

**Better
Immunization
Data Initiative**

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**LITERATURE REVIEW ON IMPROVING DATA
QUALITY & PROMOTING THE USE OF DATA FOR
DECISION MAKING**

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EXECUTIVE SUMMARY

This literature review was conducted to identify, review, and analyze published and grey literature to inform the behavior, organization, and practice activities to be conducted as part of the Better Immunization Data (BID) Initiative, and to inform the Initiative's theory of change and monitoring and evaluation plan.

The overall hypothesis of the BID Initiative is that design and national-scale implementation of a defined technology platform and supporting activities will improve data quality and use to strengthen decision making related to immunization programs. This literature review will be used to expand and ground this hypothesis and guide the development of a theory of change.

METHODOLOGY

The primary questions this review aims to answer ask which interventions have proven effective in influencing the:

- Motivation of health workers to use data
- Availability of quality data in a simple and usable format
- Capacity of health workers to use data in management processes
- Supervision and mentoring of health workers to improve management processes
- Role of peer networks and communities of practices in supporting data for decision making
- Organizational change needed to adopt new strategies

The literature search was implemented in phases. In the **first phase**, we made initial search queries in Pubmed, Psycinfo, Sociological abstracts and EBSCO databases to ensure we reviewed literature from the health sector as well as the social sciences, education, and business sectors. These search queries only included the relevant target population(s), proposed outcomes for the BID Initiative and related Mesh terms. Because the scope of these queries was extremely broad, few relevant articles emerged from the Phase I searches. As a result, reviewers decided to conduct a "call for evidence" among the BID team and noted experts in the field of data for decision making to request guidance and actual evidence that could help refine potential intervention areas for the BID Initiative. Literature collected through this phase yielded more specific topic areas for further focus and identified interventions that were incorporated into the second phase of the search.

In the **second phase**, we conducted focused searches in Medline on the key populations, interventions as illustrated in the literature review questions above, and proposed outcomes. The same exclusion criteria of Phase I were applied in Phase II. Literature collected through the second phase yielded more relevant results than Phase I. We further screened these articles to achieve a final list of review articles. Appendix A provides a summary of databases searched, search terms, and the number of articles retrieved and reviewed by phase. The final review focused on 357 articles, 69 of which are summarized in this literature review.

KEY FINDINGS BY DOMAIN

Health worker motivation

Individual health worker motivation is an important factor in improving health system performance and supporting increased use of data for decision making by staff at the facility level. Levers to increase health worker motivation include both financial and non-financial incentives. Financial incentives include increases in salary or pay-for-performance approaches, while non-financial incentives can vary widely, including career development and continuing education, increased infrastructure and resource availability (transport, commodities, etc.), improved management and supervision, and personal recognition and appreciation. Studies found meeting financial needs to be a prerequisite to motivating health workers with non-financial approaches, particularly where social status and respect were linked to salary. Findings on what package of non-financial incentives were most effective in increasing motivation were inconsistent and varied across countries and regions, as motivation is closely tied to social and cultural factors, but they were demonstrated to be effective in increasing health worker motivation, particularly when partnered with financial incentives.

Data usability and simplicity

Identifying and meeting the information needs of health workers by providing information in simple, consumable formats is essential to promoting the use of information at various levels of the system. Articles reviewed in this domain focused on health information more broadly as clinical support tools and health data, which was a limitation of this review. Literature overwhelmingly emphasized the importance of understanding how data and information will be used by health workers in order to tailor performance improvement and information system interventions and platforms to maximize the use of reference materials at different levels of the health system. Researchers also found that health data is more readily accessible at higher levels of the system, limiting the availability of information to health workers who could use it for planning and delivery of services.

Capacity building

Capacity to use data for decision making is important to ensure that evidence is used in policy making and health practice. For data use capacity to increase, activities should focus not only on the individual level but also on teams, organizations, and networks. Training approaches vary, with skills developed through academic degree programs, in-service trainings and workshops (most common in developing countries), and online/remote training programs. In a review of partnerships to promote capacity building for sustained management development, Rowe et al. (2010), found key factors for the success of trainings included: 1) use of a short-course format focusing on four key skill areas with practical tools; 2) inclusion of didactic training, on-site projects, and on-site mentoring; 3) collaboration with an in-country academic institution, willing and able to scale-up and maintain the training; 4) providing training for the in-country academic faculty; and 5) securing Ministry-level support to ensure participation.

While training programs have demonstrated great success, research on the outcomes from the five-country Public Health Implementation and Training (PHIT) Partnerships found that training alone is insufficient to engage and build capacity for facility and community health workers.

Supportive supervision and mentoring

Capacity building for data management and use entails not only increasing knowledge and skills but also implementing approaches that achieve behavior change. Various activities—such as adult learning, behavior

change, social learning, and quality improvement approaches—have been implemented to improve the use of data and information through routine supervision and cultivating mentoring relationships. Remote and rural health workers in particular may be neglected in routine supervision systems. This might be remedied by mentoring systems that provide remote doctors with periodic engagement and learning from specialists, and programs that could accelerate their learning while improving the quality of care in rural areas. Findings from additional studies have found that interactive educational meetings, audit and feedback, friendly competition, peer feedback mechanisms, routine review, and supportive supervision improve healthcare worker performance. Where supportive supervision visits are limited and cannot be further strengthened due to limited resources, cascade training packages (where some health workers are trained and instructed to train their colleagues) can improve performance and be cost-effective, although they do not match the outcomes of strengthened routine supportive supervision.

Peer networks

Networks are emerging as a new technique to build capacity for technical understanding of research and supporting data use. Peer networks and communities of practice can support improvements in system performance and related factors through peer learning, sharing experiences, and other activities. In a systematic review of collaborative initiatives, quality improvement process measures were reported to be improved across all of the initiatives. Success factors included a) the establishment of trust among health professionals and health institutions; b) the availability of accurate, complete, relevant data; c) clinical leadership; d) institutional commitment; and e) the infrastructure and methodological support for quality management.

Organizational change

Increasing data use and improving performance within a health system require a shift in behavior beyond frontline workers. In order to improve performance, a holistic approach that includes change at the organizational level is needed. John Kotter, a leading voice in change management, suggests that organizational change can be managed using an 8-step approach (Kotter, 2007). The steps in his model fall within three distinct phases: 1) creating a climate for change; 2) engaging and enabling the whole organization; and 3) implementing and sustaining the change. However, change at this level can be difficult and poses formidable challenges for managers as it requires the adoption and implementation of new processes or the adaption of existing processes, which affect activities performed within the organization and personnel at all levels. As the pathways to change emerge, it is critical to produce short-term wins. This can be done by completing tasks that clearly show that the change initiative is succeeding. Later, implementing and sustaining change can be achieved through increasing the credibility of early wins and hiring, promoting, and developing employees who can implement the vision.

Another approach to change management, described Sirkin et al. (2005), focuses less on the “soft factors” (i.e. culture leadership, and motivation) and instead emphasizes the “hard” side of change management. In their initial study of 225 companies, Sirkin found a consistent correlation between successful change implementation and four key variables: duration, integrity, commitment, and effort (the DICE factors). Similar to Kotter, Sirkin found it critical to review the change initiative frequently and schedule milestones to assess performance and impact. This will allow managers to identify gaps, spot new risks, and adjust as needed. Practitioners have also identified tools that assess organizational readiness for change that can be used to identify and monitor organizational strengths and weaknesses to support the implementation of

organizational change. Finally, when embarking on a change initiative, it is essential to understand the resources and time required to ensure activities associated with the initiative do not stretch workers—such as frontline health staff—so far beyond their existing responsibilities that the initiative becomes unsustainable or negatively impacts performance.

CONCLUSIONS & RECOMMENDATIONS

A key outcome of this literature review is to identify potential interventions to address the behavior, organization, and practice dimension of delivering immunization services as part of the BID Initiative. Possible interventions for each domain, based on the findings from the literature, have been listed here. The Initiative's next step will be to identify the BID package interventions, included here and/or through additional experiences, that will need to be prioritized and tested based on relevance and acceptability in the demonstration countries and cost.

Possible interventions and activities of interest for the BID Initiative to **increase health worker motivation** include:

- Long-distance or in-person learning opportunities, such as remote training through mobile applications or web-based platforms where connectivity is reasonable, to increase staff skills and position staff for professional advancement. These were found to be less expensive and as effective as traditional methods in a review of motivation and training approaches (Rowe et al., 2005).
- Decentralize training opportunities for health workers, with training coordination based at the district, rather than national or regional levels, to allow training topics and schedules to be determined by local needs.
- Managerial training at the district level, leveraging existing administrative meetings and training sessions to increase the supervisory skills of district health management committees, coupled with the provision of practical tools for priority setting, resource allocation, and routine supervision (Hirschhorn 2013).
- Implement supervision and routine performance audits with an integrated feedback loop between supervisors and the health workers they support.
- Provide a structured system to reward and recognize high-performing staff.
- Develop structured approaches to engage community members through district health boards or other formal mechanisms to promote communication between health staff and community and increase communication between facilities and the communities they serve.

Possible interventions and activities of interest for the BID Initiative **to improve the usability and simplicity of immunization data** include:

- Improve feedback loops from higher to lower levels of the system to ensure that facility-level health workers have access to data in simple consumable formats (e.g. simple flyers with graphs, charts, and summary statistics by facility) and the appropriate support to improve analytical skills for interpretation.
- Routine measurement of data quality using simple assessments where forms are paper based, and data checks integrated into electronic health information systems where they are in place.

- District-level training on how to conduct routine data quality assessments of EPI data, including strengthening how these checks can be used as part of routine supportive supervision visits.
- Implement a simplified register to reduce data volume and make reporting more manageable at the facility level, and develop and implement of a District Health Planning and Reporting Toolkit with the district health management team.
- Develop and distribute a quarterly report card (from the region to the district and the district to its facilities), to include a data dashboard to provide longitudinal comparisons of key PHC indicators across facilities and districts.

Possible interventions and activities of interest for the BID Initiative **to build the capacity of staff across the health system** to produce quality data and use data for decision making include:

- Structured hands-on training on reporting, data quality, and the use of data as part of program planning that allows skills building with minimum work disruptions while encouraging greater involvement of other institutional staff to enhance continuity and sustainability.
- Using scenario-based approaches to give examples of immunization reporting forms for facility and district staff to review for quality (accuracy, completeness, and timeliness) and then use the information gathered to identify which program changes or activities should be planned. These small-scenario work groups should be embedded in existing meetings to avoid overburdening health workers.
- Continued rollout of mid-level manager (MLM) training in the districts, with specific and targeted follow up activities to ensure skills learned are transferred to facility-level health workers. This could also be achieved through a peer learning or mentoring approach in which MLM learning is rolled down to specific facilities that then share the learning with other facilities in their area.
- Hosting and facilitating routine data review meetings to support the routine review of information, the feedback of data from the district to the facility levels, and the increase of data ownership among facility staff. Specific activities to be conducted at such review meetings might include identifying priority areas for planning and resource allocation; trend analysis to identify priority problems and monitor implementation of solutions; and identification of service gaps (e.g. defaulter and left out tracing).
- Include cross-site learning opportunities across sites and districts, to allow health workers and district health management staff to learn from high performing locations who have overcome similar challenges and constraints.
- Ensuring stakeholder consultation and buy-in to support the ongoing capacitation of staff, particularly at the national level where multiple stakeholders may be working with the same Ministry or regional staff members. Stakeholder consultation can also help identify and cultivate champions for improved capacity building at the lower levels.

Possible interventions and activities of interest for the BID Initiative **to improve supportive supervision and build mentoring relationships** to support the production of quality data and data use for decision making include:

- Training packages to support knowledge and capacity to perform supportive supervision at the district level, including training not only on supervision content, but how to conduct supervision with a mentoring (rather than punitive) approach.
- Measure data quality as part of routine work and monitoring and evaluation rather than as separate data collection efforts, and embed routine data quality checks into supportive supervision visits from the district to the facility level.
- Provide a structure for regular review of program and health worker performance, including regular reviews of data and promoting open discussion of performance targets and achievements, which could be conducted through regular review meetings, supervision, coaching, and on-the-job training.
- Provide an improved model for closing the feedback loop between supervisors and health facility staff by developing and ensuring the use of simple supervision checklists and action items as a leave-behind, or automating the supervision feedback loop through technology.

Possible interventions and activities of interest for the BID Initiative **to leverage the power of peer networks** include:

- Develop a virtual QI network at the district and regional levels (where connectivity is relatively reliable) to support the implementation of best practices and to exchange strategies for improvement.
- Develop immunization provider and manager networks at the district and regional level to support the exchange of information through meetings, an electronic platform, or other mechanisms, as collaboratives have been demonstrated as a way to close the know-do gap.

Finally, there are a number of ways the tools and approaches developed **to create organizational change** could be adapted and applied within the BID Initiative. These might include:

- Adapt and use organizational readiness tools at national and district level to assess the capacity for change and to inform the change management plan.
- Management training focused on creating and communicating a vision for change, mobilizing and building a team with the appropriate skill set, motivating workers, setting up milestones, and engaging in positive feedback.
- Create a forum (or group) that includes influential leaders at all levels of the national immunization system (in-country BID network), stakeholders, mid-level managers, and influential front line workers (large group). This approach can be applied to the regional level- creating an advisory group for the implementation.
- Invest in a “change campaign” that communicates the change vision broadly and frequently.
- Create a tool to monitor the progress of change throughout the life of the change initiative, and design built-in learning milestones where management can reflect upon progress, deliver feedback to staff, and adjust the change initiative based on these reflections.

I. INTRODUCTION

BACKGROUND

Routine immunizations and new vaccine introductions in Africa have proven to be among the best investments to improve people's health. Over the last ten years, increased attention and investment in immunization have reduced mortality rates, particularly among children under five years of age. However, despite this progress in routine immunization coverage of basic vaccines (WHO, 2012) and the introduction of new vaccines to address key diseases (e.g., pneumonia, rotavirus), African immunization rates remain in the mid-70th percentile (UNICEF, 2012).

Global stakeholders and national governments openly acknowledge that routine immunization and new vaccine introductions still face strong challenges related to collecting and using quality data for planning, management, and performance improvement, yet few can identify which barriers matter most, or the scope of the problem within a particular country. Specifically, management information systems and a culture of evidence-based decision-making that would help identify operational issues and provide actionable information to better inform immunization programs are in the early stages of development.

Because of this, performance monitoring using routine data is often flawed and many national EPI managers and global policymakers struggle to understand how to effectively target limited resources to reach health goals. In the absence of easy-to-access and actionable data on performance gaps as well as understanding of the drivers of immunization coverage, stakeholders must rely on limited and often anecdotal data that do not reflect actual problems or performance. Additionally, shortcomings in immunization-focused information systems may translate into other programs and functions within the health system as those basic data are needed to populate integrated electronic immunization information systems (EIS).

DESCRIPTION OF BID INITIATIVE

Over the last year, the Bill & Melinda Gates Foundation (BMGF) and PATH have worked together to develop a concept that would support the scaling of a suite of country-selected improvements to immunization information systems (IIS) with an equal emphasis on empowering users of those information systems to improve data capture, data use, and data quality for operational improvements in expanded programs on immunization (EPI).

Specifically, the Better Immunization Data (BID) Initiative is a bold effort to augment and link the many disparate technology solutions in the immunization and global health arena to enable a "best-in-class," enterprise-wide management information system (MIS) designed to extract operational data most useful to immunization managers at multiple levels of the health system and channel these data to improved immunization program performance. Its aspirational aim is to help achieve sustained increases in immunization coverage, and program efficiency and equity through support for country-owned, country-led policies, practices, and information system tools that enable evidence-based decision making.

The overall hypothesis of the BID Initiative is that design and national-scale implementation of a defined technology platform and supporting activities ("BID in a box") will improve data quality and use to strengthen

decision making related to immunization programs. This literature review will be used to expand and ground this hypothesis and guide the development of a theory of change and a program strategy.

LITERATURE REVIEW OBJECTIVES

The purpose of this review is to summarize findings from the literature on the effectiveness of behavior and organizational approaches that are considered to be well-suited to the Better Immunization Data (BID) Initiative. Although the BID Initiative represents the melding of technology and health system strengthening strategies for improving immunization data quality and the use of information for performance improvement, this literature review focuses mainly on the system strengthening aspects of the work. The BID team will draw on other reviews and analyses of technology-based solutions and combine them with this review to inform overall strategies for the Initiative.

The literature review helps the BID Initiative:

1. Understand and think about our interventions.

Conducting a literature review gives projects a thorough understanding of their topics. It helps program managers understand what has been done before and what has and hasn't worked. Because there are limited resources in-country and from the BID Initiative, a literature review also grounds the Initiative in evidence so that potential future innovations advance learning and avoid duplication of strategies that have failed.

2. Plan an approach that will lead to our overall goal.

The existing literature supports the project by providing an empirical base for the project theory of change. The literature can help program managers define and refine the hypothesis or performance improvement pathways that inform the choice of interventions, and clarifies the causal links between different components of the proposed pathway. It ensures that the theory of change is comprehensive and addresses all the factors that have been identified as contributing to the proposed outcomes.

3. Position our evaluation so that we can publish results.

By understanding how a project fills a gap in the existing knowledge base, we are better able to identify what issues require further investigation or are likely to address program goals. Therefore, the literature review helps us develop our project research questions and ensures that we can publish the results.

LITERATURE REVIEW QUESTIONS

The main questions that this review seeks to answer are:

- Which interventions have proven to positively influenced the:
 - Motivation of health workers to use data
 - Availability of quality data in a simple and usable format
 - Capacity of health workers to use data in management processes

- Supervision and mentoring of health workers to improve management processes
- Role of peer networks and communities of practices in supporting data for decision making
- Organizational change needed to adopt new strategies

II. METHODS

SEARCH STRATEGY

Phase I: The literature search was implemented in phases. In the first, we made initial search queries in Pubmed, Psycinfo, Sociological abstracts, and EBSCO databases to ensure we reviewed literature from the health sector as well as those of social sciences, education, and business. In addition to selecting articles for screening using the search terms, we applied the following set of inclusion and exclusion criteria to refine the document search process.

Inclusion Criteria:

1. Document is in English (documents translated into English will be included)
2. Documents from both developed and developing countries
3. Document was published on or after January 1, 2000
 - a. Document is from a peer-reviewed/scholarly journal¹
 - b. Grey literature is identified through a call for evidence among subject matter experts
4. Document focuses primarily on a **strategy or approach** used to address
 - a. Motivation of health workers to use data
 - b. Availability of quality data in a simple and usable format
 - c. Capacity of health workers to use data in management processes
 - d. Supervision and mentoring of health workers to improve management processes
 - e. Role of peer networks and communities of practices in supporting data for decision making
 - f. Organizational change needed to adopt new strategies

Exclusion Criteria:

Document is in one of the following formats:

1. Letter to the editor
2. Obituary
3. Commentary/recommendation
4. Book review

¹ Scholarly Journal: Scholarly journal articles often have an abstract, a descriptive summary of the article contents, before the main text of the article. Scholarly journals always cite their sources in the form of footnotes or bibliographies. These bibliographies are generally lengthy and cite other scholarly writings. Articles are written by a scholar in the field or by someone who has done research in the field. The affiliations of the authors are listed, usually at the bottom of the first page or at the end of the article and include universities, research institutions, think tanks, and the like. The main purpose of a scholarly journal is to report on original research or experimentation in order to make such information available to the rest of the scholarly world. See: <http://olinuris.library.cornell.edu/ref/research/skill20.html>

5. Job posting
6. Historical account

These search queries only included the relevant target population(s), proposed outcomes for the BID Initiative and related Mesh terms. Because the scope of these queries was extremely broad, few relevant articles emerged from the Phase I searches.

As a result, reviewers decided to conduct a “call for evidence” among the BID team and noted experts in the field of data for decision making to request guidance and actual evidence that could help refine potential intervention areas for the BID Initiative. Literature collected through this phase yielded more specific topic areas for further focus and identified interventions that were incorporated into the second phase of the search.

Phase II: In the second phase, we conducted focused searches in Medline on the key populations, interventions as illustrated in the literature review questions above and proposed outcomes. The same exclusion criteria as Phase I were applied to Phase II. Literature collected in the second phase yielded more relevant results than Phase I. We further screened these articles to achieve a final list of review articles. Appendix A provides a summary of databases searched, search terms, and the number of articles retrieved and reviewed by phase. Citations were entered into Zotero reference management software.

There was no systematic assessment of the strength of the study methodologies applied to the papers identified during the review. From the Phase II articles screened, a total of 1,223 articles were selected for further review. The final review focused on 357 articles, 69 of which are summarized in this literature review. The articles with the greatest relevance to BID were included in the final literature review paper for the sake of brevity, including select articles recommended in the initial call for evidence. All articles identified as relevant are available in the shared Zotero library.²

REVIEW STRATEGY

To facilitate document review in Phase II, the documents were sorted into categories based on the focus of the intervention. Document categorization included individual health worker motivation, data usability, capacity building, supervision/mentoring, peer networks, and organizational change. Reviewers populated a matrix related to their category that systematically captures specific details from each article including the citation, objectives, findings, key words, and notes. Each reviewer summarized their matrix for contribution into the literature review.

LIMITATIONS

The limitations of the literature review included the challenge of finding the appropriate search terms to capture relevant activities across technical fields (health, literature, social science, etc.) due to the extreme number of articles returned when running broad, inclusive searches. More relevant targeted literature was identified through health-targeted searches and the call for evidence. In addition, due to the volume of

² BID team members and Gates Foundation staff can request access to the BID Zotero library by contacting Amanda Makulec at amakulec@jsi.com.

articles returned from the various searches, the review was not conducted using a traditional systematic approach engaging multiple reviewers for every article. As a result, there may be some bias in selecting what is perceived as relevant to BID based on existing knowledge of the reviewer.

III. SUMMARY OF RESULTS

The findings from the literature review are summarized by the following intervention domains:

- **Health worker motivation** – approaches to increasing individual health worker motivation, which has been demonstrated to be an important factor in improving health system performance and supporting increased use of data for decision making by staff
- **Data usability and simplicity** – how to identify and meet information needs of health workers through providing information in simple, consumable formats
- **Capacity building** – proven approaches to support skill development, linkages and partnerships, invest in infrastructure, dissemination of learning, and building sustainability
- **Supportive supervision and mentoring** – approaches to improving the use of data and information through application of specific approaches to routine supervision and cultivating mentoring relationships through adult learning, behavior change, social learning, and quality improvements
- **Peer networks** – how peer networks and communities of practice can support improvements in system performance and related factors through peer learning, experience sharing, and other activities
- **Organizational change** – organization-level approaches to behavior change, specifically in the use of information for decision making

By summarizing literature through these categories, including background on each domain and relevant interventions applied and/or studied through past activities, we have identified a number of potential intervention areas to explore as part of the development of the BID approach. Notably, many of these intervention domains are closely linked, as illustrated in some of the examples provided from the literature. For example, decentralized training and supervision activities could be partnered with a new dashboard platform and related training activities to empower health workers to perceive data as more accessible, use it routinely, and, in turn, increase feelings of motivation and job satisfaction. As such, some activities are highlighted in more than one section.

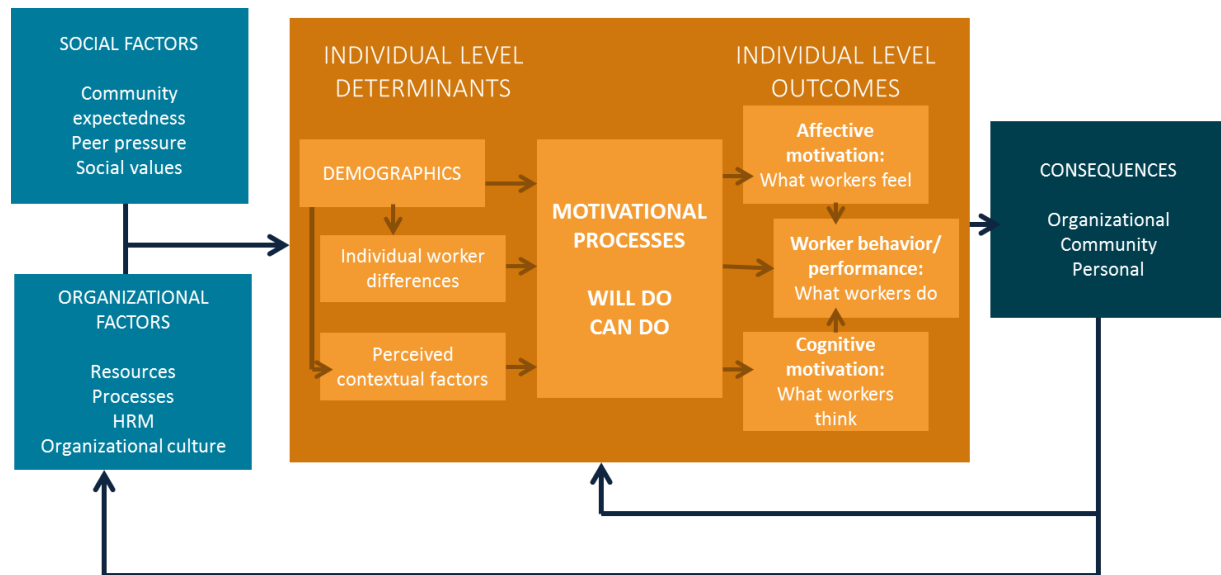
a. MOTIVATION

According to Franco, Bennett, and Kanfer (2002), motivation is an individual's degree of willingness to exert and maintain effort toward organizational goals. Alignment of individual health worker goals with the goals of the employing organization is at the core of motivation, making health sector performance critically dependent on health worker motivation. When aiming to increase the demand for and use of data, understanding and applying approaches to increase individual motivation to use information as part of their routine activities are essential to program success.

When looking at factors that motivate health workers, country experience differs across the domains of culture, organization, and broader health reform environment. As a result, reviews of research on health worker motivation have found common themes but also highlighted how interventions must be tailored to local context. Globally, determinants of health worker motivation typically fall into categories across two typologies: “will do” and “can do” components; and individual, organizational, and community factors (Franco et al., 2002). Organizational culture in particular often varies considerably across units (e.g. districts, health facilities) and it is common to find performance of one particular health care unit with considerably higher staff motivation and performance outcomes than another unit with similar structures and levels of resources (Franco et al., 2002).

The framework below (see Figure 1, highlights the interrelated factors impacting health worker motivation and was validated through the Franco, Bennett, Kanfer, & Stubblebine (2004) study aimed at identifying the determinants of health worker motivation that should be considered in the process of implementing broad health sector reforms in Georgia and Jordan. Findings from their analysis of determinants found that improving health worker motivation requires addressing multiple determinants and acting at both operational and policy reform level to be effective. While the methodology used was not designed to generate findings statistically generalizable beyond the countries of study, the results were definitive in the need for multi-faceted and integrated approaches to addressing health worker motivation.

Figure 1: Determinants of health worker motivation (Franco et al., 2004)



Adapted from Franco et al., 2004

Health Worker Motivation Intervention Domains

Health workers typically work within a dynamic and challenging environment. They face continuously changing conditions and are required to adapt individual practices to satisfy both personal and professional goals. This work environment creates complexity in identifying the appropriate mix of interventions to improve health worker motivation (Rowe, de Savigny, Lanata, & Victora, 2005). A systematic review

conducted by Willis-Shattuck et al. (2008) examined the factors that motivate health workers in developing countries. Following a review of 3,412 references, the authors identified the following themes from the twenty articles that met all inclusion criteria. These themes relate to potential intervention domains to improve health worker motivation:

- **Financial:** Eighteen of the twenty articles discussed the importance of financial incentives (e.g. increased salary) in motivating health workers. Low salaries made health workers feel that their skills were not valued, and therefore de-motivated them. As a result, health workers often took up a second job to supplement their low wages and ended up being overworked.
- **Career development and continuing education:** Health workers felt motivated when there were opportunities for them to progress professionally. Education and training opportunities were particularly important for young health professionals to enable them to have the skills to take on more demanding duties and to cope better with their job requirements. They also enabled health workers to achieve personal goals for professional advancement.
- **Hospital infrastructure and resource availability:** Lack of materials and poor infrastructure were important de-motivators for health workers, who felt discouraged and unable to do their jobs and utilize their knowledge to the fullest when they did not have basic drugs, equipment, or proper infrastructure. The review article concludes that patient care cannot be effective without the proper resources, and working within a resource-constrained environment can be demotivating for health workers.
- **Hospital management and supervision:** The presence of adequate skills among supervisors, managers, and leaders motivated health workers. Skilled and effective managers have the ability to motivate their staff by lobbying on their behalf. High quality leadership permeates every sphere of organizational management. Health workers are motivated and tend to stay with the post when they are managed by leaders with the following qualities/skills: listening to staff, lobbying on their staff's behalf, increasing staff participation in decisions, encouraging innovation, and fair opportunities for promotion and career advancement.
- **Personal recognition and appreciation:** Health workers felt motivated when they achieved results from their work, were useful to society, and took care of people. For some, feeling valued and supported was more motivating than having proper infrastructure and adequate equipment. It was also stated that to be trusted by the community was a crucial component for health worker motivation. Social embeddedness in their community and peer network, promoting strong patient-provider relationships, affects both motivation to provide good service and health workers desire to be appreciated by their clients (Franco et al., 2002).

Literature on health worker motivation across various countries points to the importance of having financial (salary) needs met before or as part of any package of non-financial interventions to increase health worker motivation. In Tanzania, a mixed-methods study of motivation in non-physician clinicians in the Kilimanjaro and Tanga regions found meeting financial needs was a clear prerequisite for motivation, and non-salary motivators will only have an effect where salary requirements are satisfied. Social status was a key factor underlying both financial and non-financial incentives, as a good salary could accrue respect from both colleagues and community members, conferring status on the health worker. As a result, the researchers recommended the establishment of clinical officers as a professional body to improve perceived status in

their own eyes and the views of colleagues, managers, and clients (Chandler, Chonya, Mtei, Reyburn, & Whitty, 2009).

A review of incentives for retaining and motivating health workers in Pacific and Asian countries also found salaries and benefits together with non-financial factors (working conditions, supervision, management, and education and training opportunities) could improve health worker motivation, but packaging financial and non-financial incentives together was important (Henderson & Tulloch, 2008). Additional findings from a study of determinants and consequences of health worker motivation in hospitals in Jordan and Georgia illustrated the distinction between expressed and actual needs of health workers, where clinicians expressed a need for increased salary but data suggested a number of non-financial interventions may be more effective for improving health worker motivation. Limiting interventions to financial incentives increased the possibility that incentives would have a distorted effect on organizational performance though, and an integrated package was preferred. Other non-financial activities could include job enrichment (more responsibility), job enlargement (to integrate tasks and decrease monotony), and job rotation (to increase skills and work flexibility through “cross training”) (Franco et al., 2004).

Professional advancement opportunities are also a key motivator for health workers. Participants in a qualitative study of health worker motivation in Ghana, including practicing doctors and medical leaders, felt that rural postings must have special career incentives given the professional isolation of remote assignments (Snow et al., 2011). Medical professionals in remote facilities described their workload as “professional imprisonment,” because of the slow career progression. Their hard work did not translate into any recognition from influential positions, and the volume of work made it difficult for them to attend meetings, to network, to study, or to pursue new opportunities. Doctors expressed the importance of a learning environment to acquire new information and skills.

Ruano, Hernández, Dahlblom, Hurtig, and San Sebastián (2012) explored how the values and personal motivation of community health workers influence their experience with the primary health care strategy in Guatemala. An ethnographic approach was used and data were collected using participant observation and in-depth interviews. The study found that some CHWs who were committed to learning and leadership channeled these values into health by the desire to become a health professional. CHWs are motivated to do primary care work through positive encounters with a doctor or a nurse that made them feel special and allowed them to start working with health at the community level. CHWs have a sense of purpose and motivation to continue their work when they are able to share their time and expertise to help others. As they work with their communities, they develop a sense of commitment and responsibility to deal with the negative aspects of the work, especially when the workload gets too heavy and tiring. Lack of support from official community committees or from stakeholders in the municipality can also make the work overwhelming, but to deal with the lack of support, some CHWs see their profession more as a responsibility than a job to keep doing the work. CHWs are motivated in their work, but there is a lack of infrastructure and growth opportunities. Facility leaders suggested long distance learning as a possible way to meet this interest among the staff; however, doctors emphasized that they do not have time to spare for professional development credits due to their workload.

Ambitious programs to promote health sector-level reform to improve individual motivation have been deployed with varying levels of success; experience has shown that the manner in which the reform is

designed as well as how it is communicated and introduced, are essential to its success and acceptance. In Zambia, for example, health sector reform included decentralized training in planning and management, the creation of District Health Boards of community members, the introduction of user fees, and attention to supervision issues. While these reforms all presented great potential to increase motivation, the communication of these reforms was described as “too little, too late,” undermining their immediate effectiveness and generating initial resistance from health workers (Franco et al., 2002).

Motivation and Performance Improvement

Health sector performance is highly dependent on the motivation of the health worker due to the labor-intensive nature of health service delivery. In addition to affecting service efficiency and equity, health workers’ willingness to apply themselves to their duties and tasks also impacts the quality of health services. Quality health services are defined as effective, safe, centered on the patients’ needs and given in a timely fashion (Hirschhorn et al., 2013). Resource availability and health worker competency are not sufficient in themselves to ensure the desired level of worker performance; a worker’s performance is greatly dependent on their motivation, inspiring them to come to work regularly, work diligently, be flexible, and willing to carry out their duties (Hornby & Sidney, 1988).

The domain of human resource management recommends various tools to facilitate both “can do” and “will do” components of motivation including: clear roles and responsibilities through providing well-defined job definition and descriptions, incentive packages (e.g. bonuses, promotions, training opportunities), recruitment to ensure the fit between job requirements and employee skills, staff development opportunities, and supervision and performance assessment to provide routine feedback to health workers (Hirschhorn et al., 2013).

Rowe et al. (2005) conducted a review to identify which interventions were most effective or cost-effective for maintaining high-quality performance of health workers in low resource settings, and in what situations a particular intervention be used. While there were limitations in the findings across the 11 existing literature reviews (including 5 systematic reviews) included in the analysis, they revealed some consistent themes. First, dissemination of written guidelines without additional interventions was generally ineffective. Second, supervision and routine performance audits with an integrated feedback loop were generally quite effective for improving motivation. Third, non-traditional training methods such as computer-based training might be less expensive than and as effective as traditional methods. Rowe et al. (2005) recommend additional high-quality studies be conducted to assess the various approaches to improving health worker motivation using metrics like long-term effectiveness (e.g. over 5 years), cost, minimum infrastructure requirements, determinants addressed by each approach, and which approaches are most effective for achieving versus maintaining high-quality performance.

Reviewers also found system-level interventions such as low-cost strengthening of decentralized district health management teams and supervisors can quickly improve the performance of a much larger number of frontline health workers, which has the potential for scale (Rowe et al., 2005). In the more recent Population Health Implementation and Training (PHIT) Partnerships across five countries, examples of decentralized training approaches and their impact demonstrated success. In Tanzania, for example, managerial strengthening was conducted through locally available training in administration and management, team

building, delegation, and community negotiation, coupled with provision of practical managerial tools for priority setting, resource allocation, and routine supervision (Hirschhorn et al., 2013; Mutale et al., 2013).

Based on the findings from the literature, possible interventions and activities of interest for the BID Initiative to **increase health worker motivation** include:

- Long-distance or in-person learning opportunities, such as remote training through mobile applications or web-based platforms where connectivity is reasonable, to increase staff skills and position staff for professional advancement. These were found to be less expensive and as effective as traditional methods in a review of motivation and training approaches (Rowe et al., 2005).
- Decentralize training opportunities for health workers, with training coordination based at the district, rather than national or regional levels, to allow training topics and schedules to be determined by local needs.
- Managerial training at the district level, leveraging existing administrative meetings and training sessions to increase the supervisory skills of district health management committees, coupled with the provision of practical tools for priority setting, resource allocation, and routine supervision (Hirschhorn 2013).
- Implement supervision and routine performance audits with an integrated feedback loop between supervisors and the health workers they support.
- Provide a structured system to reward and recognize high-performing staff.
- Develop structured approaches to engage community members through district health boards or other formal mechanisms to promote communication between health staff and community and increase communication between facilities and the communities they serve.

b. DATA USABILITY AND SIMPLICITY

Based on the searches conducted as part of the review, the term health information was taken broadly to include both tools for clinical decision support and information (data) being used by the health worker him/herself. The findings that follow are focused on using available information rather than on ways to simplify the forms and materials used to collect and aggregate information. Looking through the lens of the BID Initiative, we can also consider that decisions that workers make while delivering immunization services that are akin to clinical practice—such as determining the eligibility of the child for immunization by age/dose interval/health status (no contraindications); reviewing health records; providing information and counseling; motivating clients to comply with follow-up steps; and investigating of adverse reactions—while not treatment provision per se, may require similar decisions and data. Additional examples of how forms and reporting have been simplified are included in the landscape analysis.

Understanding Information Needs

Ensured access to and facilitated use of health information in health workers' daily routines can be a powerful way to improve curative and preventive care. In contrast, lack of access to information and services can result in feelings of isolation for health providers and create obstacles to diagnosis or provision of appropriate care, particularly in specialized cases (Mechael et al., 2010; D'Adamo, Fabric, & Ohkubo, 2012). Meeting the information needs of health workers requires understanding of those needs, the way in which health workers prefer to access and actually use the information, and cultivating a culture of information use.

Literature overwhelmingly emphasized the importance of understanding how data and information will be used by health workers before embarking on any activities about health worker use of information in their daily work. Understanding the needs of health workers allows one to tailor performance improvement and information system interventions and platforms to the needs of health workers in various contexts. By tailoring information system interventions to fit how data is routine (or could be routinely) used by health workers, there is great potential to maximize the use of information for decision making at different levels of the health system.

Information Use among Health Workers

Increasing access to information alone will not solve many of the challenges health workers face. “The major gap to overcome related to knowledge and information management is not about information access, but information use.” The culture of knowledge sharing among health workers is typically weak, despite the depth of knowledge health workers have from their curative care experiences. Organizations must cultivate this culture of knowledge in order to support the diffusion of information. Barriers, including delays in receiving information at the community and facility levels and limited in-service training, must also be addressed (D’Adamo et al., 2012).

Pakenham-Walsh & Bukachi's (2009) literature review of information needs of health care workers in developing countries identified a total of 1,762 papers through a Medline search, with 35 studies identified as highly relevant. Overall findings suggest a gross lack of knowledge of basic clinical care for diagnosis and management of common diseases, as well as practices associated with poor quality of care. When health information is available, though, it “provides confidence in clinical decision making, improves practical skills and attitude to care, and alleviates professional isolation.”

Consideration of individual needs and tailoring materials to local context is essential to promote the use of health information. Assessing the information needs of health workers is best accomplished through a mixed-methods approach (i.e., using both qualitative and quantitative approaches), and it should be noted that “expressed needs” are not the same as actual needs and may be limited by the paradigm within which the health worker has been operating. Successfully sharing information in a format facilitating use by health workers requires improving the usability of materials and training health workers on the use of the information. As the number of relevant papers was small, generalizability of these findings and recommendations may be limited (Pakenham-Walsh & Bukachi, 2009).

A later article by Pakenham-Walsh (2012) explores approaches to meeting information needs in additional depth. While sharing information with health workers regarding appropriate practices in clinical care in counseling typically follows a linear research-to-practice pathway, Pakenham-Walsh (2012) argues for systems thinking that considers not only the dissemination of new information through a top-down approach, but the identification of health worker needs at the point of care and development of reliable, appropriate tools to promote the use of that information among health workers. Identifying the health worker’s actual needs (rather than perceived needs) requires objective knowledge testing or observation of health care in practice, rather than relying solely on in-depth interviews and focus groups (Pakenham-Walsh, 2012).

As one country-specific example, Kapadia-Kundu et al. (2012) conducted a health information needs assessment in Uttar Pradesh, including 46 key informant interviews and nine focus groups. Overall findings suggest information is more accessible at central levels of the health system, often excluding access to information for frontline workers. Across levels of the system, health information is used for different purposes (i.e. in policy setting at the national level and to motivate behavior change or increase referrals at the frontline level). The quality of the information being provided to health workers needs to be assessed and improved related to domains such as reliability, relevance, and usability, in order to overcome barriers to the effective use of information in practice. At the frontline, information is often transmitted orally through supervisory lines or groups. Across levels, usability (defined as the need for actionable information) was an essential consideration in making information accessible to health workers, and can be measured along dimensions of language, timeliness, simplification, amount of information, and access to information. In creating any information-sharing platform, these domains should be considered in order to tailor the platform to needs at a specific level (Kapadia-Kundu, Sullivan, Safi, Trivedi, & Velu, 2012).

Another assessment of health information needs was conducted in Senegal by Sylla, Robinson, Raney, and Seck (2012). The researchers collected qualitative data from 75 key informants and two focus groups, with the goal of understanding information needs for providing family planning services. Frontline health workers routinely cite poor availability of current, context-specific health information to support patient care as a major challenge. Respondents in the study specifically identified the need for information and tools to motivate men's involvement in reproductive health and to address religious and cultural barriers to family planning. Mobile tools, if designed appropriately, were identified as one scalable platform for information sharing. Researchers also identified a persistent need for paper-based information and knowledge exchange through interpersonal communication. Numerous respondents indicated that "networks play a crucial role in knowledge exchange, including that of sharing information between groups and individuals that otherwise might not collaborate, such as public and private sector providers." Hierarchy and social organization play a crucial role in the flow of information and should be considered in any network structure. Additional details on the role of networks among health workers are discussed in a subsequent section.

Meeting Information Needs to Facilitate Improved Data Quality and Use

Literature suggests that health information and robust dissemination channels are essential to support high-quality care. In addition, numerous projects have addressed the challenge of data quality and how data are used to support improved health service performance. Research on how information is applied in health workers' daily workflows in developing countries is limited.

Across the five countries targeted through the PHIT Partnerships (see "Motivation"), ensuring data quality was the most common approach to strengthening health information systems. Among the country interventions PHIT used various approaches for health information system strengthening and metrics to gauge the effect of these actions. Activities included routine measurement using data quality audits; data checks integrated into electronic health information systems; analysis of HMIS gaps at facility and district levels; routine reviews by supervisors; focus on concordance with primary sources; and completeness and correctness. Additional capacity-building activities to support data quality and the use of data for decision

making included building skills to improve the functionality of HMIS, training on performing routine data quality assessments, and instruction and coaching on how to understand and use results from the assessments.

Specific interventions by country include:

- **Ghana:** Implementation of a simplified register to reduce data volume and make it more manageable, development and implementation of a District Health Planning and Reporting Toolkit, use of simplified logistic monitoring tools to strengthen capacity to monitor supply readiness, and management training to ensure the utilization of the District Health Planning and Reporting Toolkit and other data for decisions and resource allocation.
- **Mozambique:** Development of appropriate tools (quarterly report card, data dashboard to provide longitudinal comparisons of key PHC indicators across facilities and districts) to facilitate decision making for provincial and district managers.
- **Rwanda:** Partnering with the MOH to perform routine DQAs with ongoing follow-up to address and improve data quality, and support to district, facility, and community health staff to use data through training, report development, and decision aids (e.g. dashboards).
- **Tanzania:** Launch of information and monitoring operation and implementation of logistics support systems.
- **Zambia:** Implementation of a performance feedback loop based on information from clinical management tools to support clinician and health center mentoring and supervision and identify health system gaps contributing to lower performance.

Integrated and robust feedback loops across levels of the health system are essential to ensure trainings and activities address real needs in the five countries. In Tanzania for example, in-service trainings are designed and implemented to address specific gaps identified through review of monthly reports submitted by community health agents. In Rwanda and Mozambique, trainings are conducted to develop analytic, interpretation, and communication skills for program managers, health center directors, and data managers; capacity building in these domains is reinforced through routine meetings. Strengthening data utilization requires these feedback loops. In Ghana, team leaders in regions, districts, and sub-districts are responsible for monitoring and evaluation supported in data interpretation, systems analysis, and development of an action plan (Hirschhorn et al., 2013; Mutale et al., 2013).

Data Analysis and Visualization

More studies have been conducted on the use of data analysis or visualization tools in developed countries, where meaningful use of data has emerged as a central tenet of national health systems and policies, such as the United States' Affordable Care Act. Key findings from those studies, while focused on developed-country contexts, have also been summarized here to inform the BID approach to designing appropriate tools.

Literature on business intelligence (BI) tools illustrates an approach to managing the flow of multiple information streams through a dedicated dashboard or other device. Business intelligence refers to the technology platform and tools used to gather, provide access to, and analyze data about organization operations and activities. Viable BI tools should include scorecards, dashboards, custom reporting, and services to transform data into indicators of interest to inform individual and organizational decisions (Baim,

2012). Successful use of BI tools requires obtaining buy-in from facility and higher level staff; defining data standards; eliminating some current reporting approaches; establishing BI governance; and improving data quality (Glaser & Stone, 2008). Ensuring the quality of data coming into the system is paramount as information coming out of the systems for decision making is only as good as the data put in. Determining the appropriate data ownership structures and process for eliminating bad data input are key steps to ensure valid data and integration in a BI system (Rohloff, 2011).

Installing any information system or BI tool requires understanding the common gap between information technology experts and health staff, which can create slow uptake of the use of BI tools. User acceptability and usability of the systems is arguably the most important consideration. Issues to consider include the time to reach the data entry point, speed of information retrieval, quality of information, and complexity of security factors. A system not accepted by the user is often a system with poor data quality or no data at all due to the lack of buy-in from those responsible for entering the data (Berler, Pavlopoulos, & Koutsouris, 2005).

Lately due to the growth of information and communication technologies, health information is more accessible particularly through the internet and mobile phones, including in developing countries where point-of-care data collection tools have been increasing in reach. Sullivan, Harlan, Pakenham-Walsh, & Ouma (2012) reported that this increased access to information also has its challenges, such as greater demand of time and of critical appraisal skills to sift through the abundance of information. The authors explained that health information and materials need to be tailored to the varying needs and preferences of health care professionals across health systems to ensure information access and knowledge sharing. There is a persistent need for a variety of information types, such as research synthesis to job aids and case studies. A strong knowledge management system that can facilitate the flow, exchange, and use of these variables types of information can improve the health system in general.

Possible interventions and activities of interest for the BID Initiative **to improve the usability and simplicity of immunization data** include:

- Improve feedback loops from higher to lower levels of the system to ensure that facility-level health workers have access to data in simple consumable formats (e.g. simple flyers with graphs, charts, and summary statistics by facility) and the appropriate support to improve analytical skills for interpretation.
- Routine measurement of data quality using simple assessments where forms are paper based, and data checks integrated into electronic health information systems where they are in place.
- District-level training on how to conduct routine data quality assessments of EPI data, including strengthening how these checks can be used as part of routine supportive supervision visits.
- Implement a simplified register to reduce data volume and make reporting more manageable at the facility level, and develop and implement of a District Health Planning and Reporting Toolkit with the district health management team.
- Develop and distribute of a quarterly report card (from the region to the district and the district to its facilities), to include a data dashboard to provide longitudinal comparisons of key PHC indicators across facilities and districts.

c. CAPACITY BUILDING FOR DATA MANAGEMENT AND USE

The capacity to use data for decision making is important in order to ensure that evidence is used in policy making and health practice. For data use capacity to increase, activities should be focused not just on the individual level but also on teams, organizations, and networks. Cooke puts forth an empirically based framework for understanding research capacity building that measures progress based on six principles. This framework has relevance to strategies for improving data use in the health system. Cooke notes that research capacity building should develop skills, support linkages and partnerships, ensure that research is 'close to practice,' develop appropriate dissemination, invest in infrastructure, and build elements of sustainability. The framework also acknowledges the need for greater involvement by policy makers in the entire capacity-building process (Cooke, 2005).

Developing Skills

Building research, M&E, or data-use capacity starts with identifying the right people to be trained by ensuring that they have the appropriate educational background, experience, and energy to use the training skills. Building capacity in research, M&E, and data use can be developed in a variety of ways. Academic training in research is a traditional starting point. However, in developing countries, workshops and work-based training programs are normally used for strengthening capacity (Nchinda, 2002). Makerere University School of Public Health (MakSPH), with funding from the Centers for Disease Control and Prevention (CDC), developed an 8-month modular in-service work-based training program aimed at strengthening the capacity for monitoring and evaluation (M&E) and continuous quality improvement (CQI) in health service delivery, pairing data use, and service delivery/performance improvement. This capacity building program, initiated in 2008, was offered to in-service health professionals working in Uganda. The purpose of the training was to strengthen capacity to provide quality health services through hands-on training that allows skills building with minimum work disruptions, while encouraging greater involvement of other institutional staff to enhance continuity and sustainability. The hands-on training used practical gaps and challenges at the workplace through a highly participatory process that has been proven in other contexts (Sogorić et al., 2009). Trainees worked closely with mentors and other staff to design and implement 'projects' meant to address work-related priority problems. Trainees' knowledge and skills were enhanced through short courses offered at specific intervals throughout the course. An evaluation of the training found it to be effective (Matovu et al., 2013).

Implementation of the World Health Organization's mid-level manager training for immunization program managers, which takes a more traditional training approach, also found that the capacity building resulted in some knowledge improvement, greater compliance with vaccine management practices, and improved vaccine coverage. However, deficiencies in information transfer to the periphery were identified due to inadequate funding for supervision (Milstien, Tapia, Sow, Keita, & Kotloff, 2007).

Matovu et al. (2013) documents an innovative 2-year long-term apprenticeship program implemented by Makerere University School of Public Health (MakSPH) to strengthen capacity for leadership and management of HIV programs in Uganda. Enrolled Fellows were attached to host institutions implementing HIV programs and placed under the supervision of host institution and academic mentors. Fellows spent 75% of their apprenticeship at the host institutions; the remaining 25% was dedicated to didactic short courses conducted at MakSPH to enhance their knowledge base. The success of the program hinged on support from mentors, stakeholder involvement, and the hands-on approach employed in training (Matovu et al., 2013).

While training programs have demonstrated great success, research on the outcomes from the Public Health Implementation and Training (PHIT) Partnerships found that training alone is not enough to engage and build capacity for facility and community health workers. Activities that proved successful as additions to training programs across the Partnerships in five African countries included stakeholder meetings, data reviews, and mentored use of data as the basis for decisions. These additional activities engage health workers and demonstrate the value of data, quality information systems, and ownership of data collection and management tools (Mutale et al., 2013). These activities, which were integrated in the district, health facility, and community levels, ensured that data were linked to decision making. Specifically, at the district, provincial, and facility level, data were used to:

- Identify priority areas and guide planning and resource allocation
- Conduct trend analysis to identify priority problems, monitor implementation and modifications, and link with district activity plans and budgets
- Guide clinicians to plan patient management as well as district and health facility managers to identify service quality gaps

At the community level, data were used for problem solving and planning and incorporated into facility and district planning. Activities also helped provide data used by CHWs to identify patients for follow-up as well as clinicians and facility managers for performance assessment and improvement.

Support Linkages and Partnerships

Collaboration between managers and researchers can improve the relevance of data and information, data quality, and research capacity development. Factors critical to success relate to the researcher having the appropriate connections, credibility, backing of colleagues, and whether the opportunity allows for skill development (Bullock, Morris, & Atwell, 2012). Wetta-Hall et al. (2004) used case studies to illustrate how collaborations between universities and community-based organization can result in the development of successful management planning tools by using geographic information systems and secondary sources. Canadian Heart Health Initiative provides another example that created an environment where science and public health policy became aligned by establishing partnerships between government and non-governmental organizations (Riley et al., 2009).

Partnerships that have focused on linking institutions from north-to-south and south-to-south have proven effective in fostering sustained management capacity. In Liberia, a health management delivery program in which a north and south institution collaborated to integrate classroom and field-based training in health management and to transfer capacity for sustained management development to the Ministry of Health and Social Welfare identified key elements for implementing a successful management training program. These elements included: 1) use of a short-course format focusing on four key skill areas with practical tools; 2) inclusion of didactic training, on-site projects, and on-site mentoring; 3) collaboration with an in-country academic institution willing and able to scale-up and maintain the training; 4) providing training for the in-country academic faculty; and 5) securing Ministry-level support to ensure participation. The collaboration reported substantial improvement in self-reported management skills and rated the helpfulness of the course

and the degree to which it met its objectives highly. Levels of improvement and course ratings were similar over the three cohorts as the course was transferred to the south institution (Rowe et al., 2010).

Increasingly, national programs and leaders are looking at interdisciplinary collaborations as essential to future research. Twelve years ago, the National Institutes of Health (NIH) Office of Research on Women's Health (ORWH) developed and implemented the Building Interdisciplinary Research Careers in Women's Health (BIRCWH) K12 program to focus on interdisciplinary mentored career development for junior faculty in women's health research. Factors associated with success included ensuring sufficient protected time for regular (weekly or biweekly) mentoring; mentors promoting the research independence of the scholar; a team mentoring approach, including career as well as content mentors; and explicit and clear expectations outlined between the scholar and mentor (Guise, Nagel, & Regensteiner, 2012).

Invest in Infrastructure

Ensuring that capacity is sustained requires an emphasis on building infrastructure to support data production and use (Nchinda, 2002). A review of barriers affecting research capacity found that for research capacity to be sustained, an overall strategic approach must be developed, clearly communicated, and accompanied by effective leadership. Specific capacity strategies identified through this review were the creation of infrastructures, the fostering of research cultures and environments, and the facilitation of training and collaboration (Segrott, Mclvor, & Green, 2006).

Dissemination

Kasonde et al. (2012) discuss nine key lessons from the Zambia Forum for Health Research (ZAMFOHR's) experience with a knowledge translation platform. Lessons from ZAMFOHR's organizational development included the necessity of selecting a multi-stakeholder and multi-sectoral board of directors; performing comprehensive situation analyses to understand not only the prevailing research-and-policy dynamics but a precise operational niche; and selecting a leader who bridges the worlds of research and policy. Programmatic lessons included focusing on building the capacity of both policy-makers and researchers; building a database of local evidence and national-level actors involved in research and policy; and catalyzing work in particular areas by identifying leaders from the research community; creating policy-maker demand for research evidence; and fostering the next generation by mentoring both up-and-coming researchers and policy-makers (Kasonde & Campbell, 2012).

Findings from a knowledge transfer and exchange initiative in Canada uncovered four key themes related to the nature of effective knowledge transfer and exchange initiatives. These included the importance of personal relationships and cultivating champions supporting communities of practice, and building receptor capacity (Mitton et al., 2009).

Building Sustainability

Institutional capacity is defined as the ability of an organization to have effective management to build local capacity and achieve goals with local ownership. As a result of decentralization in Cambodia, there was a need to increase district-level institutional capacity. Interventions designed by a nongovernmental organization worked with five operational districts to provide management assistance to increase

institutional capacity. Supportive supervision and widening of decision-making authority were identified as key factors for sustainable institutional capacity development (Okamoto et al., 2009).

Possible interventions and activities of interest for the BID Initiative **to build the capacity of staff across the health system** to produce quality data and use data for decision making include:

- Structured hands-on training on reporting, data quality, and the use of data as part of program planning that allows skills building with minimum work disruptions while encouraging greater involvement of other institutional staff to enhance continuity and sustainability.
- Using scenario-based approaches to give examples of immunization reporting forms for facility and district staff to review for quality (accuracy, completeness, and timeliness) and then use the information gathered to identify which program changes or activities should be planned. These small-scenario work groups should be embedded in existing meetings to avoid overburdening health workers.
- Continued rollout of mid-level manager (MLM) training in the districts, with specific and targeted follow up activities to ensure skills learned are transferred to facility-level health workers. This could also be achieved through a peer learning or mentoring approach in which MLM learning is rolled down to specific facilities that then share the learning with other facilities in their area.
- Hosting and facilitating routine data review meetings to support the routine review of information, the feedback of data from the district to the facility levels, and the increase of data ownership among facility staff. Specific activities to be conducted at such review meetings might include identifying priority areas for planning and resource allocation; trend analysis to identify priority problems and monitor implementation of solutions; and identification of service gaps (e.g. defaulter and left out tracing).
- Include cross-site learning opportunities across sites and districts, to allow health workers and district health management staff to learn from high performing locations who have overcome similar challenges and constraints.
- Ensuring stakeholder consultation and buy-in to support the ongoing capacitation of staff, particularly at the national level where multiple stakeholders may be working with the same Ministry or regional staff members. Stakeholder consultation can also help identify and cultivate champions for improved capacity building at the lower levels.

d. SUPPORTIVE SUPERVISION & MENTORING

Capacity building for data management and use entails not only increasing knowledge and skills but also implementing approaches that are most effective in achieving behavior change. Prashanth et al. (2012) summarizes a review of theories on capacity building to understand plausible mechanisms for change in planning and supervision. Developing guidelines through local consensus, small-group interactive and problem-based learning has its foundation in adult learning theory. Using opinion leaders or respected peers to disseminate guidelines are interventions that build on social learning theory. Total quality management, total quality improvement, and changing structures and tasks are types of interventions that incorporate management and process theory in their design. Audit and feedback interventions, reminders, modeling correct performance, incentives, sanctions, and removing factors that are demoralizing are interventions that are built on behavioral and learning theory. These theories are discussed further below.

Adult Learning

According to Adzei and Atinga (2012), health workers identify management and leadership skills to be among the most important factors in retention and motivation in the work place. The skill of the manager serves as a starting point for determining health workers' motivation and performance as well as their intention to remain at the job posting. Health workers in remote locations are often frustrated with the lack of demonstrated leadership among management staff; this is particularly evident in the lack of relationship management often has with their clinical staff. Adzei and Atinga (2012) conclude that managers need to be constantly willing to assist with and share in the staff problems. Health workers who feel respected by managers are more motivated, as managers try to develop their staff's competence and have mutually benefitting discussions. When necessary, managers should offer health workers the opportunity to participate in meetings to discuss issues that affect them to foster a strong and balanced relationship between managers and employers in the work environment.

In the study by Snow et al. (2011), Ghanaian doctors and hospital leaders mentioned the importance of supervision in relation to continuing education. They advocated for mentoring systems that would provide remote doctors with periodic engagement and learning from specialists, and programs that could accelerate their learning while improving the quality of care in rural areas. Doctors in the study were motivated to improve their skills and better serve their patients and thought that could be achieved through efficient mentoring or supervision. To them, on-the-job learning is essential if they are to improve their ability to conduct their tasks. One surgeon stated, "[Learning in the job] is about a mentor, it's about apprenticeship. Somebody taking your hand and showing you what to do..."

Furthermore, in Prytherch et al.'s (2012) comparison of health workers from Ghana, Burkina Faso, and Tanzania, only participants from Ghana mentioned supervision as a non-financial incentive to do their job; however, it emerged that winning the approval of managers was extremely important, not least for getting a good appraisal and future promotion. Interviews with Ghanaian health workers were marked with a strong sense of competition. Not all managers were referred to with respect, and there was some criticism regarding managers' use of their position to avoid hard work or indulging in favoritism. But some health workers did mention that having managers work alongside them was extremely encouraging.

Behavior & Learning

An assessment based on responses from national and provincial EPI managers in South Africa identified key challenges facing EPI and proposed appropriate solutions. The information collected was used to conduct a systematic review on the effectiveness of the proposed solutions. Challenges identified by EPI managers were linked to healthcare workers (insufficient knowledge of vaccines and immunization), the public (anti-immunization rumors and reluctance from parents), and the health system (insufficient financial and human resources). Strategies proposed by managers to overcome the challenges include training, supervision, and audit and feedback; strengthening advocacy and social mobilization; and sustainable EPI funding schemes, respectively. The findings from reliable systematic reviews indicate that interactive educational meetings, audit and feedback, and supportive supervision improve healthcare worker performance (Wiysonge et al., 2012).

In Georgia, an intervention package that focused on “supportive” supervision was evaluated to assess its effects on the performance of the immunization program at the district level. The intervention package resulted in a number of improvements. Among immunization managers, the intervention independently contributed to improved knowledge of supportive supervision, and helped remove self-perceived barriers to supportive supervision, such as availability of resources to supervisors, lack of a clear format for providing supportive supervision, and lack of recognition among providers of the importance of supportive supervision. The intervention independently contributed to relative improvements in district-level service delivery outcomes, such as reducing vaccine wastage and increasing DPT-3 immunization coverage rate (Djibuti et al., 2009).

Social Learning

Social network analysis is an approach to studying the interactions and exchange of resources among people, and can help to understand how interventions and innovations diffuse through a population. Using social network analysis can increase understanding of the underlying structural and behavioral complexities that influence the process of capacity building toward evidence-informed decision making.

In Ontario, a social network analysis was used to understand if and how staff could secure help in turning research evidence into practice. The staff were invited to respond to an online questionnaire on information seeking behavior, identification of colleague expertise, and friendship status. Three networks were developed to assess information seeking and recognition of expertise and friendship, based on the 170 participants. The overall shape of the networks, including their size and density as well as the most-central people and brokers and their characteristics, were identified. The network analysis showed a low density (meaning the number of connections of an individual divided by the total possible connections) and localized information-seeking network. Inter-personal connections were mainly clustered by organizational divisions; and people tended to limit information-seeking connections to a handful of peers in their division. However, recognition of expertise and friendship networks showed more cross-divisional connections. A small group of professional consultants and middle managers were the most-central staff in the network, also connecting their divisions to the center of the information-seeking network. Social network analysis was useful in providing a systems approach to understanding how knowledge might flow in an organization. The findings of this study can be used to identify early adopters of knowledge translation interventions, forming communities of practice, and potential internal knowledge brokers (Yousefi-Nooraie, Dobbins, Brouwers, & Wakefield, 2012).

In Kenya, managers and trainers chose intensive, district-level training workshops to disseminate family planning guidelines and to update health workers on guideline content and best practices. The training workshops were held in 41 districts in 1999. Trainees were instructed to update their untrained co-workers afterward. As a reinforcement, some providers in randomly selected areas received an additional 'cascade training package' of instructional materials and training tips. Providers in 15 randomly selected clinics also received 'supportive supervision' visits as a second reinforcement. The cascade training package showed less impact than supportive supervision, but the former was more cost-effective (Stanback, Griffey, Lynam, Ruto, & Cummings, 2007).

Quality Improvement Activities

A review of quality improvement activities under the Population Health Implementation and Training (PHIT) Partnerships in Ghana, Mozambique, Rwanda, Tanzania, and Zambia identified four common themes related to the Partnerships' quality improvement interventions: defining and measuring quality; ensuring data quality and building capacity for data use for decision making and response to quality measurement; strengthened supportive supervision and/or mentoring; and operational research to understand how the factors associate with observed variation in quality. The Partnerships' focus on improving data quality and use was "expected to result in more effective, evidence-based use of limited resources and measurement capacity, stewardship, accountability, and transparency." Efforts to measure data quality were integrated into routine work and monitoring and evaluation, rather than as separate data collection efforts, to ensure that activities supported health workers' day-to-day work. While each country partnership prioritized varied performance improvement approaches, the activities centered on data quality and building capacity to use these data to identify gaps and improve quality more effectively and efficiently than through trainings alone (Hirschhorn et al., 2013).

In ARISE (African Routine Immunization System Essentials), a study that documented interventions that drive strong immunization system performance across three African countries, it was found that one of the drivers of routine immunization performance improvement is the regular review of program and health worker performance (LaFond et al., 2012). According to the study, the practice of conducting regular reviews of data and promoting open discussion of performance targets and achievements contributed to improved immunization coverage. The performance review mechanisms often used were regular review meetings, supervision, coaching, and on-the-job training. The outcomes of these performance reviews were that it motivated staff and community members and helped maintain a focus on improving delivery and demand for immunization. According to the findings, learning from peers, friendly competition, and "naming and shaming" gave rise to a sense of collective accountability among health staff and renewed their commitment to improve routine immunization performance.

A virtual quality improvement (QI) learning network on adherence to clinical guidelines for childhood obesity prevention in rural clinics was developed for seven primary care clinics in California. The clinics participated in a virtual QI learning network over nine months to implement best practices and to exchange strategies for improvement. Following the intervention, documentation of weight assessment and counseling increased significantly. Children who received care from clinicians who led the implementation of the intervention at their clinic showed significant improvements in nutrition and physical activity (Shaikh, Nettiksimmons, Joseph, Tancredi, & Romano, 2013).

The Performance of Routine Information System Management (PRISM) framework and tool has been applied in more than 20 countries to measure RHIS performance. The framework postulates that poor-quality data and poor use of information for evidence-based decision making are the result of three key factors: organizational and behavioral barriers and technical issues. The tool, therefore, measures these factors and provides quantifiable information related to these three RHIS determinates that can be used to evaluate results. In several countries, evidence suggests that the use of the PRISM tool over time has led to the improved of data quality at the health facility level and at district level. As one example, between 2008 and

2012, data accuracy improved in Cote d'Ivoire by 17% at health facilities and more than doubled at district level (Lippeveld & Belay, 2013).

The Lean Six Sigma (LSS) approach is a widely used quality improvement methodology focused on improving performance by reducing waste and variation from processes within a business—such as health care delivery—in order to improve the value and efficiency of the work. Numerous studies of LSS have highlighted the value and potential for improving the processes embedded in the delivery of health services (Bernedetto, 2003; Bahensky, Roe, and Bolton, 2005; Antony, J., Downey-Ennis, Antony, F., and Seow, 2007; Becerril-Alquiecir and Ortiz-Posadas, 2010). Key stages in the Six Sigma approach include defining the problem; measurement; analysis; improvement; and control. While LSS grew out of the total quality management (TQM) domain, it is distinguished by its “critical to quality” dimension that keeps the focus only on improvements that matter to the end client (Black and Revere, 2006).

While published literature on application of LSS primarily focuses on developed countries, select literature highlights where LSS approaches have been used within developing country health systems. The Core Lab at Uganda Makerere University provides laboratory support to more than 70 clients in the US and Uganda, and applied the LSS approach to improve data entry quality. The LSS QI team included the QI project facilitator, technical managers, departmental, data entry, and information systems staff. A key problem identified by the team was unclear forms. Innovative solutions were designed using existing technology and a redesign of the data entry process. Key control activities included but were not limited to continuous daily tracking of all data entry errors, ongoing discussion of quality management at monthly staff meetings, staff encouragement, sharing data entry error metrics with staff at monthly meeting, and sharing tips and best practices. Solutions to the various root causes included not only improved clarity of forms, but also attention to staff workload, pressures, and fatigue. Application of Six Sigma resulted in a 60.5 percent reduction in data entry errors over the course of one year (from 423 errors per month to 166 errors per month), generating an estimated \$50,115 in cost savings annually. The authors identified the Six Sigma approach as being both replicable and of great potential to improve clinical workflow processes and realize cost savings, particularly in clinical laboratory settings (Elbireer, Le Chasseur, and Jackson, 2011).

In Morelos State, Mexico, the health service (including 238 health facilities) used the Six Sigma approach to create a Health Technology Management Plan to be applied across three levels of the health system. The ten innovations suggested to address gaps in the system for managing medical technology included: de-duplicating receipt of reports (from phone and paper to phone only); improved management of vehicle fueling to address transport challenges; reduction in required signatures for selected reports; priority indexing for failed equipment reports; and additional staff (Becerril-Alquiecir and Ortiz-Posadas, 2010). In addition, standard forms for recording and monitoring medical events were created to ensure ongoing monitoring of the health technology.

Aleem (2013) highlights how the LSS approach to manufacturing has been translated into primary care settings in the U.S. for quality improvement, as both industries seek have the manufacturing in a desire to improve performance and reliance on data. University of Buffalo residents were offered green belt certification courses in LSS as one tool to improve primary care provision. Review of data on patient care and satisfaction generated through a survey identified six solutions to be implemented to improve patient care. Selected findings of interest from the generation, implementation, and evaluation of these solutions

included: the importance of having those who own the process (the residents) as champions of the processes themselves; engagement of a cross-functional team (providers and patients) in the identification, planning, and implementation of the solution in order to identify the “path of least resistance to change;” the importance of visualization of the process in sufficient detail to identify sources of variation and waste; challenges of automating a system as person-driven as health care; and the importance of the external environment.

Neufeld et al. (2013) analyzed the application of LSS to increase completeness of required discharge charts in a comprehensive integrated inpatient rehabilitation program. Discharge summaries are used to ensure quality across the continuum of care, and are essential reporting forms within rehabilitation care. Multiple LSS tools were applied, including development of a process map, review of the data elements on the form in order to develop a questionnaire to assist in the completion of the form without asking the client unnecessary questions, root cause analysis, Pareto charts, and Fisher exact test statistical analysis of charts. These activities resulted in an increase in form completeness, from 61.8% to 94.2% of required elements on the form. Key to the increase in completeness was the use of an electronic medical record system that could automatically populate known fields, reducing burden on the provider and increasing form completion.

Beard (2006) and his project team applied a Six Sigma approach to improve the percent of times behavioral health staff were able to reach patients via telephone. The project achieved statistically significant increases in the number of times patients were reached. Key elements of the Six Sigma approach employed to optimize the process of conducting phone outreach included a root cause analysis and 5-Why process analysis, as well as data plots of successful and unsuccessful call times and a clear control plan for monitoring metrics looking forward. In addition to increasing the number of times the clients answered, the process improved data quality by identifying possible errors not logged in the existing system. Embedding the team leader from the pilot site in the quality improvement team was identified as a key factor in the success of the approach, and learning from variation in how the approach was applied was a key way to identify best practices for the team.

While LSS has demonstrated clear value across multiple health care settings in the articles reviewed, a comprehensive review of Six Sigma literature by DelliFraine, Langabeer, and Nembhard (2010) showed limited reporting on outcomes of the LSS systems employed (34 of 177 articles reviewed), with fewer than one-third including statistical analysis to test for significance of change. An additional systematic review of Six Sigma literature in the same year by Glasglow et al. (2010) found a lack of rigorous evaluation or clear sustained improvements as a result of applications of Six Sigma in health. Aleem (2013) also notes that a review of published literature on the application of LSS in health care has pointed to a decrease in external validity of the studies to date due to limitations in research design, bias toward reporting positive results, and variation in variables of interest.

Possible interventions and activities of interest for the BID Initiative **to improve supportive supervision and build mentoring relationships** to support the production of quality data and data use for decision making include:

- Training packages to support knowledge and capacity to perform supportive supervision at the district level, including training not only on supervision content, but how to conduct supervision with a mentoring (rather than punitive) approach.
- Measure data quality as part of routine work and monitoring and evaluation rather than as separate data collection efforts, and embed routine data quality checks into supportive supervision visits from the district to the facility level.
- Provide a structure for regular review of program and health worker performance, including regular reviews of data and promoting open discussion of performance targets and achievements, which could be conducted through regular review meetings, supervision, coaching, and on-the-job training.
- Provide an improved model for closing the feedback loop between supervisors and health facility staff by developing and ensuring the use of simple supervision checklists and action items as a leave-behind, or automating the supervision feedback loop through technology.

e. PEER NETWORKS (COMMUNITIES OF PRACTICE)

Networks are emerging as a new technique to build capacity for technical understanding of research and supporting data use. Through its interactive capacities, Web 2.0 applications are worth exploring to establish virtual communities of practice that can address gaps in evidence-based practices that have not been overcome by traditional strategies, such as distribution of educational materials, outreach visits, and consensus building efforts. Findings from an intervention with clinicians found that most participants identified knowledge transfer as the most useful outcome of a Web 2.0 platform. Access to a computer and the Internet, features of the Web 2.0 platform, user support, technology skills, and previous technological experience were found to influence perceived ease of use and usefulness. However, lack of time and lack of technological skills may limit the participants' use of a future Web 2.0 platform (David, Poissant, & Rochette, 2012).

Fung-Kee-Fung et al. (2009) conducted a systematic review to evaluate the effectiveness of collaborative initiatives. Motivations for initiating collaborations were often in response to external demands for performance data. Quality improvement process measures were reported to be improved across all of the collaborative initiatives. Success factors included: a) the establishment of trust among health professionals and health institutions; b) the availability of accurate, complete, relevant data; c) clinical leadership; d) institutional commitment; and e) the infrastructure and methodological support for quality management. A community of practice framework incorporating the success elements described in the systematic review of the literature can be used as a valuable model for collaboration among health care professionals and organizations to improve quality of care and foster continuing professional development (Fung-Kee-Fung et al., 2009).

Communities of practice have emerged as an effective technique to close evidence-practice gaps. The National Institute of Clinical Studies (NICS), established in 2000 by the Australian government, used communities of practice to help emergency clinicians implement best-practices research. The approach combined aspects of evidence implementation science, quality improvement techniques, and knowledge management within a social network model to provide a mechanism for rapid sharing of explicit and tacit knowledge (Huckson & Davies, 2007).

Findings from qualitative research conducted among health practitioners in Canada found that communities of practice provide an opportunity for health workers to incorporate explicit and tacit knowledge in their work processes. Tacit knowledge, particularly from peers and personal experience, was the preferred source of knowledge, with informal peer interactions being the favored form of communities of practice to support evidence-informed decision making. Communities of practice were found to help practitioners build relationships and community capacity, share and create knowledge, and build professional confidence and critical inquiry (Meagher-Stewart et al., 2012).

The findings from a research study involving two integrated services were used to explore the role of and approach to learning and knowledge management. The evidence indicated no planned strategies for learning and knowledge management, although interventions and mechanisms at different levels were in place to support integration processes. These included formal activities, particularly on training and appraisal, as well as informal activities within communities of practice, and networking. Although structural enablers such as a co-location of facilities and joint appointments were important, the value of trust and interpersonal relationships was highlighted especially for tacit knowledge exchange. The infrastructure for learning and knowledge management was based on a collaborative culture characterized by a coherent strategic framework; clarity of purpose based on new models of service; a collaborative leadership approach that was facilitative and distributed; and a focus on team working to exploit the potential of multidisciplinary practice, generic working, and integrated management (Williams, 2012).

Research into networking and interactivity among practitioners is providing new information that has the potential to enhance the effectiveness of practice improvement initiatives. Curriculum to teach relationship building in communities of practice and facilitation skills to enhance learning in small group education sessions may explain why some groups respond more favorably to improvement initiatives than others (Parboosingh, Reed, Caldwell Palmer, & Bernstein, 2011).

Possible interventions and activities of interest for the BID Initiative **to leverage the power of peer networks** include:

- Develop a virtual QI network at the district and regional levels (where connectivity is relatively reliable) to support the implementation of best practices and to exchange strategies for improvement.
- Develop immunization provider and manager networks at the district and regional level to support the exchange of information through meetings, an electronic platform, or other mechanisms, as collaboratives have been demonstrated as a way to close the know-do gap.

f. ORGANIZATIONAL CHANGE APPROACHES

Increasing data use and improving performance within a health system requires a shift in behavior that goes beyond frontline workers. A holistic approach that includes change at the organizational level is needed to improve performance. Studies show that organizational change, if executed properly, can lead to improved performance (Thompson, 2010). However, change at this level can be difficult and poses formidable challenges for managers, as it requires the adoption and implementation of new or the adaptation of existing processes, which affects activities performed within the organization and personnel at all levels (Bobiak et al.,

2009). Thus, managing the change process within a health system is an important but delicate process that requires systematic and well-managed approaches.

John Kotter, a leading voice in change management, suggests that organizational change can be managed using an 8-step approach (Kotter, 2007). The steps in his model fall within three distinct phases: “creating a climate for change;” “engaging and enabling the whole organization;” and “implementing and sustaining the change.”

Figure 2: John Kotter’s Eight-Step Approach to Change Management



Establishing a sense of urgency entails pinpointing the problem and communicating broadly and effectively how the issue affects the organization and why the change must occur. Once a sense of urgency grows among workers, managers must develop a guiding team of individuals to carry the change initiative forward. Kotter emphasizes the need for this team to include individuals who possess the appropriate skill set (i.e. relevant expertise, credibility with peers, tacit knowledge, and leadership) to move change forward. He also emphasizes that this team of individuals must be large and inclusive of individuals from all levels of the system (Kotter, 2007). Once a team has been established, a vision statement must be created and communicated clearly and broadly. This is a critical step in the change process because the vision lays out the pathway to change. Failure to articulate and communicate the vision clearly will reduce the understanding of the initiative at all levels and undermine the buy-in necessary for success (Narine & Persaud, 2003; Kotter, 2007).

Communicating buy-in is critical in change management, and is echoed throughout the literature (Narine & Persaud, 2003; Scott, Mannion, Davies, & Marshall, 2003; Sirkin, Keenan, & Jackson, 2005; Kotter, 2007; Campbell, 2008; Peirson, Ciliska, Dobbins, & Mowat, 2012). According to Campbell (2008), this is done through identifying the individuals or groups who will be affected by change, communicating the vision, and engaging them in continuous dialogue. Achieving buy-in at all levels will increase the commitment that individuals and groups have toward change and empower them to take action and participate (Narine &

Persaud, 2003). As pathways to change emerge, it is critical to produce short-term wins. This can be done by completing tasks that clearly show that the change initiative is succeeding (Campbell, 2008). By completing tasks that provide examples of short-term wins, urgency and momentum continue to build and the impact of criticism is lessened (Kotter, 2007). The final steps in Kotter's model involve implementing and sustaining change. This is done through increasing the credibility of early wins and hiring, promoting, and developing employees who can implement the vision. Sustaining change comes when the new approaches are institutionalized, which can be done through leadership development and succession plans that remain consistent with the new approach.

Though Kotter's model is designed with large companies in mind, literature suggests that the underlying principles are relevant to any system interested in instituting large-scale change. In a qualitative study exploring organizational change within a public health unit in Ontario, Canada, it was found that critical factors for building evidence informed decision-making capacity at an organizational level included clear vision, strong leadership, effective communication, and a receptive organizational (Peirson et al., 2012). Similarly, in their review of organizational change literature, Scott et al. (2003) found that key factors to successful change management included commitment from stakeholders, buy-in at all levels, and leadership that possessed the appropriate skills to implement the initiative.

Another approach to change management, described by Sirkin et al. (2005), focuses less on the "soft factors" (i.e. culture, leadership, and motivation) and instead emphasizes the "hard" side of change management. In their initial study of 225 companies, Sirkin found a consistent correlation between successful change implementation and four key variables: duration, integrity, commitment, and effort (DICE) factors. The duration of a change initiative is important. They found that longer change initiatives tend to be more successful than those of shorter duration. However, similar to Kotter's findings, it is critical to review the change initiative frequently and schedule milestones to assess performance and impact. This allows managers to identify gaps, spot new risks, and adjusted the initiative as needed.

Sirkin also found that the performance integrity of the team leading a change initiative is crucial to success. Performance integrity is dependent upon executives clearing defining roles and choosing team members with the appropriate skills and traits necessary to execute change. The third key factor found to be important in change management is commitment. In order for organizational change to take place, the most influential people within the system must back the initiative, and there must be buy-in from those who are most affected by the change, often mid-level managers and frontline workers. Without commitment from all levels, the change initiative will falter. The final factor in Sirkin's model for successful organizational change is calculating and understanding how much effort a change initiative will require. It is incredibly important to understand the resources and time that will be required because these efforts often involve stretching employees beyond their existing responsibilities.

In order to calculate how a change initiative is succeeding, Sirkin created a DICE scale that allows companies to gauge whether their change initiatives will succeed. This tool includes a series of questions that address each DICE factor. Samples of these questions are:

- Duration: "Do formal project reviews occur regularly?"

- Integrity: “How strong are team members’ skills and motivations?”
- Communication: “Is the change message consistent across all levels of the organization, and is it consistent over time?”
- Effort: “What is the percentage of increased effort that employees must make to implement the change effort?”

Each subset of factor questions is graded using a scale from 1 to 4, with a lower score indicating more success. The score from each factor is added together to create a total score. Thus, lower scores (between 7 and 14) suggest the project is highly likely to succeed and higher scores (more than 17) indicate that the project is extremely risky. According to Sirkin, a score over 19 suggests the project is too risky and likely to fail. This tool has been used in corporate settings with success, but there is no literature on whether this tool can be adapted for use in other contexts.

Another important factor of organizational change not mentioned in either Kotter or Sirkin’s model, but found in other literature, is organizational readiness to change (Narine & Persaud, 2003). ‘Readiness for change’ refers to an organization’s plan for change and its ability to execute change based on availability of resources, commitment of staff members, and historical experience implementing change (Ingersoll et al., 2000; Weiner, 2009). According to the literature, an organization’s ability to successfully implement large-scale change has been shown to be directly related to its readiness for change (Ingersoll, Kirsch, Merk, & Lightfoot, 2000; Narine & Persaud, 2003). According to Ingersoll et al. (2000), an important aspect of an organization’s readiness for change is related to the encouragement of innovation, risk taking, and the extent to which organizational leaders outline a clear vision for the future. As with all factors in the change process, managers play a key role in establishing an organization’s readiness to change. According to Nardin and Persaud (2003), managers can enhance employee commitment to change by providing requisite training, encouraging knowledge and skill development, and reinforcing behaviors that reflect the vision of the change initiative.

Several tools have been created to assess organizational readiness for change. The Organizational Readiness for Change Assessment (ORCA) tool was developed from the Promoting Action on Research Implementation in Health Services (PARIHS) framework, and historically used to measure organizational readiness to implement evidence-based practices in clinical settings (NCCMT, 2013). This tool can be used to identify and monitor organizational strengths and weaknesses to support the implementation of organizational change. It consists of three major scales that measure the strength of the evidence for proposed change/innovation; quality of the organizational context to support the practice change; and organizational capacity to facilitate change (NCCMT, 2013). The tool consists of 77 items, with subscales, groups according to the key areas of the PARIHS framework: evidence, context, and facilitation (NCCMT, 2013). This tool has been tested and has proven to be an acceptable measurement for organizational readiness for change in a clinical setting (Helfrich, Li, Sharp, & Sales, 2009; Hagedorn & Heideman, 2010). Another tool for assessing organizational capacity for change is the Measuring Practice Capacity for Change tool, developed by Bobiak et al. (2009). This tool was developed to measure organizational capacity for change in a primary care setting by measuring 25 key indicators related to organizational structure, climate, and culture. According to the author, this tool has been statistically validated and tested for relevance.

Finally, there are a number of ways the tools and approaches developed **to create organizational change** could be adapted and applied within the BID Initiative. These might include:

- Adapt and use organizational readiness tools at national and district level to assess the capacity for change and to inform the change management plan.
- Management training focused on creating and communicating a vision for change, mobilizing and building a team with the appropriate skill set, motivating workers, setting up milestones, and engaging in positive feedback.
- Create a forum (or group) that includes influential leaders at all levels of the national immunization system (in-country BID network), stakeholders, mid-level managers, and influential front line workers (large group). This approach can be applied to the regional level- creating an advisory group for the implementation.
- Invest in a “change campaign” that communicates the change vision broadly and frequently.
- Create a tool to monitor the progress of change throughout the life of the change initiative, and design built-in learning milestones where management can reflect upon progress, deliver feedback to staff, and adjust the change initiative based on these reflections.

IV. CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS

The findings from this literature review focus on approaches to improve data quality and promote data use, provide numerous examples of approaches tried and tested in the past. The intent of this review is to present various approaches to improved data quality and increased data use from the literature that could be considered for the BID Initiative. Throughout the different dimensions explored as part of this review (motivation, data usability and simplicity, capacity building, supportive supervision, peer networks, and organizational change), there was a clear emphasis on the importance of both organizational and behavioral aspects inherent in improving the quality of information, particularly in cultivating data users.

As a consequence of addressing a wide topic area, we had limited time to dig deep into any one dimension impacting data quality and use. While the broad searches conducted as part of this review resulted in a diverse array of articles and findings, the breadth was a confining factor in identifying specific best practices that resonate across domains of expertise, e.g. health, education, and business. Many publications focus on data quality or on the use of information for clinical decision making (i.e. clinical support tools), while fewer articles discuss why individuals or organizations become data users and use routine information as part of their decision-making processes.

In addition, we found limited published or grey literature in our searches and call for evidence answering the questions of *how* interventions work and *why* they were effective, with publications focusing primarily on the results achieved. While this may be a limitation inherent in our search terms, it was consistent across the dimensions explored in this review; even those articles that identify processes or packages of interventions used seldom unpack these interventions to a level of detail to allow us to understand how and why the intervention worked or did not. This gap in the literature could be addressed through routine and thorough documentation of the process of testing, validating, and scaling various interventions as part of the BID

Initiative, which has great potential to add to the global body of knowledge on approaches to improve data quality and use.

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APPENDIX A: SUMMARY OF DATABASES, KEYWORDS, SEARCH TERMS, AND ARTICLES IDENTIFIED AND REVIEWED

Database	Keywords	Search Terms	Number of Articles Screened	Number of Articles Selected for Further Review
Phase I				
Call for Evidence	Data use	Articles forwarded from BID team members, Tara Nutley, and identified through scans of Business Review Articles (i.e. Sloan & Harvard) published since May 2013	76	76
Pubmed	Decision maker & resource allocation	(((((("planner*" OR ("manager*" OR ("executive*" OR ("director*" OR ("decision maker*" OR ("health worker*")[Title/Abstract])) OR (("Administrative Personnel"[Mesh]) OR ("Physician Executives"[Mesh])))) AND (((("performance improvement*" OR ("Quality Improvement"[Mesh]) OR ("Resource Allocation"[Mesh]))	155	15
Sociological Abstracts	Decision maker & resource allocation	(AB("planner*" OR "decision maker*" OR "health worker*") OR SU.EXACT.EXPLODE("Administrators" OR "Deans" OR "Directors" OR "Executives" OR "Managers" OR "Principals" OR "Superintendents")) AND (AB("performance improvement*" OR "management and planning") OR SU.EXACT.EXPLODE("Resource Allocation"))	27	3
Psychinfo	Decision maker & resource allocation	((KW "planner*" OR (KW "manager*" OR (DE "Management Personnel") OR (DE "Middle Level Managers") OR (DE "Top Level Managers") OR (KW "executive*" OR (KW "director*" OR (KW "decision maker*" OR (KW "health worker*")) AND ((KW "performance improvement*" OR (KW "resource alignment") OR (KW "management and planning") OR (MM "Management Planning") OR (DE	1869 (exported first 50 to zotero)	6 (of the 50 imported were reviewed. Due to the low level of relevancy, we did not continue the screen

		"Management") OR (DE "Business Management") OR (DE "Case Management") OR (DE "Classroom Management") OR (DE "Customer Relationship Management") OR (DE "Disability Management") OR (DE "Educational Administration") OR (DE "Emergency Management") OR (DE "Health Care Administration") OR (DE "Household Management") OR (DE "Risk Management") OR (DE "Self Management") OR (MM "Hospital Administration") OR (MM "Management Decision Making") OR (MM "Resource Allocation"))		on this search)
EBSCO	Business & decision making	planners OR managers OR executives OR directors OR "decision makers" OR "people making resource allocation decisions" OR "health workers" AND "performance improvement" OR "resource alignment" OR "management & planning"	92	15
Phase II				
Pubmed	Individual motivation	(motivation[mesh] OR "provider motivation"[tiab] OR incentives[tiab] OR supervision[tiab] OR "professional development"[tiab] OR "access to resources"[tiab]) AND data[tiab] AND ("meaningful use"[mesh] OR "meaningful use"[tiab] OR "quality improvement"[tiab] OR "quality improvement"[mesh] OR "resource alignment"[tiab] OR "performance improvement"[tiab] OR "organizational improvement"[tiab] OR "decision making"[mesh] OR "decision making, organizational"[mesh] OR "decision making, computer assisted"[mesh] OR "community health workers"[mesh] OR "community health workers"[tiab] OR planners[tiab] OR managers[tiab] OR "decision makers"[tiab] OR executives[tiab])	22	3

		OR directors[tiab]OR "information dissemination"[mesh] OR "diffusion of innovation"[mesh])		
PubMed	Health worker motivation	((("health worker"[All Fields] OR "health workers"[All Fields] OR "healthcare worker"[All Fields] OR "healthcare workers"[All Fields] OR "community health worker"[All Fields] OR "community health workers"[All Fields]) AND ("motivation"[All Fields] OR "satisfaction"[All Fields])) AND ("maternal"[All Fields] OR "newborn"[All Fields] OR "child"[All Fields] OR "mnch"[All Fields]))	189	93
	Street level bureaucrats	N/A	220	N/A
Pubmed	Data visualization	("data visualization"[tiab] OR "dashboards"[tiab] OR "dash boards"[tiab] OR "business intelligence"[tiab]) AND ("meaningful use"[mesh] OR "meaningful use"[tiab] OR "quality improvement"[tiab] OR "quality improvement"[mesh] OR "resource alignment"[tiab] OR "performance improvement"[tiab] OR "organizational improvement"[tiab] OR "decision making"[mesh] OR "decision making, organizational"[mesh] OR "decision making, computer assisted"[mesh] OR "community health workers"[mesh] OR "community health workers"[tiab] OR planners[tiab] OR managers[tiab] OR "decision makers"[tiab] OR executives[tiab] OR directors[tiab] OR "information dissemination"[mesh] OR "diffusion of innovation"[mesh])	74	19
	Technology acceptance model	planners OR managers OR executives OR directors OR "decision makers" OR "people making resource allocation decisions" OR "health workers" AND "decision support systems" OR "business intelligence" OR "health information systems" OR "management information systems" AND "performance improvement" OR "resource alignment" OR "management & planning"	170	87

		OR "meaningful use" OR "data use" OR "organizational improvement"		
	Balance scorecards	planners OR managers OR executives OR directors OR "decision makers" OR "people making resource allocation decisions" OR "health workers" AND balanced scorecard AND "performance improvement" OR "resource alignment" OR "management & planning" OR "meaningful use" OR "data use" OR "organizational improvement"	97	12
Pubmed	Capacity building (including supervision & mentoring)	("capacity building"[mesh] OR "capacity building"[tiab] OR "supportive supervision"[tiab] OR "supportive mentoring"[tiab] OR mentors[mesh] OR "supportive training"[tiab]) AND ("meaningful use"[mesh] OR "meaningful use"[tiab] OR "quality improvement"[tiab] OR "quality improvement"[mesh] OR "resource alignment"[tiab] OR "performance improvement"[tiab] OR "organizational improvement"[tiab] OR "decision making"[mesh] OR "decision making, organizational"[mesh] OR "decision making, computer assisted"[mesh] OR "community health workers"[mesh] OR "community health workers"[tiab] OR planners[tiab] OR managers[tiab] OR "decision makers"[tiab] OR executives[tiab] OR directors[tiab] OR "information dissemination"[mesh] OR "diffusion of innovation"[mesh])	271	69
Pubmed	Peer networks	("peer networks"[tiab] OR "learning networks"[tiab] OR "communities of practice"[tiab] OR "community of practice"[tiab]) AND ("meaningful use"[mesh] OR "meaningful use"[tiab] OR "quality improvement"[tiab] OR "quality improvement"[mesh] OR "resource alignment"[tiab] OR "performance improvement"[tiab] OR	53	22

		"organizational improvement"[tiab] OR "decision making"[mesh] OR "decision making, organizational"[mesh] OR "decision making, computer assisted"[mesh] OR "community health workers"[mesh] OR "community health workers"[tiab] OR planners[tiab] OR managers[tiab] OR "decision makers"[tiab] OR executives[tiab] OR directors[tiab] OR "information dissemination"[mesh] OR "diffusion of innovation"[mesh])		
Pubmed	Change management	("change management"[tiab] OR "change initiative"[tiab] OR "organizational change"[tiab] OR "transformation initiative"[tiab]) AND ("meaningful use"[mesh] OR "meaningful use"[tiab] OR "quality improvement"[tiab] OR "quality improvement"[mesh] OR "resource alignment"[tiab] OR "performance improvement"[tiab] OR "organizational improvement"[tiab] OR "decision making"[mesh] OR "decision making, organizational"[mesh] OR "decision making, computer assisted"[mesh] OR "community health workers"[mesh] OR "community health workers"[tiab] OR planners[tiab] OR managers[tiab] OR "decision makers"[tiab] OR executives[tiab] OR directors[tiab] OR "information dissemination"[mesh] OR "diffusion of innovation"[mesh])	127	36