Arise

AFRICA ROUTINE IMMUNIZATION SYSTEM ESSENTIALS

May 2011

LANSCAPE ANALYSIS SYNOPSIS:

AN INITIAL INVESTIGATION OF THE DRIVERS OF ROUTINE IMMUNIZATION SYSTEM PERFORMANCE IN AFRICA

JSI

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Acknowledgments

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Acronyms/Abbreviations

AARISE	Africa Routine Immunization System Essentials
CDC	U.S. Centers for Disease Control and Prevention
CHW	community health worker
cMYP	comprehensive multiyear plan
CSO	civil society organization
DHS	Demographic and Health Survey
DTP1	diphtheria-tetanus-pertussis vaccine (1st Dose)
DTP3	diphtheria-tetanus-pertussis vaccine (3rd Dose)
EPE	External Panel of Experts
EPI	Expanded Program on Immunization
GAVI	Global Alliance for Vaccines and Immunization
GH	global health
GHP	global health partnership
HSA	health surveillance assistant
ICC	Interagency Coordinating Committee
IMCI	Integrated Management of Childhood Illness
KII	key informant interview
MCH	maternal and child health
MDG	Millennium Development Goal
ODA	overseas development assistance
PIRI	Periodic Intensification of Routine Immunization
PPP	purchasing power parity
PRSP	poverty reduction strategy paper
RED	Reaching Every District
RHINO	Routine Health Information Network
RI	routine immunization
SWAp	sector-wide approach
UNICEF	United Nations Children's Fund
WHO	World Health Organization
WHO/AFRO	World Health Organization Africa Regional Office

About ARISE

African countries have achieved solid advances in immunization performance in the past 10 years. The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) estimate that coverage with a third dose of diphtheria-tetanus-pertussis vaccine (DTP3[1] in sub-Saharan Africa[2] increased from 55 percent in 2000 to 71 percent in 2009. The DTP1–DTP3 dropout rate decreased over this same period, falling from an average of 20 percent to 12 percent. Many countries have reduced measles mortality dramatically and have introduced new vaccines against common childhood killers. In general, progress in the Africa region has been steady and sustained.[3]

At the heart of such immunization efforts is routine immunization (RI), an ongoing system that provides timely protection against common childhood diseases to all children born in a single country. An RI system is the foundation of a national immunization program. It also helps sustain gains from special campaigns and serves as a platform to introduce new vaccines. The Africa Routine Immunization System Essentials (ARISE) project was created to learn from the countries whose RI systems are performing well. In general, policy makers and practitioners lack an in-depth understanding of the underlying reasons that certain routine systems achieve improvements in immunization performance, while others do not. ARISE therefore aims to identify and explore the drivers of improved coverage (performance) by documenting experiences and consolidating them into a body of evidence for informing programming and investment. ARISE addresses the need to learn from recent performance improvement experience in Africa to improve and sustain routine coverage in all countries and districts in the region. (See Box 1 for definitions of key terms used by ARISE).

Project Objectives

1. Strengthen the evidence base to improve understanding of the drivers of RI system performance.
2. Deepen and broaden African and global stakeholder engagement in improving RI.
3. Position the learning to help stakeholders improve RI systems in Africa, identify potential investment options, and clarify stakeholder roles.

Specifically, ARISE will learn from existing evidence and will gather new evidence on the drivers of RI system performance in sub-Saharan Africa through (a) a review of existing literature and experience, (b) a set of in-depth case studies in several sub-Saharan African countries, and (c) an analysis of available quantitative data. Results will be translated into clear and focused investment options at the global, regional, national, and subnational levels that can optimize the resources available to support routine immunization.

1 DTP3 refers to the third dose of any vaccine containing DTP including quadrivalent and pentavalent vaccines.

2 In this report, Africa refers to the 46 countries in the World Health Organization Africa region (WHO/AFRO).

3 DTP3 and DTP1: WHO/UNICEF coverage estimates for 1980–2009 (as of December 15, 2010). Retrieved May 18, 2011, from http://apps.who.int/immunization_monitoring/en/globalsummary/timeseries/tswucoveragedtp3.htm.

ARISE Research

A set of key research questions guide data extraction, collection, and analysis for ARISE. The main research question is: **What are the drivers of RI system performance?** Several sub-questions help break down the analysis into discrete components:

1. At country level, what are the defining characteristics of the current RI system?
    a. Did performance change over time (regionally, nationally, subnationally)?
    b. What changes took place in the RI system as performance improved?
2. What is driving performance change?
    a. How do specific drivers affect RI systems?
    b. Which drivers were successful in improving RI system performance?
    c. How do specific contextual factors influence the effectiveness of RI system performance drivers?
    d. Who are the key stakeholders associated with the drivers?
    e. Which drivers present viable investment options?
    f. How can investments promote or establish drivers in other similar contexts?

BOX 1. KEY TERMS

ARISE defines a *routine immunization system* as a set of independent but interrelated components that work in concert to deliver vaccinations of the national immunization schedule over time to each new cohort of children born.

An RI *performance driver* is a structure, resource, or process that works on or through RI system components and that enables the RI system to perform effectively and improve over time. Drivers may take multiple forms, including specific interventions, innovations, policies or practices, as well as health system components.

Traditional measures (DTP3 coverage, DTP1 coverage, dropout rates) are used to understand RI *performance*. However, ARISE will also explore other possible performance metrics that track interim steps and conditions that enable an RI system to reach coverage goals.

Landscape Analysis Synopsis

Purpose of the Landscape Analysis

This landscape analysis represents the first step of the ARISE project in exploring the drivers of routine immunization (RI) system performance in sub-Saharan Africa. It reports on a systematic examination of written documentation of RI performance and existing performance data, and it summarizes interviews with implementers and technical and development partners to improve understanding of the drivers of system performance.

The overall purpose of the analysis is to generate a broad range of ideas about the drivers of RI system performance in Africa for further exploration in a second phase of the project.

Objectives of the Landscape Analysis

1. Begin to build an evidence base to improve understanding of the drivers of the RI system performance.
2. Guide the framing of questions and issues to be examined through ARISE in-depth country studies.
3. Identify countries and country experiences for investigation in ARISE in-depth studies.

Summary of Methods for the Landscape Analysis

Three data streams fed into the landscape analysis: (a) the document review, (b) the key informant screening interviews and key informant in-depth interviews, and (c) secondary data analysis.[4] (See appendix A for details). The document review broadly followed systematic review techniques. It focused on published (including non–peer reviewed) and unpublished literature from 1995 to the present. In total, 757 documents were identified for review. After screening for relevance, researchers extracted data from 150 documents. Researchers conducted 46 key informant-screening interviews with a range of key informants and an additional 13 in-depth interviews in Ghana. In addition, secondary data were reviewed for existing measures of routine immunization (RI) system performance. These data were used to explore performance trends in sub-Saharan Africa and to guide the selection of in-depth study countries for the next phase of the project. Researchers examined a series of indicators, including coverage and equity, over the past decade.

4 ARISE also conducted a series of interviews with stakeholders representing key development partners and technical agencies to gain an understanding of their particular issues of interest in RI and investment strategies for health and immunization in Africa. Findings from this stakeholder consultation are contained in a separate document.

Findings

Analysis of Routine Immunization Performance in Africa

ARISE reviewed existing data on coverage and other measure of RI performance from 2000 to 2009 from all countries in the World Health Organization Africa region (WHO/AFRO) and grouped countries into coverage categories (Table 1).

Researchers also built on an analysis conducted by Cutts and Biellik (2011) to review and analyze RI performance trends in sub-Saharan Africa. Figure 1 summarizes DTP3 coverage trends in the WHO/AFRO region from 1980 to 2009.

Observations on Performance: Table 1 groups countries by DTP3 coverage experience (high, medium, low, and strongly increasing) and compares a range of performance and other indicators by country category.

- Approximately half the children born in Africa live in countries in the medium range of DTP3 coverage, which is estimated at 75 percent in 2009.
- Much of the improvement in DTP3 coverage in the past decade appears to have been realized between 2000 and 2005; between 2005 and 2009, increases were minor in medium- and high-performing countries, and there was no change in low-performing countries. This finding suggests that those countries have reached a plateau.
- Almost one out of five (18 percent) African children born in 2009 were completely unvaccinated; In addition, 27 percent of children had started the immunization series but dropped out and did not complete it. In no country has the number of unvaccinated children exceeded the number of undervaccinated children. The problem of dropout is particularly elevated in countries in the low range of coverage, where the mean dropout rate across countries is 32 percent and where almost twice as many children are undervaccinated as are unvaccinated.
- At subnational levels, general progress has been made in countries in all coverage categories with respect to the proportion of districts achieving at least 80 percent DTP3 coverage. This situation is most notable in countries categorized as strongly increasing coverage and as having low coverage. However, because such data come from routine administrative reports that cannot be validated through surveys, the figures must be interpreted with caution.
- There does not appear to be a clear link between immunization performance and countries' total health expenditures. Whereas, overseas development assistance (ODA) appear to increase successively as categories of DTP3 coverage increases.

ARISE will conduct additional analyses of these and other data in its next phase of activity.

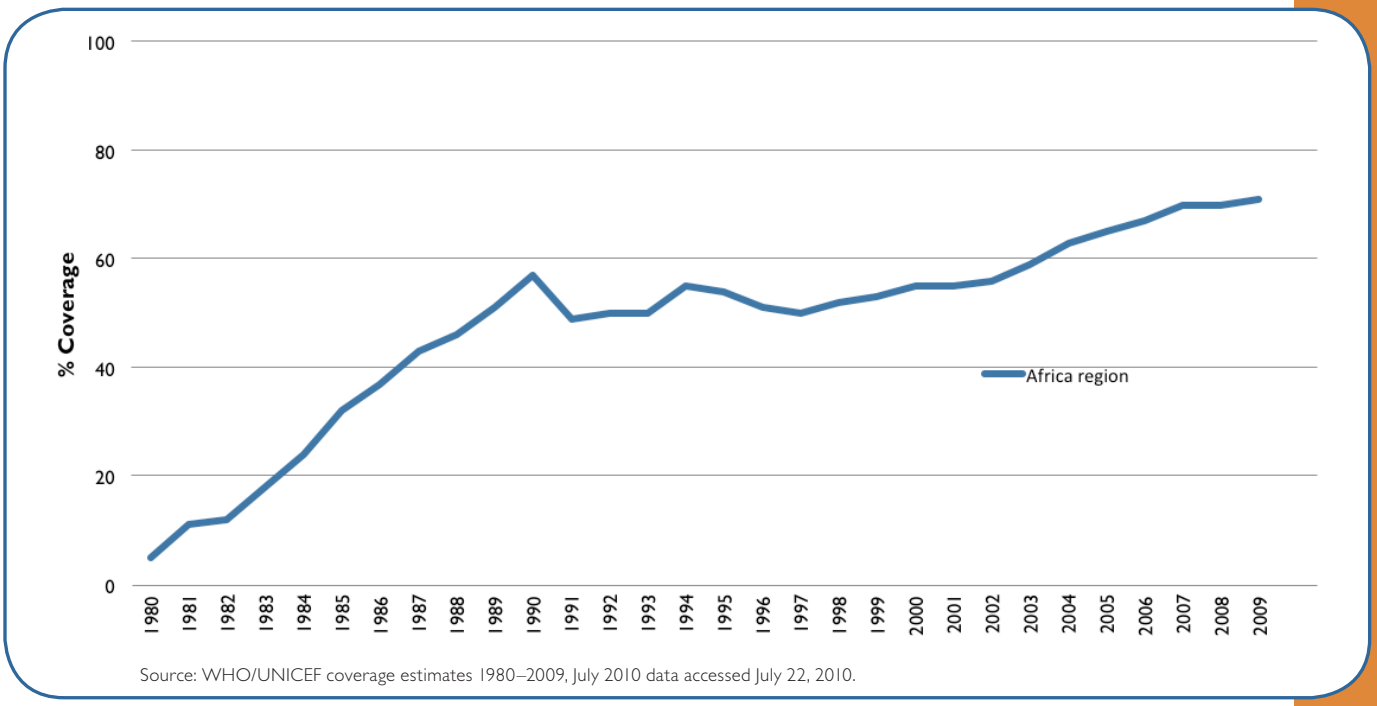
Table 1. Classification of 46 WHO/AFRO Countries According to DTP3 Coverage Trends

Category of Coverage (per WHO/UNICEF estimates)	DTP3 (mean %)			DTP1 (mean %)	DTP1–DTP3 Dropout (mean %)	Mean % of Districts with >80% DTP3 Coverage		Total # of Births	Total # Unvaccinated1	Total # Under-vaccinated2	Total Health Expenditure (median and range in $PPP)	ODA $ per child (median and range)
	2000	2005	2009	2009	2009	2004	2009	2009	2009	2009	2006	2006
High: >80% DTP3 coverage, 2005–2009 (19 countries)3	82	91	92	95	3	69	77	6,474,000	436,550	671,470	82.5 (19–815)	10 (3.1–20.7)
Medium: 60%–79% DTP3 coverage, 2005–2009 (18 countries)4	61	71	75	87	14	43	66	15,635,000	1,841,020	3,490,420	51 (27–715)	7.7 (2.4–23.5)
Low: <60% DTP3 coverage, 2005–2009 (6 countries)5	36	42	42	62	32	13	46	7,206,000	3,007,390	3,742,350	68.5 (27–633)	6.3 (2.1–37.8)
Strongly Increasing: DTP3 coverage increased by >25 percentage points, 2005–2009 (3 countries)6	33	52	78	89	12	18	72	1,725,000	192,210	421,890	74 (38–115)	5.4 (1.3–9.1)

Sources: Table adapted and modified from Cutts and Biellik (2011).
WHO/UNICEF estimates as of December 15, 2010. Retrieved May 18, 2011, from http://apps.who.int/immunization_monitoring/en/globalsummary/timeseries/tswucoveragedtp3.htm.
Districts with >80% DTP3 Coverage: WHO vaccine preventable disease monitoring system, as of December 15, 2010. Retrieved May 18, 2011, from
Births and Surviving Infants: UNICEF/WHO (2011). UNDP data. Retrieved May 18, 2011, from http://www.childinfo.org/files/32775_UNICEF.pdf.
Total Health Expenditure per capita in US$ parity purchasing power: WHO Health Statistics 2009. Retrieved May 19, 2011, from http://www.who.int/whosis/whostat/2009/en/index.html .
ODA: Greco, G., Powell-Jackson, T., Borghi, J., & Mills, A. (2008). Countdown to 2015: Assessment of donor assistance to maternal, newborn, and child health between 2003 and 2006, The Lancet, 371 (9620): 1268–1275.

Notes:1 Unvaccinated = surviving infants minus the number receiving DTP1.
2 Undervaccinated = surviving infants minus the number receiving DTP3.
3 High-Coverage Countries: Algeria, Botswana, ,Burundi, Cape Verde, Eritrea, Gambia, Ghana, Lesotho, Madagascar, Malawi, Mauritius, Namibia, Rwanda, São Tomé and Principe, Senegal, Seychelles, Swaziland, Tanzania, and Togo.
4 Medium-Coverage Countries: Benin, Burkina Faso, Cameroon, Comoros, Côte d'Ivoire, Democratic Republic of Congo, Ethiopia, Guinea-Bissau, Kenya, Liberia, Mali, Mauritania, Mozambique, Sierra Leone, South Africa, Uganda, Zambia, and Zimbabwe.
5 Low-Coverage Countries: Central African Republic, Chad, Equatorial Guinea, Gabon, Guinea, and Nigeria.
6 Strongly Increasing Coverage Countries: Angola, Niger, and Republic of Congo.

Figure 1. DTP3 Coverage Trends in AFRO Region 1980-2009 (WHO/ UNICEF Estimates)



Source: WHO/UNICEF coverage estimates 1980–2009, July 2010 data accessed July 22, 2010.

Identification of Drivers of Routine Immunization

Researchers also identified potential drivers of RI system performance from data extracted from written sources and key informant interviews (Table 2), using criteria explained in Table A.1 in appendix A. They recorded each possible driver that emerged in a "driver journal," which documented evidence and project thinking about the particular driver area. From this exhaustive list, a short-list of main drivers was compiled, This list consists of drivers that have both a theoretical basis—to suggest they are important—and drivers that emerged from a larger and more rigorous evidence base.

RI Performance Drivers: Table 2 shows the complete list of 58 potential drivers identified by the landscape analysis. Those drivers were identified under 27 coded themes from data drawn from the literature review and key informant interviews. Some themes were consolidated during analysis. Themes (a total of 22) are listed first followed by the drivers. This table reports potential drivers by level of the ARISE conceptual framework (context, health system, and immunization system, see appendix B) and by thematic area. One contextual theme (the Millennium Development Goals) in the original framework is not presented in Table 2 because it did not emerge from the analysis.

From this list in Table 2, nine drivers emerged that had both strong theoretical support and a basis in the empirical and qualitative evidence. Several of those drivers were identified in multiple levels of the project's conceptual framework. In most cases, key informant interviews, nonempirical literature, and the data review lent additional support of the drivers, often providing details specific to implementation practices and contextual factors.

Main Drivers

1. Multidimensional Interventions Involving Systems Change

Interventions that combine several components of care, or that involve multisystem change, emerged as a driver at several levels in the ARISE conceptual framework. At the immunization system level, both theory and evidence support the idea that multidimensional intervention strategies, such as Reaching Every District (RED), Periodic Intensification of Routine Immunization (PIRI), and other examples are effective at improving performance (a review of both are outlined in Cutts and Biellik (2011) and examples are found in Sia, Kobiané, Sondo, and Fournier (2007).

Experience varies for the different foci of these interventions. To illustrate, Tanner (2005) noted a program that simultaneously improved allocative efficiency (through burden of disease planning), strengthened technical and management capacity, marginally increased funding, improved district-level ownership of decisionmaking, strengthened institutions and governing practices, and improved demand-side activities.

With respect to PIRI, Cutts and Biellik (2011) noted that it may be most appropriate in areas of difficult geographic access or low security, but that the effect on coverage "has not been adequately demonstrated." At the health system level, Abebe (2008) found that integrated child health programs had a positive effect on immunization coverage. However, the introduction of Integrated Management of Childhood Illness (IMCI), an integrated approach specifically targeting sick children, was associated with a slight decrease in immunization coverage (Armstrong Schellennberg et al., 2004; Atun, de Jongh, Secci, Ohiri, & Adeyi, 2010; Masanja, Schellenberg, De Savigny, Mshinda, & Vitoria 2005).

Table 2. Potential Drivers of Routine Immunization System Performance, by Level

THEME	POSSIBLE DRIVER
Country policies and strategies	• Decentralization and the district-level role • Multidimensional routine immunization (RI) system-strengthening focused interventions • National commitment to health
Global and regional initiatives—design of initiative and adoption or adaptation process	• Global health programs or initiatives
Role of development partners	• Donors' role in vaccine supply

Socioeconomic or demographic conditions	• Examples include: income per capita; education or literacy, female in particular; social development of a country; contextual incentives to staunch outmigration of health professionals; equity and gender issues at macro level in country; and geography
Country-specific governance structures and strategies	• Multidimensional health system strengthening strategy • Adaptation of strategies to contexts • Introduction and development of Interagency Coordinating Committee (ICC) mechanisms • Strong district or decentralized team with effective leadership • Effectiveness and quality of country institutions
Strategies and policies	• Multidimensional intervention/factors for system change • Decentralized systems • Financing strategies • Country commitment to health • Role of Civil Society Organizations (CSOs)
Integrated maternal and child health (MCH) services	• Integration of MCH services
Finance and budgeting	• Immunization and vaccine financing • Funding flows and budgeting • Conditional cash transfers
Governance and leadership	• Health system ability to adapt • Devolution of financial and operational aspects of Expanded Programme on Immunization to district level • Local ownership at district and community level • Levels of government and health structure working effectively together in support of health • Community structures working in support of health • Leadership knowledgeable about immunization
Human resources	• Community health workers • Performance-based strategies and health workers' performance • Supply of health staff members at district level • Health work force and opportunities for a career track • Task shifting
Information systems	• Use of data for action
Monitoring and surveillance	• Use of data for action
Logistics, supplies, and equipment	• Centrality of cold chain and of logistics and transport management • Links with private sector; contracting out supply chain and transport management

Planning, management, and finance	• Decentralized planning • A management approach that uses data for analysis and that encourages problem solving. • A well-functioning ICC supports RI system management • District health management teams • Performance-based financing • The predictability and security of funding flows for RI from government and donor to central and to district level
Program characteristics	• Strong country ownership
Program strategy	• Outreach to enable access, promote use, and address low-performing (in terms of coverage) communities • Child health weeks or days to enable access, promote use, and address low-performing (in terms of coverage) communities • Strong and strategic community engagement
Training and supervision	• Pre-service training • In-service training • Supervision
Health work force	• Incentives • Creation of special corps of workers • Overall supply of health workers
Community action	• Community involvement and close links/action between formal RI system and community structures and individuals • Community health workers (see health work force theme). • Use of a variety of incentives: to increase demand or use, to increase supply • Ways to create and sustain demand
Advocacy and communication	• Communication • Advocacy for RI
Individual demographics and knowledge, attitudes, and practices	• Role of RI system in creating and sustaining demand for immunization

Naimoli, Challa, Schneidman, and Kostermans (2008) noted that what distinguished the higher-performing countries in their sample of case studies was fairly robust implementation of immunization programs across all building blocks of the health system. In addition, several household- and community-level empirical studies (e.g., Antai, 2009; Bosch-Capblanch, 2010; Partha & Bhattacharya, 2002; Sia et al., 2007) found that use of other health services, such as antenatal care and facility delivery, predicted immunization coverage and completion of the immunization series even when controlling for other factors that may influence use, such as wealth, education, and distance. Such findings suggest that increases in immunization are more likely to be sustained in the presence of gains in other areas of health services, particularly maternal health.

2. Country Commitment to Health

The manifestation of country commitment to health, specifically to immunization, can be measured in levels of country financing for vaccines, government statements, and behavior critical to overall prioritization of immunization in the health system. Cutts and Biellik (2011) interviewed key informants in Indonesia who stated that strong commitment from the Ministry of Health and the President were integral to improving RI. Country commitment was also among the most frequently noted influences on performance reported by ARISE key informants.

The case study in Mauritania by Naimoli et al. (2008) emphasized the important role of government support and pressure from the highest levels in improving DTP3 coverage, at all costs. Indeed, Gauri and Khaleghian (2002) hypothesized that political will had an effect on immunization coverage. Their analysis found that in middle-income countries, autocracies had significantly higher coverage rates than did democracies. This hypothesis has not been examined in low-income countries, nor does it suggest that autocracies are good for the overall health of their citizens. The point to note here is that a variety of forms of political will appear to be key to improving RI system performance.

3. Strong Country Ownership of Routine Immunization

Strong country ownership of RI can be related to country commitment, but may also convey a sense of independence from external influence, sovereignty, and pride in the program. Several funders and numerous key informants have identified country ownership as a key element of improved RI performance, and several donors have tried to promote strategies to improve ownership. The Global Alliance for Vaccines and Immunizations (GAVI) co-financing initiative has, as an intermediate goal, promoted country ownership of vaccine financing. Goeman et al. (2010) noted that when the GAVI Alliance allowed Ministries of Health to identify health system constraints and appropriate interventions themselves, without a prescriptive blueprint from the donor side, it produced greater diversity in interventions at both the systemic and the operational levels.

Despite the assumed importance of this driver by donors and key informants who named ownership and commitment (as stated earlier), little hard evidence exists of the effect of country ownership on RI performance. The absence of evidence may be due, in part, to the difficulty in measuring this driver alone without including other drivers (financing, governance, training of health work force, etc.).

4. Immunization Financing

From ARISE's extensive literature review, immunization financing was defined in broad terms, both across levels of the system and by source and mechanism. It includes the effect of pooled funding and GAVI Alliance financing mechanisms on vaccine supply, access to resources at the district level, and financial sustainability of RI. Most evidence was found on donor financing for RI and health. Some studies included immunization financing in their theoretical models of immunization coverage (Brenzel et al., 2010; Mahoney & Maynard, 1999).

In general, however, empirical evidence is weak. Lu, Michaud, Gakidou, Khan, and Murray (2006) found that the GAVI alliance funding significantly increased DTP3 coverage in countries with DTP3 coverage of 65 percent or less at the baseline, but not in the categories of countries with coverage at 65 percent or higher. Few other empirical studies found significant effects. As described by Chee, Fields, Hsi, and Schott (2004), increases in doses of DTP3 administered in countries receiving GAVI alliance cash support were difficult to attribute specifically and solely to that funding. The relationship between such support and changes in RI performance was further complicated by fluctuations over time in the quality of immunization data, partly because of efforts to improve data quality that were supported by the GAVI Alliance funding itself.

Naimoli et al. (2008) noted that external financing for routine programs did not vary in any particular pattern across the high and low performers in a deviance analysis of several African countries. The absence of any clear trend may have occurred for several reasons. Current measures of donor funding are often focused on all areas of health, not just immunization, and, within immunization, not just RI. This way of tracking funds can mask trends and relationships between funding and immunization coverage. Financial figures that do focus on RI have been collected (e.g., financial sustainability plans, cMYP [comprehensive multi-year plan] database) over shorter periods, but pervasive problems with missing data preclude the ability to develop robust time series analyses.

Another challenge is the common reliance on budget records rather than actual expenditures to track funding. Finally, several studies have shown that corruption has a significant effect on immunization (Azfar and Gurgur, 2008; Gupta, Davoodi, & Tiongson, 2000), which will likely decrease the effectiveness of funding. If the analysis does not control for the effect of corruption on financing, the results may be spurious.

Aside from donor financing, additional evidence of level and distribution of funding for RI is spotty. Naimoli, Challa, Schneidman, Kostermans, and Sharma (2005) concluded in their case studies that countries require assistance in budgeting and allocating their financial resources, both domestic and external, across immunization system program components. Sustainability of financing is also a concern, and several studies using the GAVI alliance data have explored the financial sustainability of current immunization plans, plus the cost of making them so (Kaddar, Lydon, & Levine, 2004; Kamara et al., 2008; Lydon et al., 2008; Wolfson et al., 2008).

5. Use of Community Health Workers/Special Cadres in RI

The use of well-trained, motivated community health workers (CHWs) can help expand coverage to remote areas and can increase demand. CHWs often promote immunization and, in some cases, provide immunization services. Cutts and Biellik (2011), reporting on a review of the literature from the 1980s and 1990s (including Batt, Fox-Rushby, & Castillo-Riquelme, 2004 and Pegurri, Fox-Rushby, & Damian, 2005), found that CHWs were one of the most cost-effective ways to increase immunization coverage when mean baseline coverage among fully vaccinated children was 34 percent (range, 3–65 percent).

A recent Cochrane review concluded that such health workers provide promising benefits in promoting immunization uptake (Lewin et al., 2010). Other studies have empirically measured the effect of CHW programs on immunization outcomes and found positive effects on immunization coverage (Abebe et al., 2008; Banteyerga & Kidanu, 2008). Several qualitative studies found CHWs were an essential driver of RI coverage (e.g., Chopra & Wilkinson, 1997; Kadzandira & Chilowa, 2001), and ARISE key informant findings strongly support the positive influence of community-level workers on RI in Ethiopia, Ghana, and Malawi, all of which have active CHW and extension worker programs.

More generally, studies have found an effect of community-level factors, such as social norms and support of health or immunization ideation (Babalola, 2009; Kiros & White, 2004), which are important. The finding suggests the health promotion and education (demand generation) efforts by CHWs and health extension workers are as important as their assistance in provision of immunization services.

6. Overall Supply of Health Workers

ARISE has defined *health work* force as an essential component of a well-functioning RI system. The drivers that mobilize the supply of health workers to perform at a high level would include those that ensure that competent, capable health personnel are available in sufficient numbers at the time and place necessary to provide immunization to all subpopulations.

The health systems building blocks framework of the World Health Organization (WHO, 2007) hypothesized that the distribution, management, and levels of health workers were critical to health outcomes, but because of a lack of data on the three elements, only the level of health worker category had been measured. Even here, spotty data have undermined the strength of findings. Kruk, Prescott, de Pinho, and Galea (2009) and Speybroeck, Kinfu, Dal Poz, and Evans (2006) found that physician density per capita had a significant positive effect on vaccination coverage, while nurse or midwife densities had no effect. However, Kruk et al. found that the indicator for aggregate health workers (physicians, nurses, and midwives) did have a positive effect on measles vaccination.

In contrast, and based on experiences in Asia, Anand and Bärnighausen (2007) reported that nurse or midwife densities were significant while physician density was not. In addition, Mitchell, Bossert, Yip, and Mollahaliloglu (2008), using panel data from Turkey, found a positive relationship between health worker densities in the early years of the data, but a negative relationship in later years. Additional studies may be required to understand such relationships in Africa.

Few concrete approaches to scaling up health worker density have been put forth to improve distribution of workers with regard to RI. In their review of the grey literature, Batt et al. (2004) found that alternative approaches for payment and contracting of Expanded Programme on Immunization (EPI) –trained health workers was a cost-effective way to improve EPI coverage, but do not discuss how this affected distribution of workers. Moreover, Cutts and Biellik (2011) made several suggestions on alternative approaches to increasing

workforce but did not address how to redistribute providers to areas in need. Clearly, further efforts are needed, both to measure the effect of the health work force on RI system performance and to improve equity of work force distribution.

7. Availability and Use of Data for Action

The effective "use of data for action" driver emerged from the extensive literature review and from key informant interviews, but often in combination with other drivers. This clustering may be because the use of health information—tracking defaulters, registration of children, action planning, supervision—while essential, often acts indirectly to improve outcomes, such as immunization coverage.

Cutts and Biellik (2011) discussed the importance of EPI data for improving performance and summarized successful efforts that combined data collection, use for action, and data quality review to improve strategic intervention into the RI system with health workers, management changes, and so forth. Bjorkman and Svensson (2009) found that complementarities between health worker effort in using data for community mobilization and a more engaged and supportive community improved service quality and shifted patients from self-treatment toward facility care, thereby improving health outcomes. Further investigation is needed to identify the necessary levers to operationalize health information in the RI system.

8. Role of RI System in Creating and Sustaining Demand

An RI system must continually work to promote initial use of immunization among parents, while maintaining demand among those whose children have already started the vaccination schedule so that they complete it. Bjorkman and Svensson (2009) reported that in Uganda, a community mobilization program did indeed contribute to increased coverage during the intervention. Naimoli et al. (2005) noted that investment in improving the availability and quality of service provision, a supply-side intervention, may be an important element of demand creation.

Health workers also play an important role in generating and maintaining demand for and use of vaccination services; yet formal health workers may not see demand generation as one of their responsibilities. In a comprehensive review of literature related to barriers to immunization, the U.S. Centers for Disease Control and Prevention (CDC) found that lack of health worker referral of children for immunization and missed opportunities for vaccinating while interacting with clients at service delivery points were two of the top 10 most-cited reasons for nonvaccination and undervaccination (CDC Global Immunization Division, 2009).

This same review, along with a related review of the grey literature (IMMUNIZATIONbasics, 2009) found that one major reason children were completely unvaccinated was parental resistance or nonacceptance of immunization. By contrast, a key reason children were incompletely vaccinated was that parents had had prior difficult or unpleasant experiences with immunizing their children—despite their perception of immunization as an effective intervention.

Findings from a related body of literature that identified the sociodemographic characteristics of the unimmunized children (e.g., Antai, 2009; Bosch-Capblanch, 2010; Waters et al., 2004) can be used to help target demand generation activities to the populations most in need of intervention.

9. Adaptation of RI Strategies to Contexts

Two drivers emerged frequently from in-depth key informant interviews. They relate mainly to the innate ability of the system to transform resources into outcomes. Although not confirmed with empirical data, the frequency of their occurrence suggests an important role. The first, contained within other driver areas in Table 2, relates to the practice of adapting program strategies to a specific context. The ability of a district or country to adapt strategies was discussed with respect to introducing new program strategies (such as integration), financing conventions (such as sector-wide approaches), and introducing new health worker roles (Tanner, 2005).

Respondents from Ghana referred to the skills required in leaders and managers to make standardized strategies work effectively in a specific context. For example, among the respondents that reported on the effectiveness of Reaching Every District (RED), it was suggested that success or failure of RED in improving RI systems often depended on the way a country tailored the RED framework to its own needs. The ability to be strategic and to adapt was reported as relevant at both the central and district levels.

A second, related driver that emerged in the review was the district's role in ensuring RI system performance. It relates to the ability of the district leadership or district health team to innovate or to use available resources strategically in a way that results in better program outcomes. The ability to innovate in settings of limited resources is a characteristic of some district teams whose RI services are performing well.

Naimoli et al. (2005) noted in their case studies of African RI performance that certain combinations of delivery strategies may be more appropriate in some contexts than in others and that each country must make its own decisions on the basis of what works best in each setting. They call for more documentation of context-specific approaches to improve the knowledge base surrounding this driver.

The Clustering of Drivers

In many cases the literature and respondents reported that several drivers clustered together suggesting a synergy among them. For example, a clustering of drivers can be related to district-level management of RI activities that often occur together to enable performance. Such drivers include the existence of skilled team members and leaders, the quality of local institutions, the use of data, a focus on the hard to reach and defaulters, the use of evidence-based planning, the use of community health workers, the strong community-health system links, and the bureaucratic systems that facilitate or impede resource allocation. Decentralization per se (of the planning, management, and financing of health services) is not a driver; rather, it is the district setting and the characteristics and behaviors of the key actors (described as "leading on immunization") that may drive performance.

Possible Limitations with Driver Identification

The extensive document review and prioritization of evidence allowed some hypotheses related to RI performance drivers to emerge. Nevertheless, there are limitations associated with this process of driver identification:

- In spite of the length of the list of potential drivers, some areas of the conceptual framework are under-represented in the driver summary table (Table 2). For example, it is reasonable to expect that a reliable and sufficient supply of vaccines and that effective cold chain and logistics management are central to RI performance. Cutts and Biellik (2011) and many others have described at length the importance of the cold chain. Yet cold chain did not emerge as a particularly strong driver from the document review or key informant interviews. The absence of reported drivers in this area may be the result of any or all of the following factors:
  - The literature reports mainly deficiencies in vaccine supply and in cold chain and logistics management as obstacles to performance rather than naming them as positive drivers. Because the review focused on the identification of positive drivers, cold chain issues were not included in the data extraction.
  - Similarly, in interviews, it is possible that strong supply chain management went relatively unnoticed when functioning well, becoming noteworthy only when it presented an obstacle.
  - Certain perceptions among respondents indicated that the cold chain is not a "driver" of performance in the sense that it is an essential component of the RI system but does not improve performance.
- Understanding the roles of external development partners (funding, strategies, and technical assistance roles) and their effect on RI system performance is a continuing challenge, partly because strategies are dynamic and continue to evolve. Studies of the GAVI alliance immunization services support, as described by Chee et al., (2004, 2007), provided useful findings that need to be updated as external partners implement new funding strategies.
- The quality of data with which to judge immunization coverage, financing, and distribution of services varies by country, potentially making cross-country comparison, and "high" performance selection, difficult. (See Biellik and Cutts [2011] for more detail.)
- The type of drivers reported here move the understanding of RI system performance only a few steps forward. First, many descriptions of drivers include elements of RI systems and health systems that are already perceived or known to contribute to RI system performance. Second, the data did not really increase understanding of how the potential drivers play out in practice. With the exception of the in-depth key informant interviews, very few data sources provided sufficient detail about a particular driver or driver cluster to determine when it was introduced, how it was implemented, and how it contributed to performance. Innovative drivers were rare and, when identified, often had insufficient evidence to warrant further exploration. Moreover, the influence of contextual forces was

rarely reported, restricting the researchers' ability to determine the relevance of the setting to the performance achieved.

- In many examples found in the nonempirical literature and reported in interviews, the link between the driver and performance was a presumed relationship rather than a statistically proven link, limiting ARISE's ability to compare drivers or to confirm the strength of a hypothesized association between the driver and RI system performance.
- The literature review, by design, took a retrospective approach and does not capture newly developed or real-time interventions whose effect on RI performance has yet to be reviewed systematically.

Conclusions

The landscape analysis represents a discovery period, setting the stage for future exploration of drivers in specific contexts. The large number of potential drivers identified during this process enriches understanding of the many factors that practitioners, researchers, and program managers report as important influences on RI system performance. However, the data for the most part fail to clearly link drivers to performance either for changes in essential system functions or for system outcomes (e.g., coverage, equity).

In addition, because most reports lacked detail or failed to substantiate findings, the data did not allow researchers to prioritize any one of the emerging drivers over another. Finally, none of the data gathered for this analysis allowed researchers to assess the full picture of country experience or to review enough examples of proposed drivers to generalize about driver behavior and capacity to improve performance.

Current Needs

If we are to move beyond this basic understanding of performance drivers to develop actionable findings, information is needed on the way a driver manifests itself, how it contributes to performance, and how it behaves in different contexts. Several recurring themes about performance drivers, however, as well as examples of driver clusters, will inform future thinking and will warrant greater attention in the next phase of the project. Additionally, some glaring gaps in information exist that must be addressed in order to move from the global landscape to field-level specifics.

Next Steps

- As part of the landscape analysis, ARISE examined national-level coverage, equity, and dropout data to determine high-performing countries. Of those, ARISE selected three countries for in-depth case studies, following on from work such as Naimoli et al. (2008). The case studies will provide the best vehicle for understanding how and why specific performance drivers improve coverage and how they behave in different contexts. Data collection is currently under way for Cameroon, Ethiopia, and Ghana, and those case studies will provide significantly more information on the drivers found in the landscape analysis and will generate information on other performance drivers.
- ARISE will attempt to map out the driver pathways for RI system performance in a theory-of-change-style conceptual framework, which will help succinctly summarize the findings of the case studies, as well as the landscape analysis findings and current expert opinion, to derive some theory-driven hypotheses that could be tested empirically. This framework may also be used to inform future interventions and investments in RI systems.
- ARISE will examine what datasets are currently available to explore these hypotheses via quantitative analysis. So far no adequate data have been identified, and if no other new data become available, then the results of this search will be presented alongside the above products, and suggestions will be provided on the type of new data that need to be collected to adequately test some of the hypotheses identified in the framework.

Appendix A

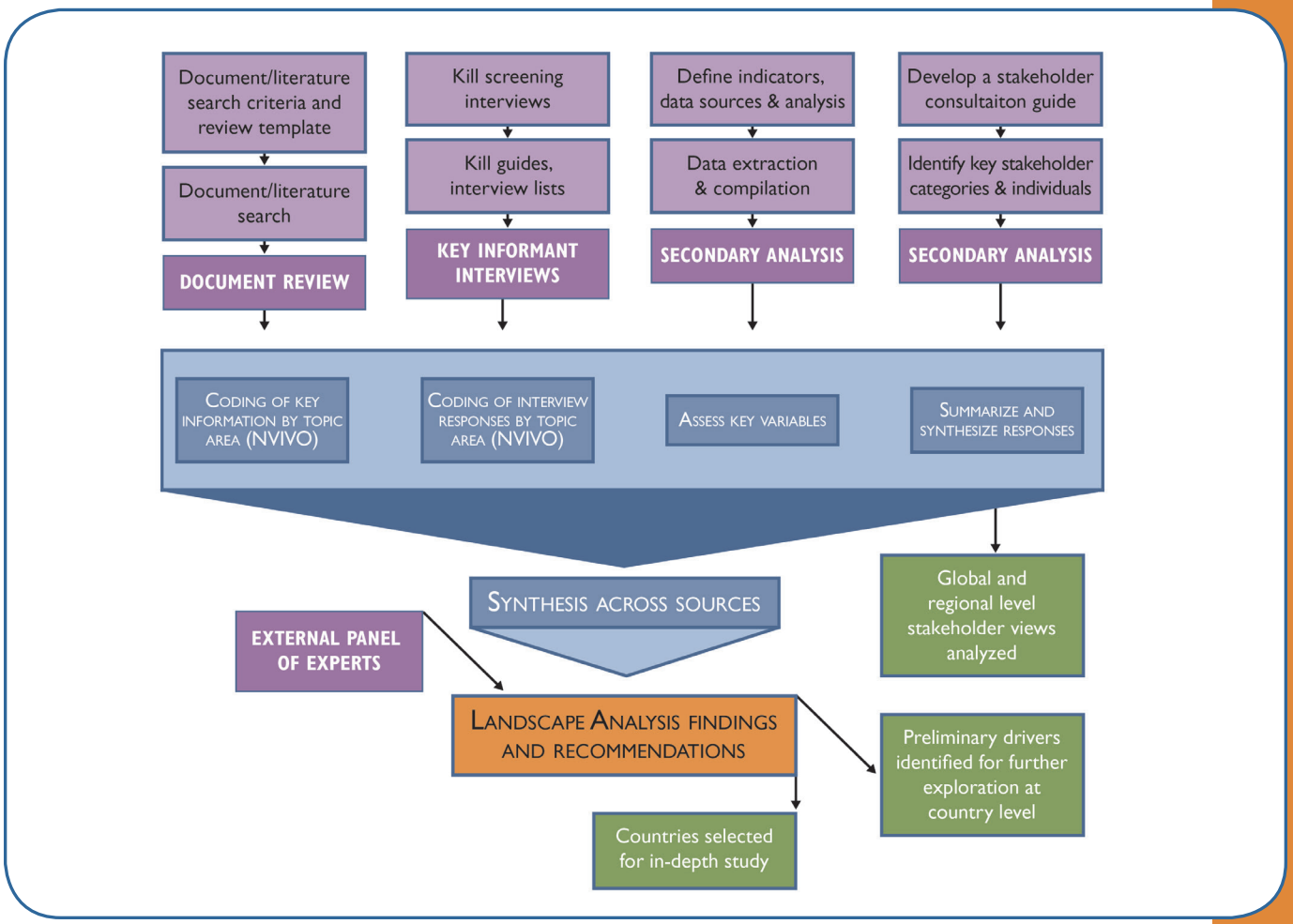
The following is an excerpt from the full landscape analysis report.

Methodology

Introduction

The ARISE team used a range of both qualitative and quantitative methods to identify and explore drivers associated with routine immunization (RI) system performance. Three data streams fed into the landscape analysis: a systematic document review on RI, key informant interviews, and an assessment of secondary data. The ARISE team also worked with an external advisory panel of experts (EPE) to review the preliminary findings of the landscape analysis, guide its completion, and apply the findings in the subsequent design of the in-depth country studies. The conceptual framework (Appendix B) guided the identification and framing of possible drivers that might emerge from the analysis and was used to structure the analytical approach described below). Figure A.1 summarizes the methods the project used in the landscape analysis to generate this preliminary set of drivers.

Figure A.1. Multiple Methods Used in the Landscape Analysis



Analytical Approach

The ARISE conceptual framework formed the basis of the analysis presented in the landscape document. The framework guided researchers in their investigation of RI system performance and potential performance drivers or driver clusters. Researchers categorized potential drivers by themes, using the three levels of the framework—context, health system, and immunization system.

The three data sources provided insights into one or both of the main areas of investigation (drivers and performance), thereby allowing researchers to (a) increase understanding of the key variables and the relationship between variables, (b) identify and frame a set of preliminary performance drivers (or clusters of drivers) for consideration in the in-depth studies to follow the landscape analysis, and (c) guide the selection of country study sites.

Document Review

The purpose of the document review was to capture key information on factors influencing positive routine immunization (RI) system performance. The review involved a search of published (including non-peer reviewed) as well as unpublished documents and materials relating directly to the RI systems in sub-Saharan Africa. It also included relevant documentation identified through the key informant interviews (KII). Only documents that related to positive change in RI were examined.

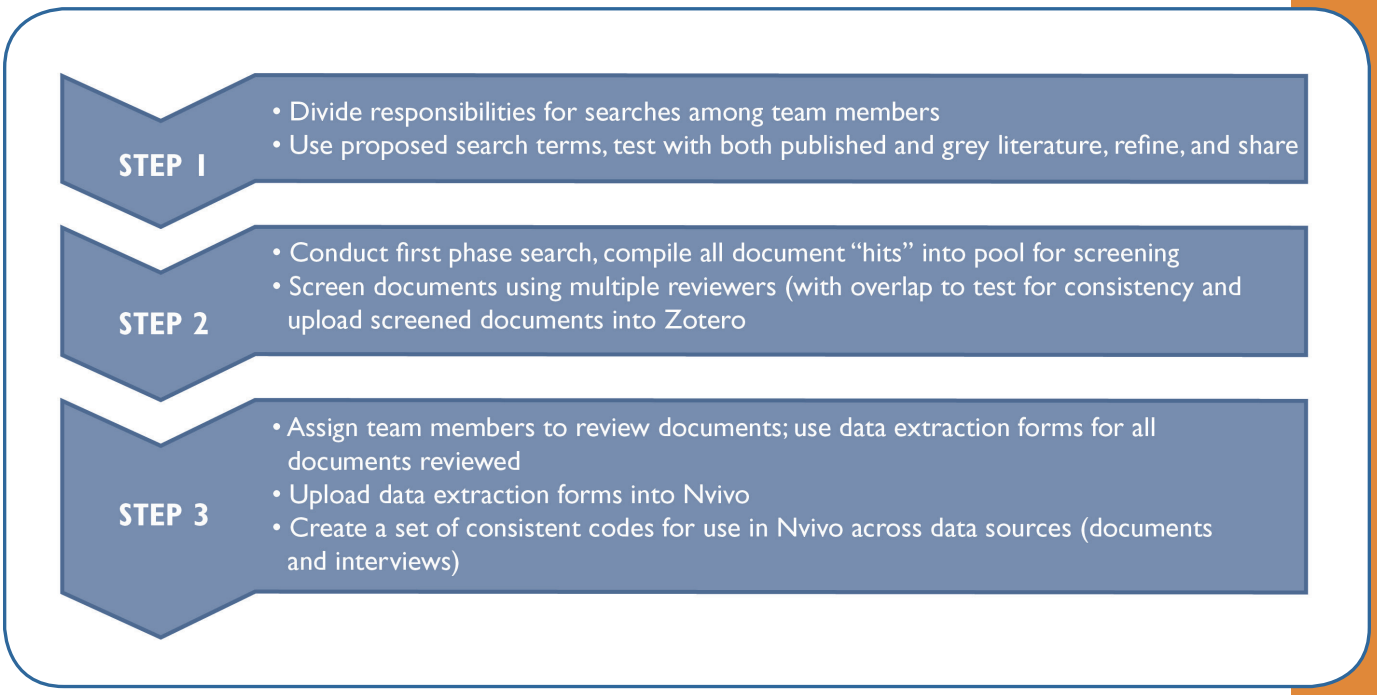
The document search protocol did not limit the review to those materials reflecting high standards of research design and conduct. Rather, it purposefully included documents with evidence that ranged from anecdotal and subjective to scientifically rigorous to take full advantage of the wide range of experiences in RI programming. The selection included documents published or released between 1995 and the present in order to capture experience before the inception of the Global Alliance for Vaccines and Immunizations (GAVI).

Performance was defined as positive changes in immunization coverage or other system performance-oriented measures (quality, disease control, equity, etc.), as well as determinant-oriented, operational processes, including availability, affordability, acceptability, accessibility, and affability. The document review also sought to illuminate the circumstances surrounding positive performance and the processes that linked drivers to outcomes. See figure A.2 that describes the approach to the document search and review.

ARISE developed a review protocol with a search strategy elaborated in PubMed and adapted to other relevant databases and non-database searches. Search terms focused on words or phrases related to immunization (e.g., immunization or immunisation, expanded program or programme on immunization, national immunization program, or a combination of these items) and were co-joined with words (i.e., used "and" in an advanced Boolean search) that link with routine immunization (i.e., related to components of an immunization subsystem outlined in the ARISE conceptual framework) and sub-Saharan Africa or countries in sub-Saharan Africa. Country searches, where possible, were combined with the Boolean term "or" as well as with exclusion terms.

Searches were conducted in English and French. The team conducting the searches first tested the process through a pilot review of selected documents from the first day's searches to appraise the quality of documents. A detailed list of the 20 databases and 52 organizational websites (grey literature) used for document searches is available on request. The search also captured documents recommended by key informants.

Figure A.2. Stepwise Approach to Document Search and Review



Four members of the ARISE team screened titles, abstracts, and full articles, with two members double-screening 50 percent of the search hits for inclusion or exclusion on the basis of specified criteria. After screening, the pairs reconciled their selections and finalized the search hits. If the pair did not agree, they requested third-party input and, after discussing their viewpoints, decided to either include or exclude the article.

Documents were retrieved and uploaded into Zotero (http://www.zotero.org/) and were referenced in MEDLINE format. Zotero was used to store documents and delete duplicates. A second-level screening gave a relevancy score to each document.

The relevancy score was developed on the basis of a set of preliminary research questions:

- What are drivers of RI system performance in Africa?
- What is the specific nature, content, or both of the driver?
- How does the driver bring about improved RI system performance?
- What are the circumstances or context for the driver and its use?
- What is the form of its outputs (systems improvement), outcomes (immunization status), or positive effects (disease prevention)?

In total, 696 documents were identified for review. After screening for relevancy, researchers extracted data from 150 documents that had earned a relevancy score of 3 or 4, the two highest relevancy categories.

Data extraction took place in two phases. In phase 1, nine researchers extracted themes from documents using a standard data extraction form. In phase 2, three researchers completed the extraction with a streamlined data extraction form that eliminated elements of the first form that had been found to be less critical when addressing the research questions.

Researchers used NVivo 8 software to organize and analyze qualitative data and to house the extraction forms (http://www.qsrinternational.com/). During the extraction process, the team assigned theme-based codes outlined in the "guidance" section of the extraction form for manual analysis after phase 1 and for analysis using NvVivo 8 in phase 2.

The project's External Panel of Experts (EPE) reviewed preliminary results after the first phase of analysis. The EPE's feedback guided revision of the extraction form and review process to allow for streamlining without compromising a uniform approach to data extraction.

Key Informant Interviews

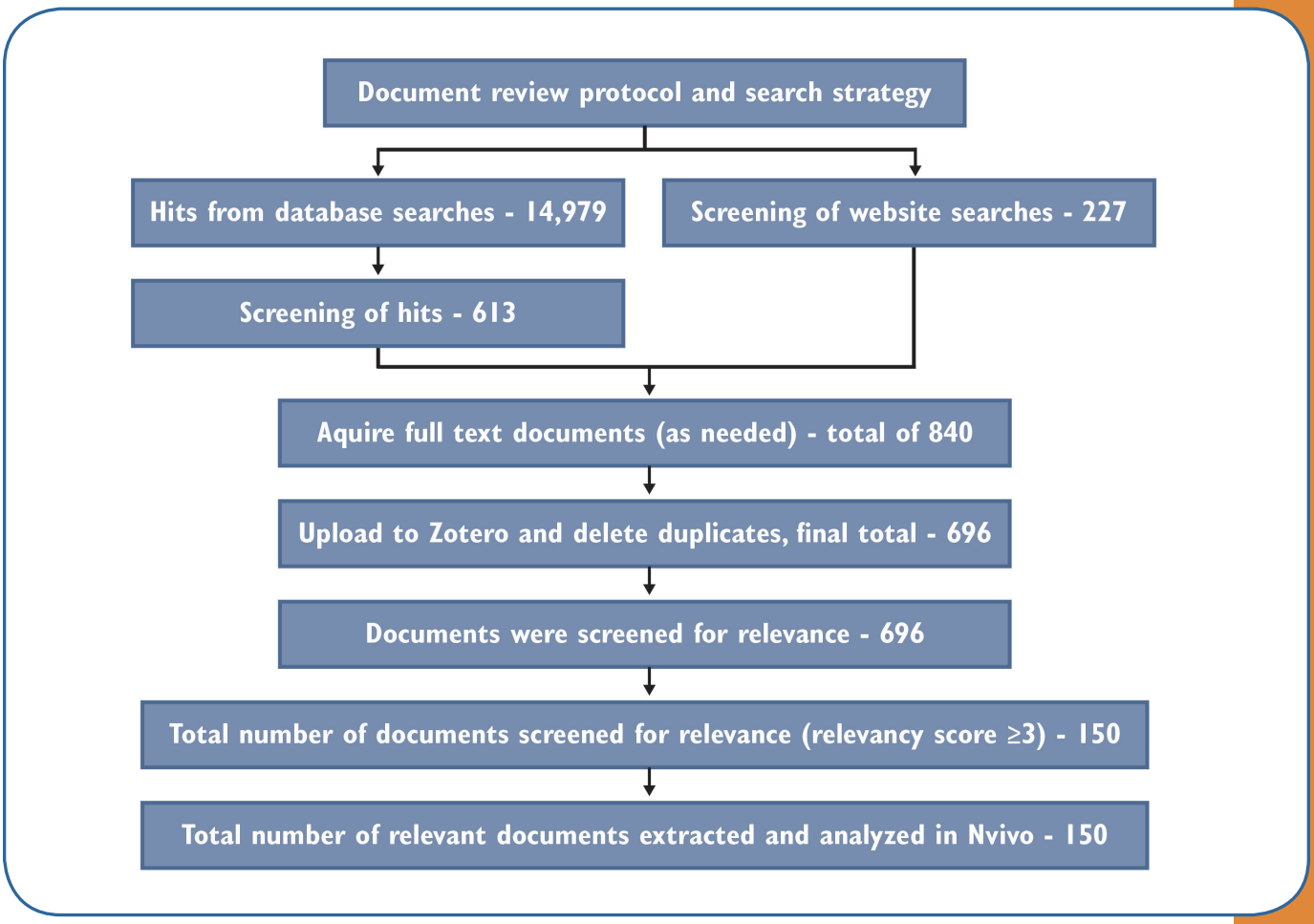
The landscape analysis also used key informant interviews as one of the main data sources to begin identifying drivers of RI performance, to frame questions for further investigation, and to select countries for in-depth study. The process of conducting key informant interviews was divided into two stages.

Stage 1 interviews acted as a screening mechanism to help ARISE rapidly identify countries or districts in sub-Saharan Africa where RI systems are working well and to link country performance with key contextual elements or potential drivers of performance. In-depth, country-based key informant interviews marked the second stage. ARISE will continue to use such interviews beyond the landscape analysis to generate data to support the country-level studies.

Other respondents were identified on the basis of their immunization expertise, through email solicitation using Listservs, such as TechNet21, CORE Group, RHINO (Routine Health Information Network), Communication Initiative Network, Child Survival Updates (CSU Update), Immunization Action Coalition's IAC Express Listserv, U.S. Coalition for Child Survival, AFRO-NETS Listserv, GAVI Independent Review Committee members Listserv, Global Health Council's newsletter, Optimize e-newsletter, DB Click Immunisation newsletter, Vaccine & Polio and Soul Beat newsletters, and the Global Immunization Newsletter.

Email requests were also sent to Ministry of Health Planning Units in 16 African countries with GAVI Health System Strengthening grants and to members of the African Evaluation Association in 25 African countries. Interviewers used a standard interview guide to identify factors critical to good RI system performance, country-level examples of drivers of performance, and potential additional respondents.

Figure A.3. Document Review Process



In stage 2 key informant interviews, ARISE developed modular topic guides that were based on input from the screening interviews. Stage 2 interviews examined in greater detail interventions or specific drivers of performance in one country setting (Ghana) and explored the influence of different contextual factors. Time constraints prevented further use of in-depth interviews at this stage of the project. Interviews were conducted with 13 respondents from public-sector institutions (i.e., Ministry of Health), civil society organizations, private sector, and development partners. Information was recorded and interviews transcribed for analysis.

Driver Identification

Identification of potential drivers of RI system performance was based on data extracted from both written sources and key informant interviews. Researchers manually reviewed the data and coded them in NVivo 8. Codes reflected 27 themes that were based mainly on elements of the conceptual framework and additional themes that emerged from the manual analysis. NVivo 8 was used to group data by thematic area, and researchers then synthesized findings by theme and identified driver-related subthemes or potential "driver areas of investigation."

The researchers applied standard criteria to identify potential drivers of RI system performance (see Table A.1). Potential drivers or driver areas of investigation emerged from the analysis if they met criterion 1 in the Table—association with performance improvement—and 2 or 3 of the other standard criteria.

Table A.1. Criteria for Driver Identification

1	Association with RI system performance—is there improved system performance or improved outcomes?
2	Frequency of the evidence or occurrence of the driver—how often does this driver area emerge?
3	Triangulation of data sources—is this driver emerging from one or more data source?
4	Strength of evidence, is the evidence categorized as 3 or 4 using ARISE definitions?
5	The driver resonates with the experience of technical team—is it plausible or known to be important for positive performance?

Researchers recorded each possible driver that emerged from the thematic areas, the supporting data sources, and the country examples in a "driver journal," which will become an organic or evolving documentation of the development of project thinking about this particular driver area. Each journal entry includes (a) a description of the potential driver or driver area of investigation, (b) a discussion of issues surrounding the driver on the basis of descriptive material in the data source (where available), and (c) a set of key questions. The driver journals will be used in the next stage of the project to (a) brief field-level investigators on issues relevant to the driver area, (b) suggest areas for further exploration of the driver at country level, and (c) link the driver to the data source and country where it was reported.

Secondary Data Assessment

The intent of the secondary data assessment was to supplement the other two data collection methods through compilation of a set of internationally recognized and comparable indicators available through existing sources. The compilation and assessment of secondary data was used to do the following:

- Review RI system performance in sub-Saharan Africa.
- Explore additional measures of performance, such as equity of outcomes.
- Supplement key informant responses on well-performing countries.

Using web-based searches, the ARISE team compiled a list of indicators that (a) could in some way reflect an immunization output, outcome, or performance level of an RI system as defined

by the ARISE conceptual framework;[5] (b) could be compared cross-nationally; and (c) had data available from an internationally recognized source. The resulting list reflects the indicators that are currently publicly available to measure the performance, goals, and outcomes of an RI system.

Rather than conduct a similar review to identify available indicators related to the context, inputs, drivers, and processes that could be measured against the RI system performance indicators, the ARISE team identified and will rely on recently completed compendiums of indicators related to the different levels of the conceptual framework. For example, health systems indicators can be identified by using the recent review done by Alva, Kleinau, Pomeroy, and Rowan (2009); household- and individual-level indicators can be identified using the *Guide to DHS [Demographic and Health Survey] Statistics* (Rutstein & Rojas, 2006).

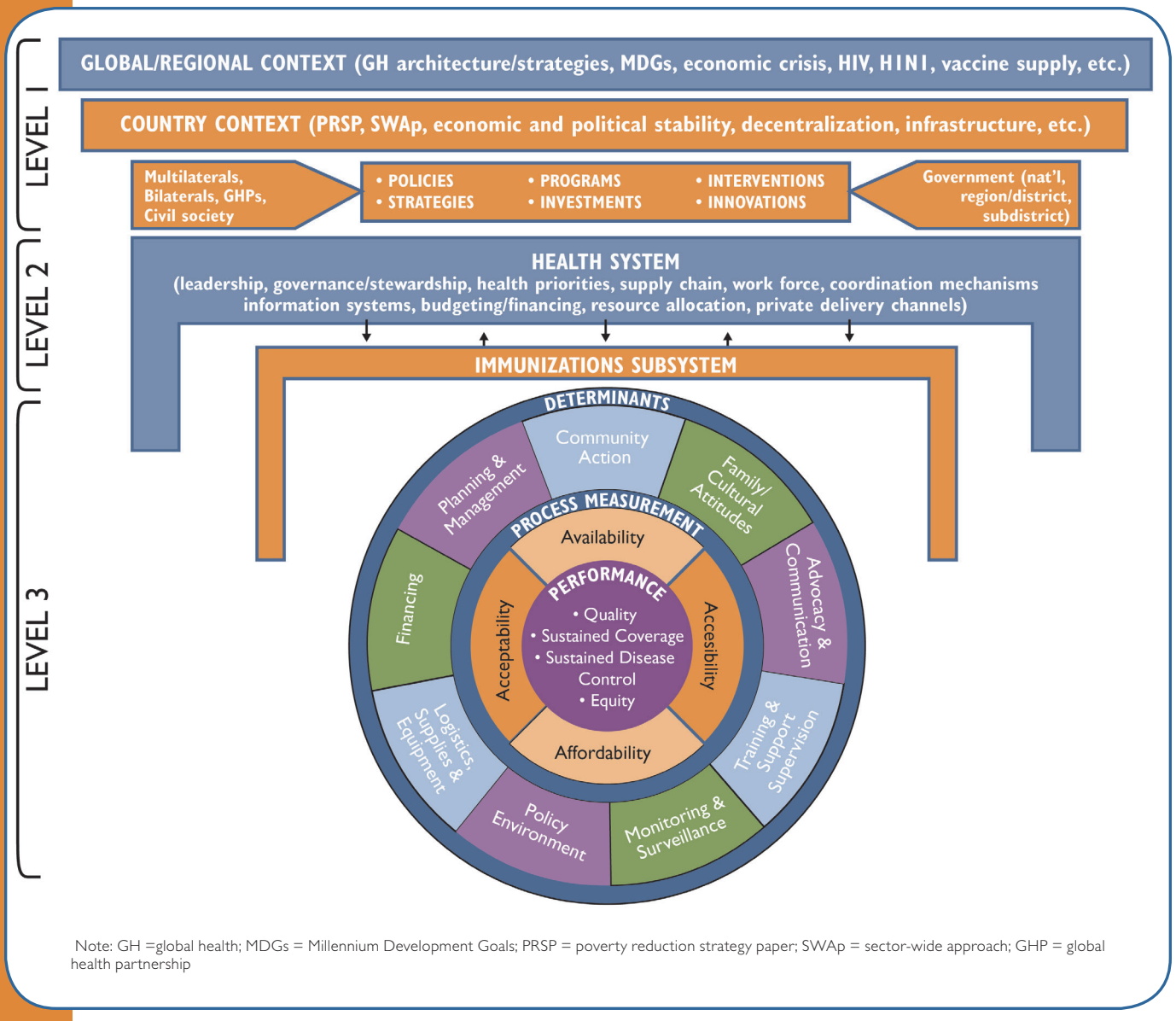
From this compilation, ARISE chose to analyze data related to three indicators from this list that had the most complete data for all sub-Saharan African countries: DTP1, DTP3, and dropout. Researchers also looked at equity data, with equity defined as the difference in DTP3 coverage rates by wealth quintiles. They used a simple ratio (DTP3 in highest wealth quintile compared to DTP3 in lowest wealth quintile) for countries with two or more household surveys from 1996 through 2010. The Demographic and Health Surveys (DHS) or the Multiple Indicator Cluster Survey provided all data, allowing assessment of change over time in equity ratios for 27 sub-Saharan African countries. Data were grouped into two time periods: surveys carried out between 1996–97 and 2003 and those carried out between 2003 and 2008. On average, there were six years between an individual country's two survey data points.

The secondary data assessment was also used to inform the selection of countries for the in-depth studies in the next stage of the project.

5 As per the conceptual framework, RI system performance relates to at least one of these dimensions: quality, sustained coverage, sustained disease control, or equity.

Appendix B

Figure B.1. ARISE Conceptual Framework for Understanding Factors That Influence RI System Performance



Note: GH =global health; MDGs = Millennium Development Goals; PRSP = poverty reduction strategy paper; SWAp = sector-wide approach; GHP = global health partnership

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