
Ottar Maestad³, Josephine Borghi^{2,*}

Tanzanian Context

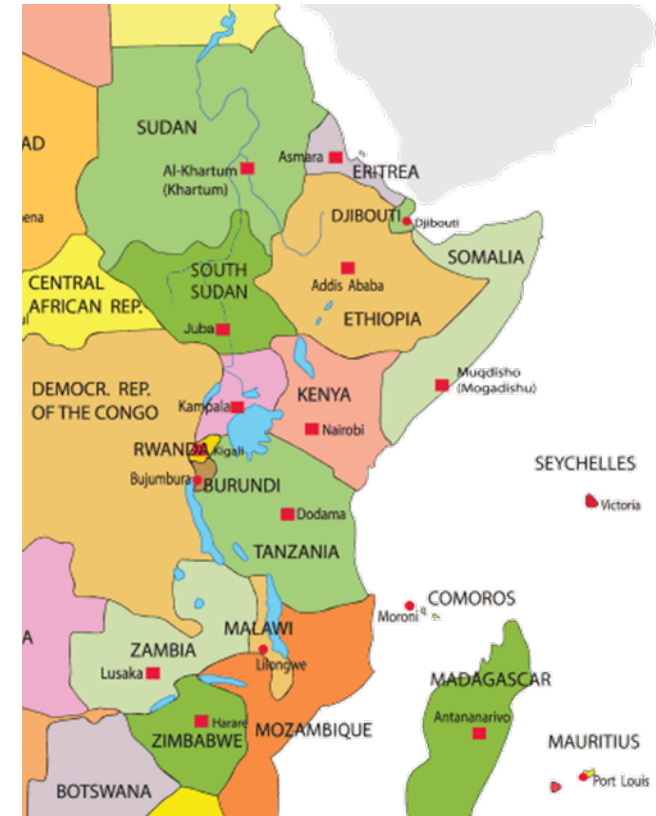
- East Africa
- Decentralised health system
- User fees at public facilities with selective exemptions
- Missing half required staff across all cadres
- GDP per capita 1076 USD (2020)
- 63% institutional delivery rate (2016)
- U5 mortality: 67 per 1000
- MMR: 578 per 100,000



- P4P introduced to accelerate progress to MDGs4 and 5.
- Pilot from 2012-2013 funded by Government of Norway

Incentives paid every 6 months

- 75% to health workers – 10% of salary
- 25% to health facilities for investment in drugs and supplies, equipment
- Incentives to district and regional managers



Facility level:

- ANC: IPT2; % *HIV+ women on ART*
- Institutional delivery rate (increase in % points)
- % of completely filled partograms
- % of newborns with OPV0 in first 2 weeks
- % infants with Penta 3
- % infants with measles vaccine
- HMIS reports correctly filled and submitted
- % of *PNC visit w/n 7 days (increase in % points)*
- *CYP (increase in % points)*

District – regional level:

- % of maternal/perinatal deaths audited on time
- % of facilities with stock outs



Design: Controlled before and after study design

- 7 intervention districts (contracts and bonus)
- 4 neighbouring control districts (no contracts or additional funds)
- Matched on poverty, literacy, rate of institutional deliveries, IMR, pop. per health facility, no. of children < 1 yr

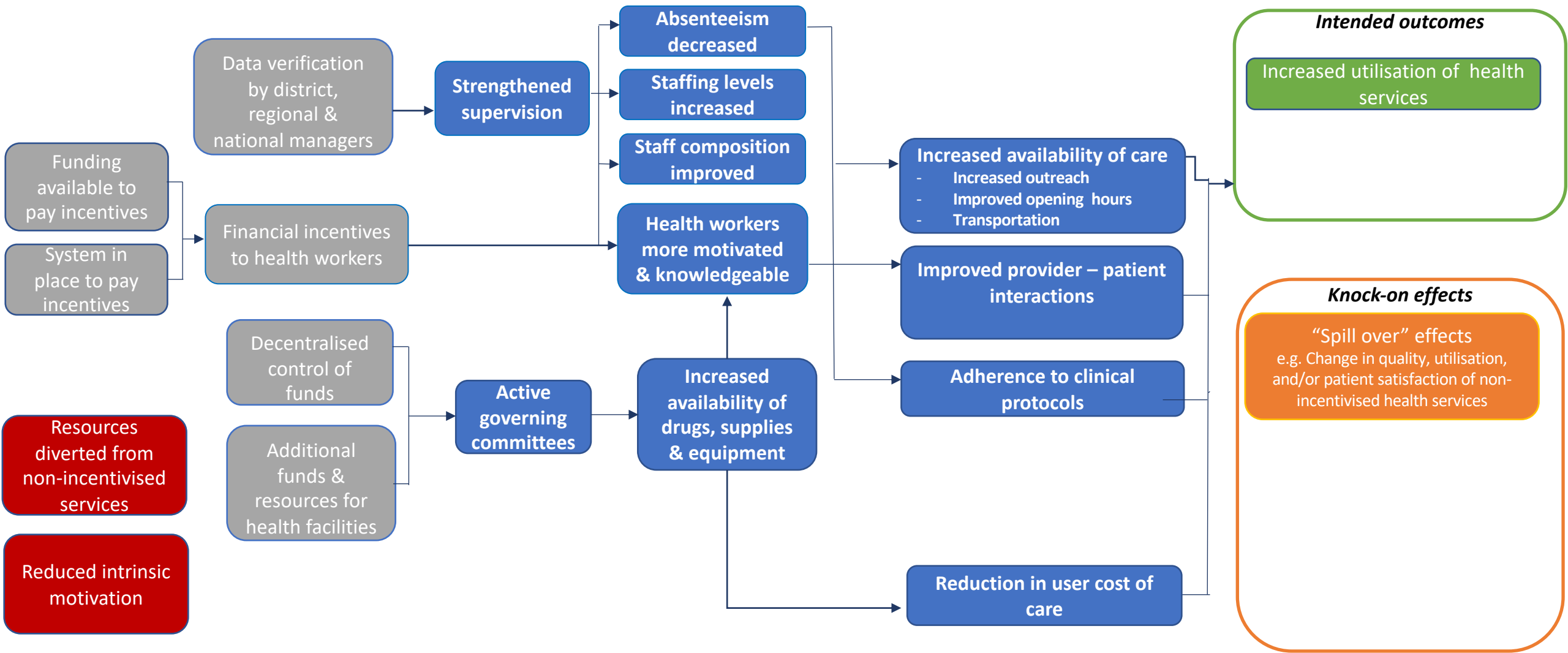
Timing: Baseline in January-February 2012 – Endline in March-April 2013

Three rounds of process evaluation in 5 intervention districts, interviews and FGD with stakeholders at all system levels

PROGRAMME DESIGN & DELIVERY

IMPACT ON THE HEALTH SYSTEM

OUTCOMES



Intervention areas
7 districts of Pwani
region

Control areas
3 districts in Morogoro region
and 1 district in Lindi region

150 health facilities, 75 in each arm incl.
6 hospitals
16 health centres
53 dispensaries

1 facility survey at each
facility

1-2 health workers
surveyed at each facility

10 exit interviews with
patients at each facility

20 interviews with women from
the catchment area of each
facility

- Difference-in-difference analysis, linear model

$$Y_{ijt} = \beta_0 + \beta_1(P4P_j \times \delta_t) + \beta_2\delta_t + \beta_3X_{ijt} + \gamma_j + \varepsilon_{ijt}$$

- Model with covariates and facility fixed effects, with facility-level clustering
- Test whether pre-trends were parallel for key outcomes

Impact on Incentivized Outcomes

Variables	Baseline			Follow up			Impact
	P4P	Comp	Diff	P4P	Comp	Diff	DID
ANC							
2+ doses of anti-malarial (%)	49.5	56.7	-7.2***	73.0	69.2	3.8*	10.3***
Treated for HIV/AIDS (%)	7.8	6.8	1.0	6.1	6.2	0.1	-0.3
Intra-partum care							
Delivery in a facility (%)	84.7	86.8	-2.1	89.2	83.1	6.1***	8.2***
Postpartum care							
PNC < 7 days after birth (%)	21.6	16.9	4.7**	19.5	13.8	5.7**	0.6
Family planning current (%)	37.1	39.8	-2.7	26.0	29.7	-3.7*	-0.9
OPV0 (%)	77.4	78.5	-1.1	79.1	74.4	4.7**	5.6
DPT 3 (%)	76.4	79.9	-3.5	79.1	74.4	4.7**	2.4
Measles (%)	51.4	53.3	-1.9	44.3	39.2	5.1	9.6

Health System effects: Quality and Cost

Variables	Baseline			Short term impact
	P4P	Control	Diff	DID
ANC				
Quality of ANC (index)	0.78	0.75	0.03**	0.00
Stock out of IPT (%)	27.1	17.8	9.3	-10.0*
Pay for ANC (%)	8.1	7.5	0.6	-2.7
Intrapartum care				
Staff kindness at delivery (index)	7.2	7.6	-0.4***	0.49*
Stock out of oxytocin (%)	42.9	18.1	25***	-40.0***
Pay for delivery (%)	16.5	11.9	4.6**	-5.0**

Increase in availability of drugs linked to non-incentivised services, e.g. antibiotics

Health system effects: Governance and accountability

Outcome	Baseline			Impact (DID)
	P4P	Control	Diff	
Supervision >90 days (%)	11.3	9.3	1.9	-17.1***
Providing feedback (%)	10.0	29.2	-19.2	24.8**
Governing committee met within 90 days (%)	94.4	93.2	1.3	18.2**

Health system effects: Motivation and Knowledge

- Small but positive and significant effect on IM (not crowded out)
- Programme effects greater in facilities with lower baseline IM
- 13.4 pp increase in knowledge of ANC clinical care guidelines

Unintended effects

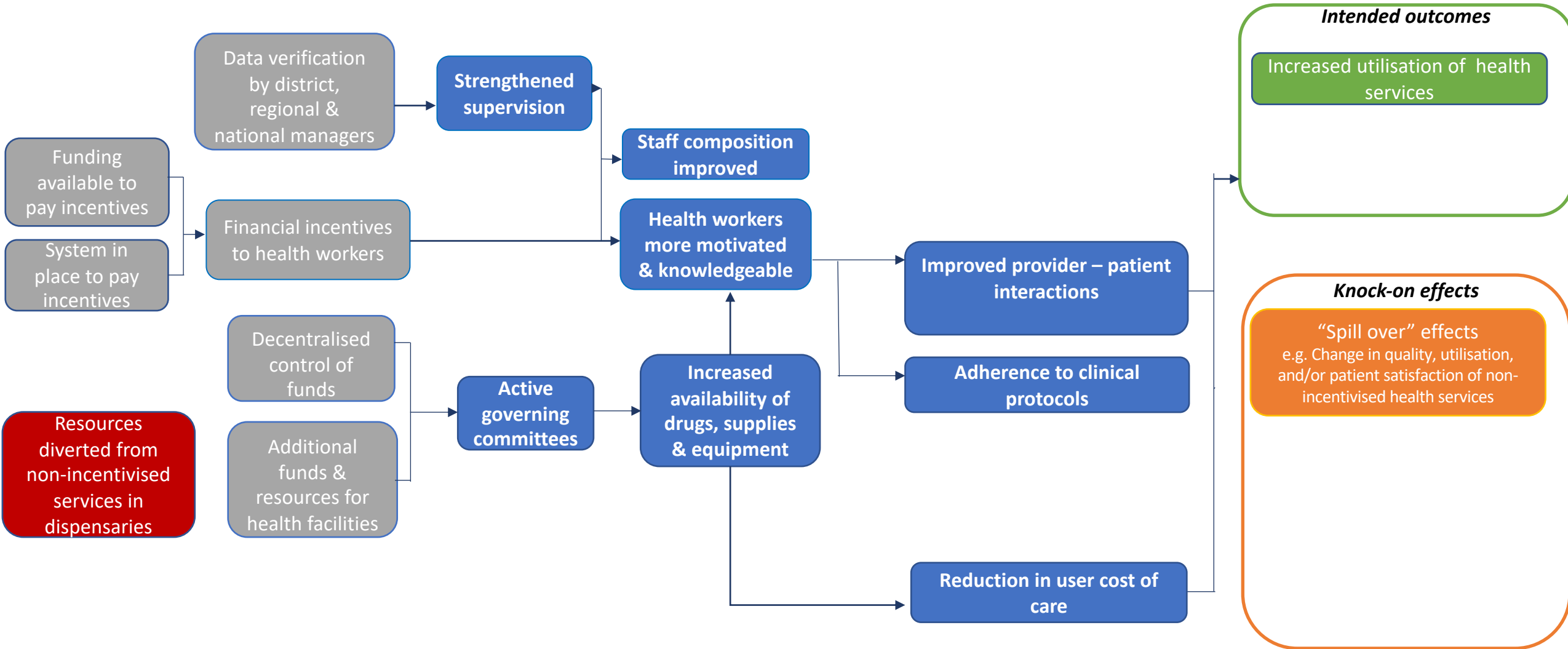
Variables	Baseline			DiD
	P4P	Contr ol	Diff	
Outpatient < 5 years	223.9	193.7	30.2	-41.1
Outpatient < 5 years in dispensaries	164.8	172.6	- 7.8	-57.5**
Outpatient > 5 years	359.5	287.3	72.2	-15.8
Outpatient > 5 years in dispensaries	276.8	235.4	41.4	-90.8***

50% of economic cost of the programme involved data generation and verification, only 15% incentives

PROGRAMME DESIGN & DELIVERY

IMPACT ON THE HEALTH SYSTEM

OUTCOMES



Testing causal pathways: mediation analysis

Anselmi et al. *Implementation Science* (2017) 12:10
DOI 10.1186/s13012-016-0540-1

Implementation Science

RESEARCH

Open Access



Understanding causal pathways within health systems policy evaluation through mediation analysis: an application to payment for performance (P4P) in Tanzania

Laura Anselmi^{1*}, Peter Binyaruka² and Josephine Borghi³

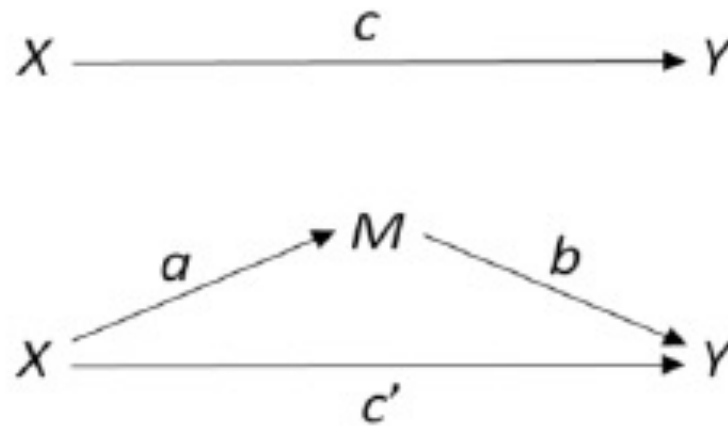
Abstract

Background: The evaluation of payment for performance (P4P) programmes has focused mainly on understanding contributions to health service coverage, without unpacking causal mechanisms. The overall aim of the paper is to test the causal pathways through which P4P schemes may (or may not) influence maternal care outcomes.

LONDON
SCHOOL of
HYGIENE
& TROPICAL
MEDICINE



Health system 'mediators'



1. Total effect: $c = ab + c'$

2. Direct effect: $c' = c - ab$

3. Indirect effect: $c - c' = ab$

Figure 1. Details from Baron and Kenny's (1986) mediation model.

"The identification of a causal mechanism requires the specification of an intermediate variable or a mediator that lies on the causal pathway between treatment and outcome." (Imai et al. 2011)

Methods Baron & Kenny

- **Step 1: Estimating the impact of P4P on outcomes (DiD)**

$$Y_{ijt} = \beta_0^1 + \beta_1^1 (P4P_j \times \delta_t) + \beta_2^1 \delta_t + \beta_3^1 X_{ijt} + \gamma_j + \varepsilon_{ijt}^1$$

$P4P_t$ from areas exposed to P4P

δ_t time indicator

X_{ijt} women socio-economic characteristics

γ_j HF fixed effects

- **Step 2: Identifying effect of P4P on potential mediators (DiD)**

$$M_{ijt} = \beta_0^2 + \beta_1^2 (P4P_j \times \delta_t) + \beta_2^2 \delta_t + \beta_3^2 X_{ijt} + \gamma_j + \varepsilon_{ijt}^2$$

- **Step 3: Identifying direct and indirect causal effects (DiD)**

$$Y_{ijt} = \beta_0^3 + \beta_1^3 (P4P_j \times \delta_t) + \beta_2^3 \delta_t + \beta_3^3 X_{ijt} + \beta_4^3 M_{ijt} + \gamma_j + \varepsilon_{ijt}^3$$

β_1^3 P4P direct effect

$\beta_1^2 \times \beta_4^3$ P4P indirect effect through mediator M

- *Sequential ignorability*
 - Mediators on the causal pathway if:
 - Assignment of intervention is independent of outcomes and mediators
 - There are no unobserved pre-intervention covariates that effect the outcome and mediator
- Tests sensitivity of results to *sequential ignorability*
 - Indicates minimum correlation between error terms of regressions (2 and 3) that would reduce indirect effect to zero

- **Facility based delivery**

P4P total effect: +8.2%

P4P indirect effect through reduction in stock-out of oxytocin: +1.8 % (share of effect: 22%) – corr 0.04

P4P indirect effect through kindness at delivery: +3.9% (share of effect: 48%) **corr 0.21**

P4P indirect effect through probability of paying out of pocket: +3.9 % (share of effect: 48%) **corr 0.23**

- **Uptake of two doses of IPT during pregnancy**

P4P total effect: +10.3 %

P4P indirect effect through reduction in last supervision < 90 days ago: +1.5 % (share of effect: 15%) corr 0.03

- Only considered quantitative data, and limited to what was measured in surveys
- Mediators measured at same time as outcomes (not sequential)
- Unable to examine causal chain (multiple mediators)

Towards a complexity science approach

Commentary

BMJ Global Health

Square peg in a round hole: re-thinking our approach to evaluating health system strengthening in low-income and middle-income countries

Josephine Borghi,¹ Zaid Chalabi²

BMJ Glob Health: first published as 1

Cassidy et al. *BMC Health Services Research* (2019) 19:845
<https://doi.org/10.1186/s12913-019-4627-7>

BMC Health Services Research

RESEARCH ARTICLE

Open Access

Mathematical modelling for health systems research: a systematic review of system dynamics and agent-based models



Rachel Cassidy^{1*}, Neha S. Singh¹, Pierre-Raphaël Schiratti^{2,3}, Agnes Semwanga⁴, Peter Binyaruka⁵, Nkenda Sachingongu⁶, Chitalu Miriam Chama-Chiliba⁷, Zaid Chalabi⁸, Josephine Borghi¹ and Karl Blanchet¹

- Evaluations treat health system **as static, one-directional and linear**
- Health systems **complex**: dynamic, multidimensional with feedback loops, non-linear.
- Limited application of CLD, SDM or ABM in health systems research, especially in LMIC

Analysing the Health System Response to Payment for Performance in Tanzania Using Systems Thinking Methods

Social Science & Medicine 285 (2021) 114277



ELSEVIER

Contents lists available at [ScienceDirect](#)

Social Science & Medicine

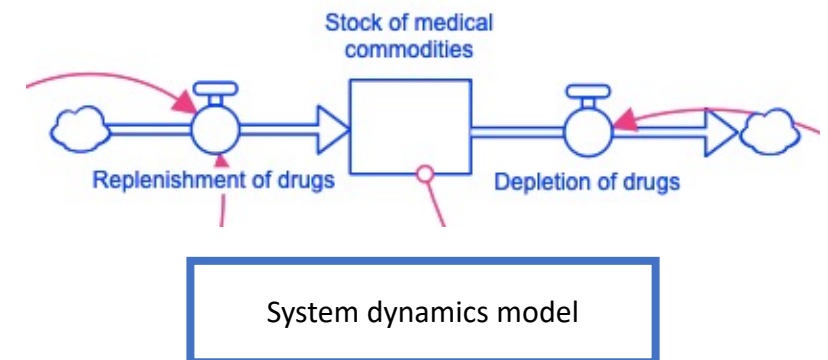
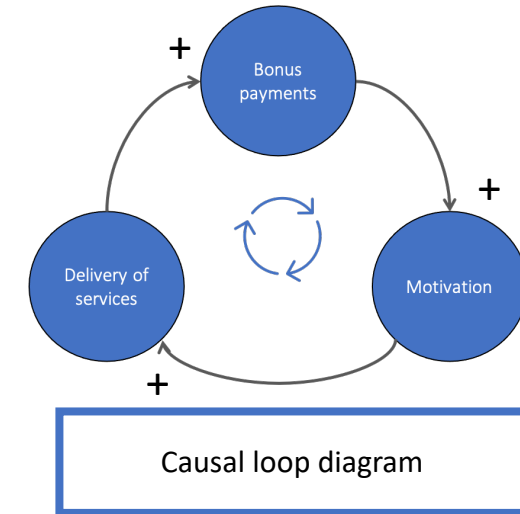
journal homepage: www.elsevier.com/locate/socscimed



Understanding the maternal and child health system response to payment for performance in Tanzania using a causal loop diagram approach



Rachel Cassidy^{a,*}, Andrada Tomoaia-Cotisel^b, Agnes Rwashana Semwanga^c, [Peter Binyaruka](#)^d, Zaid Chalabi^{e,f}, Karl Blanchet^g, Neha S. Singh^a, John Maiba^d, Josephine Borghi^a

- CLD and SDM: Capture macro-level system behaviour
- **Causal loop diagrams (CLDs)**
 - Visualise complexity and system structure related to a problem
 - Gain holistic perspective of system to investigate delays and bottlenecks in health facility processes
 - Can be developed using a variety of data sources
- **System dynamics models (SDMs)**
 - Exploring behaviour over time
 - Monitoring interconnected processes between sub-systems over time
 - To determine impact of interventions before real world application
- **Agent-based models (ABM)**
 - Explore micro-level behaviour of the system and heterogeneity within the system: at the household, provider or district level.



Method: Causal loop diagram

Data

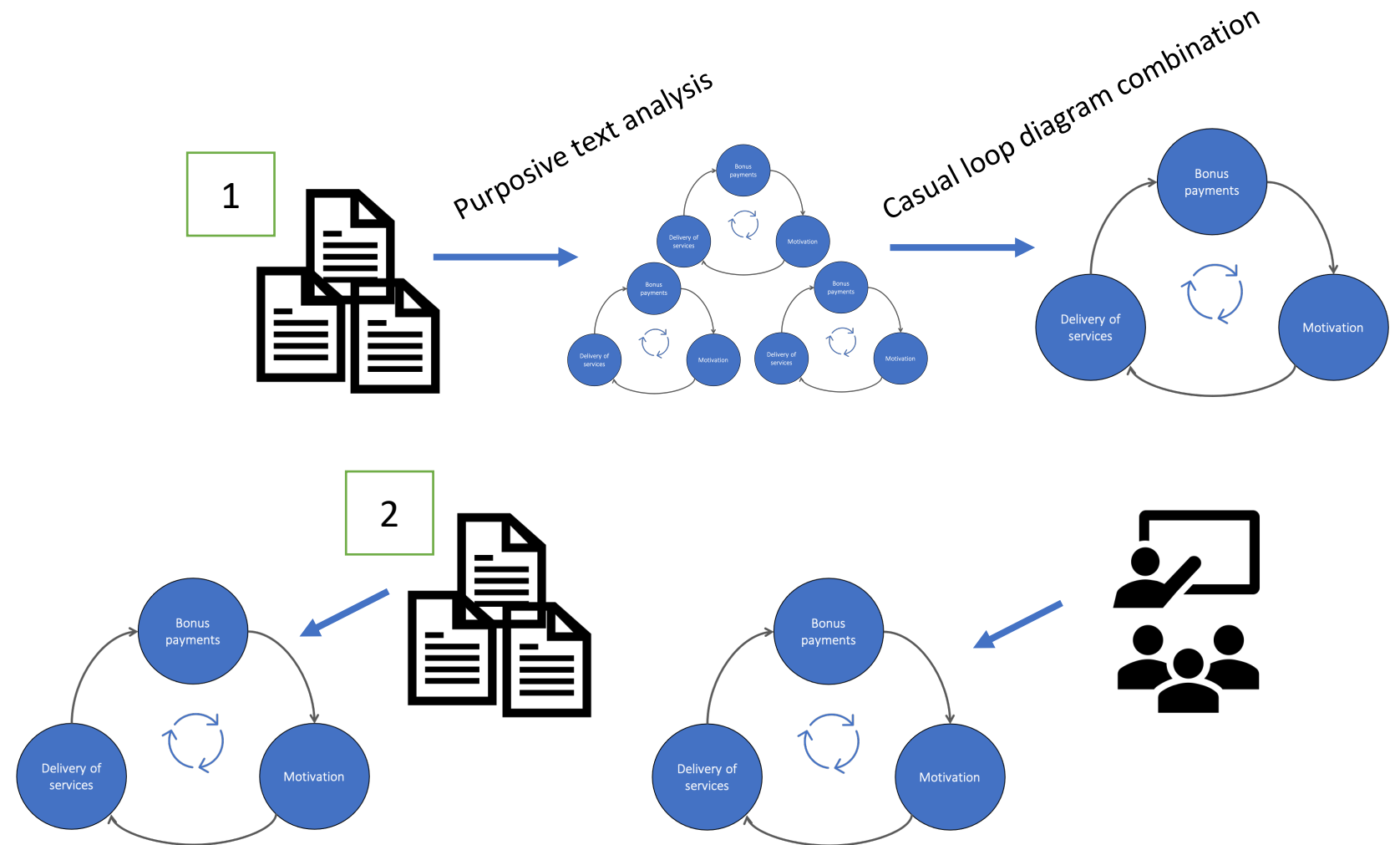
- Primary data 
- Secondary data 

Method for development

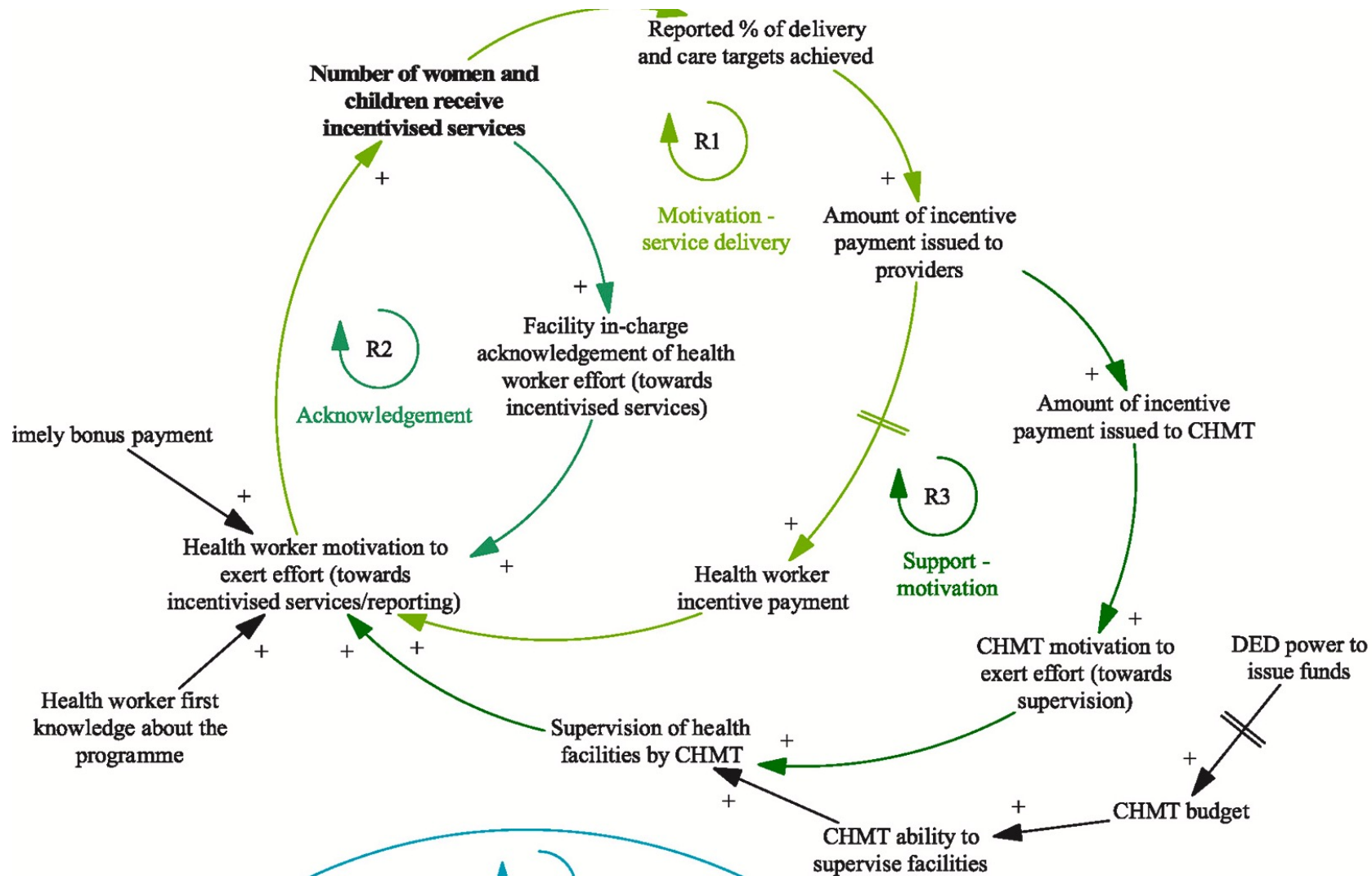
- Purposive text analysis
- CLD combination

Method for validation

- Comparison to data source
- Discussion with stakeholders

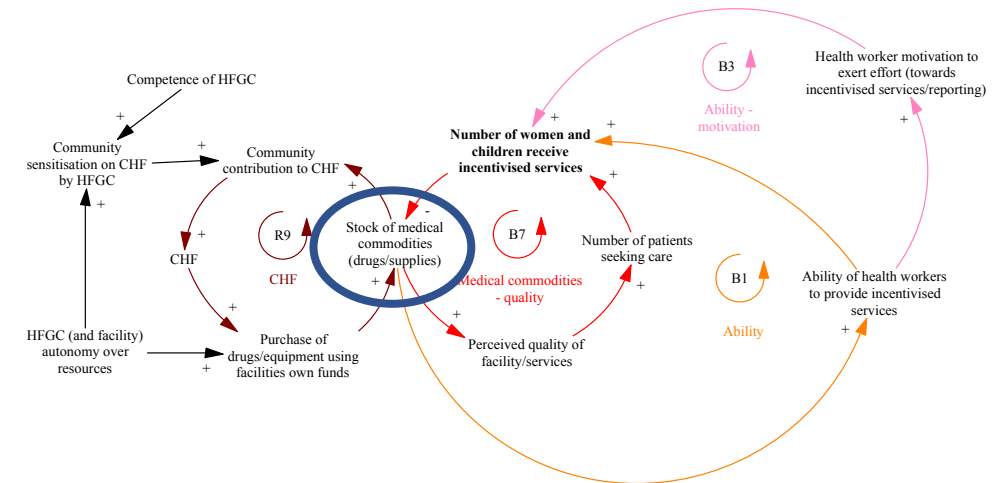
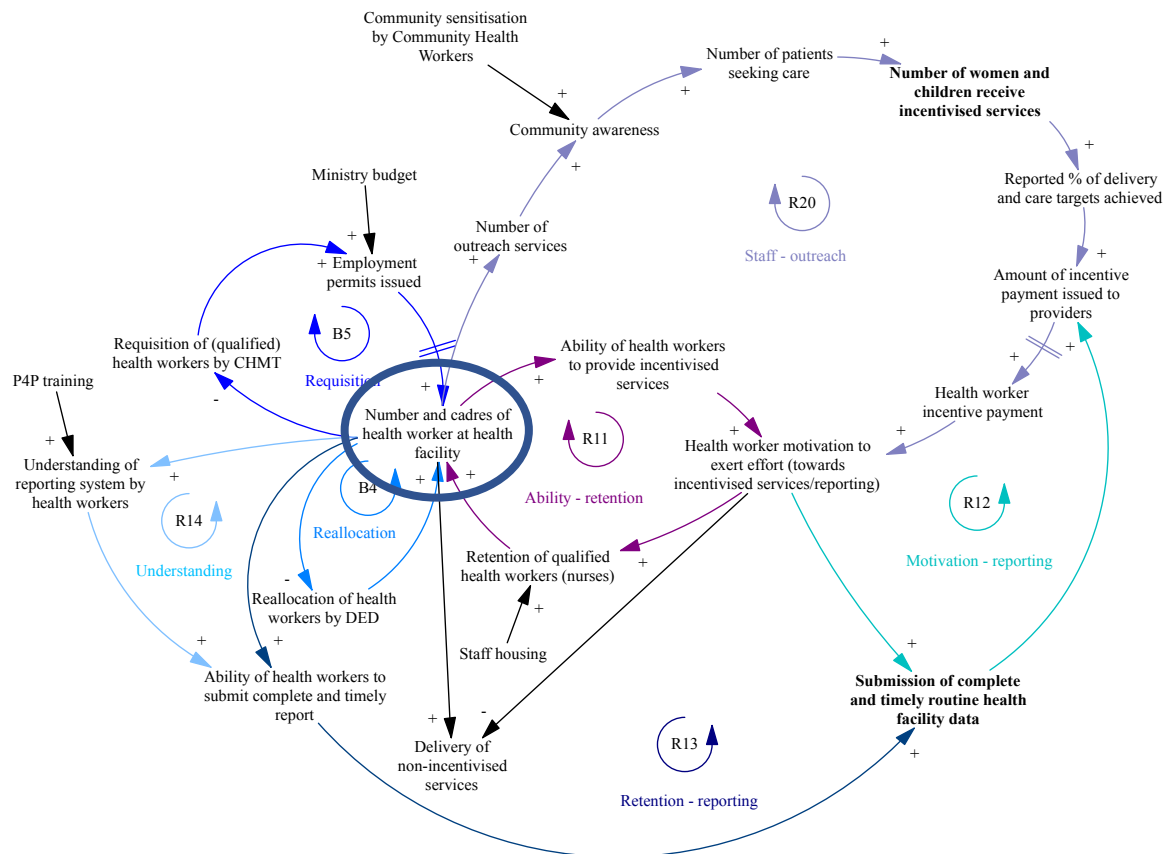


Viewing the system holistically



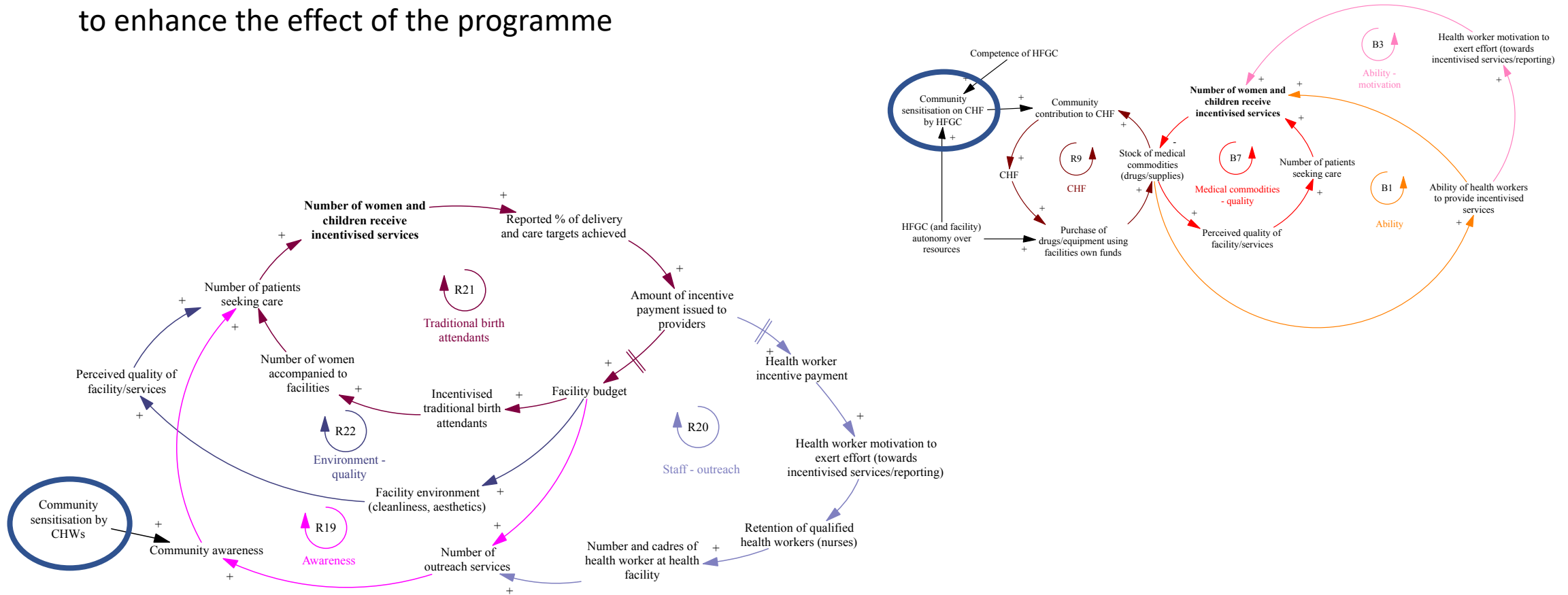
What further insights can be gained from a causal loop diagram?

Catalytic variables: affect multiple outcomes or mechanisms and therefore deserve careful consideration in the design of P4P schemes



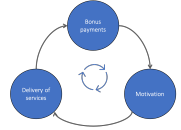


What insight can be gained from a causal loop diagram?

System levers: Not targeted by P4P but could be incorporated to enhance the effect of the programme



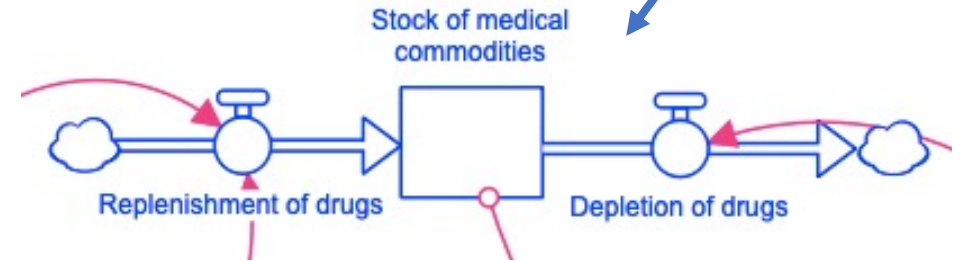
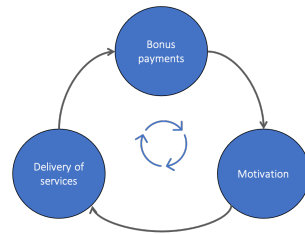
Method: *System dynamics model*

Data

- CLD 
- Secondary data 
- Primary data 

Method for development

- Stock and flow diagram
- Quantifying relationships



Method for validation

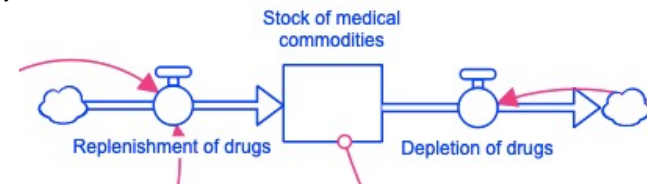
- Structural and behavioral validation tests
- Discussion with stakeholders

Dimensional consistency?

Extremes?

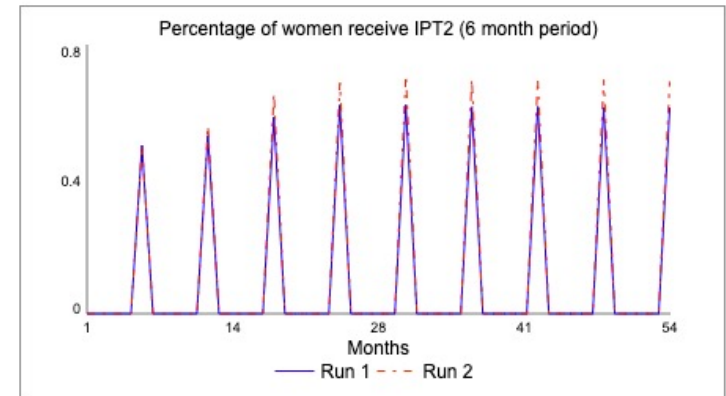
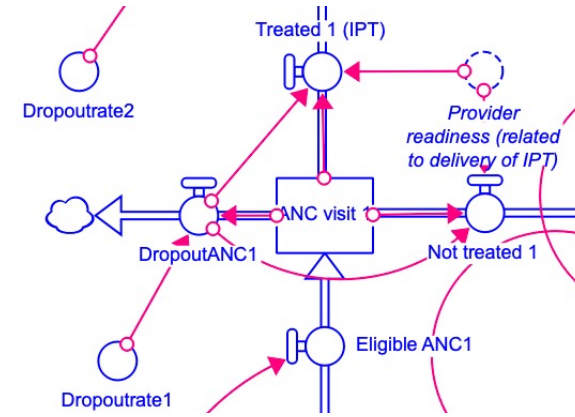
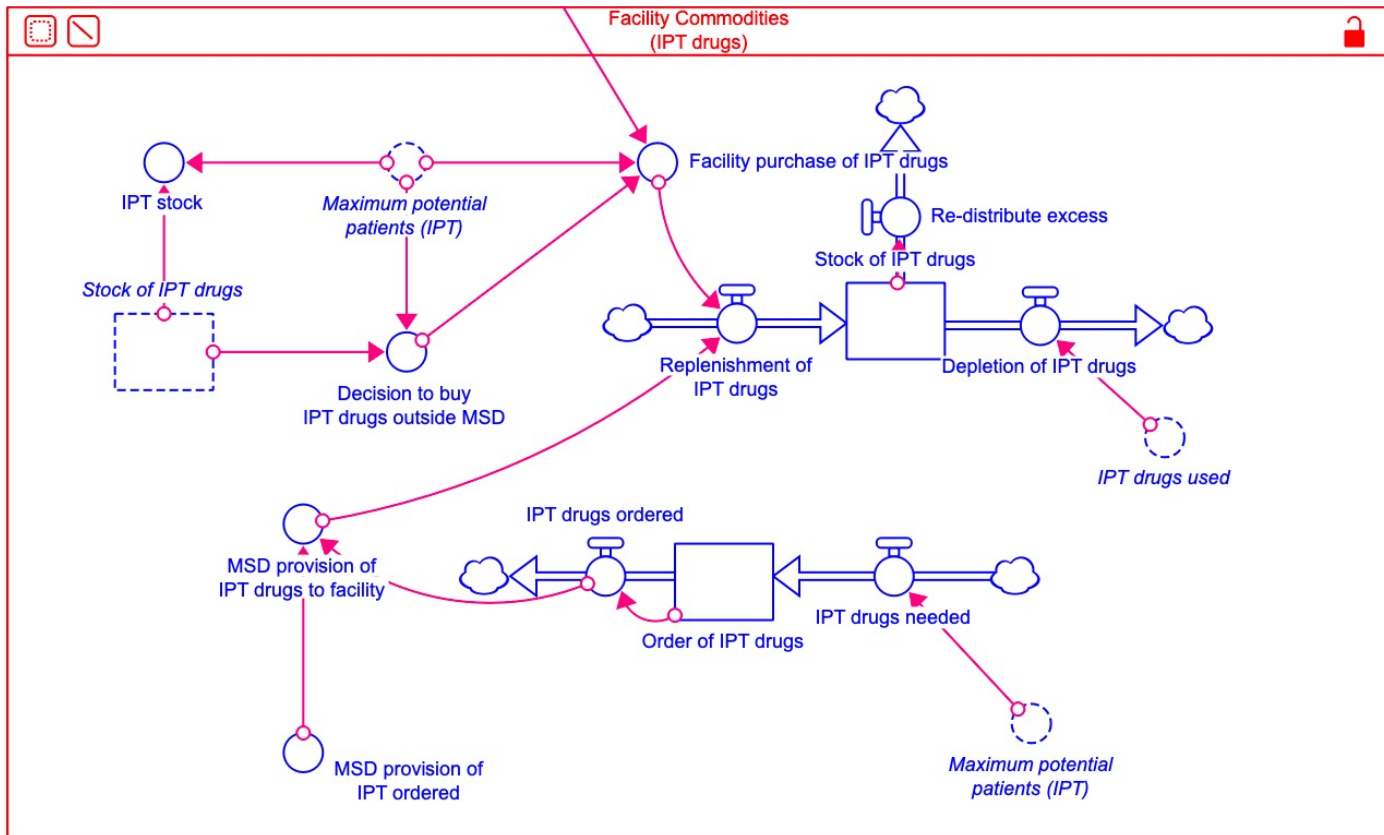
Structure?

Credible behaviour?



Work in progress!

Results: What insight can be gained from a system dynamics model?



Work in progress!

Method: System dynamics model

The COSMIC Project

Using computer modelling to optimise the design of health system programmes



Introduction

Background

Instructions

Additional questions

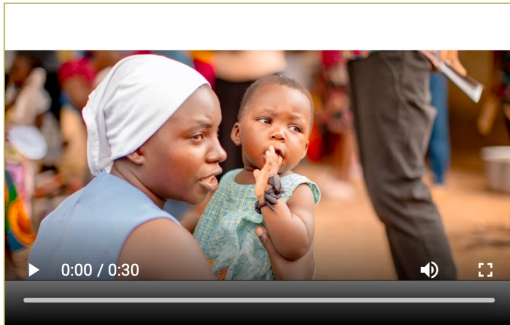
Interface Options

Antenatal care target

Facility-based deliveries target

Model assumption (trust and motivation)

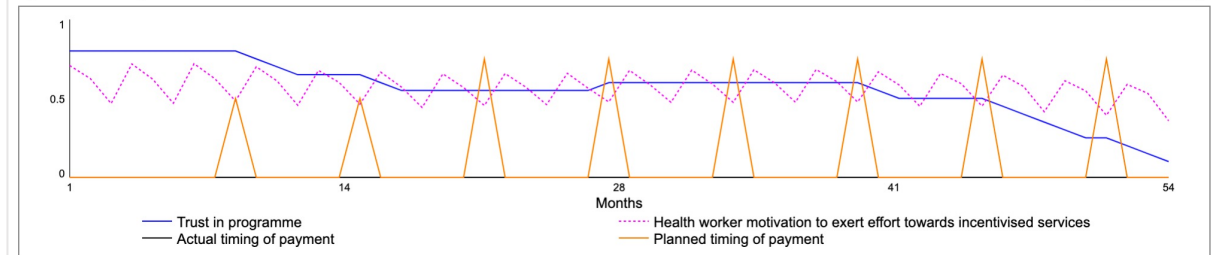
Model assumption (CHF)



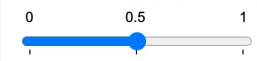
Home page

How health worker trust in the programme and motivation changes in response to delays

Next



Effect of incentives threshold on trust



Effect of payment delay on trust



P4P switch



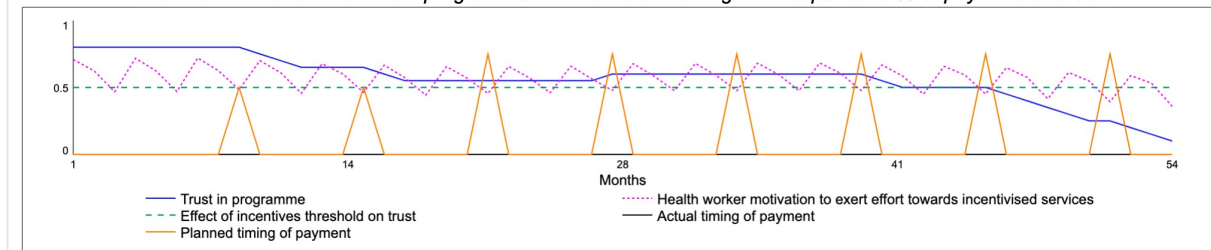
Delays in payment?



Run

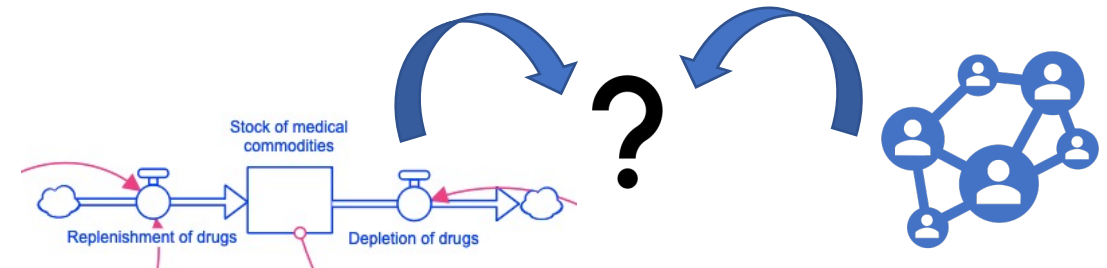
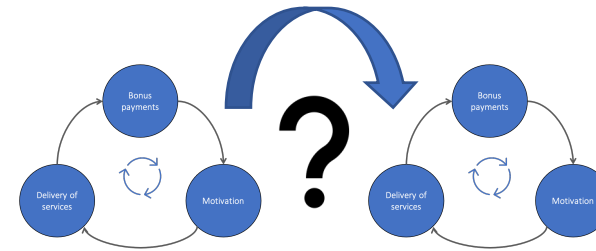
Restore

How health worker trust in the programme and motivation changes in response to % of payment awarded



Next steps

- What if scenarios regarding changes to programme design
- Is our model generalisable to another LMIC?
 - Zambia P4P programme
- Hybrid modelling:
 - What can we learn from the CLD, SDM and ABM
 - Developing a hybrid model



Further information on the COSMIC project: <https://www.lshtm.ac.uk/research/centres-projects-groups/cosmic#welcome>

Understanding how context shapes mechanisms and outcomes

Social Science & Medicine 285 (2021) 114277




Contents lists available at [ScienceDirect](#)

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Understanding the maternal and child health system response to payment for performance in Tanzania using a causal loop diagram approach


Rachel Cassidy^{a,*}, Andrada Tomoaia-Cotisel^b, Agnes Rwashana Semwanga^c, Peter Binyaruka^d, Zaid Chalabi^{e,f}, Karl Blanchet^g, Neha S. Singh^h, John Maiba^d, Josephine Borghi^g



Health Policy and Planning, 33, 2018, 1026–1036
doi: 10.1093/heapol/czy084
Advance Access Publication Date: 31 October 2018
Original Article

Does payment for performance increase performance inequalities across health providers? A case study of Tanzania

Peter Binyaruka^{1,2,3,*}, Bjarne Robberstad¹, Gaute Torsvik^{3,4} and Josephine Borghi⁵



Socioeconomic inequalities in the quality of primary care under Brazil's national pay-for-performance programme: a longitudinal study of family health teams

Roxanne Kovacs, Jorge O Maia Barreto, Everton Nunes da Silva, Josephine Borghi, Søren Rud Kristensen, Devson Rayner T Costa, Luciano Bezerra Gomes, Garibaldi D Gurgel Junior, Juliana Sampaio, Timothy Powell-Jackson



Health Policy and Planning, 37, 2022, 429–439
DOI: <https://doi.org/10.1093/heapol/czab154>
Advance access publication date: 29 January 2022
Original Article

Who is paid in pay-for-performance? Inequalities in the distribution of financial bonuses amongst health centres in Zimbabwe

Roxanne Kovacs¹, Garrett W Brown², Artwell Kadungure³, Søren R Kristensen⁴, Gwati Gwati⁵, Laura Anselmi⁶, Nicholas Midzi⁷ and Josephine Borghi^{1,*}



Mechanisms and Context – Realist review

- Utilisation

- Increased availability of drugs
- Clinical guidelines adherence
- Interactions with patients
- Reduction in user fees
- Supported by facility autonomy

- Quality

- Drugs and infrastructure
- Increased availability of services
- User fees

- Productivity

- Motivation
- Accountability effects

- Task shifting

Degree of decentralisation: autonomy

Efficiency of banking

Degree of reliance on user charges

Staffing levels

Knowledge of staff

Distal

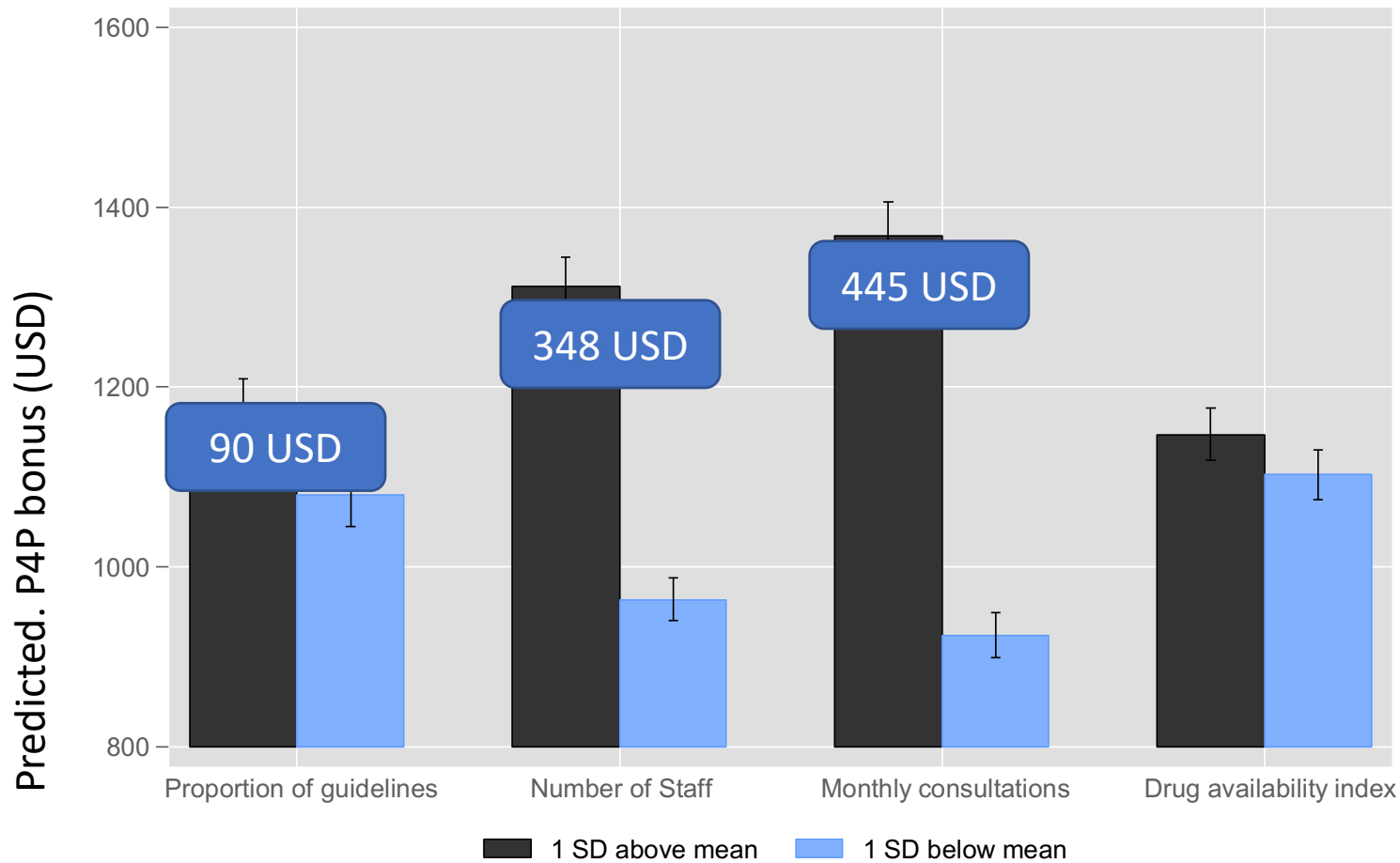
Proximal

Pro-rich distribution of payouts declining over time - Tanzania

Cycle	Overall	Poorest	Least Poor	CI
1	50	43	55	0.04*
2	50	42	58	0.09***
7	78	77	79	0.01
Overall	65	61	68	0.03**

Binyaruka P, Robberstad B, Torsvik G, Borghi J. [Does payment for performance increase performance inequalities across health providers? A case study of Tanzania.](#) Health Policy Plan. 2018 Nov 1;33(9):1026-1036.

Bonus allocation based on facility characteristics - Zimbabwe

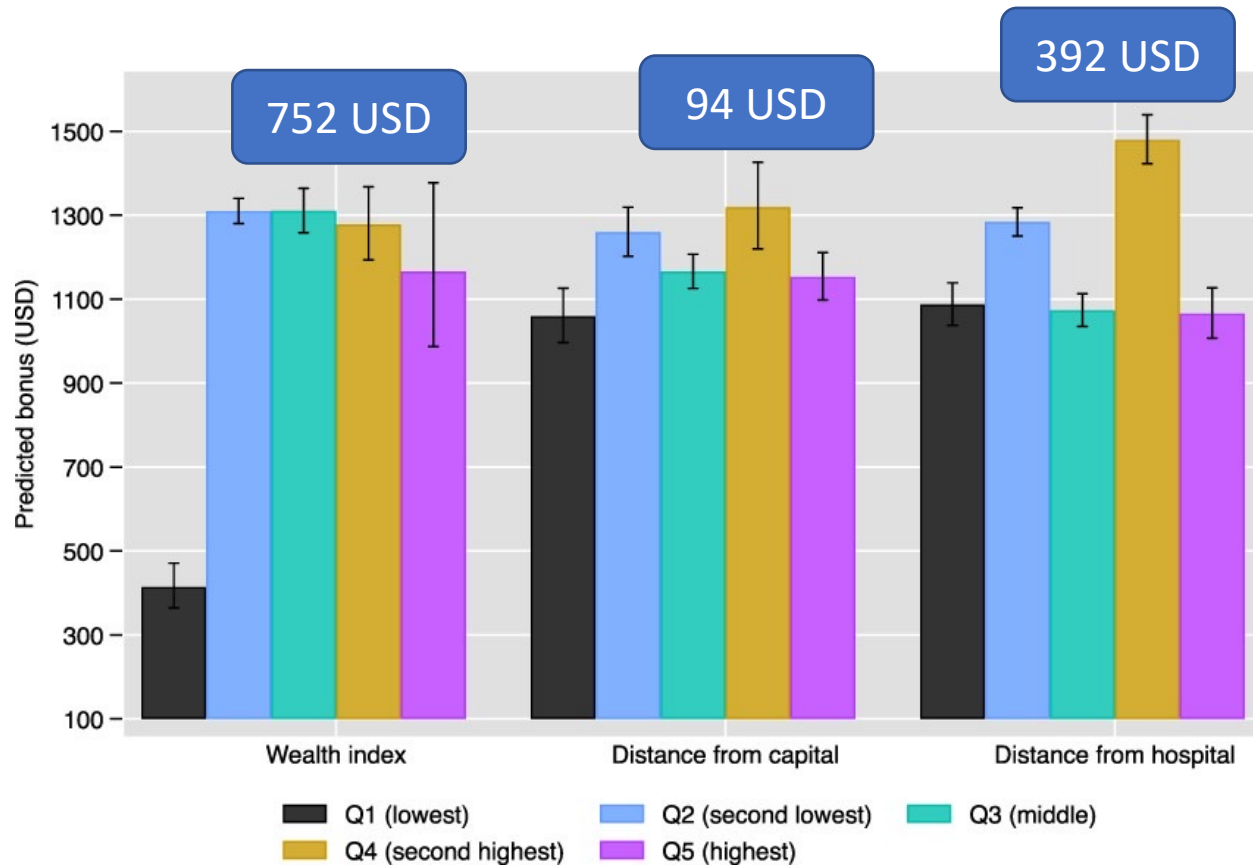


Facilities with better access to clinical guidelines, more staff and higher consultation volumes before the start of the intervention are able to earn higher P4P pay-outs

'some indicators fail because there are too many tasks to be done. We are understaffed and without capacities to perform well, which causes burnout.'

Kovacs R, Brown GW, Kadungure A, Kristensen SR, Gwati G, Anselmi L, Midzi N, Borghi J. [Who is paid in pay-for-performance? Inequalities in the distribution of financial bonuses amongst health centres in Zimbabwe.](#) Health Policy Plan. 2022 Apr 13;37(4):429-439.

Results: Bonus based on local area characteristics



Some evidence that facilities located in areas where households are wealthier, as well as those that are closer to provincial capitals earn higher P4P bonuses

“When a facility has a small catchment area, it reaches a plateau and cannot attract more patients beyond a certain point, so it loses out on revenue compared to larger catchment area facilities.”

“sometimes when it rains it is very hard for patients to get to us and transportation is not always reliable, so we miss potential bonuses”

Inequalities: Brazil's PMAQ

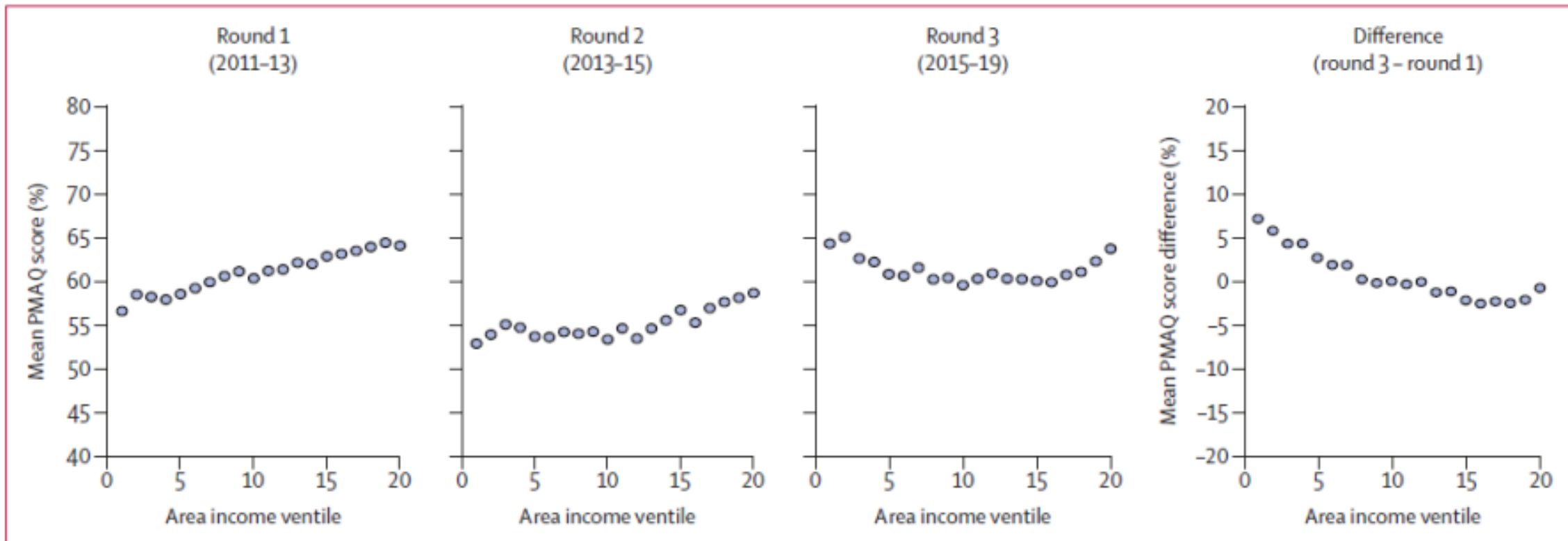


Figure 1: PMAQ score by ventile of household income per local area

Each graph shows the mean PMAQ score in 20 income groups (ventiles) of equal size, with 697 family health teams in each group. Income groups are ranked from poorest (1) to richest (20). Mean monthly household income is R\$919 (US\$549) in ventile 5, R\$1357 (US\$810) in ventile 10, and R\$1849 (US\$1103) in ventile 15. Exchange rate is for the year 2011. PMAQ=Brazil's National Programme for Improving Primary Care Access and Quality.

Kovacs R, Maia Barreto JO, da Silva EN, Borghi J, Kristensen SR, Costa DRT, Bezerra Gomes L, Gurgel GD Junior, Sampaio J, Powell-Jackson T. [Socioeconomic inequalities in the quality of primary care under Brazil's national pay-for-performance programme: a longitudinal study of family health teams.](#) *Lancet Glob Health.* 2021 Mar;9(3):e331-e339.

Scheme Design Matters

LONDON
SCHOOL of
HYGIENE
& TROPICAL
MEDICINE



A typology of Scheme Design

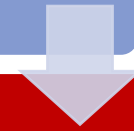
Performance measures

Basis for payment

Payment attributes

Recipient of payment

Outcomes



- Payments for reaching a certain level of coverage may outperform other scheme designs and that utilization and delivery outcomes may increase most in schemes adjusting for service quality and equity (Cochrane review, Diaconu et al. 2021).
- Schemes with a wide range of indicators; schemes that incentivise all those involved in service delivery; and schemes with efficient verification systems may be less likely to experience unintended negative effects (Realist review, Singh et al. 2021).

Closing reflections

LONDON
SCHOOL of
HYGIENE
& TROPICAL
MEDICINE



Concluding remarks

- Importance of studying health system response to reforms aimed at changing health systems like P4P
- Unpacking design of a given reform type (e.g. P4P, or insurance) as these will shape programme effects.
- Mixed methods evaluation (realist perspective) can provide valuable insights
- Complexity science methods add value in understanding interconnections between system elements, existing bottlenecks, can be used to guide intervention design and evaluation