

Drivers of routine immunization coverage improvement in Africa: findings from district-level case studies

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There is limited understanding of why routine immunization (RI) coverage improves in some settings in Africa and not in others. Using a grounded theory approach, we conducted in-depth case studies to understand pathways to coverage improvement by comparing immunization programme experience in 12 districts in three countries (Ethiopia, Cameroon and Ghana). Drawing on positive deviance or assets model techniques we compared the experience of districts where diphtheria–tetanus–pertussis (DTP3)/pentavalent3 (Penta3) coverage improved with districts where DTP3/Penta3 coverage remained unchanged (or steady) over the same period, focusing on basic readiness to deliver immunization services and drivers of coverage improvement. The results informed a model for immunization coverage improvement that emphasizes the dynamics of immunization systems at district level. In all districts, whether improving or steady, we found that a set of basic RI system resources were in place from 2006 to 2010 and did not observe major differences in infrastructure. We found that the differences in coverage trends were due to factors other than basic RI system capacity or service readiness. We identified six common drivers of RI coverage performance improvement—four direct drivers and two enabling drivers—that were present in well-performing districts and weaker or absent in steady coverage districts, and map the pathways from driver to improved supply, demand and coverage. Findings emphasize the critical role of implementation strategies and the need for locally skilled managers that are capable of tailoring strategies to specific settings and community needs. The case studies are unique in their focus on the positive drivers of change and the identification of pathways to coverage improvement, an approach that should be considered in future studies and routine assessments of district-level immunization system performance.

Keywords Immunization, vaccination, DTP3, Penta3, performance improvement, Africa, immunization system, health system, case study, mixed method, positive deviance, Cameroon, Ethiopia, Ghana, EPI

KEY MESSAGES

- The ability to deeply understand community needs and desires, and tailor implementation strategies to specific needs appears fundamental to district-level routine immunization (RI) coverage improvement. A balance is needed between investment in the essential components of an immunization system (resources that enable programme readiness) and work force capacity to design and execute implementation strategies.
- Networks and partnerships that build trust through collaboration among district health teams and local actors provide a critical foundation for shared commitment to improving the performance of immunization programmes.
- Assets-based evaluation strategies that focus on defining and applying effective implementation strategies are important tools for understanding the dynamic pathways of coverage improvement and enabling learning across different settings.
- There is limited understanding of why RI coverage improves in some settings and not in others. Studies using an assets-based lens are needed to explore the dynamics of coverage improvement to complement typical evaluations that assess why coverage improvement strategies fail.
- Many of the drivers that directly influence immunization coverage improvement are strategies that are equally relevant to health system strengthening.

Introduction

Immunization is a proven strategy for reducing morbidity and mortality among women and children in Africa. Substantial investment has been made in the past three decades to establish and maintain national routine immunization (RI) systems (Okwo-Bele and Cherian 2011; GAVI 2012; Kamara *et al.* 2013) and progress has been remarkable.¹ In spite of these advances, equity in access to vaccination remains a challenge and coverage rates vary greatly among countries. Even within countries, where there is greater potential for consistent resource allocation, coverage is uneven (Bryce *et al.* 2006; Hanson *et al.* 2013).

The factors leading to coverage disparities in immunization programmes in Africa are generally not well understood; only a few studies ask why coverage has improved in some settings and not others (Gauri and Khaleghian 2002; Pegurri *et al.* 2005; Naimoli *et al.* 2008). The most common approaches to assessing the performance of immunization systems focus on identifying key factors associated with high or low coverage, barriers to obtaining or delivering immunizations and problems or deficiencies in immunization programmes (gap analysis). Missing in general from published and unpublished work is an exploration of the dynamics of coverage improvement—analyses that focus on the complexity of implementation and on what can be learned from studying success rather than failure.

We began exploring the drivers of improved RI system performance with an extensive literature review to understand key factors associated with high immunization coverage levels (JSI Research & Training Inc. 2012a). The document review broadly followed systematic review techniques, focusing on published (including non-peer reviewed) and unpublished literature from 1995 to 2011. In total, we identified 757 documents for review. After screening for relevance guided by a set of preliminary research questions, researchers extracted data from 150 documents.

Using a conceptual framework defined in the preparatory phase of our study, we found 56 potential performance drivers² and categorized them as context, health system or

immunization system factors. Most analysts pointed to one factor or another to explain high or low coverage, yet few studies increased our understanding of how the potential drivers affected performance in practice. Tanner (2005) and Cutts and Biellik (2011), referring to the Reaching Every District approach (World Health Organization and Regional Office for Africa 2008), cited the effectiveness of multi-dimensional interventions, suggesting that synergies rather than single elements could explain the attainment of adequate coverage levels. However, studies generally lacked sufficient detail about a particular driver or driver cluster to determine when it was introduced, how it was implemented, or how it contributed to performance improvement. Moreover, the influence of contextual forces, such as global health policies, country-level economic and political factors, and health system capacity, was rarely reported, restricting us from assessing the relevance of the setting to the performance achieved (JSI Research & Training Inc. 2012a).

In contrast, Naimoli *et al.* (2008) generated hypotheses about coverage differences across multiple settings based on ‘key constructs commonly associated with improving immunization coverage’ in six sub-Saharan African countries. They found that the combination of good governance with a ‘solid institutional framework with reasonably good management, service delivery, financing and demand’ was associated with higher performance in two of the six countries. They also called for more systematic inquiry and ‘practical theory building’ that compares implementation experiences ‘within’ countries.

This study was conducted as part of the African RI System Essentials (ARISE) project. Our research was designed to understand how and why immunization coverage improves in some settings and not others. Using a grounded theory approach (Glaser and Strauss 1967), which formulates hypotheses or theories based on the analysis of data collected, we conducted in-depth case studies to identify factors that influence the improvement of immunization coverage at district level in Africa. Rather than focusing on reasons why coverage was low, like Naimoli *et al.* (2008) and others (Marsh *et al.* 2004; Pascale *et al.* 2010), we applied a positive deviance lens in three countries—meaning we explored cases with positive

outcomes—and compared the experience of districts where coverage improved with districts where coverage remained unchanged. Finally, we delved into the dynamics of implementation and the interplay among drivers of change. The results from 12 districts informed a model for immunization coverage improvement that emphasizes the dynamics of immunization systems at district level and maps a pathway to coverage improvement.

Study methods

Case study design

To explore the drivers of immunization coverage improvement, we employed a mixed-method multiple case study approach in three countries (Ethiopia, Cameroon and Ghana). We also borrowed techniques from a Realist Inquiry approach (Pawson and Tilley 1997), which seeks to understand and explain the mechanisms of change within a programme by identifying the pathway from intervention to outcome while accounting for the role of context in determining success or failure. For case selection, we first used a step-wise process to identify candidate countries in sub-Saharan Africa based on a review of World Health Organization (WHO)/United Nations International Children's Emergency Fund (UNICEF) estimates of national RI performance [trends in diphtheria–tetanus–pertussis (DTP3)/pentavalent3 (Penta3) coverage from 2000 to 2009]³ as well as other criteria. Countries were excluded from consideration based on low coverage of DTP3/Penta3,⁴ little recent change in DTP3/Penta3 coverage, lack of representativeness on key background variables (e.g. gross national product and population size) and being a conflict or post-conflict setting. From a shortlist of 10 countries, a panel of immunization experts chose three countries for study: Ethiopia, Cameroon and Ghana. Then, in each country, we selected three districts that had demonstrated recent positive improvement in DTP3/Penta3 coverage, and, for comparison, one district where DTP3/Penta3 coverage remained 'steady' or unchanged over the same 3- to 4-year period (between 2006 and 2010). The case selection process at each stage represented a 'positive deviance' or 'assets-based' (Morgan and Ziglio 2007) approach that was considered to be methodologically more robust for retrospective exploration of the experience of coverage improvement. The use of standard case selection criteria and the application of a systematic process was intended to maximize the analytical generalizability of the case study findings (Mookherji and LaFond 2013).⁵

The study time frame in each country was chosen based on the availability of immunization coverage data and focused on recent patterns of change to reduce recall bias. We purposefully

selected districts with baseline coverage levels of at least 60% for both types of districts in order to eliminate those that were likely to have serious gaps in basic infrastructure or resources for delivering immunization services. In several instances, the team had to consult with local immunization managers and adapt the standard district selection criteria because of challenges faced with the availability and quality of coverage data. The final list of countries and districts is shown in Table 1.

Data collection and analysis

Data collection strategies included open-ended and semi-structured key informant interviews, focus group discussions, field observation, document and programme data review, and group prioritization exercises. The study teams, which consisted of local and international researchers and immunization experts, collected data at national, regional/zonal, district, health centre, health post and community levels. Researchers conducted over 300 interviews across the three countries, with an even distribution in each. The study teams also conducted a district-level RI situation analysis to assess readiness to provide immunization services over time (JSI Research & Training Inc. 2012b; Justice *et al.* 2012; Larson *et al.* 2012). In the absence of globally accepted measures of district RI operational capacity (Godiskine and Jose 2012), we established an illustrative set of indicators of RI readiness that reflected essential immunization programme components (U.S. Agency for International Development 2009). These components included immunization sites (fixed and outreach), human resources, cold chain equipment, vaccine supply and transportation. The goal was to provide sufficient information about how the RI system was organized and resourced, rather than a comprehensive picture of capacity to deliver RI.

Data analysis to identify and explore performance drivers took place in stages. Within each country, as the researchers progressed from district to district, they developed and tested theories of driver-to-performance pathways by reviewing interview notes, holding team discussions, constructing timelines and pathway diagrams, and cross-referencing interview data with data collected from the RI situation analysis. The study team compared the experience of each district where coverage improved to find common or contrasting patterns related to strategies and decisions that influenced coverage improvement. They also analysed data from the district where coverage had not improved—the 'steady' district—to determine whether patterns observed in the other districts were present or absent, and built theories on the drivers' link to coverage improvement. Figure 1 presents an example of how this process transpired in Ghana. Draft findings were presented and verified at stakeholder workshops in each country.

Table 1 Study districts

Country	Ethiopia	Cameroon	Ghana
Districts with improved coverage	Alage, Tigray Region	Kribi, South Region	Ejisu-Juaben Municipality, Ashanti Region
	Toke Kutaye, Oromia Region	Ndop, Northwest Region	Asikuma–Odoben–Brakwa District, Central Region
	Sekota Zuria, Amhara Region	Bali, Northwest Region	Krachi West District, Volta Region
District with steady coverage	Tikur Incini, Oromia Region	Bafang, West Region	Ho Municipality, Volta Region

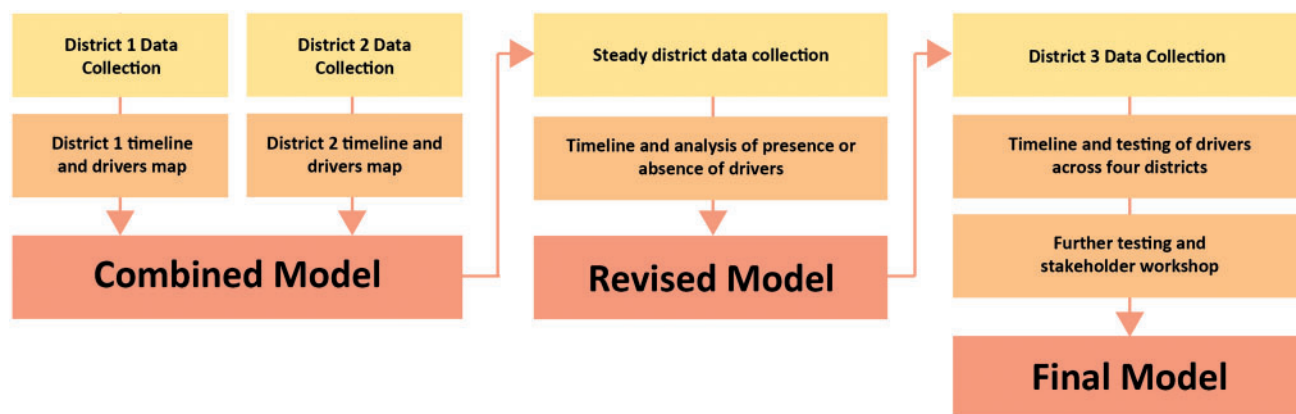


Figure 1 Example of grounded theory development process in Ghana (Larson *et al.* 2012).

To synthesize findings across all cases, we first identified cross-case common themes during a 3-day workshop with the country study teams. This cross-case analysis identified common patterns related to the drivers of RI performance, contextual influences on performance improvement and the role of system readiness across the 12 districts. It involved several steps including construction of programme timelines, coding of interview transcripts, thematic grouping and classification of the data, triangulation among data sources and levels of data collection, construction of thematic journals that condensed (using a standard format) the data supporting each driver, comparison of drivers in improving and steady districts, and identification of driver clustering. We employed NVivo 9 software (QSR International 2010) to code and sort qualitative data. Codes captured the type of driver, how and when it was introduced, at what level of the health system the driver functioned and challenges faced in implementation. To ensure coding quality, each team member coded the same 10 transcripts at the start, coders held weekly meetings, and we used NVivo to check inter-coder reliability coefficients.

Results

Comparing districts: coverage trends and RI readiness

Findings from the RI situation analysis are presented in Table 2. They compare districts by DTP3/Penta3 coverage trends, contextual characteristics and selected indicators of RI system readiness. In the nine districts where DTP3/Penta3 coverage improved, coverage increased by 15% on average between 2006 and 2010. In all districts, whether improving or steady, we found that a set of basic RI system resources were in place from 2006 to 2010 and did not observe major differences in RI infrastructure. For example, in all districts cold chain and vaccine supply were adequate and reliable, and stockouts were negligible. Appropriately trained staff were available to manage and provide immunization services, transportation was limited but available, and financing to support routine operations was both available and sustained. The number of vaccination sites increased over time in all districts. Differences were observed between well-performing and steady districts in Cameroon and Ethiopia with respect to the ratio of target population to

vaccinator. In addition, in Cameroon, the steady district delivered a larger portion of services through fixed rather than outreach sites. Overall, however, study findings suggest that the difference in coverage trends from 2006 to 2010 between improving and steady districts was due to factors other than basic RI system capacity or service readiness.

Common drivers of performance improvement

When data from all districts were compared and synthesized, six common drivers of RI performance improvement emerged in the nine districts where coverage improved. Although the way in which these drivers contributed to improved coverage varied by district, each was present in some way in the better-performing districts and was either absent or weaker in the three districts where coverage remained steady. In addition to identifying common drivers of improved coverage, during synthesis and analysis we also categorized drivers by function—‘enabling and direct’—based on their role in the pathway from driver to performance improvement (Table 3).

Direct drivers of RI performance

Four RI performance drivers were found to have a ‘direct influence’ on the supply of immunization services, the demand for immunization and subsequently improved coverage.

Cadre of community-centred health workers

Figure 2 depicts the pathway of the direct driver—cadre of community-centred health workers—using the structure ‘Mechanism–Transformational step–Effect’ to explain the pathway to coverage improvement. In this structure, mechanisms equate to interventions or actions taken to implement the driver and the effect is the outcome (defined in terms of supply of and demand for immunization). The transformational step is the way in which the driver influenced performance improvement.

The mechanism, for the community health worker driver, is the act of taking vaccination directly into the community. Examples include outreach, home visits, community meetings, birth registration and defaulter tracing. In districts with improved coverage, community-centred health workers were instrumental in facilitating access to immunization through

Table 2 Selected indicators of immunization system readiness in study districts, various years^a

District	District population ^b	Ratio of target pop. to vaccinators, 2010 ^c	DTP3/Penta 3 coverage 2006 and 2010 ^{d,e}	Change in number of health facilities offering routine immunization services ^f	Estimated % vaccination given through fixed services	Reported stockouts in past 12 months
Ethiopia						
Alage	116 263	3321:1	75%; 87%	11–14	40	None
Toke Kutaye	122 582	1977:1	78%; 95%	10–31	30	None
Sekota Zuria	142 728	2230:1	73%; 93%	5–33	15	None
Tikur Incini (steady)	107 536	2757:1	61%; 66%	3–7	20	None
Ghana						
Krachi West	101 856	2546:1	85%; 97%	N/A to 16	N/A	None
AOB ^g	110 045	2822:1	86%; 98%	N/A to 11	N/A	None
Ejisu-Juaben	179 376	4172:1	83%; 87%	N/A to 9	N/A	None
Ho municipality (steady)	225 000	2528:1	62%; 64%	N/A to 40	N/A	None
Cameroon						
Kribi	114 952	121:1	72%; 88%	40–55	70	None
Ndop	197 215	91:1	77%; 90%	16–35	70	None
Bali	73 614	Not avail.	34%; 33%	3–7	70	None
Bafang (steady)	135 646	226:1	48%; 63%	27–38	94	Limited

^aData sources are national and district-level administrative records.

^bCameroon: 2010; Ethiopia: Alage 2009, other districts 2010; Ghana: 2010.

^cEthiopia: includes Health Extension Workers; Ghana: Community Health Nurses are vaccinators; Cameroon: Nurses are vaccinators.

^dCameroon: 2007 and 2010; Ethiopia: 2006 and 2009; Ghana: 2008 and 2010.

^eCoverage in Bali reported here is based on official administrative reports. The study team re-estimated coverage for Bali based on discussions with local programme managers and determined that Bali's coverage had improved several years prior to the period under study (2006–10) and had remained at this level since then. These revised and informal estimates place Penta3 coverage in Bali in 2010 at ~75%.

^fEthiopia: Health posts, 2006 and 2010; Ghana: Health facilities, 2011; Cameroon: Health facilities, 2000 and 2010.

^gAOB, Asikum Odoben Brakwa.

Table 3 Six common drivers of routine immunization coverage improvement by category

Type of driver	Driver of immunization coverage improvement	Definition
Direct	Cadre of community-centred health workers	Paid cadre of community-centred health workers who delivered vaccination through health facilities, outreach services, and home visits
	Health system and community partnership	Health system works with district and local government and community groups to plan and execute immunization services, raise awareness and define strategies to reach all children.
	Regular review of programme and health worker performance	Conduct regular reviews of data and promote open discussion among peers of performance achievements and shortcomings
	Immunization services tailored to community needs	Deliberate efforts to assess community needs and conditions and adapt services accordingly
Enabling	Political and social commitment to routine immunization	Policies and investments made in routine services and the prominence given from national to local levels to increasing coverage
	Actions of development partners	National and local-level support provided by development agencies through funding, technical advice, capacity building, and commodities and equipment

regular service provision that was planned in collaboration with communities. By virtue of their proximity (many lived within the community), the health workers became the local authority on the advantages of immunization. Using routine interaction with communities, they raised awareness of the benefits of immunization and encouraged timely attendance at facilities and

outreach sites. The transformational step between intervention and outcome entailed the building of a sense of trust between the health worker and the community that came primarily from frequent contact and familiarity but also from ensuring a predictable supply of immunization services. The outcome was increased access to immunization and increased use.

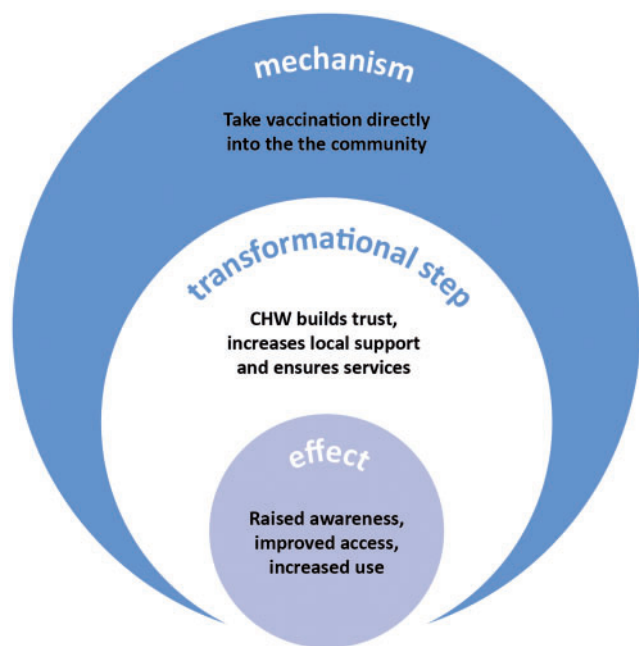


Figure 2 Pathway of community-centred health worker driver.

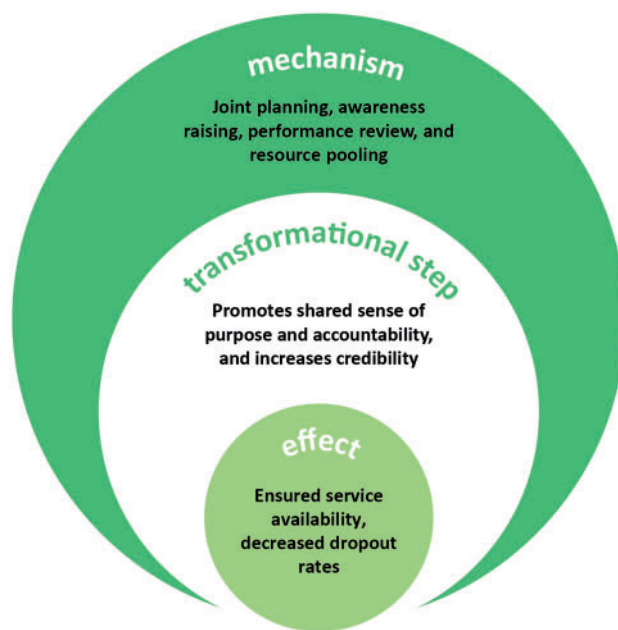


Figure 3 Pathway of health system-community partnership driver.

Partnership between the health system and community

The pathway in Figure 3 begins with close co-operation between the health sector and the administrative and political structures at the district and community level. These groups jointly planned services, raised awareness, reviewed performance and defined strategies to reach remote or reluctant communities. In the improving districts, community volunteer networks were extensive and active, and volunteers regularly supported health workers without receiving formal compensation. Community volunteers essentially became an extension of the official health team through their work in organizing immunization sessions, tracing defaulters and motivating caretakers. Local governments also contributed resources, such as transportation and leadership when needed. Through these partnership mechanisms the health system, community leaders and volunteers developed a shared sense of purpose and built credibility for immunization. The effect of this driver was greater regularity and predictability of service delivery and improved respect for health workers for maintaining the service delivery schedule.

Regular review of programme and health worker performance

The direct driver—regular performance review—was implemented in different ways in districts with coverage improvement. It included practices such as quarterly district-level programme review meetings, regular supervision of health workers and monthly meetings among health workers, local government and communities. Managers and supervisors also employed coaching and on-the-job training to guide and support workers.

The transformational characteristics of this driver (Figure 4) included the use of data to assess performance through open discussion, collective identification of weaknesses or gaps, and most importantly the sharing of experience and suggestions on how to improve performance. Performance review was

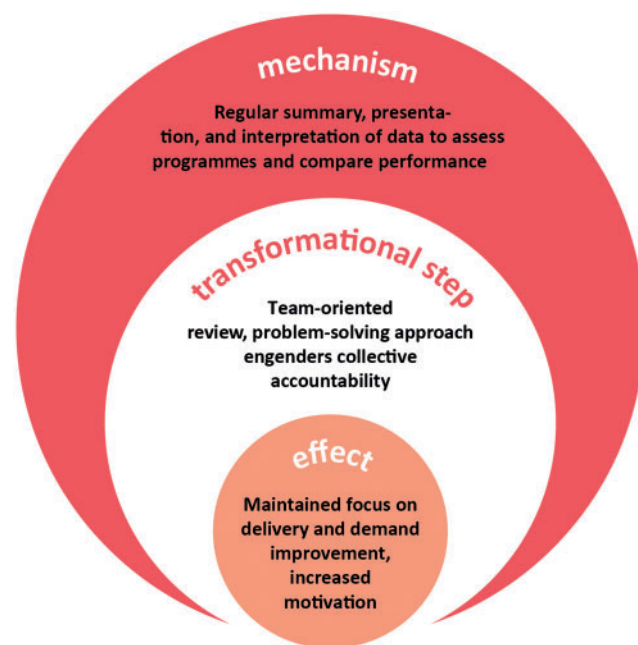


Figure 4 Pathway of regular review of performance driver.

team-oriented and focused on problem solving. It encouraged constructive discussion, employed strategies of peer learning and friendly competition, and engendered collective accountability for improving RI. Combining data-based monitoring with non-threatening, transparent, learning-focused management techniques was highly motivating for health workers and community members. It also helped maintain a focus among workers on testing strategies to improve services and increase demand for RI.

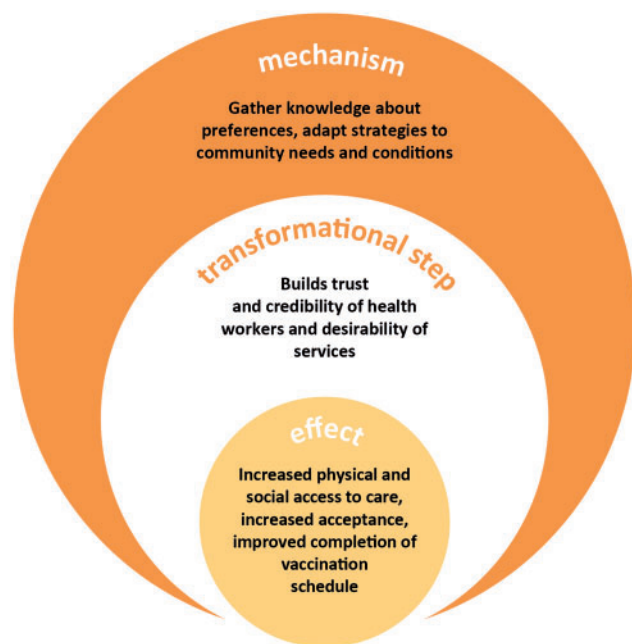


Figure 5 Pathway of tailoring immunization services to community needs driver.

Immunization services tailored to community needs

The fourth direct driver pathway (Figure 5) arose from the other three drivers. Health managers and workers at all levels undertook deliberate steps to tailor immunization services to community needs. Using the knowledge gleaned from working closely with the community and tapping ideas from community members, health workers chose appropriate sites for outreach, adapted the service times and days to encourage maximum attendance, and took services into the home when needed. Community-level respondents reported that health worker adherence to planned delivery schedules made services predictable and reliable, and easier to attend.

Transformation from driver to outcome happened when health workers responded to community demands and worked with the community regularly using local venues and communication channels. Health workers crafted the messages to reach different segments of the population: mothers, fathers, religious leaders, traditional leaders and local government officials. These strategies increased health worker credibility among community members, which resulted in better physical and socio-cultural access to care. Caretakers responded with increased attendance for immunization. Dropout rates declined in many districts where coverage improved, suggesting that caretakers were motivated to complete the vaccination series for their children.

Enabling drivers, health system factors and system level pathway

To enhance our understanding of the pathway to performance improvement, we categorized the two remaining performance drivers—political and social commitment to RI, and the actions of development partners—as ‘enablers’ rather than direct

drivers of coverage improvement. The enablers created supportive conditions in the improving districts, which in turn facilitated the emergence and effectiveness of the other (direct) drivers.

The case studies also set out to understand which elements of the health and immunization system underpinned the performance drivers. Two key components emerged from districts where coverage improved:

- A basic level of resources or capacity to deliver RI.
- The district management team.

The sustained availability at district level of basic supplies, equipment and human resources to provide immunization services provided the foundation for performance improvement. In districts where coverage improved, the district health team selected and refined the strategies and practices that drove performance improvement. RI performance often hinged on the decisions and the behaviour of these teams and on their ability to creatively manage limited health system resources. The key role that district-level management teams play in the execution of performance drivers made them critical to the pathway to improved RI coverage.

Our analysis of district experience also revealed that performance improvement was not explained by the presence or absence of any single driver. Rather, the six common drivers were often interlinked and worked in synergy using specific mechanisms to bring about conditions or actions that resulted in improved supply, demand and ultimately coverage. Figure 6 depicts a comprehensive pathway to improving RI coverage that includes all six performance improvement drivers, their interaction with key health and immunization system elements, and with each other.

Discussion

The six common drivers of coverage improvement identified in this study are consistent with findings of other studies. Gauri and Khaleghian (2002) found a link between coverage and the presence of international agencies and political will. Engagement with local communities, using data for action, and introducing a community-centred cadre of health workers are familiar coverage improvement strategies (Lehmann and Sanders 2007; IMMUNIZATIONbasics 2009). Yet, our cases stand out because of the creative and consistent application of these drivers by districts teams in their specific settings. As noted in Naimoli *et al.* (2008), different countries have different pathways to coverage improvement. It is ‘how [countries] execute their programmes [that] seems to make a difference in coverage outcomes’. We present several themes that emerged from this study of the drivers of immunization coverage improvement.

Community-centred strategies

Investment in community-centred health workers is receiving increased attention following a period of scepticism about the cost and utility of investing in grassroots structures (McCord *et al.* 2012; Naimoli *et al.* 2012; Somanje *et al.* 2012). Ethiopia markedly increased the number of community-based

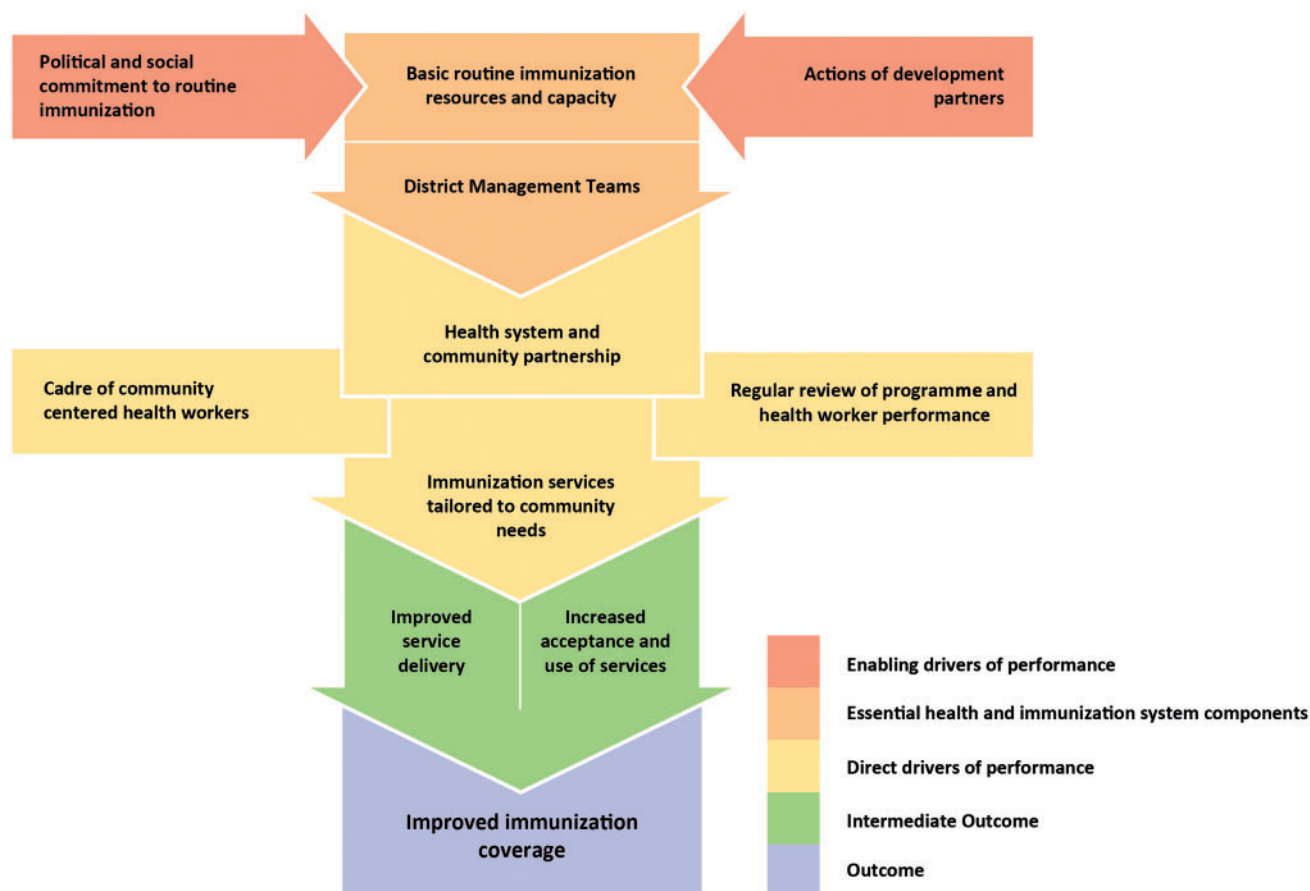


Figure 6 Pathway to improving routine immunization coverage at district level in Africa.

paid health staff and continuously introduces mechanisms to link communities, community health workers, and facility-based health providers in a network of shared responsibility and commitment to common goals (Bilal *et al.* 2011; Karim 2011). In districts where coverage improved, these community workers catalysed district efforts to improve the supply and uptake of vaccination and engender health system accountability to the community. Interestingly, not all districts with community workers were equally successful, partly because of the lack of integration of the worker in the community and failure to build and maintain public trust in vaccines.

Networks, partnership and meaningful collaboration

We found that the trust built through collaboration among district health teams, local government and communities also provided a critical foundation for shared commitment to improving immunization coverage. The districts that were successful in improving coverage built solid networks among health offices, district governance offices, community groups and leaders. Trust building has been named as a key aspect of relationships in the health sector that ultimately determines the effectiveness of health workers in promotion of behaviour change and health improvement practices (Gold 2010; Sanchez *et al.* 2012). Yet, networking or partnership—a recommended implementation strategy in some guidelines (World Health

Organization and Regional Office for Africa 2008)—garners few direct resources. International development agencies and governments might consider increased investment in networking and emphasize the benefit of partnership through various channels (health, local government, community development).

Motivating health workers

In districts where coverage improved, the health teams practiced data-based performance review and cultivated an informal and non-threatening culture of learning from peers and local experience. This culture became normative over time and was highly motivating for facility and district-level actors. It contrasts with the familiar practice of linking rewards or punishments to immunization coverage without placing equal emphasis on the reasons for success or failure. Programme managers may do better by rewarding health teams for practices such as using data to tailor interventions to community needs, testing strategies for improving coverage, and sharing what they have learned within and across districts. Fritzen (2007) in a review of literature on the health workforce in developing countries writes that

“organizational culture can be as critical as the direct monetary incentives of the workforce. Although pay and job security are clearly important determinants of morale, many organizations in

developing countries have been able to significantly improve performance by cultivating a participatory, open, performance-oriented culture in which the workforce is deployed."

Health and immunization systems

It is noteworthy that most of the drivers that directly influenced immunization coverage were not unique to immunization, but were equally relevant to other primary health care interventions. Some of the drivers were introduced as part of an immunization programme (e.g. Reaching Every District). Others emerged from national efforts to strengthen basic health care (e.g. the Health Extension Programme in Ethiopia), to build the health workforce (e.g. training community health nurses in Ghana) or to develop strong district-level management for health (e.g. the long-standing use of review meetings in Ghana). Whatever the genesis or the intent of a particular implementation strategy, the findings suggest the importance of health system strengthening as a key strategy for achieving results in specific health programmes, including immunization (Galichet *et al.* 2009).

Finally, a key finding of this study is that a basic readiness to deliver immunization services is important but not sufficient to drive coverage beyond a certain level. In all of the study districts, programme resources were in place and routine services were reliably available, yet coverage improved in some districts and not in others. We posit that in these cases, implementation strategies were critical for moving these districts closer and closer to achieving universal immunization coverage. We do not underestimate the value of years of investment to establish a reliable vaccine supply and sound technical practices in service delivery. However, our findings show that a balance is needed between investment in those essential components of the system and implementation strategies that foster a competent, motivated workforce with the autonomy and ability to adapt services to community needs.

Study limitations

Our study had some limitations related to executing case selection, applying measures of immunization programme readiness and generating hypotheses that included contextual analysis. We had to depend on secondary reports of DTP3/Penta3 coverage. National coverage figures came from WHO/UNICEF with known limitations (Lim *et al.* 2008). Moreover, estimates available in 2010 when the study began were revised in 2013 based on the availability of new survey data (WHO 2013). Had they been available to us, they might have influenced our country case selection. District case selection was based on coverage using nationally reported administrative data and validated with local reports. In several instances, these two data sources were not in agreement because of variation in population estimates used to estimate coverage. In some cases, we decided to use numerator trends coupled with local expertise to establish the existence of upward or steady coverage, depending on the data quality.

Although we went to great lengths to document all data collection and analysis steps, it is likely that some aspects of our approach are easier to reproduce than others (Mookherji and LaFond 2013). In addition, because we studied district experience retrospectively through administrative records and

respondent interviews, our assessments may be influenced by recall bias as well as inconsistent indicator definitions related to service capacity. We were limited in our ability to conduct in-depth analysis of all key contextual factors, including national-level policy and financing, because of the sheer number and complexity of relationships, timing of events, and limited access to data. Analytical challenges at the time of cross-case synthesis included the varied iterative approaches employed by the three field teams to uncover the pathways of coverage improvement, many of which are complex and multidimensional.

Conclusions

Our study demonstrates that improvement of DTP3/Penta3 immunization coverage at district level in three African countries is associated with the active presence of six performance drivers working together to improve the availability and quality of immunization services, raise awareness of immunization and ultimately increase demand. The data indicate that no single strategy provides the 'magic bullet' for change. Rather it is the synergy among drivers combined with a solid foundation for immunization service delivery that increased coverage 15% on average over 4 years. In addition, the strategic decisions by district management teams to tailor implementation to need can make the difference between maintaining the status quo and meeting coverage targets of 85% and above. District immunization systems prosper when capable managers use creative, adaptable approaches to channel resources to reach women and children on a regular basis. Strong and routine engagement between health teams and the community underpins and fuels the tailoring of implementation strategies to community needs and inspires commitment among caretakers to immunize children routinely.

Previous research on RI in Africa mainly reported on obstacles to achieving high coverage. The case studies reported here are unique in their focus on the positive drivers of change and the use of evidence to elaborate the implementation processes and dynamic pathways to coverage improvement. For this reason, they fill a critical evidence gap by building grounded programme theory (Naimoli *et al.* 2008) and help move the discussion of performance improvement strategies for immunization beyond the normative and prescriptive advice often given to countries to strengthen their immunization programmes. Although it is not possible to predict that introducing the same drivers in other districts in the study countries or elsewhere in Africa would improve immunization coverage in the same way, these drivers may prove relevant in areas that have reached a similar stage of immunization programme maturity as those represented by the nine study districts where coverage improved. Similarly, these findings may be relevant to other health programmes, such as directly observed treatment short-course (DOTS) for tuberculosis treatment and malaria prevention and control. Finally, we believe that applying an assets-based lens to programme design, as applied in this study, allows the identification of varied local and successful pathways to coverage improvement and should be considered in future studies and routine assessments of district-level immunization system performance.

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Endnotes

- ¹ The proportion of infants vaccinated with a third dose of the vaccine for diphtheria–tetanus–pertussis (DTP3) in the region grew from 55% in 2000 to 77% in 2010.
- ² For the purposes of the ARISE project, a routine immunization performance driver was defined as a structure, resource, or process that works on or through the immunization system to improve performance or perform effectively (LaFond et al. 2011, 2012).
- ³ WHO–UNICEF. 2010. Estimates of DTP3 coverage. http://apps.who.int/immunization_monitoring/globalsummary/timeseries/tswucoveredt3.html, accessed July 2010.
- ⁴ DTP3 or Penta3 relate to coverage with the third dose of vaccine. Pentavalent vaccine combines the DTP vaccine with vaccines for hepatitis B and Haemophilus influenzae type b. These metrics are accepted indicators of routine immunization system performance. Pentavalent3 and DTP3 are used interchangeably in this article.
- ⁵ The case selection process is described in more detail in Mookherji and LaFond (2013).

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