DEVELOPING A METRIC FOR FRONTLINE WORKER COLLABORATION IN INDIA'S INTEGRATED CHILD DEVELOPMENT SERVICES:

A STEP TOWARD MEASURING THE "MISSING MIDDLE" OF MULTI-SECTORAL COLLABORATION

by

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Abstract

Multi-sectoral collaboration (MSC) is widely recognized as a critical aspect of policies, programs, and interventions to address complex public health issues, yet it tends to be undertheorized and difficult to measure. Limited understanding of the intermediate steps linking MSC formation to intended health outcomes leaves a substantial knowledge gap about the types of strategies that may be most effective in making such collaborations successful. This dissertation takes a step toward filling in this "missing middle" of MSC by developing and testing a scale-based instrument to assess collaboration between the frontline workers of one of India's largest and most widely known MSCs: the Integrated Child Development Services (ICDS) scheme.

Informed by Emerson's & Nabatchi's Integrative Framework for Collaborative Governance, the study follows a mixed methods design for instrument development and construct validation, including a quantitative strand (Paper 1) to develop the 18-item, Likert-type scale and test its psychometric properties; a qualitative strand (Paper 2) to identify key collaboration factors among the frontline workers through in-depth interviews (IDIs) and inductive thematic analysis of transcripts; and a mixed analysis (Paper 3) triangulating the quantitative and qualitative findings to further assess the construct and content validity of the scale. Embedded within a parent study conducted in two districts of Uttar Pradesh, India, data

collection involved field testing of the scale in Hindi with frontline workers in 346 villages and in-depth interviews with those workers in six purposively sampled villages.

Results provide clear evidence supporting the internal consistency and validity of the frontline worker collaboration scale in the study context and serve as a proof of concept for possible adaptation of the scale elsewhere. Recommendations for scale refinement are provided, including the development and testing of two additional scale items (*flexibility* and *locus of control*). The frontline worker collaboration scale may be useful for ICDS managers as the Indian Government redoubles its efforts to strengthen and monitor MSC, or "convergence", in the scheme, while identified collaboration factors may have implications for ICDS program management, training, and hiring. Finally, the study's design introduces a useful adaptation of an existing mixed methods instrument development framework.

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Table of Contents

CHAPTER 1: INTRODUCTION 1

1.1 Study Overview 1

1.2 Early childhood health, nutrition, and development in India 4
1.2.1 Status of children's health, nutrition and development in India 4
1.2.2 Integrated Child Development Services (ICDS) scheme 5

1.3 Multisectoral and inter-professional collaboration 14
1.3.1 Concept and definition of multi-sectoral collaboration (MSC) 14
1.3.2 Origins and evolution of MSC for health in LMICs 15
1.3.3 Concept and definition of inter-professional collaboration 18

1.4 Conceptual framework 20

1.5 Study aim, research objectives and mixed methods design 24
1.5.1 Overarching aim and research objectives 24
1.5.2 Mixed methods instrument development design 25

1.6 Contribution of this study 28

1.7 Parent study 30
1.7.1 Research site 32
1.7.2 Parent study team 33

1.8 Organization of the dissertation 34

CHAPTER 2: SCALE DEVELOPMENT AND TESTING (PAPER 1) 36

2.1 Introduction 36
2.1.1 Background 36
2.1.2 Research objectives 38
2.1.3 Parent study and research site 38
2.1.4 Ethical considerations and review 39

2.2 Conceptual framework 40

2.3 Methods 44
2.3.1 Key methods for Objective 1 44
2.3.2 Key methods for Objective 2 49

2.4 Results 58
2.4.1 Key results for Objective 1 58
2.4.2 Key results for Objective 2 63

2.5 Discussion **77**
2.5.1 Relevance of the study 77
2.5.2 Content and face validity in scale development 78
2.5.3 Internal consistency, construct and criterion validity of the scale 79
2.5.4 Study limitations 83
2.4.5 Study strengths 86
2.5.6 Conclusion 87

CHAPTER 3: KEY COLLABORATION FACTORS (PAPER 2) **90**

3.1 Introduction **90**
3.1.1 Background 90
3.1.2 Research objective 92
3.1.3 Parent study and research site 93
3.1.4 Ethical considerations and review 94

3.2 Methods **94**
3.2.1 Worldview, research philosophy, and positionality 94
3.2.2 Conceptual framework 95
3.2.3 Key methods 98

3.3 Results **107**
3.3.1 AAA frontline worker context 108
3.3.2 Key factors affecting AAA frontline worker collaboration 119

3.4 Discussion **141**
3.4.1 Key collaboration factors 141
3.4.2 Study limitations 147
3.4.3 Study strengths 149
3.4.4 Conclusion 151

CHAPTER 4: MIXED ANALYSIS OF CONSTRUCT AND CONTENT VALIDITY (PAPER 3) **152**

4.1 Introduction **152**
4.1.1 Background 152
4.1.2 Research objective 154
4.1.3 Parent study and research site 155
4.1.4 Ethical considerations and review 156

4.2 Methods **156**
4.2.1 Personal worldview and research philosophy 156
4.2.2 Conceptual framework 157
4.2.3 Mixed methods instrument development framework 159
4.2.4 Key methods 165

4.3 Results **169**
4.3.1 Construct validity of the frontline worker collaboration scale 169
4.3.2 Content validity of the frontline worker collaboration scale 176

4.4 Discussion **180**
4.4.1 Relevance of the study 180

4.4.2 Construct validity 181
4.4.3 Content validity 183
4.4.4 Scale modifications 186
4.4.5 Mixed methods instrument development and construct validation design 189
4.4.6 Study limitations 191
4.4.7 Study strengths 193
4.4.8 Next steps 194
4.4.9 Conclusion 195

CHAPTER 5: CONCLUSION AND FUTURE DIRECTION 197

5.1 Research purpose 197

5.2 Significance of this study 199

5.4 Future research 204

5.5 Conclusion 208

APPENDICES 210

A1: Health and sociodemographic indicators in Hardoi, Sitapur and Uttar Pradesh 210

A2: Ethical considerations 212
Frontline health worker surveys 212
In-depth interviews 214
Institutional Review Boards 217

A3: Cognitive Interviewing 218

A4: Collaboration questionnaire revisions 221

A5: Distribution of factor scores from EFA by dyadic vector 222

A6: Interview guide for in-depth interviews with ASHA 223

A7: Interview guide for in-depth interviews with AWW 228

A8: Interview guide for in-depth interviews with ANM 233

A9: Interview guide for in-depth interviews with medical officers 239

BIBLIOGRAPHY 243

CURRICULUM VITAE 253

List of Tables

Table 1: Sub-domains of Emerson's and Nabatchi's collaboration dynamics 23
Table 2: Research objectives by dissertation paper 24
Table 3: Sub-domains of Emerson's and Nabatchi's collaboration dynamics 43
Table 4: AAA frontline worker respondents by block 52
Table 5: Survey questions to gather information from AWW and ASHA registers 56
Table 6: Variation thresholds for AWW and ASHA records to be considered "matching" 57
Table 7: Theoretical, quantitative, and qualitative basis for the collaboration construct 59
Table 8: Collaboration scale item themes and items (English version) 62
Table 9: Comparison of theorized vs. actual item loadings on factors for AWW and ASHA 74
Table 10: Sub-domains of Emerson's and Nabatchi's collaboration dynamics 97
Table 11: Qualitative data collection by respondent characteristics 104
Table 12: Key collaboration factors, including constituent facilitators, barriers and descriptions 120
Table 13: Comparison of collaboration factors from this study vs. other relevant studies 143
Table 14: Sub-domains of Emerson's and Nabatchi's collaboration dynamics 158
Table 15: Collaboration scale items (English version) 162
Table 16: Joint display of illustrative AAA worker quotes by village collaboration level 170
Table 17: Comparison of qualitative themes vs. collaboration scale indicators 176
Table 18: Summary of recommended actions for refining the collaboration scale 188
Table 19: Summary of recommendations for refining the collaboration scale 201
Table 20: Sociodemographic indicators in Hardoi, Sitapur, and Uttar Pradesh state 210
Table 21: Key steps for rapid cognitive interviewing 220
Table 22: Original and revised questions in the frontline worker collaboration scale 221

List of Figures

Figure 1: Individual and overlapping responsibilities of the ANM, ASHA, and AWW 10
Figure 2: Author's adaptation of Integrative Framework for Collaborative Governance 22
Figure 3: Flow diagram of mixed methods study design aligned to Research Objectives 27
Figure 4: Study site in Hardoi and Sitapur districts, Uttar Pradesh 33
Figure 5: Author's adaptation of Integrative Framework for Collaborative Governance 42
Figure 6: Sociometric sampling and data collection strategy for AAA workers 51
Figure 7: Boxplots of total collaboration scores, by rater cadre 64
Figure 8: Boxplots of total collaboration scores, by target cadre 64
Figure 9: Snapshots of 3D prism of total collaboration scores by worker cadre and village 67
Figure 10: Summary of parallel analysis of PCA results 69
Figure 11: Summary of skewness and kurtosis statistics for each dyadic vector 70
Figure 12: Results from the Exploratory Factor Analysis (EFA) 72
Figure 13: Scatterplots and regression results of information matching vs. collaboration 76
Figure 14: Flow diagram of mixed methods study design aligned to Research Objectives 160
Figure 15: Comparison of facilitator-to-barrier code counts ratios by village collaboration level 175
Figure 16: Comparison of facilitator-to-barrier code ratios and village-level collaboration 175
Figure 17: Distribution of factor scores by dyadic vector 222

Chapter 1: Introduction

1.1 Study Overview

Given that human health is influenced by myriad biological, environmental, and social factors, collaboration across organizational and sectoral boundaries is widely recognized as a critical aspect of policies, programs, and interventions to address complex public health issues (1–7). Although the concept of multi-sectoral collaboration (MSC) is far from novel in the global public health community (5,8), interest in MSC has been reinvigorated by the recent introduction of the Sustainable Development Goals (SDGs) (4) and growing commitment of governments around the world to achieve Universal Health Coverage (9).

Yet despite the widely recognized importance of MSC, its clear rationale, and a recently heightened level of global attention, MSC is often undertheorized and difficult to measure (1,6,10,11), resulting in a shortage of empirical evidence about what constitutes effective MSC as well as how MSC affects population health outcomes (1,5,6). Despite a growing number of case studies on MSCs, there is still a substantial knowledge gap about the types of strategies and interventions that may be most effective in establishing or improving such collaborations (5,6). Progress in this direction is often impeded by limited understanding and measurement of the hypothesized

causal links between the establishment of a collaborative structure or process and the improvement of population health outcomes (10), which I refer to in this dissertation as the "missing middle" of MSC.

These challenges are exemplified by India's Integrated Child Development Services (ICDS) scheme, a multi-sectoral program led by the Ministry of Women and Child Development (MWCD), in close collaboration with the National Rural Health Mission (NRHM) of the Ministry of Health and Family Welfare (MoHFW)[1], that delivers maternal and child health and nutrition services and early childhood education in nearly one million villages around the country. Although the scheme has achieved widespread national coverage in terms of frontline worker staffing and community-based "anganwadi" centers, results to date have been mixed: some evaluations have demonstrated reduced stunting among individual children receiving services (12,13), while others have failed to show village- or population-level impact, due in part to implementation gaps and uneven funding (13,14). One gap that has been consistently identified but never systematically measured is the collaboration between three key frontline worker from two different ministries: the anganwadi worker (AWW), accredited social health activist

[1] Note: the Ministry of Health and Family Welfare (MoHFW) operates at the state level as the Departments of Health and Family Welfare (DHFW) and the two abbreviations (MoHFW and DHFW) are sometimes used interchangeably in documentation. This paper uses the MoHFW abbreviation to refer to both structures, since for the purposes of this analysis there is no functional distinction between the national-level policy and the interpretation and implementation of that policy at the state level.

(ASHA), and auxiliary nurse midwife (ANM), sometimes collectively referred to as the "AAA" workers (15).

Even as the India's 2017 National Nutrition Strategy signals a redoubling of government efforts to enhance collaboration or "convergence" across departmental boundaries, particularly among the AAA workers at the frontline (16,17), there is still relatively little documentation of what AAA collaboration looks like in practice and what is needed in order to improve it (18). This mixed methods study develops and tests a scale-based metric to assess collaboration between these frontline workers as a step toward elucidating this critical aspect of the "missing middle" of MSC in India's ICDS. Adaptations of the scale may have much broader applications.

This introduction chapter begins by briefly summarizing the current state of early childhood health, nutrition, and development in India and describing the Indian government's efforts to address population needs in these areas through the Integrated Child Development Services (ICDS) scheme. Next is an overview of the literature on multisectoral collaboration (MSC), including the origins and evolution of MSC for health in LMICs, as well as the literature on inter-professional collaboration, which focuses on the implementation and measurement of MSC at the level of service delivery.

The chapter concludes with a summary of the overall study aim, research objectives, and mixed methods research design.

1.2 Early childhood health, nutrition, and development in India

1.2.1 Status of children's health, nutrition and development in India

Despite twenty years of economic growth, increasing agricultural productivity, and the existence of effective interventions, child health and nutritional outcomes remain poor in certain parts of India, especially the states of Uttar Pradesh and Bihar. While India achieved its 2015 Millennium Goal (MDG) target for reducing the maternal mortality ratio (down to 130 maternal deaths per 100,000 live births in 2016, as compared to a target of 139 by 2015), nearly achieved its MDG target for under-five mortality (43 deaths per 1,000 live births in 2015 as compared to a target of 42) (19), and appears to be on track for achieving its Sustainable Development Goals (SDG) targets for both indicators (20–23), progress to improve outcomes in neonatal mortality (23,24) and child nutritional and development outcomes (13) has been slower, particularly among populations of lower socioeconomic status. Full immunization coverage among children aged 12-23 months increased from 43.5% in 2005-6 to 62% in 2014-2015 (25), but remains low overall and is similarly characterized by dramatic disparities between states and socioeconomic groups (26). With rates of childhood malnutrition five

times as high as China and twice as high as countries in sub-Saharan Africa, India has an estimated 60 million underweight children, representing over a third of the global total (27). The health impact of malnutrition is often assessed through anthropometric measures, including stunting (low height-for-age), wasting (low weight-for-height), underweight (low weight-for-age), and overweight and obesity (28), as well as through laboratory and clinical measures (e.g., micronutrient deficiencies, metabolic indicators) (29,30). Societal impacts of child malnutrition include increased mortality (e.g., infant, under-five), reduced economic productivity, and deepened poverty for affected populations. On a positive note, India has seen meaningful improvements in some of these metrics within the past decade. For instance, between 2005-6 and 2013-14 the national prevalence of under-five stunting decreased from 48% to 38.7%, the prevalence of underweight decreased from 42.5% to 29.4%, the prevalence of wasting decreased from 19.8% to 15.1%, and the rates of exclusive breastfeeding increased from 46.4% to 64.9% (31). Nonetheless, substantial gaps and disparities remain, with a disproportionate burden on those with low socioeconomic status, the "backward classes", girls, and residents of northern India (32).

1.2.2 Integrated Child Development Services (ICDS) scheme

Recognizing the complex, multi-sectoral nature of child health and development, the Government of India established the Integrated Child

Development Services (ICDS) scheme in 1975, with the aim of "breaking the vicious cycle of malnutrition, morbidity, reduced learning capacity and mortality caused by nutritional deficiencies" among the country's children (33). To achieve this goal, the ICDS delivers six specific services, including: supplementary nutrition; non-formal pre-school education; immunization; health check-ups; referral services; and nutrition and health education (34). Targeted beneficiary groups include children under six years of age, pregnant women, lactating mothers, and adolescent girls. Delivered primarily at community-based ICDS centers in rural areas, at local health facilities and via home visits, these services are intended to target the nutritional issues at the critical window of child development from the antenatal period through the age of six years, improving child nutritional outcomes (e.g., wasting, stunting, underweight), development outcomes (e.g., cognitive, physical and social development), and ultimately reducing infant and child morbidity and mortality. Although less explicitly emphasized, ICDS is also intended to reduce maternal mortality (34).

Since its inception, ICDS has been the Indian Government's flagship initiative targeting childhood malnutrition, with a focus on the poorest and most underserved areas of the country. Given the overlapping responsibilities of multiple government ministries in administering the scheme, the government has repeatedly emphasized the need to "achieve effective

coordination of policy and implementation amongst the various departments to promote child development" (33). For example, although the scheme is technically led by the Ministry of Women and Child Development (MWCD), the National Rural Health Mission (NRHM) is closely involved in referrals, health check-ups and immunizations at the community level (33).

1.2.2.1 Policy-making process

In many ways, the ICDS scheme is a natural progression within a series of iterative policy decisions that began over 75 years ago. Starting in 1939-1940, the National Planning Committee promoted the provision of government support to the welfare of children during India's independence movement (34). This commitment was later codified in the Constitution of India following independence in 1947, and operationalized through the establishment of the Central Social Welfare Board (CSWB) in 1953, which implemented a variety of schemes to provide care and medical attention to children and pregnant women (34). With this policy foundation as a backdrop, combined with strong evidence of persistently high rates of child malnutrition, including stunting and wasting, two key focusing events in the early 1970s precipitated the creation of ICDS in 1975. First, a Planning Commission evaluation of key CSWB schemes found that benefits were only reaching a small proportion of the targeted beneficiaries and that the intended coordination between nutrition, health, education, and other social

welfare activities was not taking place at the local level (34). Second, as a response to the evaluation findings, the National Policy for Children in 1974 declared children a "supremely important asset" and that children's programs should figure prominently in national development plans for the country (34). Every Indian Prime Minister since Indira Gandhi has increased the financial allocation to ICDS in the country's five-year development plans (35) – with the notable exception of Narendra Modi (36) – prompted in part by a 2001 Supreme Court order to "universalize" ICDS as well as growing civil society mobilization and increased domestic and international media attention to the issue (37,38).

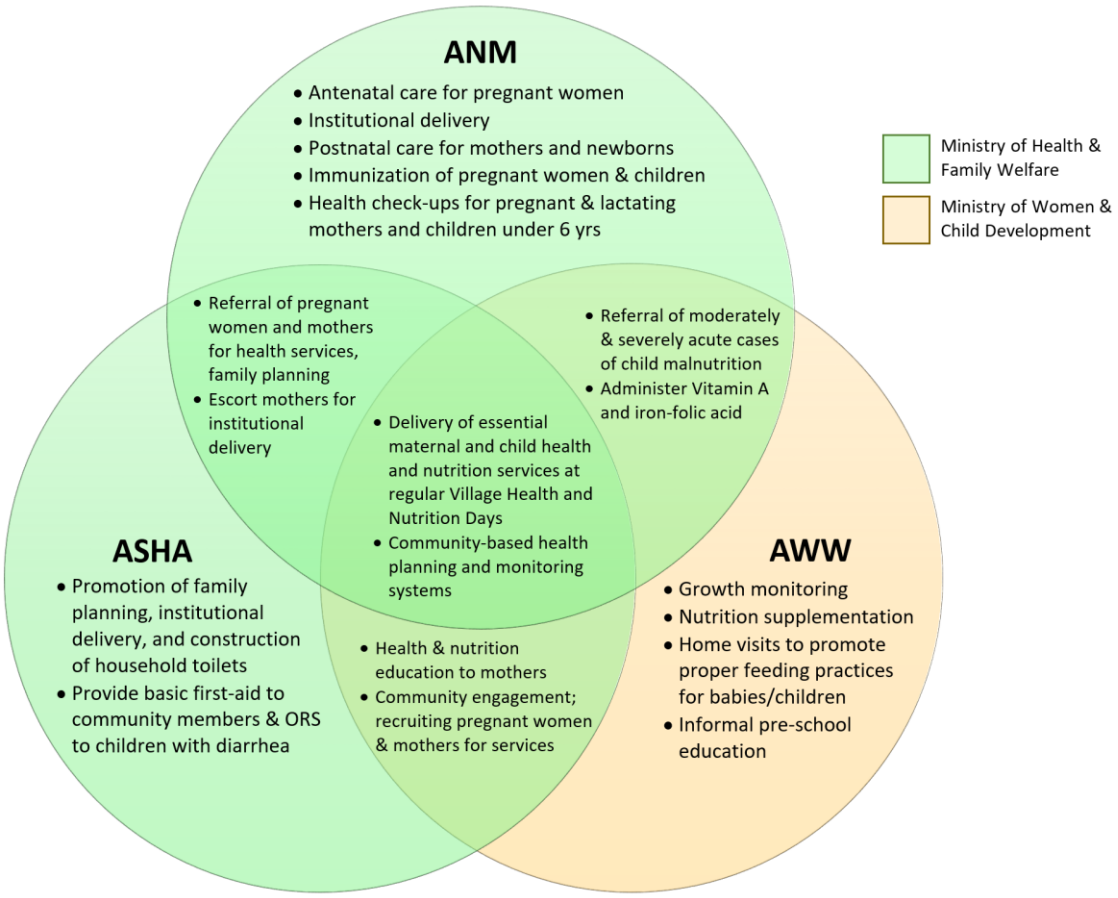
1.2.2.2 Policy implementation

Along with the national mandate to deliver the ICDS package, state governments receive central government funding for the scheme based on state-level development characteristics, including poverty rates, level of infrastructure and population health outcomes (13). The six core ICDS services are delivered at the community level by a team of three key frontline workers, including a nutrition-focused "anganwadi worker" (AWW), a health-focused accredited social health activist (ASHA), and a clinically trained auxiliary nurse midwife (ANM). These services complement and, to some extent, overlap with the basic package of primary health care services

provided by the health ministry (MoHFW), which include family planning, antenatal and postnatal care, skilled delivery and other services.

The AWW is employed by the MWCD while the ASHA and ANM are employed by the MoHFW. To achieve the multi-sectoral integration envisioned in the scheme, these three frontline workers are expected to collaborate with each other (sometimes referred to as "AAA" collaboration, given their titles) to improve the quality and continuity of services to children and mothers, including through immunization, promotion of antenatal care (including nutritional support), coordinated counseling to mothers on feeding practices (including promotion of breastfeeding), basic care (e.g., treatment of malnutrition, de-worming) and referral of severely malnourished children to health facilities for treatment (15), as outlined in Figure 1 below. Both AWWs and ASHAs have a critical role to play in working with local community leaders and community groups to inform and recruit eligible women and their children to utilize these services (13,34).

Figure 1: Individual and overlapping responsibilities of the ANM, ASHA, and AWW



Adapted from: (33,39,40)

Having been initially launched as an experimental project in twenty-nine rural and tribal blocks and four urban slums, success in the first five years to 1980 contributed to a government decision to scale it up nationally (41). That initial enthusiasm, combined with a government mandate and high political profile, eventually resulted in expansion of the scheme to over 6,000 blocks and nearly one million community ICDS centers across 91.5% of villages by 2005-6, with overall progressive implementation such that those with lower socioeconomic status were more likely to receive services (12).

Yet despite this massive scale-up, there have been numerous disparities and gaps in the scheme. Funding allocation from the central government to the states was found to be significantly associated with the percentage of the state that voted for the ruling coalition (13) rather than program need; the scheme focused almost exclusively on the supplementary nutrition component, often to the detriment of the other services (12,34); and service delivery often failed to reach key targeted groups, especially girls and children in the critical 6 months to 2-year age window (12). Additionally, multiple evaluations found that ICDS implementation consistently suffered from poor coordination and low support from key counterparts, including health service providers and local government officials, community members and leaders (13,34). These and other limitations prompted recommendations to redesign the program (13) as well as its monitoring and evaluation approach and systems (35).

1.2.2.3 Policy impact

Many evaluations have been conducted on the ICDS, generally highlighting mixed results in levels of service coverage and quality across the country and, in many cases, substantial implementation gaps. The general consensus from many evaluations of the ICDS scheme prior to 2010 was that coverage had increased substantially, albeit disproportionately in higher income areas, but

had produced minimal evidence of overall impact on key nutritional and health outcomes in children (14,42,43). More recently, researchers have highlighted limitations of the ecological design (i.e., using average utilization and nutritional status indicators at the village level or higher) that had been typically used by evaluators, which made it impossible to explore individual-level associations between exposure and outcome (12,13). Some have found significant anthropometric benefits from ICDS supplementary feeding using individual-level exposure and outcome data from the NFHS 2005-6 (12), particularly for the most malnourished children (13). Looking beyond the scheme's supplementary feeding component, which has tended to be the primary evaluation focus (44), other researchers have noted that most families use only certain ICDS services rather than the full package, the scheme does not seem to have any effect on parenting practices (such as breastfeeding), and needed medical referrals are often not provided (13). These findings, combined with evidence of gaps and disparities in service coverage and targeting, highlight both the potential value of the ICDS as well as a clear need to address outstanding implementation challenges (13).

1.2.2.4 Strengths and weaknesses of ICDS

Key strengths of the ICDS include its high profile, substantial and sustained political and financial commitment from the national government, with technical and financial assistance from major development partners, such as

UNICEF, the World Bank and others. Many areas in need of strengthening or revision within the ICDS have already been identified, such as shifting the focus to 0-2 year-olds and increased focus on parental feeding practices, including breastfeeding (12); increased funding, addressing problems with improper storage facilities, erratic food supplies, communication, logistics (15); addressing possible clientelism and bias in the distribution of funds (13); additional training, increased staffing, better resourcing and working conditions, especially for underserved areas (45).

One area that has frequently been identified as problematic but is only indirectly addressed in research and often glossed over in recommendations is multi-sectoral coordination at the local level, specifically between AWWs, ASHAs, and ANMs, as well as with local government and community members. In 2010, the Prime Minister's National Nutrition Council renewed the Indian Government's commitment to this initiative, making several key decisions that increased the emphasis on multi-sectoral collaboration, including explicit integration of a nutrition focus into the core business of other ministries, such as Health, Drinking Water Supply and Sanitation, Education, Agriculture and others (46). Related to this point, Sachdev and Dasgupta call for "better convergence and coordination" (15), while the authors of the 2011 ICDS evaluation commissioned by the Planning Commission state that "out-of-box thinking and evidence-based policy

formulation are necessary for designing an innovative implementation mechanism" (34). These recommendations are insightful and essential, if vague. Operationalizing them will require the Government of India (with support from development partners as appropriate) to move beyond the traditional logical framework approach to program implementation and incorporate systems thinking (47) and collaborative governance (48) methods to assess, manage, monitor and evaluate the complex relationships between the multiple, interdependent stakeholder groups in the ICDS scheme. This in turn has the potential to facilitate more productive partnerships and thus a more impactful program at the local level.

1.3 Multisectoral and inter-professional collaboration

1.3.1 Concept and definition of multi-sectoral collaboration (MSC)

Although the concept of collaborative or collective action dates back to – and indeed was intrinsic to – the start of human civilization, the focus of this study is on the collaboration between organizational entities or groups of entities serving fundamentally different functions in society, specifically for the purpose of improving health outcomes in human populations. Within this frame of reference, the consensus definition from the 1997 international conference "Intersectoral Action for Health: A Cornerstone for Health-for-All in the Twenty-First Century" provides additional clarity. In that conference,

intersectoral action for health – which I will treat as synonymous with multi-sectoral collaboration – was defined as:

> *"a recognized relationship between part or parts of the health sector with part or parts of another sector which has been formed to take action on an issue to achieve health outcomes (or intermediate health outcomes) in a way that is more effective, efficient, or sustainable than could be achieved by the health sector acting alone." (National Centre for Health Promotion 1995, cited in* (2)*)*

While the focus on health outcomes is particularly relevant for this analysis and public health research more broadly, the factors influencing the development and effectiveness of multi-sectoral collaboration writ large need not be health-specific. For that reason, it is worth exploring conceptual and theoretical frameworks beyond the health sector and its associated body of literature in order to understand how and when these types of multi-sectoral collaborations are formed and what makes them successful (or not).

1.3.2 Origins and evolution of MSC for health in LMICs

As articulated by Packard in his book *A history of global health: interventions into the lives of other people*, the idea of multi-sectoral determinants of health rose to international prominence in the 1920's, particularly in Europe, where

there was a movement of public health leaders emphasizing the link between health and social and economic development more broadly (8). According to Packard, that movement – along with the Great Depression in the United States, starting in 1929 – was influential in shaping thinking about multi-sectoral approaches to population health at the 1932 Cape Town Conference and the 1935 League of Nations conference in Johannesburg, both of which emphasized the importance of economic development and collaboration between colonial health authorities and other departments, ranging from agriculture to education and police (8). This growing international interest in broader social determinants of health continued until the late 1930s and was affirmed in the 1948 WHO Constitution but was then overpowered by the allure and expediency of "scientific solutions" delivered through vertical programs, which promised results without having to address underlying structural or social issues that contributed to patterns of disease around the world (8,49).

The concept of "intersectoral action for health" was formally introduced at the International Conference on Primary Health Care in Alma Ata, Kazakhstan in 1978 (3), was incorporated into many countries' official policy frameworks in the 1980s, and has been highlighted as a central component of multiple subsequent health conferences, initiatives and movements, including: "Health for All", launched by Halfdan Mahler of the World Health

Organization (WHO) in 1981 (49); the WHO's 1997 Conference on Intersectoral Action for Health (2); the Millennium Development Goals, adopted by 170 heads of state in 2000; "Health in all Policies", introduced by the European Union in 2006 (3); the 2015 Sustainable Development Goals (4); and others.

Yet despite the longstanding, high profile, global recognition of the importance of multi-sectoral collaboration, there is limited evidence to date of successful translation into policy, implementation of integrated action, and impact on health, health equity, and social determinants of health (49–52). Proposed explanations for these underwhelming results include challenges in documenting the complex dynamics of a multi-sectoral collaboration in a meaningful, systematic way (50); design issues with both interventions and evaluation studies such that observed outcomes could not be attributed to the multi-sectoral partnership (53); and, in some cases, an inherent tension between multi-sectoral action and the fundamental structure and functioning of government institutions (Vincent 1999, in (50)).

Given the inextricable linkages between the multiple facets of society that together influence human health outcomes, it would be naïve and likely irresponsible to conclude that the paucity of empirical evidence of positive health impact from MSCs indicates that the concept is inherently flawed. It

would be equally naïve to assume that MSC is a necessary or beneficial component of all public health interventions. The challenge, then, is to develop a better understanding of when, how and why MSCs succeed, which in turn requires a set of methods to systematically study the key steps and dynamics between the establishment of the collaborative arrangement and the tangible, observable outputs of the collaboration – i.e., methods to investigate the aforementioned "missing middle".

1.3.3 Concept and definition of inter-professional collaboration

In contrast to the literature on multi-sectoral collaboration, which tends to have a macro focus on the key opportunities, needs and policy details of collaboration between broad sectors (e.g., health, education, etc.), inter-professional collaboration tends to have a more micro focus at the individual and organizational levels. As defined by the WHO in the 2010 Framework for Action on Interprofessional Education & Collaborative Practice, "collaborative practice" occurs when *"multiple health workers from different professional backgrounds provide comprehensive services by working with patients, their families, carers and communities to deliver the highest quality of care across settings"* (54).

This literature is relevant to this study topic because it explores the measurement of collaboration closest to the point(s) of service delivery, which

is often an essential, if under-emphasized, aspect of multi-sectoral collaboration. Given that there has been a large amount of work done specifically to develop, test and validate psychometric scales to measure health worker collaboration at the point of service delivery, this body of work is a rich source of content for the development of a scale intended to measure collaboration between frontline health and nutrition workers in the present study.

At the same time, it is important to note that this work on inter-professional collaboration is derived largely from integrated health care practice in high income countries, specifically for topics like mental health, primary care, obstetrics and maternity care, geriatric and home-based care, and others (55). Thus, there are substantial contextual differences between the settings of these studies and the setting of the present study in rural northern India. To the author's knowledge, there are no existing scales to assess collaboration between frontline workers in India or any other LMIC.

The above observations have important implications for this study. On the one hand, the substantial amount of theoretical work, psychometric testing and validation, and effort to develop internationally generalizable instruments suggests that the existing collaboration scales may be at least partially applicable to the study context. On the other hand, the fact that

there are substantial contextual differences means that there may also be important differences in the format and content of the scale. This may mean, for instance, that certain components of the collaboration construct will need to be added, omitted, or adapted, both within the set of scale items included in the data collection instrument as well as the overarching conceptual framework for collaboration.

1.4 Conceptual framework

The conceptual framework guiding this study is adapted from Emerson's and Nabatchi's Integrative Framework for Collaborative Governance, which synthesizes and bridges several decades of research on collaboration across a broad array of professional fields and academic disciplines (48). The framework loosely follows a theory of change structure to analyze the development, functioning, actions, and outcomes of a "collaborative governance regime"[2] (CGR), which is defined as:

> *"a type of public governance system in which cross-boundary collaboration represents the predominant mode for conduct, decision-making, and activity between autonomous participants who have come*

[2] As stated by the authors, the use of the word "regime" in this framework is borrowed from Stephen Krasner, who defined it as a "governing arrangement that is imbued with a set of explicit and implicit 'principles, norms, rules, and decision-making procedures around which actor expectations converge in a given issue area.'" (Krasner 1983, in (48)).

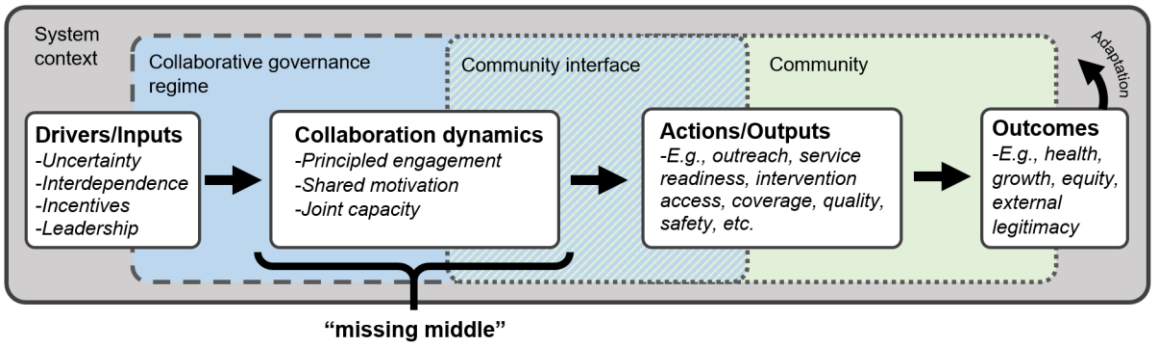
> *together to achieve some collective purpose defined by one or more target goals."* (48)

The specific form and locus of action of a CGR vary depending on its purpose. For instance, a policy-oriented CGR may involve high-level decision-makers focused on identifying strategic solutions for issues related to general policy domains, such as health, education, environment, etc., whereas a site-specific CGR may involve participants responsible for planning and delivering defined services to a specific population or community (48). Collaboration between the AAA frontline workers most closely represents the latter, implementation-oriented type of CGR.

Figure 2 shows the adapted version of the Emerson & Nabatchi framework used for this study. The framework contains several interrelated components of collaborative governance: the *system context*, which represents a variety of contextual factors that affect and are affected by the CGR; *drivers* of collaborative action and the formation of the CGR; the *collaboration dynamics*, which characterize the relationships and interactions between the key actors involved in the CGR; *actions* taken and *outputs* produced by the CGR; and *outcomes* of those actions, which may result in adaptation within the CGR as well as within the broader system context. The striped blue/green section in the middle represents the interface between the CGR and the

community and is intended to reflect the influence of community context on frontline worker collaboration.

Figure 2: Author's adaptation of Integrative Framework for Collaborative Governance



Adapted from: (48)

Within this framework, the 'collaboration dynamics' component most closely represents the "missing middle" in evaluation frameworks of multi-sectoral collaboration; this is what the collaboration scale is intended to measure.

Emerson and Nabatchi propose that "all CGRs are constituted by their collaboration dynamics and the specific actions taken as a consequence of those dynamics" (48). These collaboration dynamics consist of three primary components – principled engagement, shared motivation, and joint capacity – which interact dynamically and iteratively to determine the quality and

extent of collaboration over time. These are briefly paraphrased in Table 1 below:

Table 1: Sub-domains of Emerson's and Nabatchi's collaboration dynamics

Sub-domain	**Brief description** *(paraphrased from Emerson & Nabatchi* (48)*)*
Principled engagement	An iterative process of interaction that enables people to collaborate across their respective institutional or sectoral boundaries to solve problems or create value together. Interactions are characterized by behavioral norms, such as fair and civil discourse and open and inclusive communication.
Shared motivation	Joint recognition among participants that their ongoing investment of time and resources into the CGR is worthwhile for themselves and the organization or constituency they represent; this fosters participants' emerging identification with, and ultimately reinforces their dedication to, the CGR.
Joint capacity	A combination of essential elements – including procedural and institutional arrangements, leadership, knowledge, and resources – that enable CGR participants to accomplish their collective purpose as specified in their shared theory of change.

1.5 Study aim, research objectives and mixed methods design

1.5.1 Overarching aim and research objectives

The overarching research aim for this study is to develop and validate a quantitative scale measuring the extent or level of collaboration between the three key "AAA" frontline workers involved in delivering essential health and nutrition services in rural northern India. Within this overarching aim are four key research objectives, which are addressed in the three papers that follow, as outlined in Table 2.

Table 2: Research objectives by dissertation paper

Dissertation paper	Research objectives	Comment
Paper 1	**Objective 1:** Define and develop a scale to measure collaboration between the AAA frontline workers	The first objective is to develop a psychometric scale for measuring collaboration between the "AAA" frontline workers in rural India, drawing from existing theoretical work, empirical research – including qualitative studies as well as quantitative scales to measure inter-professional collaboration – as well as relevant policy documentation from the study context.
	Objective 2 (Quantitative analysis): Assess the psychometric properties of the frontline worker collaboration scale	The second objective is to quantitatively assess the reliability and validity of the "AAA" collaboration scale developed as part of Objective 1.
Paper 2	**Objective 3** (Qualitative analysis): Identify key factors affecting collaboration between the AAA workers	The third objective of the overarching study is to identify key factors affecting collaboration among the AAA frontline workers in the study area using qualitative data from in-depth interviews.
Paper 3	**Objective 4** (Mixed analysis): Assess the construct and content validity of the frontline worker collaboration scale via triangulation with qualitative findings	The fourth and final objective of the overarching study is to apply qualitative findings from Objective 3 in a mixed analysis to assess the construct and content validity of the collaboration scale (developed in Objective 1 and tested in Objective 2).

1.5.2 Mixed methods instrument development design

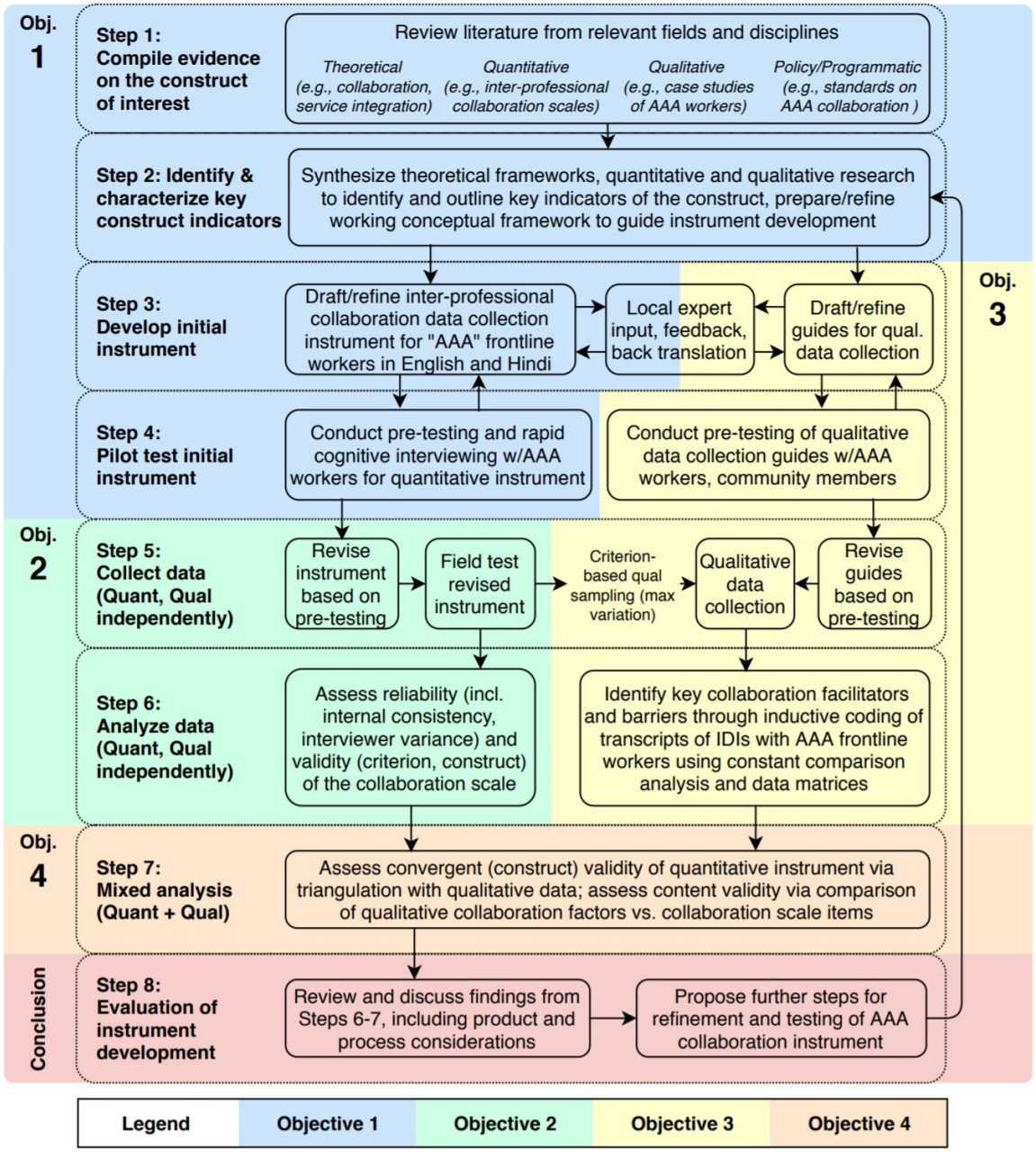
The overall study design roughly follows the Instrument Development and Construct Validation (IDCV) process, which is a 10-phase framework for applying mixed methods research to “optimize the development of a quantitative instrument” (56). The approach and timing for bringing together the quantitative and qualitative data follow a "concurrent design using identical sample" (i.e., eliciting qualitative responses in addition to quantitative responses from the same group or subset of field-test participants involved in the administration of the quantitative scale), as described by Onwuegbuzie and Collins (57).

The two theoretical purposes of combining quantitative and qualitative methods for the development of the frontline worker collaboration scale are “triangulation” and “complementarity”, as described by Greene at al. (58). The triangulation purpose, which is defined as “the use of multiple methods, with offsetting or counteracting biases, in investigations of the same phenomenon in order to strengthen the validity of inquiry results” (58), applies to the validation of the “AAA” collaboration scale using qualitative data on collaboration collected from the sampled villages. The purpose of complementarity, which Greene et al. describe as seeking "elaboration, enhancement, illustration, clarification of the results from one method with the results from the other method” (58) applies to the assessment of the

content validity of the collaboration scale, given that key collaboration factors identified through the qualitative analysis may be used to expand or refine the scale items.

Figure 3 briefly summarizes the key steps in the research design, including key methodological components, according to the four key objectives of the overall study, which are labeled and color-coded.

Figure 3: Flow diagram of mixed methods study design aligned to Research Objectives



1.6 Contribution of this study

While there is broad global consensus about the importance, necessity, and potential benefits of MSCs, there is limited empirical evidence on how they actually function in practice, which impedes our collective understanding of how to make them successful. Current barriers to gathering this evidence are both methodological and conceptual. On the one hand, the complex and evolving dynamics of MSCs obviate the possibility of experimental evaluation designs in most cases, while underdeveloped conceptual underpinnings limit theory-driven evaluation. In short, the global public health research community is still trying to figure out how best to study MSCs in order to provide practical, actionable insights that policymakers and practitioners can use to better serve their respective target populations (5).

This methodological challenge is exemplified by India's ICDS scheme. While the collaboration between the "AAA" frontline workers has been identified as an essential ingredient to the implementation of MoHFW and MWCD community-level interventions and, by extension, the overall improvement of maternal health, child survival and early childhood development, it has, to the author's knowledge, never been measured as part of routine program monitoring or systematically assessed in evaluations to date. This lack of information on how well the collaboration component of the ICDS scheme is functioning has both programmatic and policy implications.

Programmatically, ICDS officials may not be aware of whether and how collaboration dynamics between frontline workers (positively or negatively) affect the achievement of service delivery targets, which limits their ability to learn about what works or address problematic arrangements. On the policy level, the lack of a metric for frontline worker collaboration makes it difficult to assess: a) the effects of state- and local-level governance structures and multi-sectoral coordination mechanisms on frontline worker collaboration at the point of service delivery, and; b) the association, if any, between "AAA" collaboration and the coverage and quality of frontline health services. Both gaps limit the ability of the Indian government to critically reflect on the overall design and assumptions of the ICDS scheme as well as the specific policies in place to implement the scheme.

This study takes a step toward filling this measurement gap in India's ICDS scheme. In the short-term, this study is intended to produce a scale instrument that can be administered to the AAA frontline workers to quantify the degree of collaboration between them, enabling more robust evaluations of the ICDS scheme (and the MoHFW's National Rural Health Mission). The scale could also be considered for inclusion as part of the routine, joint monitoring and evaluation of the frontline health and nutrition services by the MWCD and MoHFW, which may help program managers plan targeted interventions to improve collaboration between the AAA frontline

workers and to track the effects of those interventions over time. More broadly, this study is intended to contribute theoretical and methodological considerations for the systematic measurement of frontline worker collaboration in low- and middle-income countries (LMICs), which may differ in important ways from inter-professional collaboration in high income countries, where the bulk of the research on this topic has originated. This in turn may help illuminate a critical step in the "missing middle" of the logical framework for some multi-sectoral initiatives – particularly those involving direct service delivery to rural communities – thus facilitating the generation of much-needed empirical evidence on the effectiveness of these types of partnerships in achieving their stated health and social objectives.

1.7 Parent study

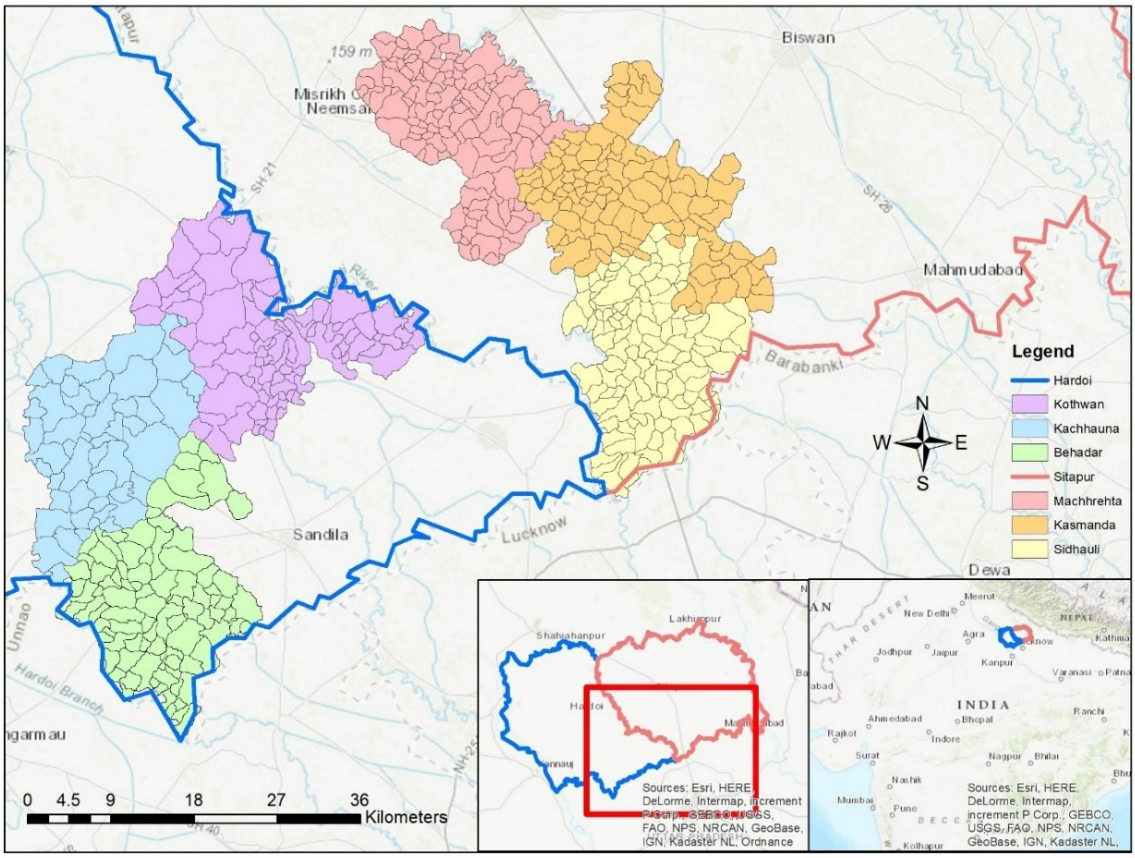
This study is nested within a broader evaluation activity conducted by the Johns Hopkins Bloomberg School of Public Health (JHSPH) and a contracted New Delhi-based social research firm, which directly managed data collection activities. The study was conducted on behalf of the HCL Foundation (http://www.hcl.com/hcl-foundation), which is the corporate social responsibility (CSR) arm of HCL Technologies (www.hcltech.com), a multi-billion dollar international technology firm based in Noida, a suburb of New Delhi, India. As part of its CSR initiative, the HCL Foundation (HCLF) launched Project Samuday to contribute to positive health and development

outcomes in the state of Uttar Pradesh (UP), India. Through this project, the HCL Foundation is seeking to develop a replicable, integrated model for improving rural economic and social development across five key areas (education, employment, health, infrastructure, and water) in partnership with central and state government, communities, NGOs, and other stakeholders. Recognizing the inherent complexity and deeply contextual nature of intersectoral interventions and meaningful community engagement, the HCL Foundation seeks to build on existing experiences in the region while incorporating innovative, participatory systems thinking methods. Based on the results of a pilot intervention in three blocks of Hardoi District (Kachhauna, Behadar, and Kothawan), HCLF seeks to develop a scale-able approach for integrated rural development in villages across Uttar Pradesh state more broadly. As a first step toward this broader objective, HCLF contracted JHSPH to conduct a baseline study, measuring a broad range of key health and social indicators at the household level in Project Samuday's targeted intervention and control areas, as well as gauging community member perceptions of local development issues and priorities, and characterizing current levels and mechanisms of group participation and collective action. This information was then provided to the HCL Foundation to inform and refine the design and implementation of Project Samuday interventions and, where applicable, to serve as a baseline to monitor changes over time (e.g., after 3-5 years) in key outcome indicators.

1.7.1 Research site

The data collected for this study come from Uttar Pradesh state, India, including three administrative blocks in Hardoi district (i.e., the purple, blue and green sections in Figure 4) and three administrative blocks in Sitapur district (i.e., the red, orange, and yellow sections), corresponding to the study area in the Project Samuday baseline evaluation. To put the study site in context within India, Uttar Pradesh is both the country's most populous state, as well as one of the least well off in terms of economic development and health outcomes. Among the seventy-five districts in the state, Hardoi and Sitapur tend to fare slightly worse than the average on a variety of health and social indicators, but are not outliers (i.e., the districts tends to be closer to the middle rather than the ends of the distribution). A table of key health and social indicators for Hardoi, Sitapur, and for Uttar Pradesh state overall is provided in Appendix *A1: Health and sociodemographic indicators in Hardoi, Sitapur and Uttar Pradesh.*

Figure 4: Study site in Hardoi and Sitapur districts, Uttar Pradesh



1.7.2 Parent study team

The Principal Investigator for the baseline evaluation was Dr. Shivam Gupta from JHSPH, who provided overall technical and managerial leadership and oversight for the HCLF contract. Other JHSPH faculty providing technical input included Dr. David Bishai from the Department of Population, Family and Reproductive Health and Dr. Krishna Rao, Dr. Kerry Scott, Dr. Connie Hoe, and Dr. Diwakar Mohan from the Department of International Health. Contributing JHSPH graduate students included Zabir Hasan and Niloufer Taber (PhD Program, Health Systems Program) and Binita Adhikari (May

2017 MSPH graduate from the Health Systems Program). The author of this dissertation was closely involved in all phases of this project, playing a lead role in the design and planning of the household survey and overall mixed methods data collection approach, and providing technical and quality control support in the development of the study protocol and Institutional Review Board submissions and process; development of data collection instruments (including with the computer-assisted personal interviewing, or CAPI, platform); preparation of training materials, field manuals and field implementation plans; pre- and pilot-testing; data collection and management; and report-writing.

1.8 Organization of the dissertation

This first chapter introduced the study context, relevant literature, research objectives and overarching design. The three pieces of research comprising this dissertation are presented in each of the three following chapters: Chapter 2, which represents the quantitative strand of the overarching study design, describes the development and psychometric assessment of a frontline worker collaboration scale; Chapter 3, which represents the qualitative strand, describes the identification of key factors affecting AAA frontline worker collaboration based on in-depth interviews with the workers; Chapter 4 brings together the results from the quantitative and qualitative stands in a mixed methods analysis of the construct and content validity of the

collaboration scale. Chapter 5 provides concluding remarks about the dissertation and outlines suggested areas for future research.

Chapter 2: Scale development and testing (Paper 1)

2.1 Introduction

2.1.1 Background

Given the interconnectedness of biological, environmental, and social determinants of health, the global public health community has long recognized the importance of designing and implementing interventions requiring collaboration between stakeholders from multiple sectors. On the surface, the justification for doing so seems irrefutable: no single sector can adequately address many of the most pressing population health issues, ranging from non-communicable diseases to antimicrobial resistance to mental health. Yet despite the clear theoretical rationale for multi-sectoral collaboration (MSC), there is a shortage of empirical evidence about what constitutes effective MSC as well as how MSC affects population health outcomes (1,5,6). In short, there appears to be broad consensus that MSC is important but a substantial gap in understanding of whether, how, when, with which actors, and in what form it should be implemented in a given context. As several researchers have noted, this lack of data is due in part to the lack of suitable indicators and research methods to evaluate the functioning of MSCs as well as the fact that evaluators tend not to clearly define the causal pathway(s) through which MSC is intended to affect population health outcomes (1,10,59). This in turn contributes to a conceptual

and evidentiary gap between the development of collaborative arrangements and the intended long-term outcomes (10), which I refer to in this paper as the "missing middle" of MSC.

These issues are particularly relevant for India's Integrated Child Development Services (ICDS) scheme, which is a holistic early childhood development program designed to address proximal factors such as nutritional intake and disease as well as underlying causes related to food security, healthcare access, social protection, and other issues. The largest program of its kind globally, the ICDS scheme is led by the Ministry of Women and Child Development (MWCD), in close collaboration with the National Rural Health Mission (NRHM) of the Ministry of Health and Family Welfare (MoHFW), and is delivered to women and children in nearly one million villages around the country by a team of frontline workers from both ministries: the anganwadi worker (AWW), accredited social health activist (ASHA), and auxiliary nurse midwife (ANM), sometimes referred to as the "AAA" workers (15).[3] Results to date are mixed: several evaluations have highlighted substantial gaps in ICDS implementation and, consequently, limited overall impact on child nutritional status (12,14); other studies have

[3] Note: the Ministry of Health and Family Welfare (MoHFW) operates at the state level as the Departments of Health and Family Welfare (DHFW) and the two abbreviations (MoHFW and DHFW) are sometimes used interchangeably in documentation. This paper uses the MoHFW abbreviation to refer to both structures, since for the purposes of this analysis there is no functional distinction between the national-level policy and the interpretation and implementation of that policy at the state level.

found positive developmental outcomes among children who received ICDS services (12,13). Although frontline worker collaboration has been identified both by the Indian government (39) and by researchers (18) as critical to the expansion of effective coverage of key maternal and child health and nutrition services, it has never been systematically measured. Furthermore, there do not appear to be any existing scales to assess collaboration between frontline workers in India (or any other LMIC) that could help fill this gap.

2.1.2 Research objectives

This paper reports results from the first two objectives of an overarching mixed methods study, corresponding to the quantitative component of the analyses in Phases 1-6 of the Instrument Development and Construct Validation framework described by Onwuegbuzie et al. (56). These objectives are to: 1) define and develop a scale to measure collaboration between the AAA frontline workers; and 2) assess the psychometric properties of the frontline worker collaboration scale.

2.1.3 Parent study and research site

This study was nested within a frontline worker survey, which itself was one component of a mixed methods baseline evaluation of Project Samuday, a multi-sectoral initiative implemented by the HCL Foundation (http://www.hcl.com/hcl-foundation) to improve rural economic and social

development in Uttar Pradesh, India across five key areas (education, employment, health, infrastructure, and water) in partnership with central and state government, communities, NGOs, and other stakeholders. The baseline evaluation was conducted in six administrative blocks of two districts (Hardoi and Sitapur) in Uttar Pradesh by the Johns Hopkins Bloomberg School of Public Health (JHSPH) and a contracted New Delhi-based social research firm, which directly managed data collection activities. The data for the present study are from the same six administrative blocks of Hardoi and Sitapur districts as the baseline evaluation. A table of key health and social indicators for these districts and for Uttar Pradesh state overall is provided in Appendix *A1: Health and sociodemographic indicators in Hardoi, Sitapur and Uttar Pradesh.*

2.1.4 Ethical considerations and review

The protocol for the research presented here was incorporated into the overall research protocol of the parent study, which was submitted to and approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board, Expedited Committee (IRB-X) as well as from an India-based IRB based in the Center for Media Studies, which reviews social science research protocols involving household, health worker and facility surveys. Details related to ethical considerations for this study are summarized in Appendix *A2: Ethical considerations.*

2.2 Conceptual framework

Collaboration is a broad concept with origins in multiple professional fields, encompasses a diverse array of governance arrangements at multiple administrative levels, and may look very different depending on the economic, social, political, and organizational context. For that reason, the conceptual framework guiding this study is adapted from Emerson's and Nabatchi's Integrative Framework for Collaborative Governance, which synthesizes and bridges several decades of research on collaboration across a broad array of professional fields and academic disciplines (48). The framework loosely follows a theory of change structure to analyze the development, functioning, actions, and outcomes of a "collaborative governance regime"[4] (CGR), which is defined as:

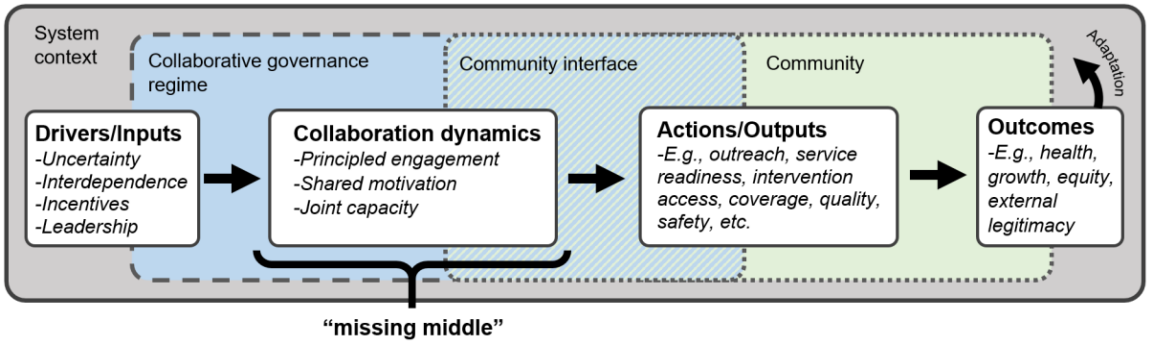
> *"a type of public governance system in which cross-boundary collaboration represents the predominant mode for conduct, decision-making, and activity between autonomous participants who have come together to achieve some collective purpose defined by one or more target goals."* (48)

[4] As stated by the authors, the use of the word "regime" in this framework is borrowed from Stephen Krasner, who defined it as a "governing arrangement that is imbued with a set of explicit and implicit 'principles, norms, rules, and decision-making procedures around which actor expectations converge in a given issue area.'" (Krasner 1983, in (48)).

The specific form and locus of action of a CGR vary depending on its purpose. For instance, a policy-oriented CGR may involve high-level decision-makers focused on identifying strategic solutions for issues related to general policy domains, such as health, education, environment, etc., whereas a site-specific CGR may involve participants responsible for planning and delivering defined services to a specific population or community (48). Collaboration between the AAA frontline workers most closely represents the latter, implementation-oriented type of CGR.

Figure 5 shows the adapted version of the Emerson and Nabatchi framework used for this study. The framework contains several interrelated components of collaborative governance: the *system context*, which represents a variety of contextual factors that affect and are affected by the CGR; *drivers* of collaborative action and the formation of the CGR; the *collaboration dynamics*, which characterize the relationships and interactions between the key actors involved in the CGR; *actions* taken and *outputs* produced by the CGR; and *outcomes* of those actions, which may result in adaptation within the CGR as well as within the broader system context. The striped blue/green section in the middle represents the interface between the CGR and the community and is intended to reflect the influence of community context on frontline worker collaboration.

Figure 5: Author's adaptation of Integrative Framework for Collaborative Governance



Adapted from: (48)

Within this framework, the 'collaboration dynamics' component most closely represents the "missing middle" in evaluation frameworks of multi-sectoral collaboration; this is what the collaboration scale is intended to measure. Emerson and Nabatchi propose that "all CGRs are constituted by their collaboration dynamics and the specific actions taken as a consequence of those dynamics" (48). These collaboration dynamics consist of three primary components – principled engagement, shared motivation, and joint capacity – which interact dynamically and iteratively to determine the quality and extent of collaboration over time. These are briefly paraphrased in Table 3 below.

Table 3: Sub-domains of Emerson's and Nabatchi's collaboration dynamics

Sub-domain	**Brief description** *(paraphrased from Emerson & Nabatchi* (48)*)*
Principled engagement	An iterative process of interaction that enables people to collaborate across their respective institutional or sectoral boundaries to solve problems or create value together. Interactions are characterized by behavioral norms, such as fair and civil discourse and open and inclusive communication.
Shared motivation	Joint recognition among participants that their ongoing investment of time and resources into the CGR is worthwhile for themselves and the organization or constituency they represent; this fosters participants' emerging identification with, and ultimately reinforces their dedication to, the CGR.
Joint capacity	A combination of essential elements – including procedural and institutional arrangements, leadership, knowledge, and resources – that enable CGR participants to accomplish their collective purpose as specified in their shared theory of change.

Consistent with the reviewed literature on this topic, collaboration is conceptualized as a latent construct, which is not directly observable, but which can be measured through a set of *indicators*, often in the form of scale questions related to perceptions, experiences, or events that are theoretically indicative of the construct. This differs substantially from other types of composite measures, such as indices, in which the construct is deterministically defined as the combination of a set of constituent measures, such as the Human Development Index or quality-of-life indices (60).

2.3 Methods

2.3.1 Key methods for Objective 1

Key methodological steps for Objective 1 included: a multi-disciplinary literature review to define the conceptual boundaries or domain of collaboration and to identify a set of potential scale item themes evenly sampled across the "universe" of the domain; formulating questions for each of the identified item themes, including refinement and translation of the instrument to the local Hindi dialect in consultation with local experts; and pre-testing of the instrument with rapid cognitive interviewing to adjust the wording and phrasing of the items so that respondents clearly understand the intended meaning of each question.

2.3.1.1 Multi-disciplinary literature review

The literature review consisted of four main search topics: 1) Policy and programmatic documentation related to India's Integrated Child Development Services (ICDS) scheme and overlapping administrative areas (e.g., the National Rural Health Mission), including policy documents, guidelines, evaluations, and other related research; 2) Theoretical frameworks on collaboration, with a particular focus on multi-sectoral or inter-sectoral collaboration, given that the "AAA" frontline workers represent two different Indian government ministries with different but overlapping social mandates; 3) Existing collaboration scales, particularly those that were

based on a clear and coherent theoretical framework and that were tested and validated using sound research methods, noting that the vast majority of the literature in this search topic focused on inter-professional collaboration scales administered to multi-disciplinary health worker teams in high income countries; and 4) Qualitative research focusing on frontline worker collaboration in India to better understand potential context-specific aspects of collaboration between the AAA frontline workers in rural northern India.

2.3.1.2 Scale item generation

From a semantic standpoint, since authors often use the term "item" interchangeably when referring both to a specific scale question and the theoretical facet of the construct targeted by a given scale question (which might alternatively be tapped using different wording or phrasing), the terms are explicitly defined in this paper as follows: *item* refers to scale questions (including the specific wording, phrasing, etc.); *item theme* refers to the theoretical facet of the construct targeted by a particular item. Thus, items appear in the form of full questions, whereas item themes appear in the form of shorthand labels, such as "open communication", "respect", etc. and there is a one-to-one relationship between items and item themes. In scale development, item themes should collectively represent the full "universe" or domain of possible indicators or facets of the construct. In some (but not all) cases, the construct may consist of theoretically-derived, *a priori*¸ dimensions

or sub-domains of the construct, in which case multiple item themes (and items) may be associated with a single sub-domain (61).

For the present study, the three collaboration dynamics within the Emerson & Nabatchi framework represent different sub-domains of collaboration and thus provide a theoretical structure for grouping the scale items. However, given that there are no existing scales or scale items associated with the Emerson & Nabatchi framework, potential scale item themes were generated deductively from the review of theoretical frameworks, inter-professional collaboration scales, and qualitative studies using a framework analysis method similar to that described by Gale et al. (15). In this process, relevant text excerpts (either explicitly listing collaboration items or describing observed key aspects of collaboration) from each paper were entered into a Microsoft Excel spreadsheet matrix and assigned a descriptive, shorthand label to represent the item theme (i.e., since different scales used differently worded questions to investigate the same apparent item theme). Item themes were iteratively updated, and excerpt groupings were divided or collapsed as needed to maintain within-group consistency and between-group differentiation. The process was concluded when no further unique item themes emerged. These item themes were then compared to the three sub-domains of collaboration dynamics in the Emerson and Nabatchi framework

– principled engagement, shared motivation, and joint capacity – and grouped according to the closest theoretical fit.

2.3.1.3 Drafting and refinement of the scale instrument

The author chose to select a single item to represent each item theme to minimize respondent fatigue and because there was no a priori basis to assume that any individual item theme was more important than any of the others. This is consistent with the guidance of Streiner and Norman that the scale should contain at least one item associated with each item theme (or "content area", in their words) and that the number of items per item theme should reflect the relative importance of that item theme in the overall construct (if known or defined) (62). Since the wording of the scale items associated with a given item theme (e.g., shared vision, interdependence) differed across the reviewed scales, wording for the scale items was adapted from existing scales where relevant (excluding, for instance, items tailored for use in advanced care settings) and then refined to fit the study context in consultation with experts familiar with the topic and context. A team from the locally-engaged social research firm conducted the initial translation of the scale questions into Hindi. This initial Hindi draft was reviewed and iteratively refined over the course of several meetings between the first author and members of the research team. These meetings involved detailed discussion of the purpose and intent of each item, the literal translation and

commonly understood meaning of the Hindi translation, and the appropriateness of the word choice and phrasing in Hindi for the target population (i.e., to ensure that the questions would be clear and comprehensible in the local dialect of Hindi within the study area).

Once this process was completed, the Hindi questions were back-translated into English by a local technical team leader from the HCL Foundation who is fluent in both languages but who was not familiar with the content of the questionnaire and did not have access to the English draft. Face validity of the scale, or the extent to which the format, wording, and content is deemed suitable for its intended purpose, was confirmed by a team of local technical experts leading a multi-sectoral development project with the AAA workers in the study area; this was completed during two 1-hr. workshop sessions in which the lead author introduced the purpose of the scale and facilitated discussion and feedback of the scale items, both individually and as a set.

2.3.1.4 Rapid cognitive interviewing and pre-testing

With guidance and oversight from the author and several other members of the JHSPH study team, a four-member team of qualitative data collection experts from the contracted Indian social research firm conducted two rounds of cognitive interviewing (63) with AAA workers in villages near the study area. Cognitive interviews were conducted with two of each AAA worker

cadre in each round, for a total of 12 interviews. As the process of cognitive interviewing can be quite time-consuming and potentially cognitively demanding for respondents, an abbreviated form of cognitive interviewing with verbal probes was administered (see Appendix *A3: Cognitive Interviewing* for details). Cognitive interviewing was supplemented by two field pre-tests (also with two AAA workers of each cadre in each round, for a total of 12 workers) in which the questions were administered by data collectors (i.e., as opposed to the technical leads of the research team) as a section within the broader frontline worker survey. Data collectors recorded observations in field notes and shared their experiences and impressions in team debriefs at the end of the day after each pre-test. In each instance, the on-site JHSPH study team, including the author, met with the research team from the data collection agency to discuss the observations and feedback from the pre-tests and to update the scale questions accordingly (refer to Appendix *A4: Collaboration questionnaire revisions* for a list of the original and final revised scale questions).

2.3.2 Key methods for Objective 2

Key methodological steps for Objective 2 included: field-testing of the refined scale instrument with all three of the "AAA" worker types in rural areas of Hardoi and Sitapur districts of Uttar Pradesh; exploratory analysis of scale

responses; and quantitative assessment of the psychometric properties of the scale, including internal consistency and construct validity.

2.3.2.1 Field-testing of the refined scale instrument

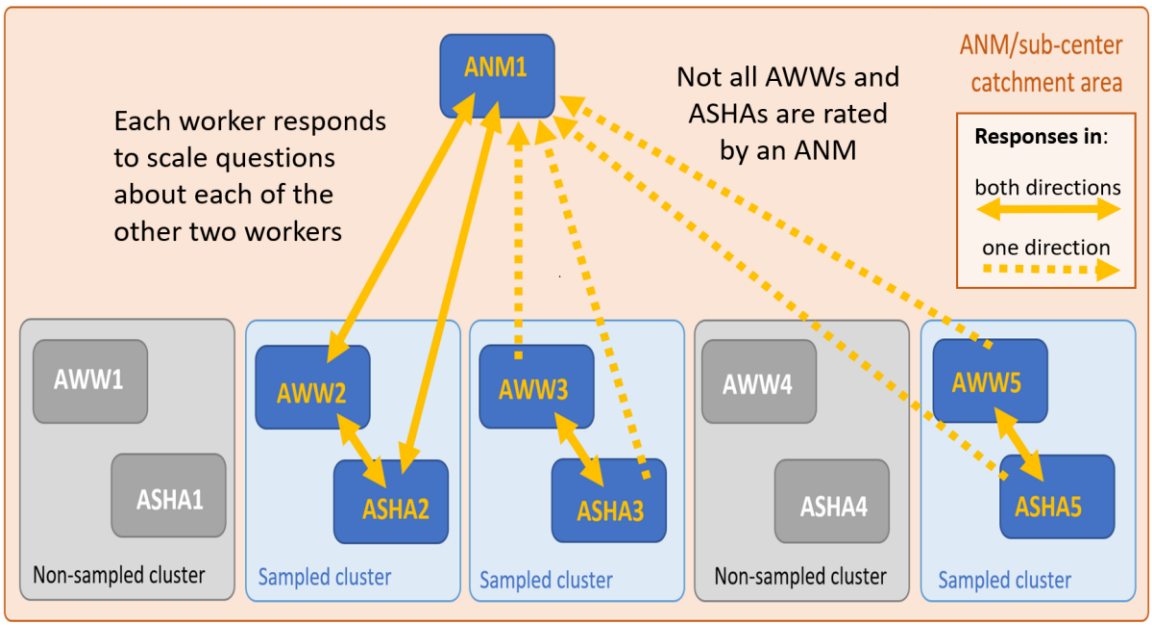
Respondent sample

The target respondents for the administration of the collaboration scale are the ASHAs, AWWs, and ANMs within each of the primary sampling units (PSUs) of larger Project Samuday baseline household survey study area. The study area includes 346 gram panchayats (GPs) - each of which typically contain 1-3 villages - distributed across six blocks of Hardoi and Sitapur districts of Uttar Pradesh state. As part of the sampling for the household survey part of the parent study, villages were segmented along the boundaries of the frontline worker catchment areas, such that each PSU represented the catchment area of a single AWW/ASHA pair. As a result, each randomly selected PSU uniquely identified a single AWW and single ASHA to be invited to participate in the frontline worker survey. Since each of the AWW/ASHA pairs is served by a single sub-center and single ANM, the selected PSUs also uniquely identified all the sub-center-based ANMs to be invited to participate in the frontline worker survey.

The sociometric structure of the collaboration scale (i.e., in which each of the AAA workers respond to the scale questions about each of the other two

workers in their AAA triad) also had implications for sampling and data collection, specifically with respect to the questionnaires administered to the ANMs. Since each ANM serves approximately 3-5 villages, there were some situations in which there were multiple sampled PSUs (and thus sampled AWW/ASHA pairs) within the catchment area of a single ANM. In these cases, simple random sampling was applied to determine which of the AWW/ASHA pairs the ANM should be asked about for the collaboration scale questions, as illustrated in Figure 6 below.

Figure 6: Sociometric sampling and data collection strategy for AAA workers



While there are no closed-form equations to determine the sample sizes needed for developing measurement models for latent variables, as is the purpose of this study, there are several approaches that can be used to

determine a reasonable sample size. First, several rules of thumb apply, including having a target of at least 100 respondents in order to assess the internal consistency of the scale and targeting a 10:1 subject to item ratio for exploratory factor analysis (64,65). Given the 18 items in the collaboration scale being field tested in this study, this would suggest a minimum sample size of 100-180 respondents. The actual sample size obtained for each of the AAA frontline workers is listed in Table 4 below. That table also contains the number of triads of frontline workers serving a common catchment area for whom the full set of collaboration scale responses are available in the data set (i.e., each frontline worker within these triads responded to the collaboration scale questions about each of the other two).

Table 4: AAA frontline worker respondents by block

Study block	AWWs	ASHAs	ANMs	Triads
Behadar	60	59	24	19
Kachhauna	36	34	22	18
Kothawan	51	51	19	13
Kasmanda	45	40	17	14
Machhrehta	38	37	20	12
Sidhauli	51	45	22	11
	281	**266**	**124**	**87**

Data collection

Collaboration scale questions were embedded within a larger frontline worker survey implemented as part of the Project Samuday baseline study. The survey was administered by trained data collectors from a contracted Indian social research firm, under the guidance and oversight of the JHSPH

study team, including the author. These data collectors and their supervisors were responsible for seeking permission from local health system and government leadership, inviting frontline workers to participate, and administering informed consent. Surveys were administered in the respondent's home or outside. Data collectors sought to maintain auditory privacy during the interview process to the maximum extent possible. If others interacted with the respondent or sought to join the conversation, the data collector paused the interview and waited until the respondent was alone to resume. Responses were recorded through an Android-based tablet device using a Computer-Assisted Personal Interviewing (CAPI) platform. Further details are provided in Appendix *A2: Ethical considerations*.

2.3.2.2 Exploratory analysis

Marginal item frequencies, overall scores, and response distributions were reviewed for each respondent type, both as a rater and as a target, and for each *dyadic vector*, or one worker's rating of collaboration with one other worker. Additionally, a 3D rotating prism was generated in the R statistical software package to visually observe the consistency or discrepancy of responses between different AAA workers within the same triads.

2.3.2.3 Assessment of reliability

Ordinal alpha, as described by Gadermann, Guhn, and Zumbo (66), was calculated to assess internal consistency between the scale items. As compared to the more commonly used Cronbach's alpha, which assumes that variables are continuous and is thus calculated based on a Pearson correlation matrix, ordinal alpha is designed for Likert-type items, such as those used in this scale, and is thus based on a polychoric correlation matrix (66). Test-retest reliability was not measured in this study as the parent study design only enabled a single measurement from each respondent.

2.3.2.4 Assessment of construct validity and criterion validity

Construct validity

Exploratory factor analysis (EFA) was conducted to examine the construct validity of the collaboration scale. As a first step, principal components analysis (PCA) of the variance-covariance matrix to identify sets of scale items with highly correlated response patterns. Parallel analysis using Monte Carlo simulation of 1,000 data sets with similar properties (i.e., sample size, number of variables, means, variances) was then conducted to determine the number of factors to extract for the EFA. Mardia's test of multivariate skewness and kurtosis was applied to test the assumption of multivariate normality required for using maximum likelihood estimation. As the assumption of multivariate normality was not met, EFA was conducted

using the weighted least squares estimation method. Factor rotation using the "oblimin" method was used to improve the interpretability of the factor loadings.

Criterion validity

Although there is no gold standard criterion variable for collaboration between AAA frontline workers, we may assume that their measured level of collaboration should be associated with some of the core tasks that they are expected to complete collaboratively during the day-to-day routine of their job. Given the centrality of information-sharing between the AAA workers regarding the number of eligible beneficiaries in the village and the services delivered to those beneficiaries, it is hypothesized that higher levels of collaboration between frontline workers would be associated with higher levels of information sharing. More specifically, since the registers and records maintained by the ASHAs and AWWs are supposed to match for several key village-level variables, it is expected that higher village-level collaboration scores would be associated with greater consistency between the ASHA's and AWW's reported values for a set of key indicators in their catchment area (see Table 5). To operationalize this assessment, ASHA-reported and AWW-reported values were compared for each of these nine indicators.

Table 5: Survey questions to gather information from AWW and ASHA registers

#	Questions to gather information from AWW and ASHA registers
1	How many live births were there in this village in the month of April 2017?
2	How many institutional deliveries were there in this village in the month of April 2017?
3	How many deaths were there in this village in the 12 months from May 2016-April 2017?
4	How many pregnancies were newly registered in this village in the month of April 2017?
5	How many lactating women were there in this village as of April 30 2017?
6	How many children reached 12 months of age in this village in the month of April 2017?
7	Of these children, how many have received all vaccinations (BCG, DPT3, OPV3, Measles1) as of April 30, 2017?
8	How many children 0-3 years of age were there in this village as of April 30, 2017?
9	How many children 3-6 years of age were there in this village as of April 30, 2017?

Differences between the two reported values that fell below a specified threshold value were considered a match. Threshold values varied depending on the magnitude of the larger of the indicator values reported by the two workers, as outlined in Table 6 below. For example, if one of the workers reported 47 children aged 0-3 yrs in the village as of April 2017, a report of 40 children 0-3 yrs. by the other worker would be considered a match but a report of 39 would not. The column on the right side of the table provides examples of indicators in the AWW and ASHA registers that tended to fall in the specified range for the villages included in the study.

Table 6: Variation thresholds for AWW and ASHA records to be considered "matching"

Range for greater reported indicator value	Matching threshold	Example of indicator in AWW/ASHA records commonly reported in the specified range
0-2	Exact match	# institutional deliveries in Apr. 2017
3-10	+/- 35%	# of deaths from May 2016-Apr. 2017
11-20	+/- 30%	# of pregnancies in village in Apr. 2017
21-30	+/- 25%	# of children 12 mos. as of Apr. 2017
31-40	+/- 20%	# of children 0-3 yrs. As of Apr. 2017; # of children 3-6 yrs. as of Apr. 2017
41+	+/- 15%	

The above step produced a set of nine dichotomized values (1= match; 0=no match) for each village to represent consistency between the ASHA's and AWW's records. These values were summed to generate an "information matching" variable representing the total number of matched indicators out of nine possible for each village (max. 8; min. 0; median 2). For this analysis, a simple sum of the collaboration scores across the six dyadic vectors in each village was used as a proxy for village-level collaboration, with a possible range of 108-540. This decision is based on the following considerations: 1) collaboration is theorized to occur at the group level, and thus would not be adequately reflected in individual-level variables, such as the factor scores from the EFA; 2) determination of the most appropriate approach for combining the individual-level data to group-level variable (e.g., averaging/summing, selecting a minimum or maximum score, etc.) requires further analysis that is beyond the scope of this paper.[5]

[5] The topic of generating a group-level collaboration variable using individual-level data will be addressed in a separate forthcoming paper.

2.4 Results

2.4.1 Key results for Objective 1

2.4.1.1 Defining the collaboration construct

The framework analysis drew from 12 resources, including three theoretical frameworks, four collaboration scales, one conceptual framework for a collaboration scale, and four qualitative studies of collaboration relevant to the study context, as depicted in Table 7. Additional resources of each type were excluded if they were deemed not directly relevant to the current study (e.g., theoretical frameworks with a predominantly intra-organizational perspective or case studies on collaboration that were not based in rural India). In the case of the scales, papers were also excluded if they did not contribute new items beyond those already identified. Upon completion of the iterative process of identifying and refining potential scale items based on the framework analysis of the selected resources, 18 item themes emerged. These items roughly align with the three sub-domains in the Emerson & Nabatchi framework.

Table 7: Theoretical, quantitative, and qualitative basis for the collaboration construct

Collaboration scale item themes *(derived from the framework analysis)*	**Mapping to Emerson & Nabatchi framework**	Theoretical frameworks			Collaboration scales and frameworks					Qualitative research (India)			
		Emerson & Nabatchi 2015 (48)	Ansell & Gash 2007 (67)	Bryson et al. 2006 (68)	Stutsky et al. 2014 (69)	Odegard et al. 2009 (70)	Orchard et al. 2012 (71)	Smith 2015 (72) *(framework)*	Kenaszchuk et al. 2010 (73)	Mishra 2014 (74)	Sharma et al. 2014 (75)	Kim et al. 2017 (18)	Unicef 2016 (76)
Shared vision	**Principled engagement** *(norms & processes of interaction)*	●	●	●			●	●	●		●		
Interdependence		●	●	●	●			●		●		●	●
Open communication		●	●	●	●	●	●	●	●	●		●	●
Joint planning		●	●	●	●		●	●	●	●	●	●	●
Role clarity		●		●	●	●	●	●	●	●	●	●	●
Power sharing		●	●	●	●	●	●	●	●	●	●		
Conflict management		●				●	●	●	●		●		
Commitment/ motivation	**Shared motivation** *(perceived value and relationships)*	●	●	●	●	●	●	●	●		●	●	●
Respect		●					●	●			●	●	
Trust		●	●	●	●		●	●		●			
Help and support						●	●		●	●	●	●	
Willingness to listen									●	●		●	
Training/guidance	**Joint capacity** *(ability and opportunity to collaborate)*	●	●		●		●			●	●	●	●
Enabling environment		●	●	●	●	●				●	●	●	●
Information sharing		●		●	●				●	●		●	●
Accountability		●		●			●	●	●	●	●		●
Service coordination					●		●	●	●	●	●	●	●
Leadership & incentives		●	●	●	●	●		●		●	●	●	●

2.4.1.2 Developing the collaboration scale

The draft scale consisted of 18 items, one per item theme. Several adjustments were made to the draft scale during pre-testing, including: sequencing questions to match the natural flow of conversation; shifting sensitive questions to the end (e.g., asking about questions related to institutional leadership, guidance and support last since they occasionally prompted comments about a general shortage of funding and supplies); re-phrasing certain questions to mitigate social desirability bias; re-phrasing to clarify the differentiation of questions (i.e., as some respondents initially found them repetitive); and adjustments to match the local Hindi dialect. A side-by-side comparison of the draft and final scale questions is included in Appendix *A4: Collaboration questionnaire revisions*. Pre-testing also confirmed the importance of the sociometric format of the scale administration (i.e., asking each worker about each of the other two workers separately), as cognitive interviewing respondents consistently reported difficulty in answering the questions about both workers together.

Each of the collaboration scale items asked about the frequency with which the respondent experienced the stated occurrence or perception, with response options as Never (1), Seldom (2), Sometimes (3), Most of the time (4), and All of the time (5). These questions were asked of each AAA frontline worker about each of the other two frontline workers serving the same

catchment area individually (e.g., the ASHA was asked about the AWW serving in her area separately from the ANM, and so forth). The English language scale items are listed in Table 8.

Table 8: Collaboration scale item themes and items (English version)

#	Themes	Scale items (English version)
1	Open communication	When you interact with the _____ for work how frequently does she communicate openly with you?
2	Respect	When you interact with the _____ for work how frequently do you feel respected?
3	Help & support	When you work with the _____ how frequently do you think that you can get help and support from her?
4	Role clarity	When you work with the _____ how frequently do you feel that both of you have a clear understanding of each other's roles and responsibilities? *(For example, if it is clear who is responsible for which tasks during Village Health Nutrition Day or immunization day)*
5	Willingness to listen	When you interact with the _____ for work how frequently do you feel that she would be willing to listen to you if there is a problem?
6	Joint planning	When you work with the _____ how frequently do you discuss the needs of the patients or beneficiaries with each other?
7	Information sharing	How frequently does the _____ provide information to you about patients or beneficiaries when required?
8	Trust	When you work with the _____ how frequently do you feel the need to double-check information which she shares with you?
9	Power sharing	When working with the _____ how frequently do you feel that she tries to dominate the conversation?
10	Shared vision	How frequently do you agree with the _____ regarding the best possible way to provide care to your patients or beneficiaries?
11	Service coordination	How frequently do you coordinate services with the _____ based on the needs of your patients or beneficiaries?
12	Enabling environment	How frequently do you encounter obstacles when trying to work together with the _____?
13	Accountability	When working together with the _____ on a common task, how frequently does she complete her share of the work on time?
14	Conflict management	How frequently do you feel satisfied with the way any disagreement between you and the _____ is managed?
15	Inter-dependence	How frequently do you feel that working together with _____ is one of the main ways to serve your village better?
16	Commitment/ motivation	How frequently do you feel that the _____ is willing to work together with you to serve your village better regardless of the constraints of her job?
17	Training/ guidance	How frequently do you feel that you have enough information and suggestions about how to work together effectively with the _____?
18	Leadership/ incentives	When you attend trainings or meetings for work, how frequently do the instructors or other officials say that it is important for you to work together with the _____?
Response options for all questions are on an ordinal frequency scale: 1 – Never 2 – Seldom 3 – Sometimes 4 – Most of the time 5 – Always		

2.4.2 Key results for Objective 2

2.4.2.1 Exploratory analysis

Boxplots of collaboration scores

Collaboration scores, which have a theoretical range of 18-90 for each dyadic vector (i.e., administration of the scale to one worker about one other worker), were relatively high across the board, which skews the distribution of responses toward the higher end of the scale. The boxplots in Figure 7 and Figure 8 display the combined sums of the collaboration scale responses by each AAA worker about the other two (i.e., as a rater) and about each AAA worker by the other two (i.e., as a target), respectively, out of a possible range of 36-180. Apart from the outliers on the lower end, the central tendency and distribution of the scale scores is quite similar between the workers, both as raters and targets. In the figures, the boxplots of the collaboration scale scores (orange) are presented alongside boxplots of hypothetical data with a normal distribution (red) based on the same mean and standard deviation.

Figure 7: Boxplots of total collaboration scores, by rater cadre

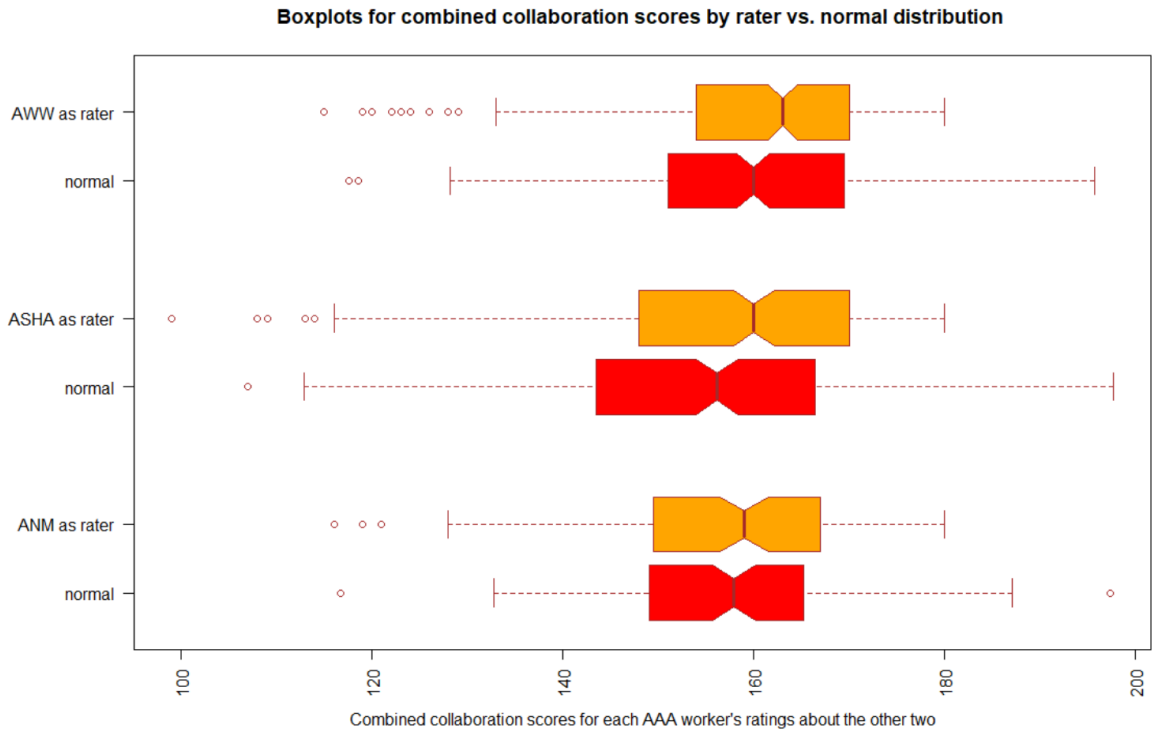
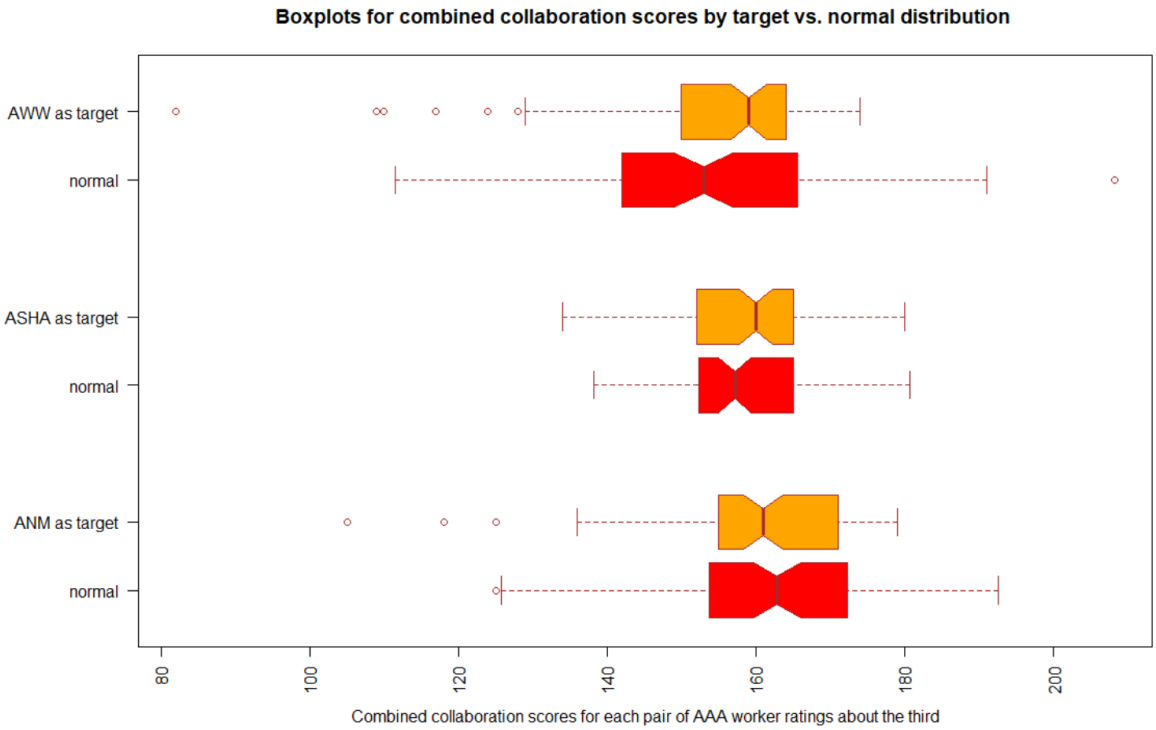


Figure 8: Boxplots of total collaboration scores, by target cadre



Visualization of collaboration scores with a 3D prism

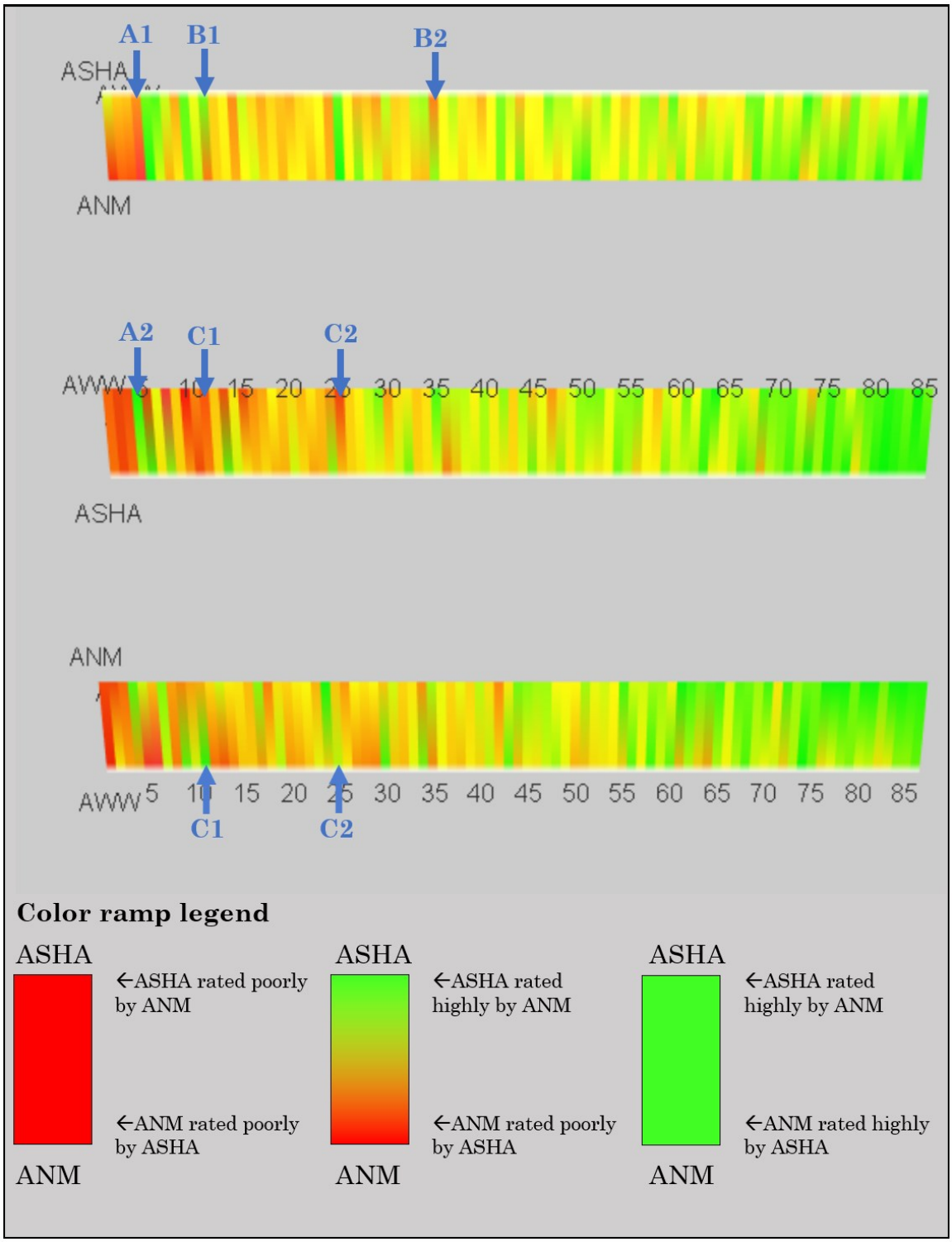
The 3D prism visually displays the total scale scores assigned by each of the AAA workers to each of the other two workers serving the same village.[6] The diagram in Figure 9 displays three different views of the prism at different points of rotation in order to show the scoring between each pair of AAA workers. Each vertical band or colored stripe represents a unique village for which scale data from all three workers are available. A color ramp is used to visually represent the collaboration scores (min: 28; max: 90). The color ramp extends from red (lowest scores) to green (highest scores), with red roughly corresponding to scores between 28-65, yellow between 66-80, and green between 81-90. The color closest to a particular vertex reflects the scale score in which that person was the target. As noted above, ratings tend to be relatively high overall – hence the skew toward the green end of the spectrum in the color ramp. For multiple villages, there are notable discrepancies in reported levels of collaboration, including:

- **Between different dyads of workers in the same village**. For example, 'A1' depicts an example where an ASHA and ANM both rate their collaboration poorly, while 'A2' shows that the ASHA and AWW of that same village rate their collaboration highly.

[6] *Note: the original code to visually map the collaboration scale data onto the 3D rotating prism depicted in the diagram was developed by Dr. Jeannie-Marie Leoutsakos of the Johns Hopkins University School of Medicine. The author then modified the code to enhance the model.*

- **Worker's ratings of each other in the same dyad**. For example, 'B1' and 'B2' depict separate examples where workers in a particular dyad – in this case, the ASHA and ANM – have divergent views regarding their collaboration with each other.
- **Two workers' ratings of the third worker in the same village**. For example, 'C1' and 'C2' show separate examples where two workers assign divergent ratings to the third worker in the same triad (in both cases, the ASHA indicated poor collaboration with the AWW but the ANM indicated a fairly high level of collaboration with that same AWW.

Figure 9: Snapshots of 3D prism of total collaboration scores by worker cadre and village



**Note: the original code to visually map the collaboration scale data onto the 3D rotating prism depicted in the diagram was developed by Dr. Jeannie-Marie Leoutsakos of the Johns Hopkins University School of Medicine. The author then modified the code to enhance the model.*

2.4.2.2 Internal consistency

Ordinal alpha values for internal consistency were relatively high (and similar) across all the dyadic vectors, ranging from 0.92-0.95. Average inter-item correlations ranged from a low of 0.38 (ANM→ASHA) to 0.50 (ASHA→AWW).

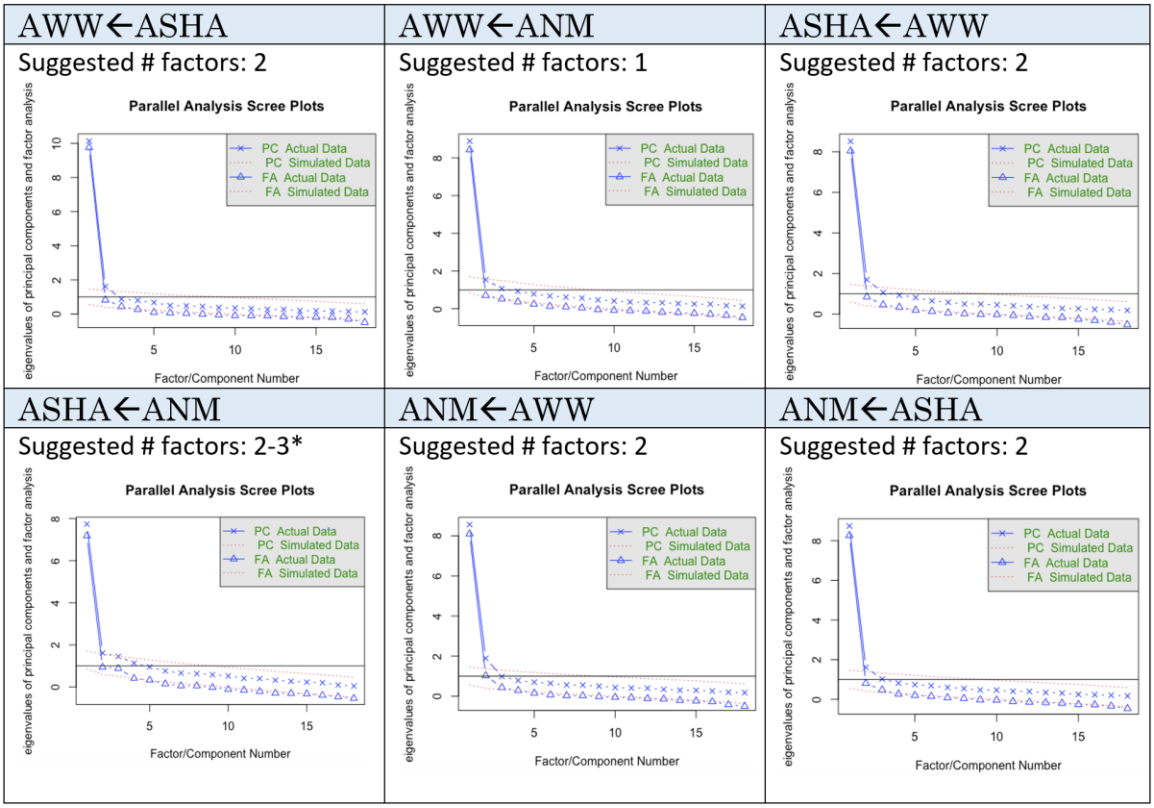
2.4.2.3 Validity

2.4.2.3.1 Construct validity

Principal components analysis (PCA) and parallel analysis

Principal Components Analysis (PCA) was conducted using the variance-covariance matrix of scale responses in order to identify sets of scale items with highly correlated response patterns (which may represent underlying variables or "factors" responsible for the variation in the data). Parallel analysis was run in order to determine the appropriate number of factors to retain from the PCA for inclusion in the EFA. As shown in Figure 10, the scree plots indicated a similar structure for all six dyadic vectors in that a single latent component appeared to account for the largest portion of the variation in the data. Parallel analysis suggested that two factors should be extracted for the EFA in five of the six dyadic vectors; for the last vector – ANMs' ratings of the AWWs – one component was suggested. Based on visual review of the parallel analysis plots, a three-factor model for the ANM→ASHA dyadic vector was also tested.

Figure 10: Summary of parallel analysis of PCA results

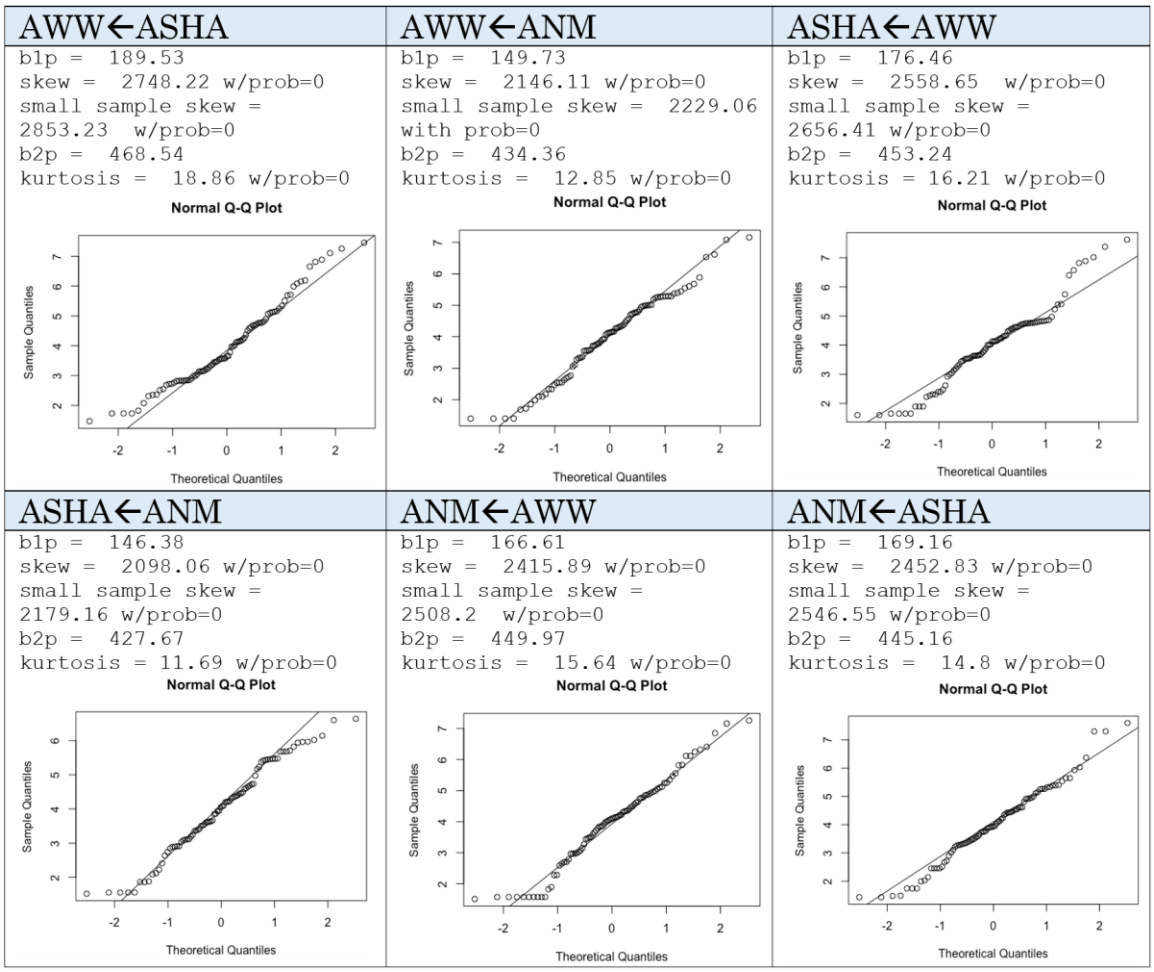


*Since the third factor was on the borderline of the parallel analysis threshold, both 2-factor and 3-factor models were tested.

Exploratory factor analysis (EFA)

As shown in Figure 11, the results from applying Mardia's test of multivariate skewness and kurtosis indicate that the data do not meet the assumption of multivariate normality required for using maximum likelihood estimation (MLE) in the exploratory factor analysis (EFA). Given this, weighted least squares (WLS) was selected as the EFA estimation method.

Figure 11: Summary of skewness and kurtosis statistics for each dyadic vector



Results from the EFA using WLS and oblimin[7] rotation for each dyadic vector are displayed in Figure 12, with dominant factor loadings above a 0.4 threshold highlighted in green. Item loadings followed the same pattern for four of the six dyadic vectors, corresponding to the responses of the ASHAs and AWWs, regardless of whether they were rating each other or the ANM.

[7] Methodological note regarding choice of rotation method: the observed association between the factors in all of the two-factor models indicated that they are not orthogonal, thus indicating that the "varimax" rotation method would be inappropriate for this analysis. Factor loadings using "promax" rotation were identical to those observed using the "oblimin" method, so only the latter are reported here.

The one exception to this pattern was the 'conflict management' item for the AWW's rating of the ASHA, which had a more evenly split loading between the two factors. For the single-factor structure associated with the ANM's rating of the AWW, 16 of the 18 items had factor loadings above the 0.4 cutoff; 'trust' and 'enabling environment' had low loadings. For the three-factor structure of the ANM's rating of the ASHA, the 'accountability' item was split across all three factors and the 'interdependence' item was cross-loaded on factors 1 and 3.

The model fit for five of the six dyadic vectors was decent but fell short of commonly used thresholds for a "good" fit, with a TLI of 0.84-0.88 as compared to a target threshold of >0.90 and RMSEA values of 0.09-0.11 as compared to a target threshold of <0.10. The initial EFA on the ANM→ASHA dyadic vector failed to run, possibly due to a combination of the relatively low sample size and ANMs' tendency to rate their collaboration with the ASHAs highly. Because of the low frequencies in the two lowest response categories, those categories were collapsed and the PCA and EFA were re-run on a four-point scale. Although there were no further issues with running the EFA, the model fit was rather poor (TLI: 0.62; RMSEA: 0.17). As with the summed collaboration scale scores, the calculated factor scores tended to be negatively skewed with a long tail on the lower end of the scoring range (see Appendix *A5: Distribution of factor scores from EFA by dyadic vector*).

Figure 12: Results from the Exploratory Factor Analysis (EFA)

ASHA→AWW (n=266)

TLI = 0.872; RMSEA = 0.11(0.097-0.118)

SCALE ITEMS	F1	F2	u2
Open communication	0.74	0.20	0.31
Respect	0.69	0.20	0.40
Help and support	0.73	0.18	0.35
Role clarity	0.76	0.09	0.37
Willing to listen	0.80	0.06	0.33
Joint planning	0.87	-0.03	0.25
Information sharing	0.86	-0.03	0.27
Trust	-0.23	0.69	0.58
Power sharing	0.34	0.68	0.27
Shared vision	0.83	-0.06	0.34
Service coordination	0.88	-0.11	0.28
Enabling environment	0.10	0.48	0.73
Accountability	0.82	-0.08	0.37
Conflict management	0.61	-0.04	0.64
Interdependence	0.81	0.03	0.33
Commitment/motiv.	0.85	-0.05	0.30
Training/guidance	0.79	-0.04	0.40
Leadership	0.65	0.00	0.58

ASHA→ANM (n=266)

TLI = 0.854; RMSEA =0.101(0.089-0.109)

SCALE ITEMS	F1	F2	u2
Open communication	0.72	0.22	0.32
Respect	0.70	0.19	0.39
Help and support	0.76	0.05	0.39
Role clarity	0.79	-0.03	0.39
Willing to listen	0.73	-0.01	0.48
Joint planning	0.76	-0.03	0.43
Information sharing	0.75	-0.08	0.47
Trust	-0.30	0.66	0.61
Power sharing	0.21	0.75	0.27
Shared vision	0.78	-0.07	0.43
Service coordination	0.71	-0.01	0.50
Enabling environment	0.28	0.47	0.61
Accountability	0.76	-0.03	0.44
Conflict management	0.44	0.08	0.78
Interdependence	0.72	0.06	0.45
Commitment/motiv.	0.70	-0.03	0.53
Training/guidance	0.73	-0.02	0.48
Leadership	0.65	-0.05	0.60

AWW→ASHA (n=281)

TLI = 0.84; RMSEA = 0.105(0.093-0.113)

SCALE ITEMS	F1	F2	u2
Open communication	0.77	0.04	0.39
Respect	0.73	0.06	0.44
Help and support	0.72	0.11	0.42
Role clarity	0.76	-0.06	0.44
Willing to listen	0.74	0.04	0.42
Joint planning	0.78	-0.15	0.44
Information sharing	0.79	-0.02	0.39
Trust	-0.28	0.65	0.61
Power sharing	0.27	0.72	0.29
Shared vision	0.74	-0.02	0.46
Service coordination	0.77	0.04	0.38
Enabling environment	0.11	0.49	0.71
Accountability	0.71	-0.04	0.51
Conflict management	0.34	0.22	0.79
Interdependence	0.68	0.17	0.44
Commitment/motiv.	0.73	0.05	0.44
Training/guidance	0.71	0.01	0.49
Leadership	0.57	-0.15	0.71

AWW→ANM (n=281)

TLI = 0.877; RMSEA = 0.092(0.08-0.1)

SCALE ITEMS	F1	F2	u2
Open communication	0.72	0.22	0.37
Respect	0.69	0.16	0.45
Help and support	0.75	-0.01	0.44
Role clarity	0.72	0.06	0.46
Willing to listen	0.72	-0.04	0.50
Joint planning	0.79	-0.09	0.39
Information sharing	0.73	-0.04	0.48
Trust	-0.16	0.74	0.48
Power sharing	0.25	0.68	0.39
Shared vision	0.81	-0.11	0.37
Service coordination	0.75	0.04	0.43
Enabling environment	0.04	0.58	0.65
Accountability	0.77	0.07	0.38
Conflict management	0.43	0.09	0.79
Interdependence	0.77	0.06	0.38
Commitment/motiv.	0.67	-0.05	0.56
Training/guidance	0.72	0.02	0.48
Leadership	0.72	-0.17	0.51

ANM→AWW (n=124)

TLI = 0.852; RMSEA =0.104 (0.083-0.114)

SCALE ITEMS	F1	h2	u2
Open communication	0.74	0.55	0.45
Respect	0.71	0.51	0.49
Help and support	0.86	0.74	0.26
Role clarity	0.82	0.67	0.33
Willing to listen	0.78	0.61	0.39
Joint planning	0.69	0.48	0.52
Information sharing	0.74	0.55	0.45
Trust	0.20	0.04	0.96
Power sharing	0.55	0.30	0.70
Shared vision	0.75	0.56	0.44
Service coordination	0.68	0.47	0.53
Enabling environment	0.19	0.04	0.96
Accountability	0.64	0.41	0.59
Conflict management	0.78	0.61	0.39
Interdependence	0.74	0.55	0.45
Commitment/motiv.	0.65	0.42	0.58
Training/guidance	0.79	0.63	0.37
Leadership	0.56	0.31	0.69

ANM→ASHA (n=124)

TLI = 0.619; RMSEA = 0.171(0.147-0.179)

SCALE ITEMS	F3	F2	F1	u2
Open communication	0.43	0.17	0.25	0.55
Respect	0.58	0.41	-0.14	0.38
Help and support	0.34	0.59	-0.01	0.35
Role clarity	0.28	0.50	0.07	0.50
Willing to listen	-0.02	0.90	-0.05	0.24
Joint planning	-0.03	0.65	0.23	0.42
Information sharing	-0.04	0.62	0.27	0.43
Trust	0.48	-0.07	-0.10	0.81
Power sharing	0.51	0.31	-0.07	0.54
Shared vision	-0.13	0.35	0.59	0.42
Service coordination	0.00	0.04	0.95	0.06
Enabling environment	0.64	-0.12	-0.08	0.66
Accountability	0.19	0.23	0.38	0.60
Conflict management	0.18	-0.06	0.60	0.56
Interdependence	0.52	-0.06	0.49	0.35
Commitment/motiv.	0.53	0.11	0.24	0.48
Training/guidance	0.54	0.01	0.40	0.38
Leadership	0.63	0.12	0.16	0.40

F1-F3=extracted factors; u2=uniqueness

From a theoretical perspective, the number of factors and the item loadings on those factors may provide empirical evidence to help substantiate the conceptual framework from which the scale domains were derived and on which the questions were based. To assess this, the factor structures and loadings for the AWW and ASHA responses (i.e., given the consistency between them) were compared to the associated domains in Emerson's and Nabatchi's Integrative Framework for Collaborative Governance, which served as the basis for this study's conceptual framework.

In the EFA, results for the AWW and ASHA responses, the majority of items (14 out of 18 for the AWW and 15 out of 18 for the ASHA) loaded strongly on the first factor, with only three items loading on the second factor. A side-by-side comparison of theorized item loadings based on this study's conceptual framework and the actual item loadings based on the AWW and ASHA scale responses is provided in Table 9 (the '●' symbol denotes the factor on which each item loads most strongly).

Table 9: Comparison of theorized vs. actual item loadings on factors for AWW and ASHA

#	Collaboration Scale Items	Theorized item loadings in conceptual framework F1 *PE**	F2 *SM**	F3 *JC**	Actual item loadings on factors from EFA** F1 *Enablers*	F2 *Barriers*	F3 ---
1	Open communication	●			●		
2	Respect		●		●		
3	Help and support		●		●		
4	Role clarity	●			●		
5	Willingness to listen		●		●		
6	Joint planning	●			●		
7	Information sharing			●	●		
8	Trust		●			●	
9	Power sharing	●				●	
10	Shared vision	●			●		
11	Service coordination			●	●		
12	Enabling environment			●		●	
13	Accountability			●	●		
14	Conflict management	●			●		
15	Interdependence	●			●		
16	Commitment/motivation		●		●		
17	Training/guidance			●	●		
18	Leadership			●	●		

*PE = Principled Engagement; SM = Shared Motivation; JC = Joint Capacity
**Factor loadings based on ASHA and AWW responses (about each other and about the ANM)

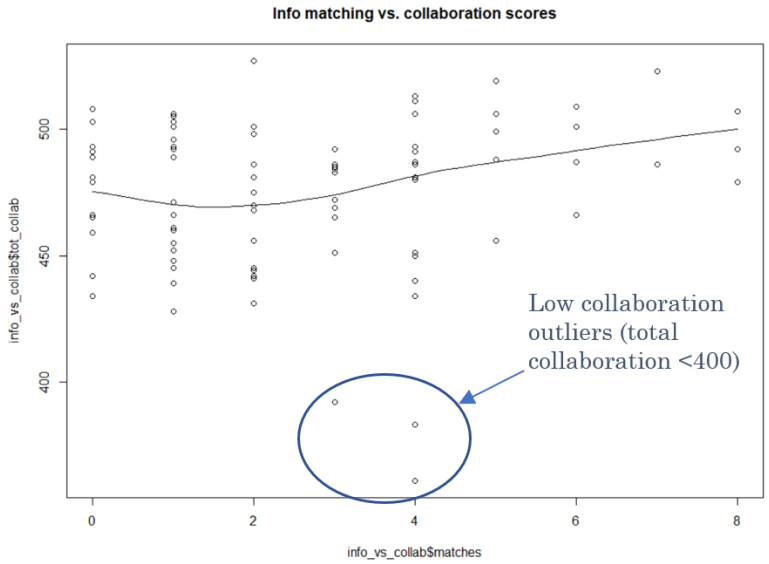
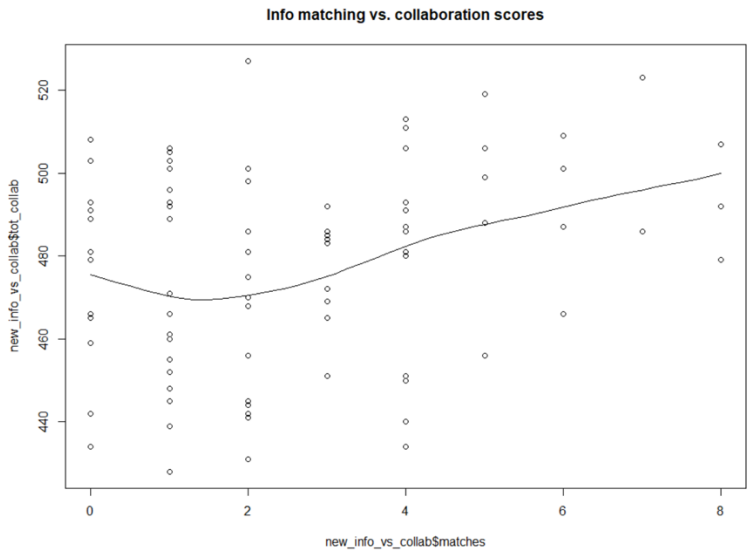
In contrast to the theorized item loadings, in which each item corresponds to one of the three "collaboration dynamics" sub-domains (principled engagement, shared motivation, joint capacity), the actual factor loadings appear to sort the items based on whether they enable or hinder collaboration. Specifically, all the items that loaded on Factor 1 (labeled "enablers") contained positive wording regarding interactions or perceptions theorized to contribute to collaboration, whereas the items loading on Factor 2 (labeled "barriers") asked were all worded such that they would be theorized to impede collaboration. The item loadings for the ANMs' ratings of the AWWs (single factor) and of the ASHAs (three factors) also show no

apparent correlation with the theorized item loadings from the conceptual framework.

2.4.2.3.2 Criterion validity

Regression of the village-level total collaboration score (range: 361-527) on the information matching variable indicated a positive but non-significant association (ß = 2.632; p = 0.098), primarily due to three outlier observations with total collaboration scores <400. Excluding these three outliers, the association increased in magnitude and became highly significant (ß = 3.528; p = 0.006), as summarized in Figure 13 below, roughly corresponding to one additional matched indicator in the AWW and ASHA registers for every additional 3.5 total collaboration points.

Figure 13: Scatterplots and regression results of information matching vs. collaboration

Data	Scatterplot of info. matching (x) vs. collaboration (y)	Model results
Full dataset		β = 2.632 se = 1.574 p = 0.098
Outliers (tot_collab <400) dropped		β = 3.528 se = 1.256 p = 0.006

2.5 Discussion

2.5.1 Relevance of the study

Although collaboration between sectors and institutions is often described in the abstract, as if these entities interact with each other directly, in practice these interactions take place between specific individuals who act on behalf of their respective organizations. In some instances, it is possible to identify specific individuals whose ongoing professional relationships across organizational boundaries are seen as essential to the success of a collaboration, as in the case of the AAA workers for the ICDS and NRHM's delivery of basic health and nutritional services to mothers and children in nearly one million villages across India. In such cases, the quality or level of collaboration between these specific individuals may serve as a key proxy variable or indicator for the functioning of a multi-organizational or multi-sectoral collaboration. The fact that such initiatives are multi-dimensional and multi-level means that no single indicator can adequately quantify an abstract concept like collaboration; it may, however, be possible to identify a constellation of measures that, taken together, provide a reasonable assessment of collaborative functioning. The collaboration scale developed and tested in this study is intended to be one such measure.

2.5.2 Content and face validity in scale development

The initial indication of the scale's content validity was the achievement of saturation in item themes during the multi-disciplinary literature review. This was assessed and confirmed by a team of local experts from the HCL Foundation working in the study area. Face validity for the scale was initially assessed by the same team of local experts as well as the quantitative and qualitative research leads from the contracted Indian social research firm, and then confirmed through cognitive interviewing and pre-testing with non-sampled AAA workers near the study area. The frontline worker scale has a high conceptual overlap with the reviewed theoretical frameworks, inter-professional collaboration scales, and qualitative studies off AAA collaboration in rural India. In contrast to the reviewed interprofessional collaboration scales, this scale is the only one applied in a LMIC context. This scale is most similar to the one developed by Kenaszchuk et al. (73), both in terms of the sociometric format and the number of items (18 vs. 14); a major difference is that this scale is designed for respondents with limited schooling in a frontline service delivery setting with respondents, whereas the Kenaszchuk et al. scale is designed for use with highly educated physicians, nurses, and allied health workers in an acute care setting in a high-income country (Canada) (73). The other reviewed scales also target highly educated healthcare workers in high-income countries but differ notably in that they all: 1) ask questions about the

respondent's personal experience or perception of the group (i.e., as opposed to exploring dyadic interactions within the group); and 2) have substantially more items in the scale, ranging from 37-48 items each (69–71)).

2.5.3 Internal consistency, construct and criterion validity of the scale

Testing of the psychometric properties of the scale produced evidence supporting the validity of the collaboration measure while also highlighting several areas warranting further investigation. The high internal consistency across the 18 scale items suggests that they are, in fact, measuring the same general construct. Results from the EFA demonstrated a decent fit for five of the six dyadic vectors based on TLI and RMSEA values, although they fell slightly short of the recommended threshold values for a good fit. In addition, the EFA for the responses of the ASHA and AWW (representing four of the six dyadic vectors) had a nearly identical two-factor structure with the same items loading on each factor and very similar factor loadings, suggesting that collaboration is experienced in a similar way by these two worker cadres and providing initial evidence that it may be appropriate to use the same scale to measure collaboration for both groups; further testing of the factor structure and measurement invariance through Confirmatory Factor Analysis (CFA) could help confirm this.

The fact that the responses of the ANM had a different factor structure than the ASHA and AWW suggests that the collaboration construct may be experienced differently by this worker relative to the other two. This may be due to the ANM's higher position in the organizational hierarchy (i.e., working with ASHA/AWW pairs across three to five villages) and the differing nature of her role vis-à-vis each of the other two worker cadres. For instance, the fact that the ANM directly supervises and works most closely with the ASHA is consistent with the more nuanced collaboration experience suggested by the three-factor structure. Similarly, the ANM's slightly more arm's length relationship with the AWW is consistent with the simpler, single factor structure; in contrast to the ASHA, the AWW works in a different ministry (and thus a different reporting hierarchy), typically meets less frequently with the ANM, and has non-health responsibilities that do not involve the ANM (e.g., early childhood education).

Although the model fit is rather poor for the ANM→ASHA dyadic vector, the item loadings offer tentative support to this hypothesis in that one of the factors (F3), consists largely of items that one might expect to be associated with a hierarchical relationship: *respect*, *power sharing* (which also may be interpreted as deference), *open communication*, an official mandate to collaborate (*leadership/incentives*), *commitment/motivation*, and *training/guidance*. A second factor (F2) including the items *willingness to*

listen, *help and support*, *information sharing*, discussing the needs of beneficiaries (*joint planning*), and *role clarity* may be more indicative of the rapport between the two workers. The third factor (F1) may reflect some aspect of carrying out the work together, or "getting the job done", as it includes agreement on the best way to take care of beneficiaries (*shared vision*), *service coordination*, and *conflict management*. As indicated by the cross-loadings, there is some overlap between these factors.

The fact that the ANM is positioned at a higher level in the organizational hierarchy also hints at the possibility that there may be important methodological differences in measuring collaboration in vertical relative to horizontal relationships. Another potential contributing factor could be that the ANM interacts with 3-5 ASHA/AWW pairs, whereas the ASHAs and AWWs primarily work with only one of each of the other two cadres. In this way, the existence of similar multiple working relationships with multiple other ASHAs and AWWs may affect their perceptions or experience of collaboration with any given individual worker. The larger number of collaborative relationships for the ANM is also quite likely to affect their available time to allocate to any one relationship, a factor which is largely unexplored in the existing literature on interprofessional collaboration.

It is also worth noting that the item loadings on the factors did not match the conceptual framework of the study but, at least for the AWW and ASHA responses, focused on positive and negative factors related to collaboration, labeled *enablers* and *barriers*, respectively. The labeling of these items was based on the fact that the latter factor was exclusively defined by negatively phrased items. This is consistent with the "Isolation" factor in the multiple-group interprofessional collaboration scale developed by Kenaszchuk et al. (73), which also consisted exclusively of negatively phrased items and which the authors retained because of: 1) the importance of acknowledging and measuring negative aspects of interprofessional care; and 2) cultural norms inhibiting hierarchically subordinate healthcare workers from openly criticizing those who are hierarchically senior (e.g., nurses avoiding openly criticizing doctors).

Kenaszchuk et al. (73) further noted that "defining a factor based on negative items acknowledges that survey scales convey information as much as they elicit it" (Schwarz 1995; Schwarz and Oyserman 2001, in Kenaszchuk et al. (73)) and that the existence of negative items on a scale may serve as a signal to the respondent of the researchers' awareness that relationships between the healthcare workers can be strained. This observation, combined with the fact that the negatively worded scale items contributed an outsized proportion of the overall variation in collaboration scores, suggests that it

may be worthwhile testing variations of the scale with a larger number of negatively phrased items. Further analysis in this direction may also be useful in investigating whether there a collaboration analog of Herzberg's Two-Factor Theory of Motivation, which states that motivation is jointly driven by higher levels of satisfaction and lower levels of dissatisfaction and that the two do not conceptually belong to the same dimension (77).

Although there is no gold standard measure to test the criterion validity of the measure, the total village-level collaboration scores were statistically significantly associated with the constructed indicator for information matching between the ASHA's and AWW's records when three outlier villages with very low collaboration scores were dropped from the analysis. This indicates that, as theorized, higher levels of collaboration between the AAA workers appear to be positively associated with greater consistency in reporting of key village indicators (e.g., number of births, number of pregnant women, number of children 0-3 years, etc.) between the ASHA and AWW, which is a core component of their respective job descriptions and one key point of interaction.

2.5.4 Study limitations

This study has several notable limitations. From a data collection perspective, the tendency for the collaboration scores to skew to the higher

end of the scale may reflect some residual social desirability bias, even though the research team explicitly sought to minimize this by refining the wording of the scale questions through the cognitive interviewing and pre-testing process. This skew limited, to some extent, the overall variation in the scale responses across the study villages and warrants further consideration in subsequent testing or adaptation of the scale. Building on the observations of Kenaszchuk et al. (73) that negatively phrased questions may in some cases help respondents more openly share critical perspectives or experiences, it may be worthwhile assessing the psychometric properties of an adapted collaboration scale with a more even balance of positively and negatively worded questions, as noted in the discussion above.

The constructed criterion variable for indicator matching between the ASHA and AWW is a plausible proxy indicator of routine interaction and information sharing between these two workers and, by extension, collaboration between all three (i.e., since the ANM relies on those indicators to keep track of service needs and coverage in the village), but is far from a gold standard. Registers may in some cases be unavailable for the frontline workers to use for reasons unrelated to worker collaboration (e.g., a supply shortage or delay). It is also possible that the AAA workers in some villages have worked out their own system of record-keeping, cross-checking and

compiling monthly reports, that does not require them to maintain consistent numbers in their respective registers.

The relatively narrow geographic scope, limited to six administrative blocks in Hardoi and Sitapur, Uttar Pradesh may limit the generalizability of the findings. However, although the size of the study area is small relative to Uttar Pradesh state, it has similar sociodemographic attributes to other districts and to Uttar Pradesh as a whole. This, along with the administrative consistency in the individual roles and joint responsibilities in the AAA triads, suggest that the collaboration scale may have relevance beyond Hardoi and Sitapur, at least in Uttar Pradesh, and possibly in India more broadly.

Collaboration is a complex phenomenon and arguably should be measured from multiple perspectives, potentially also including objective measures of collaboration to complement the subjective experience of the frontline workers. Relatedly, the growing emphasis on integrated, person-centered care within the health sector suggests that the beneficiary perspective may also have an important role to play. Further research should consider the extent to which these other perspectives complement the subjective, provider-side perspective represented in the current scale.

This study also does not directly address collaborative governance dynamics at higher levels (e.g., national, state, district), which are also critically important for program effectiveness. Nor does the study address or consider the appropriateness of the program design (e.g., whether an alternative organizational structure or another form of frontline worker collaboration would be more suitable than the current "AAA" structure).

2.4.5 Study strengths

In addition to an extensive, multi-disciplinary review of existing research, the development and refinement of the collaboration scale was informed by four months of personal field work in India by the lead author, including: consultation and close collaboration with the research team of the data collection agency and local experts from Project Samuday; direct involvement in the development of data collection instruments, field manuals, training materials, and other associated documentation as well data collector training and field monitoring/supervision. Each of these steps also benefited from the input and expertise of the skilled, multi-disciplinary research team involved in the parent study, including team members with extensive personal and professional experience in India as well as fluency in spoken and written Hindi.

The fact that this study was embedded within a broader program evaluation, including a survey of frontline workers across a geographic area encompassing a catchment area of about one million people, enabled a larger scope and scale of data collection than would have been possible if this research were implemented as a standalone study.

The close and ongoing working relationship between JHSPH and the HCL Foundation, which leads Project Samuday, means that there is an interested and engaged audience for the findings of this study as well as a capable and informed local team in the study area that may be able to participate in and/or facilitate validation of the findings with AAA frontline workers and communities. Insights related to AAA collaboration may have practical relevance for Project Samuday, as the AAA frontline workers play a critical role in the project's health and nutrition interventions. Additionally, the close relationship between the HCL Foundation and the local government (in part because they are the largest local employer) suggests that the HCL Foundation may be well positioned to share pertinent insights with their government counterparts and discuss potential policy implications.

2.5.6 Conclusion

While there is wide global consensus about the importance, necessity, and potential benefits of MSCs, there is limited empirical evidence on how they

actually function in practice, which impedes our collective understanding of how to make them successful. This gap is exemplified by India's ICDS scheme. Programmatically, ICDS officials may not be aware of whether and how collaboration dynamics between frontline workers (positively or negatively) affect the achievement of service delivery targets, which limits their ability to learn about what works or address problematic arrangements. On the policy level, the lack of a metric for frontline worker collaboration makes it difficult to assess: a) the effects of state- and local-level governance structures and multi-sectoral coordination mechanisms on frontline worker collaboration at the point of service delivery, and; b) the association, if any, between "AAA" collaboration and the coverage and quality of frontline health services. Both gaps limit the ability of the Indian government to critically reflect on the overall design and assumptions of the ICDS scheme as well as the specific policies in place to implement the scheme.

This study takes a step toward filling this critical measurement gap in India's ICDS scheme. A meaningful, valid scale for measuring collaboration between India's frontline health and nutrition workers has the potential to play a critical role in figuring out how to improve it; it may also provide a useful stepping stone for the development of collaboration scales elsewhere in India and beyond. From a more macro perspective, this type of collaboration scale may help illuminate a critical step in the "missing middle" of the logical

framework for some multi-sectoral initiatives – particularly those involving direct service delivery to rural communities – thus facilitating the generation of much-needed empirical evidence on the effectiveness of these types of partnerships in achieving their stated health and social objectives.

Chapter 3: Key collaboration factors (Paper 2)

3.1 Introduction

3.1.1 Background

Effective collaboration across organizational and sectoral boundaries has been identified as a critical component in a wide variety of health and development initiatives (1–5,78). For initiatives involving direct service delivery to the public, a substantial proportion of this collaboration is expected to take place between frontline workers (18,79). Despite calls to take into account the experience and perspectives of these workers when developing, implementing, and refining health policies and programs, this often does not happen in practice (74,80).

This need is particularly relevant in India, where the government has developed health and social policy emphasizing the importance of collaboration between the key frontline workers involved in the delivery of essential maternal and child health and nutritional services in rural areas throughout the country, focusing especially on the Accredited Social Health Activist (ASHA), Anganwadi worker (AWW), and auxiliary nurse midwife (ANM), sometimes referred to as "triple A" or AAA (81). Central to this effort is the Integrated Child Development Services (ICDS) scheme, a holistic early childhood development program designed to address proximal factors such as

nutritional intake and disease as well as underlying causes related to food security, healthcare access, social protection, and other issues. The largest program of its kind globally, the ICDS scheme is led by the Ministry of Women and Child Development (MWCD), in close collaboration with the National Rural Health Mission (NRHM) of the Ministry of Health and Family Welfare (MoHFW), and is delivered to women and children in nearly one million villages around the country by a team of frontline workers from both ministries (4).

Despite widespread national coverage in terms of frontline worker staffing and community-based "anganwadi" centers, multiple evaluations have highlighted substantial gaps in implementation and limited impact on child nutritional status (5,6) and development outcomes. The extent of collaboration or "convergence" across departments has been consistently identified as a gap, but there has been relatively little documentation of what this looks like in practice and what is needed in order to improve it (18). From the few location-specific studies conducted to date on this topic, in the states of Odisha, Uttar Pradesh, and Rajasthan, several factors (positively or negatively) affecting AAA frontline worker collaboration and performance have been identified, including: a recognized need to cooperate (+) (74); close residential proximity (+) (18); meeting regularly (+) (74); motivation (+) (18,74); active support of the village leader (+) (76); support from state-level

officials (+) (76); interpersonal relationship (+/–) (18,75); supervision (+/–) (74,75); role clarity/confusion (+/–) (18,75); equipment and infrastructure shortages (–) (75); inadequate formal education (–) (75); joint training (+) (76) vs. inadequate training (–) (75); lack of job security (–) (75); unequal compensation and professional status/trajectory (–) (18,74); narrowly focused monitoring indicators (–) (74); top-down channels of communication (–) (74); absenteeism due to pregnancy (–) (75); and nepotistic selection of ASHAs (–) (75).

This study takes a step toward expanding the evidence base on the factors affecting AAA collaboration in rural India, which may be useful in the MWCD's current effort to establish a "very robust convergence mechanism" with "intense monitoring and Convergence Action Plans right up to the grass root level" (17) as part of the 2017 update to the National Nutrition Strategy 2017 (16).

3.1.2 Research objective

The objective of this study is to identify key factors affecting collaboration between the AAA workers in two districts of Uttar Pradesh, India. This study constitutes the third of four objectives of an overarching mixed methods study, corresponding to the qualitative component of the analyses in Phases 1-6 of the Instrument Development and Construct Validation framework

described by Onwuegbuzie et al. (56). A separate paper addressing the fourth objective of the overarching study builds on the key collaboration factors identified in this paper to AAA frontline worker experiences in "high collaboration" vs. "low collaboration" villages and reflects on their implications for the conceptual framework referenced in this paper.

3.1.3 Parent study and research site

Data collection for this study was nested within a broader, multi-topic qualitative data collection exercise, which itself was one component of a mixed methods baseline evaluation of Project Samuday, a multi-sectoral initiative implemented by the HCL Foundation (http://www.hcl.com/hcl-foundation) to improve rural economic and social development in Uttar Pradesh, India across five key areas (education, employment, health, infrastructure, and water) in partnership with central and state government, communities, NGOs, and other stakeholders. The qualitative component of the baseline evaluation in which this study was nested was conducted in three administrative blocks of Hardoi district (Behadar, Kachhauna, and Kothawan), Uttar Pradesh by the Johns Hopkins Bloomberg School of Public Health (JHSPH) and a contracted New Delhi-based social research firm, which directly managed data collection activities.

3.1.4 Ethical considerations and review

The protocol for the research presented here was incorporated into the overall research protocol of the parent study, which was submitted to and approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board, Expedited Committee (IRB-X) as well as from an India-based IRB based in the Center for Media Studies, which reviews social science research protocols. Details related to ethical considerations for this study are summarized in Appendix *A2: Ethical considerations*.

3.2 Methods

3.2.1 Worldview, research philosophy, and positionality

The objectives and design of this study are influenced by several key aspects of the author's worldview, research philosophy and positionality. Key aspects of the authors' worldview influencing this study include: 1) frontline worker collaboration has the potential to positively affect service delivery and health outcomes, and by extension; 2) understanding frontline workers' experience of collaboration and the factors affecting it are critical aspects of health systems research, particularly for multi-sectoral initiatives. Regarding research philosophy, it is assumed that: 1) inter-personal collaboration has a critical psychosocial component that underlies the series of specific actions involved in joint completion of tasks or objectives, thus necessitating an emic perspective; 2) as a group phenomenon, collaboration can only be measured

by considering information from multiple collaborators, and; 3) there are certain universal or broadly applicable aspects of team collaboration, which means that insights from studying collaboration in one locale have the potential to be applicable to other contexts. With respect to positionality, the author's outsider status underscores the reliance on the interviewing skills and local contextual knowledge and experience of the qualitative research team from the Indian social research firm to develop rapport and elicit open responses, as well as their ability to accurately capture the respondents' intended meaning in the English translation of interview transcripts. This highlights the importance of a clear and common understanding between the researcher and interviewers about the scope and objectives of the study; it also provides an opportunity for the researcher to draw on the tacit knowledge of the interviewers to identify and probe for contextual subtleties of AAA worker collaboration.

3.2.2 Conceptual framework

The research objective to identify factors affecting AAA collaboration is loosely guided by Emerson's and Nabatchi's Integrative Framework for Collaborative Governance (48), which synthesizes and bridges several decades of research on collaboration across a broad array of professional fields and academic disciplines. The framework loosely follows a theory of

change structure to analyze the development, functioning, actions, and outcomes of a "collaborative governance regime"[8] (CGR), which is defined as:

> *"a type of public governance system in which cross-boundary collaboration represents the predominant mode for conduct, decision-making, and activity between autonomous participants who have come together to achieve some collective purpose defined by one or more target goals."* (48)

In the ICDS scheme, this type of cross-boundary collaboration occurs at multiple administrative levels, including the state, district, block, and village, each with a different set of key actors, goals, responsibilities, resources, governance mechanisms, and so forth (18). This study focuses on the CGR at the village or frontline level, and specifically the "collaboration dynamics" between triads of ASHAs, AWWs, and ANMs serving the same catchment area. According to Emerson and Nabatchi, these collaboration dynamics play a critical role in influencing the actions taken by CGR participants (48), which in this case refers to the AAA workers and the extent to which they are able to work together effectively to deliver basic health and nutrition services to eligible women and children in the village. According to the conceptual

[8] As stated by the authors, the use of the word "regime" in this framework is borrowed from Stephen Krasner, who defined it as a "governing arrangement that is imbued with a set of explicit and implicit 'principles, norms, rules, and decision-making procedures around which actor expectations converge in a given issue area.'" (Krasner 1983, in (48)).

framework, collaboration dynamics consist of three primary components or sub-domains – *principled engagement*, *shared motivation*, and *joint capacity* – which interact dynamically and iteratively to determine the quality and extent of collaboration over time. These are briefly paraphrased in Table 10 below.

Table 10: Sub-domains of Emerson's and Nabatchi's collaboration dynamics

Sub-domain	**Brief description** *(paraphrased from Emerson & Nabatchi* (48)*)*
Principled engagement	An iterative process of interaction that enables people to collaborate across their respective institutional or sectoral boundaries to solve problems or create value together. Interactions are characterized by behavioral norms, such as fair and civil discourse and open and inclusive communication.
Shared motivation	Joint recognition among participants that their ongoing investment of time and resources into the CGR is worthwhile for themselves and the organization or constituency they represent; this fosters participants' emerging identification with, and ultimately reinforces their dedication to, the CGR.
Joint capacity	A combination of essential elements – including procedural and institutional arrangements, leadership, knowledge, and resources – that enable CGR participants to accomplish their collective purpose as specified in their shared theory of change.

These collaboration dynamics inform the design of the study (i.e., to seek out an emic perspective from each of the three AAA workers in the study villages about their collaboration experience) as well as the overarching framing of the interview guides (i.e., to broadly understand the nature of AAA interaction, motivations for collaboration, and their ability or capacity to collaborate). At the same time, the study is not intended to test or modify the Emerson & Nabatchi framework, but rather to use it as an "underlying structure, scaffolding, or frame" (p.66,(82)) for the inductive identification of

key factors affecting AAA worker collaboration in the study context. For that reason, interview guide questions are intentionally kept broad and the analytical approach uses inductive coding, without any *a priori* codes from the Emerson & Nabatchi framework.

A key assumption behind this study design is that the CGR representing frontline worker collaboration is fundamentally similar, and thus analytically comparable, across the study villages. Consistent with Indian government policy, it is assumed that the key participants in the CGR at the village level are the three AAA worker cadres, that they are all aware of the government directives to collaborate with one another (i.e., as per their job descriptions), and that there is some official mechanism in place to facilitate or support their collaboration at the village level, such as joint meetings. The interview guides help investigate this assumption by exploring several contextual aspects of the AAA worker's collaboration experience, including their awareness and understanding of government directives related to collaboration, their participation in joint meetings, and their interactions with other key individuals who may influence their collaboration.

3.2.3 Key methods

Key steps include training of the qualitative interviewers; development and pre-testing of interview guides; data collection through in-depth interviews

(IDIs) with targeted respondents, including the AAA workers and medical officers working in the area; data management and translation; and inductive analysis of interview transcripts to identify key factors affecting AAA collaboration. Each of these steps are described in detail below. The lead author supported this process through four months of on-site field work in India between January-May 2017 and remote support thereafter through to the completion of the fieldwork report in February 2018.

3.2.3.1 Researcher training

The team directly responsible for data collection consisted of a qualitative research lead and three skilled interviewers from the contracted Indian social research firm, as well as four additional staff from the firm who assisted with logistics and note-taking. The qualitative leads from the JHSPH team and Indian social research firm co-led four trainings for these interviewers in 2017, including February 13-17, March 10, April 11-14, and August 1-2. Topics covered in the initial training included: an overview of the overarching baseline evaluation, the specific objectives of the qualitative component, sampling approach, detailed review of the interview guides in English and Hindi, fundamentals of qualitative research, skill-building activities for interviews, interview trouble-shooting, field logistics, ethics, and data management. Subsequent trainings focused on additional skill-building, troubleshooting, and reviewing early findings from the collected data. The

author contributed to the objectives and design of the training sessions and led a dedicated session focusing on the collaboration-related questions included in the interview guides.

3.2.3.2 Interview guides

A series of open-ended questions and suggested probes related to AAA collaboration were drafted by the lead author for inclusion in the overall IDI guides, which also covered five other topics (worker's job context; community health needs; healthcare infrastructure; nutrition, water and sanitation status; recommendations for improvement). The IDIs with the AAA workers themselves included six core collaboration questions covering the following areas: *perceived importance* of collaboration, *positives and negatives* of collaboration (e.g., "What are some of the good and difficult things about working with ____?"), and *recommendations for improvement*; *official directives* related to collaboration; *joint meetings;* and *other key collaborators*. The final three questions explored the respondents' perceptions and experiences with the government administration vis-à-vis collaboration and other key people in the community to help contextualize the AAA workers' collaboration experience across the villages (See Appendices *A6: Interview guide for in-depth interviews with ASHA*, *A7: Interview guide for in-depth interviews with AWW,* and *A8: Interview guide for in-depth interviews with ANM*). Medical officers based in Primary Health Centres (PHCs), who are

responsible for monthly monitoring of health indicators in ~20-30 villages (corresponding to ~4-10 ANMs and ~20-30 ASHA/AWW pairs) (83,84), were asked a single question about their perception of AAA collaboration in the sampled village, with probes about its effect on the health of the community and their personal interaction with the AAA workers serving the village (see Appendix *A9: Interview guide for in-depth interviews with medical officers*).

Draft interview guides were refined internally within the JHSPH team, with overall technical leadership and oversight provided by the JHSPH qualitative research lead and shared with the lead qualitative researcher from the Indian social research firm for review and discussion about the purpose, content, format, wording and length of the interview guides, including each of the questions and probes. Pre-testing of the interview guides with target types of respondents in non-sampled villages was completed by the qualitative research team from the Indian social research firm, with oversight from the JHSPH qualitative lead. This yielded additional feedback on the format and structure of the guides, largely related to the introduction of the topic, framing and phrasing of the questions, interviewing approach, and overall length of the interview. In particular, interviewers observed that some of the AAA workers seemed to be providing socially desirable responses to some questions about collaboration with other frontline workers. To address this, the qualitative data collection team practiced using hypothetical

scenarios to elicit candid responses, such as asking about how AAA workers in neighboring or similar villages might describe certain situations. In this process, the lead author participated in several debriefing meetings with the qualitative data collection team to discuss the pre-testing findings and refine the interview guides. No major changes were made during this process.

3.2.3.3 Sampling

The lead author developed the purposive sampling strategy for the qualitative data collection, with an aim to achieve maximum variation using a quantitative estimate of the level of AAA worker collaboration. As described in Paper 1, a quantitative measure of collaboration was derived from an 18-item psychometric scale on AAA collaboration that was administered to ASHAs, AWWs, and ANMs serving a randomly selected village in each of 173 gram panchayats in three blocks (Behadar, Kachhauna, Kothawan) of Hardoi district, Uttar Pradesh, corresponding to a catchment area of approximately 465,000 people. The collaboration scale was administered twice to each of these three workers, once about each of the other two workers serving the same village. Total scale scores from all workers were summed to generate village-level collaboration scores to be used for purposive sampling. After excluding villages with incomplete data, two villages from each block were selected for inclusion in this study – the one with the highest collaboration score and the one with the lowest collaboration score – for a total of six

villages. In each sampled village, the interview team from the Indian social research firm conducted IDIs with the key frontline workers (ASHA, AWW, nearest ANM) and a medical officer.

3.2.3.4 Data collection

Field work for this study was conducted in the six sampled villages between August 9-23, 2017. A total of 24 IDIs were conducted across four cadres of health workers (Table 11), each of whom had been working in their post for at least four months prior to the interview. The IDIs were led by an interviewer and accompanied by a note-taker, both from the social research firm. Interviews were conducted at the respondent's place of work, home, or outside, typically during the afternoon (or another scheduled time) to minimize disruption of services. All respondents were at least 18 years of age and provided informed consent before participation. Interviews were digitally recorded with consent of the interviewee. Interviewers sought to maintain auditory privacy during the interview process to the maximum extent possible. If others interacted with the respondent or sought to join the conversation, the interviewer paused the interview and waited until the respondent was alone to resume. Interviews lasted between approximately 1-2.5 hours for AAA workers and between 30 minutes to 1 hr. 20 minutes for medical officers. At the end of each day of fieldwork, interviewers held a 1-2 hour debriefing session to discuss and reflect on their interviews,

interviewing technique, and to document any relevant contextual information that may have influenced a respondent's responses. These notes were subsequently appended to the interview transcripts.

Table 11: Qualitative data collection by respondent characteristics

Respondent type	Brief description of respondent type	Collaboration questions	Interview length (min)*	Male	Female	Total
Auxiliary nurse midwives (ANM)	Trained frontline health workers providing outreach, immunization, antenatal care, and other basic care to 3-5 villages each, including supervision and support of ASHAs and AWWs	1) Importance 2) Positives/ negatives 3) Recom-mendations 4) Directives 5) Meetings 6) Other collaborators	Min: 55 Max: 152 Median: 70	0	6	6
Accredited social health activists (ASHA)	Government community health workers living and working in the villages		Min: 60 Max: 110 Median: 85	0	6	6
Anganwadi workers (AWW)	Government nutrition and early childhood education workers based in anganwadi centres in the villages		Min: 60 Max: 115 Median: 100	0	6	6
Medical officers (MO)	MBBS doctors working in government health centers	1) Perception of collaboration between AAA	Min: 30 Max: 80 Median: 66	4	2**	6
			Total IDIs	**4**	**20**	**24**

*These times reflect the length of the entire interview, during which collaboration was one of six topics covered. Other topics included: worker's job context; community health needs; healthcare infrastructure, nutrition, water and sanitation status; and recommendations for improvement.
**1 staff nurse was interviewed instead of a medical officer

3.2.3.5 Data management and translation

Each interview was assigned a unique identification code, which served as the IDI audio file name and transcript name. The identification consisted of

data type (i.e., IDI), respondent type (e.g., ASHA, ANM, AWW, etc.) and a unique number associated with that particular combination (e.g., IDI_AWW_03 for the third IDI with an AWW).

After each day of data collection, the moderators uploaded their audio files and created a word document (with unique ID for file name) with cover information (date, time, location, respondent gender, age, religion, caste) and reflections on the interview or focus group. The transcript was later pasted below the cover notes, into the same file.

Each piece of data was also indexed in a Google spreadsheet data inventory accessible only by those working closely on the research study. All researchers maintained password protection on their computers. Each file was tagged with all relevant metadata, including: data type, respondent type, date, moderator, unique identification number, location, respondent gender and age, audio file length, brief description of respondent(s), key summary points, data quality (rich, moderate or poor) and file status (i.e. whether audio was uploaded, file transcribed, and file coded).

The contracted Indian social research firm engaged a pool of translators who listened to the audio recordings of interviews in Hindi and typed the best possible English translation on a sentence-by-sentence basis. Each transcript

was checked in its entirety by listening to the audio while reading the translation and then spot checked by the qualitative lead from the social research firm before approval. One member of the JHSPH qualitative research team fluent in Hindi conducted an additional translation check. The lead author participated in regularly scheduled check-in meetings with the JHSPH and Indian social research firm qualitative teams to discuss data collection progress and any emerging issues or questions from the fieldwork.

3.2.3.6 Analysis

As a first step, interviewers from the contracted social research firm reviewed each transcript and tagged all excerpts that touched on the topic of AAA collaboration, including those from the portion of the IDI directly focused on collaboration as well as anywhere else in the interview relevant (e.g., when a frontline worker mentioned a challenge or benefit related to collaboration when discussing village-level maternal health needs and services). The lead author then reviewed the full transcripts in sets of four, grouped by a shared catchment area, and tagged several additional collaboration excerpts identified by cross-referencing comments from multiple respondents in the same village about the same topic, issue, or event. This concurrent review of transcript content between workers within the same village was particularly useful for contextualizing and understanding the attitudes, experiences and phenomena represented by the coded excerpts. Next, the lead author

inductively coded each excerpt using constant comparison analysis in Dedoose, an online qualitative data management platform. Through this process, codes were iteratively revised or refined as needed based on review of already-coded excerpts within and between each transcript. Excerpts (or portions thereof) were assigned multiple different codes if they conveyed more than one emergent concept. The output from the inductive coding process, including assigned codes, associated transcript text, respondent type, and village name, was then exported to an Excel-based data matrix to facilitate interpretation. This step involved revisiting the coded excerpts in the data matrix to further refine the applied labels, in some cases re-grouping excerpts to better match an updated framing of the underlying concept. The outcome of this process was the identification of a set of key factors affecting collaboration, either positively ("facilitators"), negatively ("barriers"), or both, depending on how the factor was experienced.

3.3 Results

The results section begins in Section 3.3.1 with a brief summary of the collaboration context from the AAA worker's perspective, including government efforts to facilitate collaboration (e.g., official directives, joint meetings), the workers' descriptions of their primary roles and responsibilities, the key points of interaction between them, and an overview of other individuals either directly or indirectly involved in the AAA

collaboration process. Against this contextual backdrop, Section 3.3.2 summarizes the key collaboration factors that emerged from the inductive analysis, including specific facilitators and barriers. In each section, responses are almost entirely from the AAA workers themselves; the Medical Officers commented generally on the need for the AAA workers to collaborate and provided basic details of the joint meetings but were not very familiar with the specifics of AAA collaboration at the village level.

3.3.1 AAA frontline worker context

3.3.1.1 Government directives

In response to the interview question about whether collaboration with the other AAA workers was an official part of their role or an arrangement they arrived at on their own, respondents unanimously and unequivocally stated that they had been instructed to work together. As succinctly stated by one AWW: "It is government order as my department is connected to health department as well." (Behadar, IDI_AWW_09). An ANM in another village pointed out that AAA collaboration "is a defined work procedure", going on to explain "when we joined CSC, we got a letter about our region and how many villages need to be covered and what work needs to be worked with which ASHA and Anganwadi I have to coordinate for every village." (Kachhauna, IDI_ANM_02). This finding is consistent with the study's assumption that

the AAA workers in all sampled villages have an official mandate to collaborate with one another as part of their job description.

3.3.1.2 Joint meetings

Similar to the widespread awareness of the government directive for AAA workers to collaborate with one another, most of the respondents described one or more different meetings they regularly attended in which other AAA frontline workers were present. There was, however, substantial variation in the way respondents described these meetings, including the number, type and purpose of meetings described, frequency of occurrence, and the respondents' level of awareness and participation in the meetings. One AWW, for instance, mentioned meetings at the nearest Primary Health Centre (PHC) and at the Community Health Centre (CHC), the latter of which are held between one to three times per month and involve all the ASHAs, AWWs, regional workers, main helpers in the block, Chief Officer and supervisor of the PHC (Kothawan, IDI_AWW_07). In a second area, a Medical Officer talked about a "Triple A" meeting at the block level led by the Block Program Manager involving the ANM, ASHA, and AWW. He said he believes it happens on the fourth Friday of every month but was not familiar with the details. When asked about the agenda, he said: "The agenda has many things. Related to work, they are given all information and as an

incentive I guess 50 Rs is given to (the ASHA and AWW)" (Behadar, IDI_MO_07).

Not all the respondents were aware of or attending these "Triple A" meetings, however. When one AWW was asked whether she had attended a meeting conducted by the government involving the ASHA, ANM and AWW, she replied: "I have never been to such meetings. I never attended such a meeting. If other anganwadi workers have attended, I can't say. Haven't attended such meeting." Also, "it may have happened or conducted by some other Anganwadi workers but I don't know about it." (Kothawan, IDI_AWW_01). Another respondent was aware of the meetings but had not attended: "These meetings are conducted but I haven't attended it yet. Why to lie?" (Kothawan, IDI_ANM_01).

3.3.1.3 Key responsibilities of AAA workers

Broadly speaking, the ASHA and AWW serve as the community-based first points of contact with village residents on behalf of the Ministry of Health and Family Welfare (MoHFW) and Ministry of Women and Child Development (MWCD), respectively. According to government policy, they each serve a population of approximately 1,000 people - typically (although not always) in contiguous catchment areas (85,86). In practice, catchment areas may be larger due to growing village populations and post vacancies

(34). The ANM is the closest skilled health provider, working out of the nearest sub-centre, each of which typically serves 3-5 villages (39).

Although there is some variation from village to village, the ANM, AWW, and ASHA typically play similar roles and have similar tasks for which they depend on each other, which are extensively described in various policy documents of the MoHFW, which employs the ANMs and ASHAs, and the MWCD, which employs the AWWs. For that reason, this summary will focus on the aspects of these roles that were highlighted by the frontline workers themselves as well as other members of their communities.

As succinctly summarized by one ANM, "I check ladies' health; I take care of mothers' and children's health" (Kothawan, IDI_ANM_05). The ANM then elaborated the services she provides in the village: antenatal care for pregnant women, including a basic checkup, vaccinations, and tablets for iron, folic acid, and calcium; counseling on family planning, including birth spacing and contraception; and vaccinations for children aged 0-5 years. (Kothawan, IDI_ANM_05)

In their community-based outreach roles, the ASHA and AWW support the ANM when she comes to the village to provide these services, which is typically during the regularly scheduled vaccination days, officially called the Village Health and Nutrition Days (VHNDs). The ASHA and AWW keep

track of which village mothers and children need vaccination and recruit them to come to the VHND, which may be held in the Anganwadi centre (AWC) or a school or family residence that is serving the function of the AWC. In addition to their specific role in supporting the ANM in delivering vaccinations, several ASHAs mentioned other responsibilities related to growth monitoring of children and delivering key health messages to community members. For instance, one ASHA explained that her daily work routine involved measuring and recording the weight of babies and children, recording their respiration rate, and counseling mothers on breastfeeding and nutrition and what to do in case of fever. (Kothawan, IDI_ASHA_06)

Similarly, the AWWs consistently highlighted the VHND as a central component of their work, often mentioning their contribution to the vaccination effort – sometimes aiding in the messaging to the community members ("I had to make them understand that vaccines are good for health"; Kothawan, IDI_AWW_06) – but especially emphasizing their responsibility in delivering nutrition-related services such as growth monitoring, provision of information about nutritional requirements for children ("I talk to the women and give instruction how to feed milk to the baby" and "good food habits" and "I tell them to feed the baby after washing their hands"; and distribution of supplementary food ("poshahar") to pregnant women and children, including extra milk and ghee for malnourished children (Kothawan, IDI_AWW_06).

Teaching was also mentioned as another key area of work for AWWs. As described by one AWW who works in a school from 8am to 1pm most days, "I teach the students. I get to know the course from the book. The course that has to be taught is given every month. Like in August I have to teach this and in September, this. These things have written in the book. I teach accordingly." (Kothawan, IDI_AWW_06)

3.3.1.4 Key areas of collaboration

The most commonly mentioned areas of collaboration between the AAA workers were: preparation of the due lists for routine immunization (i.e., the list of women and children in the village eligible for various immunizations on particular dates); planning and conducting the VHNDs; distribution of the polio vaccine (through the Pulse Polio campaign); and child growth monitoring (e.g., taking height and weight measurements). Each of these was mentioned in multiple interviews by ANMs, ASHAs, and AWWs when describing their own personal responsibilities as well as when discussing points of shared responsibility with the other frontline workers. Other activities mentioned include distributing albendazole de-worming tablets to children, participation in the government's Total Sanitation Campaign (Swachh Bharat Abhiyan) (Kothawan, IDI_AWW_07), and spraying of insecticide on grass and in sewers to reduce mosquitoes (Behadar,

IDI_ASHA_08). Among these, the due list in particular came up as a critical mechanism for information sharing, as described by one ANM:

> M: Why are you required to work with (the ASHA and AWW)?
> R: Because they also need to have a due list. Due list of ASHA, Anganwadi and ANM should be same. If I missed out a new infant who is born yesterday but Anganwadi and ASHA know which child is recently born and the pregnant lady is registered with them and I will get this information from them. For example, I have 15 names in my list and they have 16, I will get this 16th name from them. I get all the information like the infant is born in house or in hospital because if the delivery takes place in hospital, BCG is already vaccinated. (Kachhauna, IDI_ANM_02)

Another ANM described the ASHA's role in helping her communicate the benefits of vaccines to community members. She explained "I have to tell them the vaccination is for what type of disease and it would give benefit to them; if you will go to a private hospital then you would have to spend more money and you would not get proper vaccination", later adding that "I make them understand this thing and even ASHA explains it to them". (Behadar, IDI_ANM_07).

Several respondents described an agreement between the AAA workers whereby the AWW would coordinate the days and timing of supplementary food distribution (e.g., "dalia") with vaccinations for pregnant women and

children. For instance, one ANM explained that, in her experience, when supplementary food is distributed on a different day than when vaccines are administered, fewer pregnant women and mothers show up. To address this, the ANM regularly calls the AWW and the AWW's supervisor to coordinate their efforts so that food is only distributed to the women and/or their children after they have been immunized. This, according to the ANM, is quite effective at increasing vaccination in the village. (Kachhauna, IDI_ANM_05)

3.3.1.5 Other important collaborators

Respondents occasionally mentioned other people who play an important role in their work. These included several official positions supporting the AAA workers – including the *pradhan*, or locally elected village leader; various supervisors (including the Anganwadi supervisor for the AWW and the ASHA facilitator for the ASHA), and the *sahayika* (Anganwadi helper) – as well as several informal collaborators, including husbands and other community members.

While the pradhans and supervisors have an official role to help facilitate and support the AAA workers' collaboration and village-level activities, the IDIs revealed that this did not always happen in practice. Some respondents described helpful interactions, while others' experiences were frustrating.

There were no clear patterns within or between villages regarding the extent to which these individuals facilitated or impeded AAA collaboration.

For example, the pradhan's role as village leader was useful in some cases, as exemplified by one ASHA's comment that, in addition to signing off on key documents, the pradhan helps her address any problems that have arisen in the village (Behadar, IDI_ASHA_09). In other cases, however, the pradhan's influence was seen as less positive, as described by the AWW in the same village: "*Pradhan is connected with everybody. We are tied to the pradhan and we have to visit his house" – including to obtain signatures on documents related to, for instance, supplementary food distribution ('poshahar')*", adding that "*if the pradhan denies signature and that distribution was done, then we will all be in problem*" (Behadar, IDI_AWW_09).

Similarly, several respondents shared appreciative comments about their interactions with their supervisors while others shared specific frustrations. On the positive side, one AWW recounted a recent experience in which the Anganwadi supervisor gave her advice and support in managing a specific challenge that had arisen with several community members (Kothawan, IDI_AWW_07). In contrast, one ASHA mentioned that the ASHA facilitator had been holding her payment for the past three months, apparently waiting until she submitted several outstanding payment vouchers, even though the

ANM had already signed separate documents to confirm the work the ASHA had completed (Kachhauna, IDI_ASHA_05).

The Anganwadi helper, or sahayika, was widely acknowledged, especially by the AWWs, for her valuable support role in looking after the anganwadi centre and helping with some of the AAA workers' tasks. The bulk of the sahayika's support was focused specifically on nutrition-related tasks, as described by one AWW: "*she comes to the (Anganwadi) centre, opens it in the morning and she does cleaning, sweeping and all. Then she goes house to house… brings children and then makes them sit here. Nutritional food (poshahar) is distributed, so she distributes that.*" (Behadar, IDI_AWW_03). Several AWWs commented that this support from the sahayika made them more available to carry out their joint work with the other AAA workers. Several respondents also mentioned that the sahayika also sometimes helped with the outreach to gather eligible mothers and children for the VHND in addition to her primary responsibilities directly supporting the AWW. Sahayikas were present in all study villages.

Informal collaborators mentioned by the AAA workers included their own husband, another worker's husband, or other members of the community, particularly younger girls. For example, one ANM expressed her appreciation of the support she regularly received from the ASHA's husband: *"If some kid*

is handicapped, (he) goes and brings that kid here. It is important to have support of males. If males get connected to it then we get better results." The same ANM also mentioned the security benefit of traveling with one's husband or another trusted male community member: "*If the lady is going through bus or train and if her husband sits behind her then she gets confidence to go anywhere. Alone, a lady cannot do anything. Suppose we go out in a group, if males come all males are not good, they tease us, we have many problems"* (Kothawan, IDI_ANM_05).

An ASHA from a different village also talked about the help she receives from her husband to call the eligible women from their homes on the vaccination days, explaining that "*when I don't come, my husband comes. If am not well or any other problem I am not able to come, my husband comes and calls them*." (Behadar, IDI_ASHA_09). Finally, one AWW mentioned that girls from the village regularly help her complete her work in the village by looking after the young children while they are at the anganwadi center: "*The girls from backward class help me a lot. The sahayika calls the children, when I need to go out for any work, the girls look after the children, so the children can't go anywhere*." (Kothawan, IDI_AWW_07).

Overall, the other collaborators mentioned by the AAA workers seemed to have either a mixed influence (pradhans, and supervisors) on AAA

collaboration or provided a small to moderate level of support (sahayikas and community members). These findings show no substantial variations between the villages in terms of the key worker cadres involved in the frontline delivery of health and nutrition services, indicating that the "AAA" triad is a relevant unit of analysis in all study villages. Additionally, there does not appear to be any major influence from other (non-interviewed) individuals on AAA collaboration that would substantively alter the findings on key collaboration factors.

3.3.2 Key factors affecting AAA frontline worker collaboration

Respondents' comments during the IDIs highlighted 10 key factors affecting collaboration, with 8 constituent facilitators and 16 barriers. In many – but not all – cases, these factors included both facilitators and barriers representing opposite experiences with the same topic or issue, or "two sides of the same coin", so to speak. For example, the "interpersonal relationships" factor encompasses both the positive and appreciative comments some workers made about their colleagues (facilitators) as well as the tensions or personality clashes described by others (barriers). These collaboration factors and their constituent facilitators and barriers are summarized in Table 12 below, along with the number of times each code appeared across the full set of transcripts from the three AAA frontline workers. Collaboration factors are listed in order of the total code count. Collaboration factors are further

described in the text below through illustrative examples and excerpts from the IDI transcripts. As in the table, factors are presented in order based on the frequency of coding, from most frequent to least frequent (except for the "other obstacles" category, which is a grouping of multiple codes that were only applied 1-7 times each).

Table 12: Key collaboration factors, including constituent facilitators, barriers and descriptions

Factor	Facilitator (F)	Barrier (B)	Description
A. *Inter-dependence *(Count: 68)*	Inter-dependent/ coordinated tasks *(Count: 59)*	Independent/ uncoordinated tasks *(Count: 9)*	Respondent conveys that her ability to fulfill her responsibilities [**(F)** is]/[**(B)** is not] dependent on coordination/collaboration with the other worker(s) and/or that she completes her tasks [**(F)** with]/[**(B)** without] direct involvement or coordination with the other worker(s)
B. Inter-personal relation-ships *(Count: 50)*	Positive inter-personal relationship/ respect *(Count: 38)*	Interpersonal tensions *(Count: 12)*	**(F)** Respondent describes a positive, pleasant, mutually respectful, and/or rewarding relationship with the other worker(s) **(B)** Respondent does not get along with, is frustrated or upset by her interactions with, or expresses negative sentiment toward the other worker(s)
C. Resource constraints *(Count: 45)*	N/A	Infrastructure / equipment/ supply problems *(Count: 28)*	**(B)** Respondent is experiencing or has recently experienced a problem related to infrastructure, equipment, or supplies as an impediment to collaborating with the other worker(s)
	N/A	Staffing shortages *(Count: 10)*	**(B)** Respondent is experiencing or has recently experienced a problem related to the shortage of government staff as an impediment to collaborating with the other worker(s)
	N/A	Travel/transp ortation challenges *(Count: 6)*	**(B)** Respondent is experiencing or has recently experienced a problem related to travel or transportation as an impediment to collaborating with the other worker(s)
	N/A	Financial resource constraints *(Count: 1)*	**(B)** Respondent is experiencing or has recently experienced a problem related to the shortage of financial resources as an impediment to collaborating with the other worker(s)
D. Diligence/ reliability *(Count: 43)*	Diligence/ persistence *(Count: 37)*	Perceived lack of reliability *(Count: 6)*	**(F)** Respondent describes an example of another worker's diligence or persistence in completing her responsibilities despite obstacles or difficulty, or relates an experience that demonstrates her own diligence or persistence **(B)** Respondent perceives that she cannot rely or depend on the other worker(s) to fulfill her own job responsibilities, to help/support the respondent, or to make a reasonable effort to do so

Factor	Facilitator (F)	Barrier (B)	Description
**E. Flexibility *(Count: 27)*	Flexibility *(Count: 27)*	*None coded*	**(F)** Respondent describes an example of another worker's flexibility when confronted with a colleague's mistake, inability to come to work, failure to complete her tasks, or some other shortfall in fulfilling her job responsibilities. Alternatively, respondent relates an experience that demonstrates her own flexibility in such a circumstance.
**F. Role clarity *(Count: 24)*	Clarity of roles, responsibilities *(Count: 24)*	*None coded*	**(F)** Respondent conveys a clear and coherent understanding of the respective roles and responsibilities of two or more AAA workers when interacting with one another
G. Guidance/ instruction *(Count: 20)*	Useful feedback/ guidance/ supervision *(Count: 12)*	Inadequate guidance on how to collaborate *(Count: 8)*	**(F)** Respondent describes a recent experience in which she received instructions, guidance or feedback that have helped her understand how she is supposed to work with one or more of the other workers **(B)** Respondent and/or other worker(s) do not have enough guidance, instruction or feedback on how best to collaborate effectively with the other worker(s)
H. Locus of control *(Count: 20)*	Personal ability to make the collaboration work *(Count: 17)*	Collaboration depends on other person's actions *(Count: 3)*	Respondent perceives that the success or failure of the collaboration between the respondent and the other worker(s) is [**(F)** something she can influence through her own actions]/[**(B)** dependent on other workers' actions]
I. Conflict resolution *(Count: 13)*	Successful conflict resolution *(Count: 6)*	Unresolved conflict *(Count: 7)*	Respondent has recently experienced a disagreement, argument, misunderstanding, or other emotionally frustrating or upsetting interaction with the other worker(s) that [**(F)** has since been resolved]/[**(B)** has not been resolved] to the respondent's satisfaction
***J. Other obstacles *(Count: 17)*	N/A	Personal/ health/ domestic challenges *(Count: 7)*	**(B)** Respondent or one of the other AAA workers is experiencing or has recently experienced a personal, health, or domestic issue that impeded her ability to fulfill her job responsibilities
	N/A	Separate institutional structures *(Count: 4)*	**(B)** Collaboration between two or more of the AAA workers is impeded due to differences in organizational/institutional policy, systems, processes, scheduling (e.g., of meetings or activities), etc.
	N/A	Conflicting schedules *(Count: 2)*	**(B)** Collaboration between two or more of the AAA workers is impeded due to differences in worker schedules that are not explicitly related to organizational/institutional affiliation
	N/A	Caste/class discrimination *(Count: 2)*	**(B)** Collaboration between two or more of the AAA workers is impeded due to at least one worker's discriminatory attitude related to the caste or class of another AAA worker in the village.
	N/A	Skill/ capability limitations *(Count: 2)*	**(B)** Collaboration between two or more of the AAA workers is impeded due to gaps or shortcomings in the skills or capabilities of at least one of the workers

*Note: it was not always possible to clearly distinguish between a worker's perception of interdependence with other workers and their joint completion of tasks. When asked why they thought it was collaboration was important, some respondents explicitly stated something along the lines of "because I need her help in order to get my work done"; others answered the question by listing or describing the specific tasks they complete together. Additional interviews, further probing, and/or richer IDI transcripts may have resulted in a clearer distinction between the sub-concepts that were ultimately grouped within this factor (e.g., interdependence and coordinated tasks).

**For the flexibility/understanding and role clarity factors, there were no specific instances in which a respondent directly described the barrier counterpart (i.e., worker inflexibility or lack of role clarity). Although there were situations in which one worker faced an obstacle (e.g., illness, illiteracy, transportation problem) and the other workers did not take actions to accommodate them, there were no comments to suggest these workers were inflexible, per se (i.e., as opposed to fulfilling their job description). Similarly, none of the workers mentioned that they were unclear about the respective roles and responsibilities among the AAA workers, although workers did occasionally comment that they needed more instruction or guidance on how to work together (in which case the excerpt was coded as "*inadequate guidance on how to collaborate*").

***While the various types of 'other obstacles' mentioned are distinct in many ways, they are grouped together here because of how infrequently they were each mentioned.

A. Interdependence

While most of the AAA frontline worker respondents commented that collaboration was important or necessary for their work, there was substantial variation in terms of the level of detail the respondents provided to support those statements. One of the striking aspects of the interviews with those who spoke positively about their collaboration was the clarity with which they described the interdependence between the frontline workers, as exemplified by the comments of this ANM:

> M: Why is it important for you to work with ASHA?
> R: It is important because now suppose I am sitting here and if no one will go to call the children, how will they come?
> M: If you don't work along with ASHA, will that make any difference?
> R: What difference will it make? We will not be able to do any work.

M: Why is it like this?
R: Now as I come here with all my goods, who will go to call them? I cannot go to each and every house. So ASHA is important for that.
M: Ok, and how much important is it to work with Anganwadi?
R: Suppose if ASHA is not there and Anganwadi is there. Then she calls everyone for vaccination and she distributes dalia and she does the weight of the children. All these are handled by Anganwadi. (Kachhauna, IDI_ANM_04)

Similarly, another ANM told the interviewer that she could not do her work without the help of the ASHA, who calls the beneficiaries in from their homes, helping ensure that the ANM makes efficient use of her time during her visits to the village. This ANM explained that, for example, if the ASHA was not there, "I would find it difficult to call them (the children of the village), I cannot do proper work, I cannot go and give proper vaccination by going to their house. ASHA goes there and calls the kids up" so that they are present at the anganwadi center when the ANM arrives. (Kothawan, IDI_ANM_05)

Also referring to the vaccination day, an ASHA from a different village described how her workload is directly affected by the ANM's ability to carry out her own portion of the work, pointing out that if she called the children to come for vaccination but the ANM did not show up, "my work would increase the next time." (Kothawan, IDI_ASHA_06)

This sense of interdependence was not, however, universally shared by all AAA workers. Although nearly all respondents acknowledged the importance of collaboration with the other frontline workers, comments during follow-up questions occasionally revealed that they did not see collaboration as central or essential to their own work. For example, one ASHA explained that she helps the AWW whenever needed but could not think of any situations in which she might need help from the AWW: "I live in this village why would I need any help from her?" (Kothawan, IDI_ASHA_07)

Overall, all three worker types described interdependence with other workers with nearly equal frequency, with at least several instances of each possible permutation (e.g., ANM reporting interdependence with the ASHA and vice versa, ASHA reporting interdependence with the AWW and vice versa, etc.). In this respect, there did not appear to be any emerging pattern in terms of a specific dyad with a greater sense of interdependence than the others.

B. Interpersonal relationships

Although respondents did not often explicitly use words like "respect", "understanding", or "support", these feelings were often conveyed indirectly from the frontline workers who described positive interactions with the others. For instance, when one ASHA was asked whether she benefits from

working with the AWW, she succinctly responded “Anganwadi sister and I sit together and do the work. If I don't understand something then I take her suggestion” (Kothawan, IDI_ASHA_06). In another example, an AWW in a different village explained how the ANM chooses to lend a helping hand rather than reprimand her in case she misses one of the pregnant women’s houses she was supposed to visit:

> Many times I commit a mistake, like if she asks me to visit 10 houses and call the kids, sometimes I forget one house, then she (the ANM) won't scold me and she’ll ask me not to repeat this mistake and helps me to recall. Then she says that since you are leaving, let me write it and give it to you. She will write names on paper and then I will leave with that list, I feel good that she gives a list and I never forget. I even convey this to her. (Behadar, IDI_AWW_09)

The ASHA from the same village talked about her experience of feeling more comfortable and familiar with the ANM over time since their initial meeting. She also felt that the ANM puts her own work on hold to come help the ASHA as needed, echoing a similar comment made by the AWW:

> R: Earlier I didn’t know her and she didn’t know me. Now we’ve got families, whatever I need I can ask her and she can ask me.
> M: Has it ever happened that while talking to ANM you felt bad because she said something to you or she didn’t reply you?
> R: No, she is not like this, she is very good and simple. She will leave her work and will teach me first. (Behadar, IDI_ASHA_09)

An AWW from a different village conveyed a strong feeling of mutual support and reciprocity with the ANM, explaining that "if (the ANM) is having some problem in preparing the due list as she is an aged person then I offer her my help. Since she is of my age so I tell her that both of us have same kind of understanding so we can do it together. It makes it easier." The AWW also appreciatively noted that "if I am not well or have gone somewhere or on leave, then ANM does not object to it or create any issue" (Kachhauna, IDI_AWW_04).

Other respondents described tension or friction in their relationships with other frontline workers, often relating to lack of respect, poor and/or infrequent communication, and lack of tolerance or understanding for other's mistakes, shortcomings or personality differences. A good example of this comes from the comments of an ANM and ASHA from the same village who do not get along well. From the perspective of the ANM, the ASHA misses too many meetings, does not complete her work properly, and does not respond well to feedback about her job performance. Although the ANM knows that the ASHA lives some distance away and that her husband accompanies her when she travels to the village she serves, the ANM does not mention anything about the potential safety considerations behind this arrangement – an issue that was mentioned by the other two frontline workers:

R: I have great compatibility with every ASHA but not with one.
M: What is her name?
R: (First name) ASHA. She doesn't live in that area. She goes to the service area with her husband. She works well but every time she has a problem that she discusses with me. Sometimes she does not attend meetings, sometimes she doesn't even go to the CHC (Community Health Centre) and I can't tolerate that. And her paper work is never complete. If someone lacks in one thing, we can overcome that, but she has many lackings. And when I advise her, she takes it in other way. (Kachhauna, IDI_ANM_02)

On its own, this statement from the ANM may be interpreted as a reasonable criticism of an underperforming worker. However, when considered alongside the ASHA's comments about the same situation, signs of a potential relationship problem become clearer. From the perspective of the ASHA, she has struggled on the job because of illness and having a hard time understanding some of her responsibilities, but she finds that the ANM does not show empathy and does not want to help her:

R: We have a very good understanding, but if I say something to her, she scolds me. I tell her not to scold me but help me understand things. But she refuses. If I don't understand something, sometimes her husband explains it to me. He tells his wife that she should explain things to me, especially because I stay unwell and don't understand things easily. But she tells him, that if he cares more for me and then he should explain things to me.

M: Why does (she) behave this way?
R: I don't know, didi. She gets angry very quickly. If I have to go and call someone and they don't turn up even if I go twice or thrice, then she gets angry. She tells me that I didn't call them and it will delay my work. Sometimes when I can't tolerate her scolding, I also say things to her and that's why she gets angry with me. (Kachhauna, IDI_ASHA_05)

Similar instances of clashes of personality and misunderstandings were described by several other frontline workers, including one ASHA who described having to work with a very aggressive ANM who shouts regularly at her and also at the women from the village when they come to get services (Kothawan, OBC, IDI_ASHA_07). Elsewhere, an ANM explained why she doesn't get along well with one of the ASHAs: "I don't like the way she speaks to me", also mentioning her frustration about an instance when she was late to work and the ASHA complained directly to her supervisor rather than talking to the ANM about it first (Kothawan, IDI_ANM_01).

C. Resource constraints

The most commonly mentioned obstacles with respect to frontline worker collaboration related to resource constraints, including equipment and supply shortages, infrastructure problems, staffing shortages, and other issues. Here, the focus was less on the quality or level of their collaboration, per se, and more on their ability to effectively fulfill their shared work

responsibilities. For example, when asked for suggestions of how she might collaborate more effectively with the AWW, one ANM explained that the "(antenatal/postnasal/health) check-up and immunization of every village is supposed to happen at Anganwadi (centre) but the Anganwadi centre does not have all the facilities available. Sometimes, table or chairs are not available", making it more difficult to conduct the VHND (Kachhauna, IDI_ANM_02). One ASHA pointed out that if supplementary food is not available for distribution, then fewer women come for immunization, which is one of the key shared responsibilities of all three AAA workers (Kothawan, IDI_ASHA_06), while an ASHA in a separate village mentioned that due to a worker shortage in a nearby village, she is spread more thinly focusing on her health responsibilities and ultimately a portion of the pregnant women in the population miss out on nutritional food (IDI_ASHA_04).

D. Diligence/ reliability

A notable attribute of the comments from multiple AAA frontline workers describing positive collaboration was that they talked not just about getting their individual work done, but also about the diligence or persistence of another worker in completing her share of the work despite difficulties or obstacles. In other cases, workers described an experience that indirectly demonstrated their own commitment to completing the work and/or serving the local community. For instance, when asked whether the AAA workers

have meetings together, one AWW confirmed that and went further to describe their joint efforts to make sure all the eligible women and children in the village get vaccinated:

> The women who come here, the ANM talks to them and I also counsel them. Our sahayika and ASHA worker collect the children and pregnant ladies here. If a woman does not come and says that she forgot about it then they go to her household. If she still does not come then again, they go to her place. Even for 2-3 times also they visit her place. If a woman is in the farms then we try to get her vaccines so that she completes her vaccination course. (Kachhauna, IDI_AWW_04)

The same AWW also shared a message to AAA workers in other villages where there may be issues with collaboration, emphasizing the importance of thinking about responsibility in terms of the village rather than one's individual tasks:

> My message for them is that if we will work together then it will make it easier to do. Both of us will have convenience in doing anything and it will be easier for ANM also. If she comes here then both anganwadi and ASHA give their due list to her and thus ANM also prepares her own due list and starts immunization process. Sometimes I call the women over here while sometimes ASHA or sahayika goes to call them. And it gets done very easily. Like I may also say that it is not my duty to call the women and this is the duty of ASHA. But since it is my area, so it is my responsibility so see that all the women get vaccines,

> all the children get vaccines and no child should be missed. (Kachhauna, IDI_AWW_04)

In other cases, the shortfalls in collaboration were less about personality or relationship tensions and more about reliability, as in the case of one ANM who mentioned that "all my co-workers are good people… but all of them turn their backs on me when I really need them" (Kothawan, gen, IDI_ANM_01). Another ANM mentioned that she is compatible with both the ASHA and the AWW in a particular village but just can't rely on the AWW to be available to accompany the ASHA during outreach in the community to distribute food and talk about the benefits of vaccination (Kachhauna, IDI_ANM_02).

E. Flexibility

Among those AAA workers who described a generally positive working relationship with the other two in the same catchment area, several voiced their appreciation of other workers' flexibility in case, for instance, they could not make it to work on time or on a particular day or if they faced some other personal obstacle. Here, there was some overlap with positive interpersonal relationships, but with the additional element of being willing to bend or blur certain aspects of a worker's role or responsibilities in order to accommodate them or make things work. For example, although being literate is one of the selection criteria for ASHAs, one ANM found a workaround for an ASHA in

her catchment area who could not read instructions or write up a due list for vaccinations:

> ASHA is not so literate, so I have to teach her. She is intelligent, but she cannot read and write well. Even her husband helps us up, they also make the list. Once we had a talk in the meeting, they said 'why these guys sit here?' I told them please don't ask them to go, they do ASHA's work, they write and read things up. If his wife is ill, then husband would come and inform us. I say send (ASHA's name) here, he says '(ASHA's name) cannot come, she is ill', then I ask him to come, he learns what to do and he does it. We have faith in each other. All our ASHA and Anganwadi are good. (Kothawan, IDI_ANM_05)

Also reflecting the theme of flexibility, one ASHA described her ANM's efforts to accommodate her if she cannot come to work, even suggesting that the ASHA could send one of her daughters in her place to help on vaccination day if she herself is sick or otherwise unavailable, as long as the work gets done:

> (The ANM) gives me leave if I am not able to work or I am not well. She tells me that there is no problem. Don't work. If you have made the due list, if you do the work as per my target, your payment will not be deducted. Place your daughter in your position. At least help me out. It is not that you have to do but anyone can help me out. So, my daughters are there. One is in 9th standard and the other one is in intermediate. If I am not able to do and I have some problem, I have already made the due list and everything is mentioned that where is their home and which village. So, they help ANM didi by calling all the

children in the centre to give them the vaccine. (Kachhauna, IDI_ASHA_04)

F. Role clarity

While all the frontline workers knew they had to collaboration with each other and could generally describe their key points of interaction, those who reported positive collaborations often provided very specific details of the collaboration. For some respondents, as in the case of one ANM from the Kothawan block, some of these details were not necessarily part of official government policy for AAA workers but were rather defined locally by the frontline workers themselves (Kothawan, IDI_ANM_05). In one particular instance, this ANM explained the specific details of how she works with the AWW to coordinate the timing of the food distribution with the vaccine day to maximize the number of beneficiaries attending and lists examples of several key indicators that she relies on the AWW to record in her register (e.g., births, deaths, vaccinations) (Kothawan, IDI_ANM_05). Also indicating a clear and detailed understanding of her specific responsibilities, an ASHA in a different village explains the reports she provides to the ANM on a regular basis:

> I work with ANM didi to help her. As in immunization she handles the centre and the due list that I make, I make sure to call all the children to give the vaccine. In the role of ASHA, I support her fully. Whatever work she gives me, I do all her work. As she makes the list and tells

me that she needs it day after tomorrow. I prepare the list and give it to her. I have to make the list of children from the age of 0 to 2 years or I have to make a list of children from 0 to 5 years. I have to see that how many pregnant women are there and I have to make the list and give it to her. I have to make a list and give it to her on family planning. I mean I have to make the list of women who are using condoms and how many women are there who are using copper T and how many are operation. I have to make the entire list in full detail and give it to her. I have to make a list which should contain who is applying what. (Kachhauna, IDI_ASHA_04)

G. Guidance/ instruction

The AAA workers' ability to seek and obtain guidance about their work also emerged as a facilitator of collaboration. While many AAA workers described having some sort of up front instruction about working together, some highlighted the value of on-the-job feedback to help them improve over time. This is exemplified by one of the ASHAs, who described additional guidance she received about how to prepare the "due list" of women eligible for vaccination, which is a key task she needs to complete in order to help the ANM complete the vaccinations efficiently when she comes to the village for the monthly VHND:

R: When we were appointed, we were told that you have to work with ANM didi. Your work is to call the pregnant women and children and make sure to give them vaccine. You will have to make list for that and they told us how to make the list. As we are doing it since many days,

> we have become aware. Earlier we did not know how to make the list. Now we get to know that this month we make the due list for pregnant women, that she has to get first vaccine and she has to get second. Those who have got the second vaccine, they have the third checkup…. So now we are able to understand. Earlier our due list used to be wrong and we used to get scolded a lot. (Kachhauna, IDI_ASHA_04)

A lack of guidance on how to collaborate with one another was also identified as a barrier by several frontline workers. This sometimes took the form of comments by ASHAs saying that they did not receive enough instruction from the ANM or that they were not invited to joint meetings, where they would have learned about the various activities to be carried out jointly. Referring to the ASHA and AWW, one ANM commented that "all three of us know that we have to work together and support each other, but still this has to be explained to them in a better way" (Kachhauna, IDI_ANM_02).

H. Locus of control

When discussing their approach to dealing with obstacles or difficult situations with the other AAA workers, some respondents demonstrated an internal locus of control, conveying their sense of personal ability and responsibility to help address the issue(s). For example, one ASHA saw her own behavior as a key part of resolving difficulties in collaborating with a hypothetical ANM with whom she may not get along as well as with the

current one, explaining that "I would meet her and I would keep on doing my work, and slowly we can work together well" (Kothawan, IDI_ASHA_06). Similarly, an ASHA in another village described the importance of her own attitude and actions in improving coordination between the three AAA workers in her village. When asked whether the government can do anything to improve her collaboration with the other AAA workers, she commented "It is the responsibility of government and me, too. I have more (responsibility) actually," adding that "if I go to anyone, I will speak calmly and properly, I will try to understand them, not like I will show my attitude, then (any problems) won't go on" (Behadar, IDI_ASHA_08).

While respondents generally seemed reluctant to single out other workers for criticism, there were several exchanges in which the respondent's comments suggested that she felt a lapse in collaboration was primarily due to the actions of another worker – and that it was the other worker's responsibility to resolve it. For instance, one ANM has concluded that the AWW in one village stays inside her house instead of helping on vaccination day. Even though the AWW in question has apparently invited the ANM to her house to discuss the issue, the ANM maintains that it is up to the AWW whether or not she wants to show up for work:

> I guess the Anganwadi worker at (village name) is not cooperative because she's living beside the Anganwadi (centre) but she is not even ready to come out of her house….
>
> I'm visiting that place only once per vaccination and even then she is not ready to come out of her house and spend time with me by helping me…. I tried have a conversation with her, but she said 'you should come to my house for that'. I replied 'I am over here for vaccinations and I have to be present over here for that and that's what I'm asked to do. So why I should visit your house for that?'... Once her husband came to the booth and provided (supplementary food) because it is necessary to provide meals and then he asked ASHA to distribute it to everybody. The rule is Anganwadi worker should herself provide meals to the children who are immunized. They asked ASHA to do the work and she did it. I'm the one to note down the attendance of the workers and am very honest in that if they will show up I will mark them as present and if they don't I will mark them as absent. (Kothawan, IDI_ANM_01)

I. Conflict resolution

In contrast to those respondents who related their experience of an unresolved conflict, others described situations or patterns of interaction in which the respondent seemed satisfied with how the conflict was managed. One AWW, for example, explains her approach to reconciling with the ANM after an apparent disagreement: "I discuss with her, ask why she has complained. She is superior to me, but I also feel sorry and ask for forgiveness and I should have avoided those words. Then slowly things get

well." (Behadar, IDI_AWW_09). In other cases, respondents described an instance in when they had a disagreement, argument or misunderstanding with another AAA worker that apparently not been resolved. For instance, one ANM recounted an experience in which she felt anger toward an ASHA with whom she worked because the ASHA complained to the ANM's supervisor about her late arrival to work one day rather than raising the issue with the ANM directly. Noting that she has a young child to take care of at home, she explained: "So sometimes I do get late (to the village) and the new ASHA complained about me to our head. So, I got very angry on her because she should have inquired about it to be because I'm living at far distance and it may have happened that my scooter needed some repairs. So she should have inquired about it to me rather than complaining it to my head." (Kothawan, IDI_ANM_01)

J. Other obstacles

Apart from the above topics, several other infrequently mentioned barriers emerged from the IDIs, including personal obligations, health issues, domestic/spousal issues, conflicting schedules, limitations in worker skills or capabilities, and others. Two of these barriers overlap with issues that have been previously identified as important factors in the delivery of the ICDS scheme in rural India: caste/class differences and institutional differences between the MoHFW and MWCD.

Caste and class discrimination

In multiple studies and evaluations of the NRHM and ICDS scheme, difference related to both caste (i.e., the hierarchical system of social stratification based on lineage) and class (i.e., hierarchical social differences based on socioeconomic status) have been raised as an obstacle to developing trust and rapport between AAA workers and village residents (74). Evaluations of the ICDS scheme have also identified instances in which lower caste residents do not visit anganwadi centers run by higher caste AWWs. Although not mentioned frequently regarding collaboration between the AAA workers specifically, caste and class issues were raised by several respondents. One ASHA felt that the ANM serving her area consistently prioritizes and provides more support to ASHAs in neighboring villages who are of her same *caste*:

> We ask ANM didi to fill the voucher for the kids who have gotten vaccinated because you get certain money on them. But she says she doesn't have time and refuses to sign on the vouchers. It is wrong because it is my village and my signatures should be done first and not of ASHAs from other villages. But she gets their signatures first. We fight over these things with ANM…. She belongs to a lower caste and favors the (caste name) caste because she is a (caste name) herself. She does all their work and explains everything to them. She never explains anything to me. (Kachhauna, IDI__ASHA_05)

An AWW in a different village explained that while she doesn't personally experience *class-based* discrimination in her village, she felt it is a common issue between ANMs and AWWs in other villages and was not optimistic about a resolution:

> R: We come from a very lower class. Like government is giving us only 4000 rupees, while some ANMs get more salary. So they treat us with an inferior attitude. But it's not like that between us (in this village). We treat each other equally. You cannot judge someone on the basis of money. Some ANMs think that anganwadi workers only work for 4000 rupees and so they think that they are superior to them. In that case there won't be a coordination.
> M: So, what can be done for that? To improve it?
> R: You cannot change nature of anyone. (Kachhauna, IDI_AWW_04)

Separate institutional structures for ANM and ASHA vs. AWW

The departmental divide between the ANMs and ASHAs in MOHFW and the AWWs in MWCD also came up in several interviews as a barrier to collaboration because of differences in institutional scheduling and accountability structures. Referring specifically to collaboration with the AWWs during the VHND, one Medical Officer mentioned "We don't have any direct control on Anganwadi. We visit there to see VHND because their role is there on VHND", adding that "sometimes they are present and sometimes they don't come. When I can't control them directly, I will report to their

system if I don't find them. Then they take action accordingly." (Kothawan, IDI_MO_01). The same Medical Officer also described similar challenges with respect to AWW attendance at the "Triple A" meetings, noting that:

> "ASHA and ANM will definitely come (to the Triple A meeting). It's very rare that they don't attend the meeting. Anganwadi is the only absentee. We are the organizer and we don't have control on them (Anganwadis). (For example) you are directly associated with us and they are indirect, it's their wish whether they come or not but I have direct control on you and so I can call you directly. (Kothawan, IDI_MO_01)

3.4 Discussion

3.4.1 Key collaboration factors

The ten key collaboration factors identified through the inductive analysis of the IDI transcript data include a combination of facilitators and barriers to collaboration. As highlighted in Table 13, the majority (7 of 10) of these factors were consistent with findings from other qualitative studies of AAA worker collaboration in rural India. In order of highest to lowest level of overlap with the other studies, these factors (include: *guidance/instruction* (mentioned by all four studies); *diligence/reliability* (indirectly mentioned by all four studies using the terms "motivation" or "proactive"); *role clarity*

(three studies); *interdependence*, *interpersonal relationships*, and *resource constraints* (two studies each).

Table 13: Comparison of collaboration factors from this study vs. other relevant studies

This table summarizes key similarities and differences in terms of collaboration factors identified in the present study relative to other qualitative studies of AAA collaboration in rural India. The "+" and "–" symbols indicate that the associated factor was observed to positively and/or negatively affect collaboration, respectively. The "…" symbol indicates that the factor was not observed or described in the study.

Collaboration factors	***This study (Uttar Pradesh)***	**D'Alimonte (Uttar Pradesh)** (76)	**Kim et al. (Odisha)** (18)	**Mishra et al. (Odisha)** (74)	**Sharma et al. (Rajasthan)** (75)
Interdependence *(vs. independence)*	+/–	…	+	+	…
Interpersonal relationships *(positive or negative)*	+/–	…	+	…	–
Resource constraints	–	…	…	–	–
Diligence/reliability *(or lack thereof)*	+/–	*	+ "motivation"	+ "proactive"	*
Flexibility	+	…	…	…	…
Locus of control *(internal vs. external)*	+/–	…	…	…	…
Conflict resolution *(or lack thereof)*	+/–	…	…	…	…
Role clarity *(or lack thereof)*	+	…	+	+	–
Guidance/instruction *(adequate or inadequate)*	+/–	+	+	+	–
Other Obstacles *personal/health/ domestic challenges*	–	…	…	…	–
Separate institutional structures	–	–	–	–	…
Conflicting schedules	–	…	…	…	…
Caste/class discrimination	–	…	…	– **	– **
Skill/capability limitations	–	…	…	…	–
Discrepancies in professional compensation or status	…	…	–	–	–

*Both of these studies refer to motivation as an outcome in itself rather than a factor contributing to collaboration

** Caste/class issues focused on tensions between workers and village residents rather than between AAA workers, which may have an indirect effect on AAA collaboration (e.g., by impeding an ASHA's ability to gather information from residents to prepare the 'due list' or to recruit eligible residents to come to the VHND for services, both of which the other workers depend on).

Three factors were not mentioned in other reviewed studies: *flexibility*, *locus of control*, and *conflict resolution*. Each of these factors highlights potential implications for ICDS program management. *Flexibility,* or a worker's willingness to bend or blur the rules to accommodate or find a workaround for a co-worker's absence, mistake, or other shortfall without holding it against her, may in some cases conflict with training, monitoring, and supervisory practices that emphasize adherence to official guidelines and procedures. Yet in the present study, some workers' willingness to bend the rules (e.g., by allowing a worker's husband or daughter to temporarily fill in for her if she is sick or has some personal matter to attend to) appeared to have enhanced the collaboration between the workers.

Despite the highly structured and heavily documented administrative guidelines for the ICDS and NRHM, there is some government precedent for adapting these guidelines to accommodate geographic context. For instance, different states already have the ability to relax the population catchment area norms and educational requirements of ASHAs to accommodate local conditions on a case-by-case basis (84). This flexibility could potentially be extended to, for instance, allow ASHAs or AWWs in certain circumstances (e.g., if they live outside of the village or cannot read well) to nominate a specific person to help them complete their work on an as-needed basis, provided that the other AAA workers accept the arrangement and that they

are able to get the work done accurately and on time. This, or other types of localized management adjustments, would likely add non-negligible administrative complexity to the ICDS and NRHM structures, but could potentially also enable frontline workers to identify and propose innovative solutions to obstacles they experience in their day-to-day work.

The fact that *locus of control* (i.e., one's perception of the extent to which they have the ability to influence the effectiveness of the collaboration) and *conflict resolution* (i.e., successful or unsuccessful resolution of a conflict with another worker to one's satisfaction) also emerged as important factors may have implications for trainings and supportive supervision (e.g., discussing, practicing, and reinforcing various problem-solving approaches to deal with practical issues AAA workers regularly encounter on the job). One example of an intervention that may be relevant is the "Team-Based Goals and Incentives" model developed by Care India for use with AAA workers in Bihar, which provided training and facilitated group sessions emphasizing joint goal setting, structured teamwork and recognition (87); an evaluation of that intervention demonstrated significant increases in self-efficacy to work together, along with enhanced worker motivation, team performance, and job satisfaction (87). While this particular intervention did not explicitly focus on conflict resolution, they did seek to foster effective communication as a workplace norm, which may enable workers to more effectively resolve

conflicts or disagreements when they arise. Relatedly, the evaluators also found that the ASHAs and AWWs who communicated more frequently with the ANM were more aware of the specific types of support they could expect from their supervisors and reported higher levels of supervisor assistance and feedback (87); given the supervisors' role in helping the frontline workers trouble-shoot issues at the village level, this may also contribute to improve conflict resolution. While there do not appear to be any studies or interventions related to recruiting or hiring frontline workers with these attributes in a LMIC setting (e.g., high internal locus of control, conflict resolution skills), that is another conceivable application of these findings. In circumstances where there may be multiple qualified ASHAs, AWWs, or ANMs for a given post, behavioral interview questions related to the candidate's locus of control in relevant scenarios, conflict resolution skills, and flexibility to adjust to unexpected obstacles or challenges may be valuable to consider alongside other hiring criteria.

Finally, one factor that came up in several other studies but did not appear in the present one related to problems from unequal professional status and compensation. Here, it is important to note that this has the potential to be a sensitive discussion topic and was not explicitly asked about or probed for in this study. Therefore, it should not be concluded that this was not an issue

within the current study area simply because it was not present in the transcripts.

3.4.2 Study limitations

Due to the cross-sectional nature of the study (i.e., qualitative data collected at only one time point) and the design of the interview guides (i.e., asking broad, open-ended questions about positive aspects and challenges related to collaboration with other frontline workers), it is not possible to identify specific causal relationships, directionality, or the relative importance between the factors identified in this study and the level or extent of frontline worker collaboration. Thus, while the labels "facilitators" and "barriers" used in this study may imply that they produce a positive or negative effect on AAA collaboration, they may in some cases also be indicators of effective or ineffective collaboration. Further research including direct observation, iterative follow-up discussions to elaborate on specific points, and a longitudinal design over a sufficiently long period of time (e.g., a minimum of several months) would be useful for exploring how the factors identified here are associated with collaboration, and whether there are indeed causal relationships. Some form of respondent-based weighting or ranking could may help characterize the relative magnitude or hierarchy of the collaboration factors discussed, since frequency of mention cannot be directly equated with importance.

This study did not examine collaboration dynamics between key roles at higher administrative levels or how collaboration at those levels may affect collaboration at the village level. As described by Kim et al. (18), key points of collaboration between the NRHM and the ICDS also exist at the block level (e.g., joint meetings and supervision), district level (e.g., planning, training, and data sharing), and state level (e.g., setting policies and guidelines). In their study site in Odisha, they observed that the highest level of convergence occurred at the village level and the largest disconnect occurred at the block level (18). Given that the present study included data collection from two villages each across three blocks in a single district, it may be informative to further investigate any block level differences in collaboration factors. Future research may benefit from a broader data collection effort including block-level NRHM and ICDS stakeholders and explicit consideration of the multi-level nature of collaboration, or convergence, in the analysis.

As is the case with interview- and survey-based research in general, responses were vulnerable to recall bias, interviewer bias, and social desirability bias, each of which may have resulted in a skewed representation of the respondent's true experience. Efforts were made to minimize these biases through selection of experienced interviewers, additional study-specific training and pilot testing of interview guides with supervision from a

qualitative research expert, and through identification of factors through concurrent review of transcripts from multiple AAA workers serving the same village. Nonetheless, certain potential response biases were unlikely to be addressed by these measures, including cultural norms affecting how these frontline workers speak about one another, particularly to non-residents, or an underlying concern that their responses may be shared with their employer, despite assurances to the contrary.

3.4.3 Study strengths

One of the benefits of this study is that it was one component of a larger mixed methods design. Following the Instrument Development and Construct Validation (IDCV) framework described by Onwuegbuzie et al. (56) the overarching study brings together an array of complementary quantitative and qualitative data to help understand multiple facets of the complex phenomenon of frontline worker collaboration. A specific benefit for this qualitative study was the use of the quantitative data from the frontline worker collaboration surveys to purposively sample villages to include in the qualitative data collection. In short, the collection of the quantitative collaboration scores enabled a systematic approach to maximum variation sampling that would not otherwise have been possible given that there were no other readily available indicators of AAA collaboration in these villages.

The concurrent review approach during the inductive coding of the transcripts was useful in that it added contextual clarity to the sometimes partial and oblique comments made by respondents. This likely also increased the number of comments that were included in the analysis, as certain isolated details from one respondent do not seem clearly relevant until reading through the transcripts of other respondents from the same village. For instance, the ASHA in one village mentioned domestic issues with her husband at one point in her interview, also noting that her husband is the one who drops her off to work in the village. Without context, one may infer that this could affect her collaboration with the other workers in her village, but the relevance becomes much clearer when the ANM and the AWW working in the same village describe the ASHA as unreliable because she often does not show up for work.

This complex and somewhat resource-intensive design was feasible because the study was embedded within a larger evaluation study that included both a frontline worker survey and substantial qualitative data collection at the village level. This study also benefited substantially from the input and expertise of the skilled, multi-disciplinary research team involved in the parent study, which included team members with extensive personal and professional experience in India as well as fluency in spoken and written Hindi.

3.4.4 Conclusion

Like many other multi-sectoral collaborations, the ICDS model is dependent upon effective collaboration between specific units, cadres, and individuals at multiple administrative levels. Policies, plans, procedures, and job descriptions are written to ensure collaboration at these key points of interaction, yet there is little available evidence about the nature of these collaborative relationships in practice and the key factors associated with whether they work or not.

While seven of the ten key collaboration factors identified in this study have been reported in other studies and recommendations for improving AAA collaboration, the three additional factors identified in this study – *flexibility*, *locus of control*, and *conflict resolution* – point to possible policy implications (e.g., allowing additional flexibility in some aspects of ICDS and NRHM management to accommodate district-, block-, or village-level circumstances), interventions (e.g., facilitated joint training and team-building sessions), and hiring considerations (e.g., behavioral interview questions to better understand respondent attributes related to flexibility, locus of control and conflict resolution).

Chapter 4: Mixed analysis of construct and content validity (Paper 3)

4.1 Introduction

4.1.1 Background

Multi-sectoral collaboration is widely recognized as a critical aspect of policies, programs, and interventions to address complex public health issues (1–7), yet it tends to be undertheorized and difficult to measure (1,6,10,11). As a consequence, researchers have struggled to rigorously evaluate MSCs and to determine when, how, to what extent, and in which circumstances they may be more effective and/or efficient than single sector initiatives (1). Despite a growing number of case studies on MSCs, there is still a substantial knowledge gap about the types of strategies and interventions that may be most effective in establishing or improving such collaborations (5,6). Progress in filling this gap is impeded by limited understanding and measurement of hypothesized causal links – a "missing middle" – between the establishment of a collaborative structure or process and the improvement of population health outcomes (1).

India's Integrated Child Development Services (ICDS) scheme, a multi-sectoral program delivering maternal and child health and nutrition services and early childhood education in nearly one million villages around the

country, exemplifies these challenges. Led by the Ministry of Women and Child Development (MWCD) in collaboration with the National Rural Health Mission (NRHM) of the Ministry of Health and Family Welfare (MoHFW), the ICDS scheme has produced mixed results: some evaluations have demonstrated reduced stunting among individual children receiving services (12,13), while others have failed to show village- or population-level impact, due in part to implementation gaps and uneven funding (13,14). One challenge that has been frequently identified but only indirectly addressed in research and evaluations to date is the collaboration, or "convergence" between the three key frontline workers involved in delivering this scheme: the anganwadi worker (AWW), accredited social health activist (ASHA), and auxiliary nurse midwife (ANM), sometimes referred to as the "Triple A" or AAA workers. Given that collaboration between these three workers is widely recognized as essential to the success of this multi-sectoral initiative, a meaningful quantitative indicator of AAA collaboration may serve as a key proxy variable for the frontline functioning of this multi-sectoral initiative, thus enabling more rigorous assessment of how collaboration affects program outcomes and how to improve it.

This paper builds on and complements other research on AAA collaboration in rural Uttar Pradesh, India, including a study to develop and test the psychometric properties of a frontline worker collaboration scale (Paper 1)

and a qualitative study of key factors affecting AAA collaboration (Paper 2). This study draws from and compares results from both of those studies in order to assess the construct and content validity of the collaboration scale as part of an overall mixed methods design following the Instrument Development and Construct Validation (IDCV) framework developed by Onwuegbuzie et al. (56).

4.1.2 Research objective

The research aim for the overarching mixed methods study in which this paper is embedded is to develop and validate a psychometric scale measuring the extent or level of collaboration between the three key "AAA" frontline workers involved in delivering essential health and nutrition services in rural northern India. In Paper 1, which represents the *quantitative* strand of the overarching study, we reported on the development of the frontline worker collaboration scale and quantitative testing of its psychometric properties. In Paper 2, which represents the *qualitative* strand of the overarching study, we reported on key collaboration factors affecting AAA collaboration in the same study area. The research objective of this paper, which represents the *mixed analysis* component of the overarching study, is to assess the construct and content validity of the frontline worker collaboration scale (Paper 1) via triangulation with qualitative findings (Paper 2).

4.1.3 Parent study and research site

This study was nested within a broader mixed methods baseline evaluation of Project Samuday, a multi-sectoral initiative implemented by the HCL Foundation (http://www.hcl.com/hcl-foundation) to improve rural economic and social development in Uttar Pradesh, India across five key areas (education, employment, health, infrastructure, and water) in partnership with central and state government, communities, NGOs, and other stakeholders. The baseline evaluation was conducted in six administrative blocks of two districts (Hardoi and Sitapur) in Uttar Pradesh by the Johns Hopkins Bloomberg School of Public Health (JHSPH) and a contracted New Delhi-based social research firm, which directly managed data collection activities. The data used for scale development and testing (Paper 1) are from a survey of AAA frontline workers in one randomly selected village in each of 346 gram panchayats in six blocks of Hardoi district (Behadar, Kachhauna, Kothawan) and Sitapur district (Machhrehta, Kasmanda, Sidhauli) in Uttar Pradesh, corresponding to a catchment area of approximately 862,000 people. Data collection for the qualitative analysis of collaboration factors (Paper 2) was embedded within a broader multi-topic qualitative data collection exercise including in-depth interviews (IDIs) and focus group discussions held in six villages across three administrative blocks of Hardoi district (Behadar, Kachhauna, and Kothawan).

4.1.4 Ethical considerations and review

The protocol for the research presented here was incorporated into the overall research protocol of the parent study, which was submitted to and approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board, Expedited Committee (IRB-X) as well as from an India-based IRB based in the Center for Media Studies, which reviews social science research protocols. Details related to ethical considerations for this study are summarized in Appendix *A2: Ethical considerations*.

4.2 Methods

4.2.1 Personal worldview and research philosophy

The objectives and design of this study are informed by the author's worldview that: 1) collaboration between frontline workers has the potential to positively affect service delivery and health outcomes; 2) frontline workers' experience of collaboration and the factors affecting it should be taken into account in health systems policy, practice and research, and; 3) this may be particularly important for multi-sectoral initiatives in which frontline workers collaborate across organizational boundaries, as there are likely to be fewer systems in place to assess team functioning and performance relative to intra-organization teams. With respect to research philosophy, the author aligns with the "pragmatism" paradigm, in which both quantitative and qualitative methods and both deductive and inductive reasoning are

viewed as valid and appropriate if they can provide insight into the research question at hand. From an epistemological perspective, the author also assumes that: 1) inter-personal collaboration has a critical psychosocial component underlying the series of specific actions involved in joint completion of tasks or objectives; 2) as a group phenomenon, collaboration can only be measured by considering information from multiple collaborators; 3) there are certain universal or broadly applicable aspects of team collaboration, which means that insights from studying collaboration in one locale have the potential to be applicable to other contexts.

4.2.2 Conceptual framework

The overarching mixed methods study is guided by Emerson's and Nabatchi's Integrative Framework for Collaborative Governance (48), which draws from several decades of collaboration research from a range of professional fields and academic disciplines. More specifically, the study draws from a core component of that framework: the "collaboration dynamics" that characterize the interactions between key participants in a structured, cross-boundary collaborative system and play a critical role in influencing the actions they take (48). According to the authors, these collaboration dynamics consist of three sub-domains – *principled engagement*, *shared motivation*, and *joint capacity* – as summarized in Table 14.

Table 14: Sub-domains of Emerson's and Nabatchi's collaboration dynamics

Sub-domain	**Brief description** (*paraphrased from Emerson & Nabatchi* (48))
Principled engagement	An iterative process of interaction that enables people to collaborate across their respective institutional or sectoral boundaries to solve problems or create value together. Interactions are characterized by behavioral norms, such as fair and civil discourse and open and inclusive communication.
Shared motivation	Joint recognition among participants that their ongoing investment of time and resources into the CGR is worthwhile for themselves and the organization or constituency they represent; this fosters participants' emerging identification with, and ultimately reinforces their dedication to, the CGR.
Joint capacity	A combination of essential elements – including procedural and institutional arrangements, leadership, knowledge, and resources – that enable CGR participants to accomplish their collective purpose as specified in their shared theory of change.

In essence, these collaboration dynamics between the AAA frontline workers in rural India are what the collaboration scale described in Paper 1 seeks to quantitatively measure. The sub-domains, however, were considered as just one source of input within a broader, multi-disciplinary literature review to identify the key items to comprise the collaboration construct and, by extension, the scale itself. The qualitative analysis in Paper 2 takes an inductive approach to try to understand those collaboration dynamics from the perspective of the AAA workers themselves. In this way, the component of this study's research objective related to content validity applies not only to the collaboration scale, but also provides an opportunity to reflect on the conceptual fit of the current and proposed scale items with the sub-domains of Emerson's and Nabatchi's collaboration dynamics.

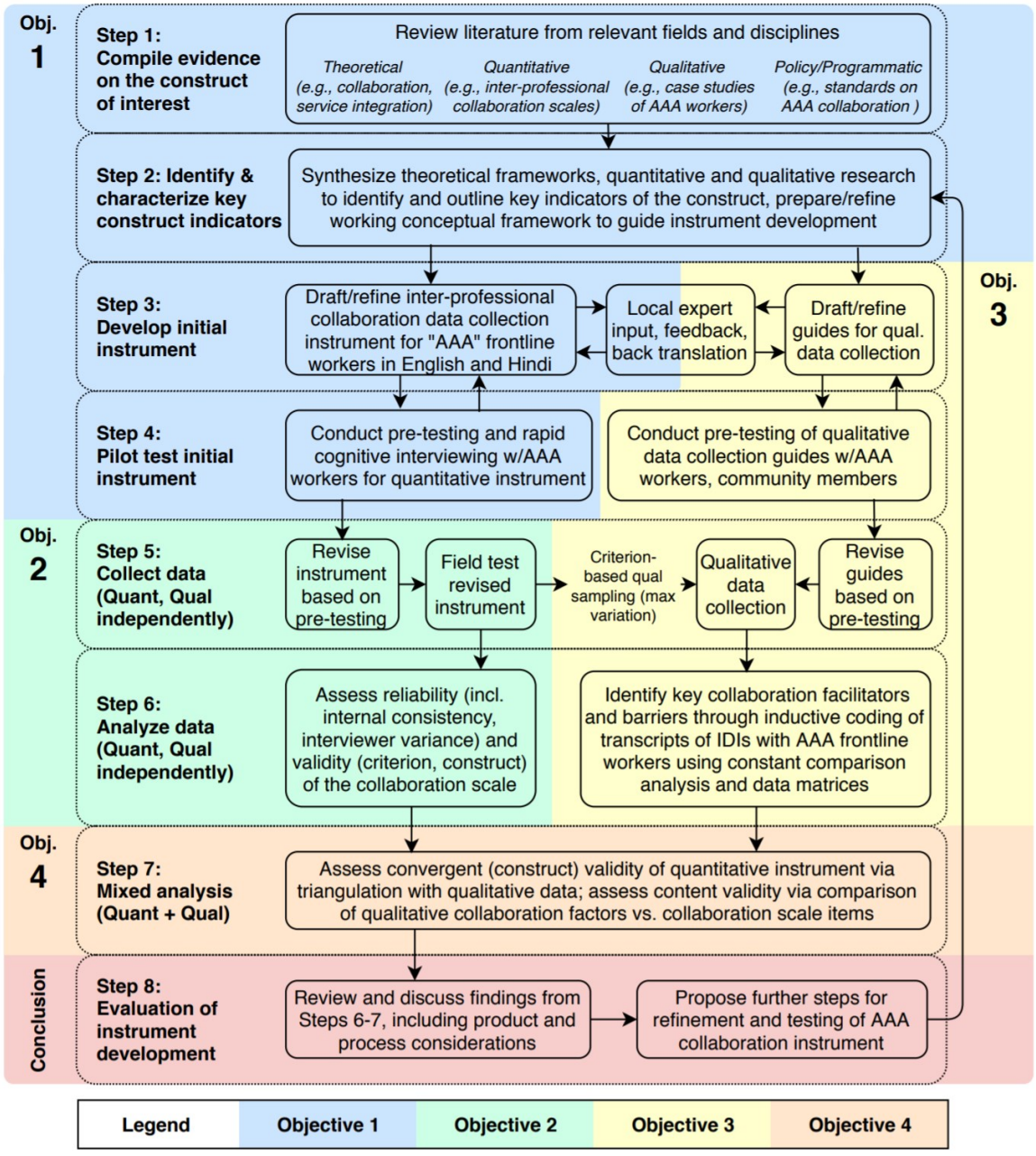
4.2.3 Mixed methods instrument development framework

The overall study design roughly follows the Instrument Development and Construct Validation (IDCV) process, which is a 10-phase framework for applying mixed methods research to "optimize the development of a quantitative instrument" (56). The two theoretical purposes of combining quantitative and qualitative methods for the development of the frontline worker collaboration scale are "triangulation" and "complementarity", as described by Greene at al. (58). The triangulation purpose, which is defined as "the use of multiple methods, with offsetting or counteracting biases, in investigations of the same phenomenon in order to strengthen the validity of inquiry results" (58), applies to the construct validation of the "AAA" collaboration scale using qualitative data on collaboration collected from the sampled villages. The purpose of complementarity, which Greene et al. describe as seeking "elaboration, enhancement, illustration, clarification of the results from one method with the results from the other method" (58) applies to the assessment of the content validity of the collaboration scale, given that key collaboration factors identified through the qualitative analysis may be used to expand or refine the scale items.

The overarching mixed methods study design has three key components corresponding to four objectives: *quantitative analysis* (Objectives 1-2, covered in Paper 1); *qualitative analysis* (Objective 3, covered in Paper 2);

and *mixed analysis* (Objective 4, covered in this paper). Each of these components and their key methodological steps are highlighted in Figure 14.

Figure 14: Flow diagram of mixed methods study design aligned to Research Objectives



4.2.3.1 Quantitative analysis (Objectives 1 and 2)

The quantitative strand of the overarching study (Paper 1) covered the development and of the frontline worker collaboration scale and testing of its psychometric properties. The 18-item scale was administered to ASHAs, AWWs, and ANMs serving a randomly selected village in each of 346 gram panchayats in six blocks of Hardoi district (Behadar, Kachhauna, Kothawan) and Sitapur district (Machhrehta, Kasmanda, Sidhauli) in Uttar Pradesh, corresponding to a catchment area of approximately 862,000 people. The analysis demonstrated high internal consistency of the scale and provided support for the construct validity of the scale. All 18 scale items were ultimately retained. The collaboration scale from Paper 1 is presented in Table 15.

Table 15: Collaboration scale items (English version)

#	Themes	Scale items (English version)
1	Open communication	When you interact with the _____ for work how frequently does she communicate openly with you?
2	Respect	When you interact with the _____ for work how frequently do you feel respected?
3	Help & support	When you work with the _____ how frequently do you think that you can get help and support from her?
4	Role clarity	When you work with the _____ how frequently do you feel that both of you have a clear understanding of each other's roles and responsibilities? *(For example, if it is clear who is responsible for which tasks during Village Health Nutrition Day or immunization day)*
5	Willingness to listen	When you interact with the _____ for work how frequently do you feel that she would be willing to listen to you if there is a problem?
6	Joint planning	When you work with the _____ how frequently do you discuss the needs of the patients or beneficiaries with each other?
7	Information sharing	How frequently does the _____ provide information to you about patients or beneficiaries when required?
8	Trust	When you work with the _____ how frequently do you feel the need to double-check information which she shares with you?
9	Power sharing	When working with the _____ how frequently do you feel that she tries to dominate the conversation?
10	Shared vision	How frequently do you agree with the _____ regarding the best possible way to provide care to your patients or beneficiaries?
11	Service coordination	How frequently do you coordinate services with the _____ based on the needs of your patients or beneficiaries?
12	Enabling environment	How frequently do you encounter obstacles when trying to work together with the _____?
13	Accountability	When working together with the _____ on a common task, how frequently does she complete her share of the work on time?
14	Conflict management	How frequently do you feel satisfied with the way any disagreement between you and the _____ is managed?
15	Inter-dependence	How frequently do you feel that working together with _____ is one of the main ways to serve your village better?
16	Commitment/ motivation	How frequently do you feel that the _____ is willing to work together with you to serve your village better regardless of the constraints of her job?
17	Training/ guidance	How frequently do you feel that you have enough information and suggestions about how to work together effectively with the _____?
18	Leadership/ incentives	When you attend trainings or meetings for work, how frequently do the instructors or other officials say that it is important for you to work together with the _____?
Response options for all questions are on an ordinal frequency scale: 1 – Never 2 – Seldom 3 – Sometimes 4 – Most of the time 5 – Always		

4.2.3.2 Qualitative analysis (Objective 3)

The qualitative strand of the overarching mixed methods study (Paper 2) used purposive criterion sampling to select study villages based on the scores from the collaboration scale described in Paper 1. More specifically, collaboration scale scores from AAA worker triads serving each village were summed to generate village-level collaboration scores, which were then used to numerically rank villages according to their estimated collaboration level, from highest to lowest scores. After excluding villages with incomplete data, the village with the highest score (representing "high collaboration") and the village with the lowest score (representing "low collaboration) were selected from each of the three blocks in Hardoi district (Sitapur district was not included in the qualitative analysis), for a total of six villages.

Within each of the sampled villages, in-depth interviews (IDIs) were conducted with each of the three AAA workers as well as with the medical officer (MO) to whom they report in order to identify key factors affecting the level or quality of collaboration between the AAA workers. Ten key factors were identified: *interdependence*; *interpersonal relationships*; *resource constraints*; *diligence/reliability*; *flexibility*; *role clarity*; *guidance/instruction*; *locus of control*; *conflict resolution*; and *other obstacles*.

4.2.3.3 Mixed analysis (Objective 4)

The mixed analysis step of the IDCV framework draws on the findings from the qualitative strand (Paper 2) to further assess the construct validity and content validity of the collaboration scale (Paper 1). With respect to construct validity, this paper specifically focuses on *convergent validity*, or the extent to which the AAA workers' lived experiences of collaboration align or "converge" with the levels of collaboration predicted by aggregating their scale scores to the village level. Consistency between the two different forms of measurement would provide evidence that the scale is, in fact, measuring what it is intended to measure (i.e., construct validity). With respect to content validity, the comparison of the qualitatively-derived collaboration factors with the 18 collaboration scale items enables analytical reflection on the extent to which items actually reflect the full domain or "universe" of the collaboration construct, as experience by the AAA workers.

The approach and timing for bringing together the quantitative and qualitative data follow a "concurrent design using identical sample" (i.e., eliciting qualitative responses in addition to quantitative responses from the same group or subset of field-test participants involved in the administration of the quantitative scale), as described by Onwuegbuzie and Collins (57). One slight variation to this design is that the quantitative data from

administration of the scale are used to identify the purposively selected sample for the qualitative data collection.

4.2.4 Key methods

As depicted in Figure 14 above, key methodological steps for Objective 4 included: 1) assessing the convergent construct validity of the collaboration scale by triangulating quantitative scale scores with qualitative experiences of AAA workers at the village level, as captured through the IDI transcripts; and 2) comparison of qualitatively-derived collaboration factors vs. collaboration scale indicators to assess the content validity of the collaboration scale. Both steps are described in further detail below.

4.2.4.1 Construct validity of the frontline worker collaboration scale

In short, construct validity is the extent to which an instrument actually measures the construct that it is intended to measure. As per the mixed methods design, the qualitative data provides an opportunity to assess convergent construct validity – i.e., to determine whether and to what extent the quantitatively-derived distinction of "high" and "low" collaboration villages reflects the lived experience of the frontline workers, as reflected in the codes from the IDI transcripts. This is done in two different ways:

1) Qualitative comparison of frontline worker experiences of collaboration themes through illustrative quotes from high and low collaboration villages. The hypothesis is that the general or overall qualitative narrative regarding collaboration at the village level will be consistent with the high vs. low collaboration classification assigned using the collaboration scale scores. This step is operationalized using visual joint displays in which relevant quantitative and qualitative information is presented side-by-side to draw out new insights (88), which is one example of what Onwuegbuzie et al. describe as a "crossover analysis" (56). The joint display follows the format used in a scale validation study by Finley et al. (89) in which they presented representative quotes from interviews with healthcare workers in high-scoring and low-scoring clinics for each of five key relationship characteristics that emerged from content analysis of the full set of interviews.

2) Comparison of ratios of coded facilitators to barriers between the high and low collaboration villages, based on the inductive coding described in Paper 2. As noted by Creswell (90), one approach to mixed methods data analysis for convergent study designs is the use of data transformations, such as "quantizing" qualitative data (i.e., converting qualitative data into quantitative data, sometimes also referred to as

"data transformation"), or vice versa. One simple and commonly used form of quantizing is the conversion of qualitative codes to frequency values based on the number of times they occurred in order to facilitate comparison with results of a quantitative dataset (90,91). However, code frequencies do not necessarily reflect importance (91) and are influenced by the conversational style of the respondent (90). To partially mitigate these limitations, frequencies of facilitators and barriers were aggregated to the village level (thus reflecting the comments of three respondents rather than one) and ratios of facilitators to barriers were calculated rather than using simple frequencies (which are likely to be more influenced by a respondent's tendency to be repetitive or how talkative they are, for instance). The hypothesis is that the facilitator:barrier ratio should be higher in the high collaboration villages. This comparison is done between the theoretical groupings of the three "high" vs. three "low" collaboration villages, as well as through a rank order comparison of individual villages using total collaboration scores and the facilitator:barrier ratios at the village-level; the latter analysis is similar to Kenaszchuk et al.'s (92) rank order comparison of hospital-level interprofessional collaboration using scale scores and qualitatively-derived ranks from a combination of interviews and observation.

4.2.4.2 Content validity of the frontline worker collaboration scale

As described by Tashakkori and Teddlie (93), another application of mixed methods data analysis is to directly compare themes or dimensions from the qualitative and quantitative components of the study. For example, qualitative data can be used "to confirm the existence of such dimensions and/or to explore the degree to which these different dimensions are present in everyday interactions" (93). The inductive coding of the IDI transcript data independently of the quantitative data provides an opportunity to assess the content validity of the collaboration scale, or the extent to which the 18 items on the collaboration scale represent the "universe" of the collaboration construct within the study context. In this way, the side-by-side comparison of collaboration themes with the collaboration scale items enables identification of key discrepancies between them, which may have implications for refinement of the scale. Qualitative assessment of content validity may be particularly useful in this study, given the paucity of existing theoretical and empirical research on collaboration in the rural Indian context, which limits the relevance of traditionally used approaches to assessing content validity, such as expert panels. In contrast, this would not have been possible in a quantitative-only scale development study, given that "psychometric analyses can identify weak, unrelated items that should be dropped from the emerging scale but are powerless to detect content that should have been included but was not" (94).

4.3 Results

4.3.1 Construct validity of the frontline worker collaboration scale

4.3.1.1 Qualitative comparison of frontline worker experiences of collaboration themes through illustrative quotes from high and low collaboration villages

The ten key collaboration factors emerging from the IDIs with the AAA frontline workers in this study area are described in Paper 2. A comparison between the "high" and "low" collaboration villages for each of these factors highlights notable differences for seven of them (*interdependence*, *interpersonal relationships*, *diligence/reliability*, *flexibility*, *guidance/instruction*, *locus of control*, and *conflict resolution*). For these factors, the AAA workers' descriptions of their collaboration experience tend to be more notably positive for those in the high collaboration villages as compared to their counterparts in the low collaboration villages. These differences are highlighted in

Table 16 through illustrative quotes related to each theme from both high and low collaboration villages. In contrast, there was little discernable variation for two of the other factors (*resource constraints* and *role clarity*).

The *other obstacles* factor was excluded from this analysis because it was an umbrella category for multiple different types of challenges that were each mentioned infrequently and not captured elsewhere. As a result, there is no meaningful comparison to be made between the "high" and "low" collaboration villages regarding *other obstacles*.

Table 16: Joint display of illustrative AAA worker quotes by village collaboration level

Illustrative quotes from "high" and "low" collaboration villages for each collaboration theme identified from the in-depth interviews	
Substantial differences between "high" and "low" collaboration villages	
Interdependence	
"High"	M: If you don't work along with ANM sister then would it make any difference? R: Yes, it would make a lot of difference, because we give vaccination together…. I call the kids and she gives the vaccination to kids…. Anganwadi sister is distributing the nutritional food and ANM sister is giving vaccination, if I don't call, the kids then kids won't come. (Kothawan, IDI_ASHA_06)
"Low"	M: Do you have to co-ordinate with ASHA or your work can go on even without her help? R: Yes, I don't need her help. As mentioned, (name of a separate helper) calls the kids and I manage that way. (Kachhauna, IDI_AWW_05)
Interpersonal relationships	
"High"	R: ASHA is not so literate so I have to teach her. She is intelligent, but she cannot read and write well. Even her husband helps us up, they also make the list. Once we had a talk in the meeting, they said 'why these guys sit here?' I told them please don't ask them to go, they do ASHA's work, they write and read things up. If his wife is ill, then husband would come and inform us. I say send (ASHA's name) here, he says '(ASHA's name) cannot come, she is ill', then I ask him to come, he learns what to do and he does it. We have faith in each other. (Kothawan, IDI_ANM_05)
"Low"	M: What is your rapport with ANM didi? R: We have a very good understanding. But if I say something to her, she scolds me. I tell her not to scold me but help me understand things. But she refuses. If I don't understand something, sometimes her husband explains it to me. He tells his wife that she should explain things to me,

Illustrative quotes from "high" and "low" collaboration villages for each collaboration theme identified from the in-depth interviews	
	especially because I stay unwell and don't understand things easily. But she tells him, that if he cares more for me and then he should explain things to me. (Kachhauna, IDI_ASHA_05)
Diligence/reliability	
"High"	The women who come here, the ANM talks to them and I also counsel them. Our sahayika and ASHA worker collect the children and pregnant ladies here. If a woman does not come and says that she forgot about it then they go to her household. If she still does not come then again, they go to her place. Even for 2-3 times also they visit her place. If a woman is in the farms, then we try to get her vaccines so that she completes her vaccination course. (Kachhauna, IDI_AWW_04)
"Low"	M: What all work do you (and the AWW) have to do together? R: Immunization - whenever she comes. If there is no one to distribute dalia and all, I come and help. M: Who calls the children? R: They come by their own; whoever can come. (Kothawan, IDI_ASHA_07)
Flexibility	
"High"	M: If ASHA cannot come due to her personal problem, then? R: Everyone has problems, I can have problem today and sometimes she has problem. We have to adjust accordingly. M: If ASHA calls and tells you, sister I would come two or three hours late today then what do you say? R: I just ask her to come quickly. (Behadar, IDI_ANM_07)
"Low"	R: Once (the AWW's) husband came to the booth and provided (supplementary nutrition) because it is necessary to provide meals and then he asked ASHA to distribute it to everybody. The rule is Anganwadi worker should herself provide meals to the children who are immunized. (Kothawan, OBC, IDI_ANM_01)
Guidance/instruction	
"High"	R: When we were appointed, we were told that you have to work with ANM didi. Your work is to call the pregnant women and children and make sure to give them vaccine. You will have to make list for that and they told us how to make the list. As we are doing it since many days, we have become aware. Earlier we did not know how to make the list. Now we get to know that this month we make due list for pregnant women that she has to get first vaccine and she has to get second. Those who have got the second vaccine, they have the third checkup and those who have not got, they will get the first vaccine.... So now we are able to understand. (Kachhauna, IDI_ASHA_04)
"Low"	M: What would you like to suggest in order improving the relation and compatibility between you and Anganwadi worker so that you both can work more effectively? R: All three of us know that we have to work together and support each other but still they have to be explained this in a better way. (Kachhauna, IDI_ANM_02)

Illustrative quotes from "high" and "low" collaboration villages for each collaboration theme identified from the in-depth interviews	
Locus of control	
"High"	M: Suppose in the future ANM is changed and there is ANM with whom you cannot work properly then what would you do? R: I would try to make her well…. M: Suppose ANM sister is changed and you cannot work well with other ANM sister, then would it affect your work? R: Yes, but slowly we would manage to work well. M: What do you mean? R: I would meet her and I would keep on doing my work, slowly we can work together well. (Kothawan, IDI_ASHA_06)
"Low"	R: I guess the Anganwadi worker at (village name) is not cooperative because she's living beside the Anganwadi (centre) but she is not even ready to come out of her house…. I'm visiting that place only once per vaccination and even then she is not ready to come out of her house and spend time with me by helping me…. I tried have a conversation with her but she said you should come to my house for that. I replied I am over here for vaccinations and I have to be present over here for that and that's what I'm asked to do. So why I should visit your house for that? (Kothawan, IDI_ANM_01)
Conflict resolution	
"High"	M: What should be done at this time so that ANM and Anganwadi worker should work together and share a good bonding? R: I discuss with them, ask why they have complained. She is superior to me but I also feel sorry and ask for forgiveness and I should have avoided those words. Then slowly things get well. (Behadar, IDI_AWW_09)
"Low"	R: I don't like the way (the ASHA) speaks to me. M: Can you give me an instance? R: Once I was returning from Lucknow and I got late…. so sometimes I do get late and the new ASHA complained about me to our head. So I got very angry on her because she should have inquired about it to be because I'm living at far distance and it may have happened that my scooter needed some repairs. So she should have inquired about it to me rather than complaining it to my head. (Kothawan, IDI_ANM_01)
**No substantial differences between "high" and "low" collaboration villages*	
Resource constraints	
"High"	M: Any problem with this Anganwadi center? R: There is no problem as such. But it becomes a little inconvenient if any meeting is held there. Because we don't have facilities here. Like there is no chair, no table, and no sitting arrangement; there is no rug for children to sit. We had got these things - rugs and mats - some 2-4 years back. Like this is a school and chairs are being provided here regularly every year. But if people like you come, then we can bring only one chair from our home. Otherwise, we don't get fund for all these

Illustrative quotes from "high" and "low" collaboration villages for each collaboration theme identified from the in-depth interviews	
	things. Like this room belongs to the school. And since I run my center here, so even Principal also tells me to bear the cost of repairing and white washing of this room. But how can I afford that? (Kachhauna, IDI_AWW_04)
"Low"	R: (Antenatal/postnasal/health) check-up and immunization of every village is supposed to happen at Anganwadi (centre) but Anganwadi centre does not have all the facilities available. Sometimes, table or chairs are not available (Kachhauna, IDI_ANM_02)
Role clarity	
"High"	I work with ANM didi to help her. As in immunization she handles the centre and the due list that I make, I make sure to call all the children to give the vaccine. In the role of ASHA, I support her fully…. As she makes the list and tells me that she needs it day after tomorrow. I prepare the list and give it to her. I have to make the list of children from the age of 0 to 2 years or I have to make a list of children from 0 to 5 years. I have to see that how many pregnant women are there and I have to make the list and give it to her. (Kachhauna, IDI_ASHA_04)
"Low"	We (the ASHA and AWW) record the details of the month during the visit to the households. At that time, we note down the vaccination details in the register. If I will not be there for any illness, then our sahayika calls the children, ASHA also helps, and ANM does the vaccination. I have to maintain different registers for the pregnant females and for the children. I also give the poshahar (supplementary nutrition). (Kothawan, IDI_AWW_07)

4.3.1.2 Comparison of ratios of coded facilitators to barriers between the high and low collaboration villages

Consistent with the study hypothesis, the ratio of coded facilitators to barriers was notably higher in the high collaboration villages (~4.5 facilitators to 1 barrier) as compared to the low collaboration villages (~0.67 facilitators to 1 barrier), as highlighted in Figure 15, which displays facilitator and barrier code counts by collaboration factor in "high collaboration" vs. "low collaboration" villages. This pattern holds at the individual village level when comparing the rank ordering of collaboration level based on the total scores from the collaboration scale with the village-level ratios of facilitators to barriers from the IDI transcripts, as depicted in Figure 16.

Figure 15: Comparison of facilitator-to-barrier code counts ratios by village collaboration level

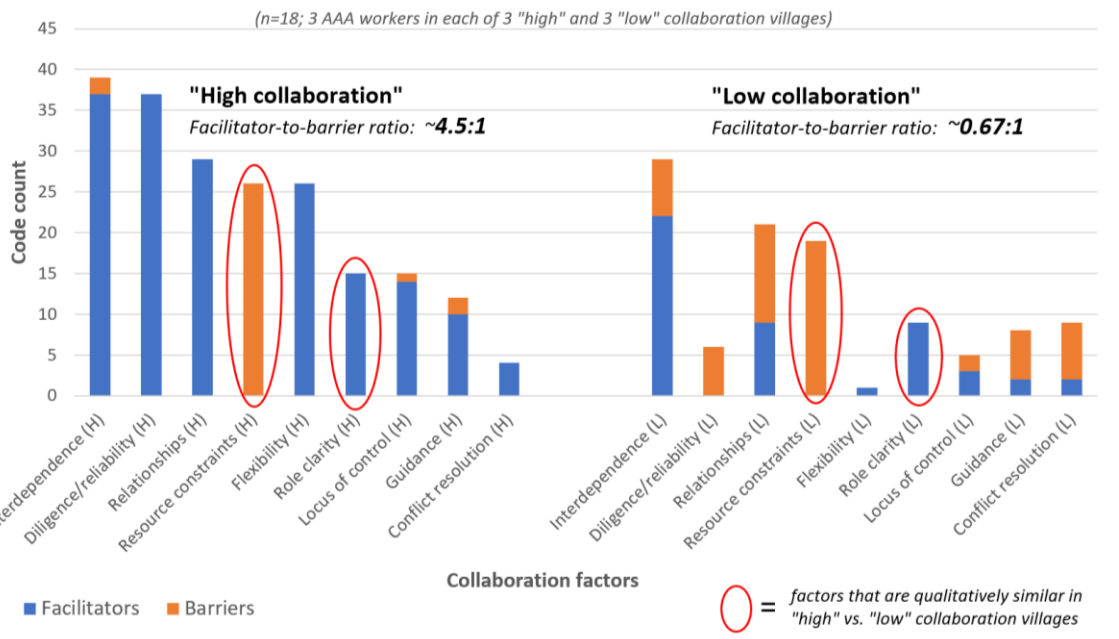
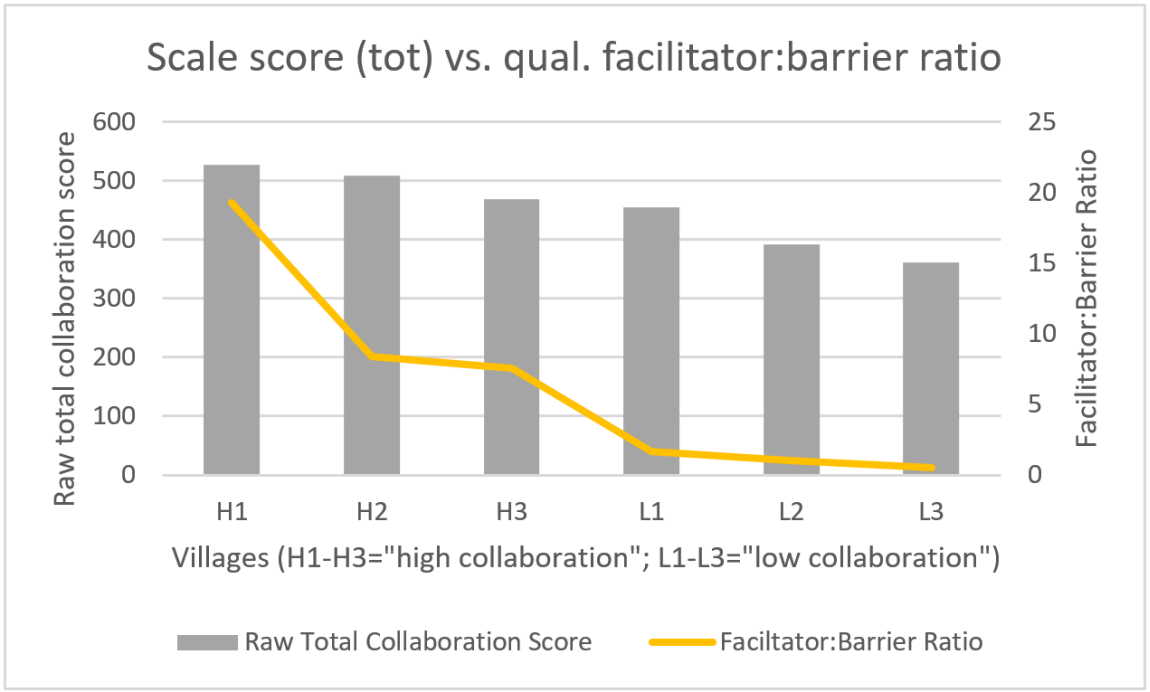


Figure 16: Comparison of facilitator-to-barrier code ratios and village-level collaboration



4.3.2 Content validity of the frontline worker collaboration scale

Side-by-side comparison of the collaboration factors from the IDIs and the 18 collaboration scale items (see Table 17) shows an overall high degree of overlap, which serves as evidence supporting the content validity of the scale. Of the ten identified collaboration factors, eight had clear corresponding scale items (*interdependence*, *interpersonal relationships*, *resource constraints*, *diligence/reliability*, *role clarity*, *guidance/support*, *conflict resolution*, and *other obstacles*). For the other collaboration two factors (*flexibility* and *locus of control*) there were no conceptually relevant items in the collaboration scale.

Table 17: Comparison of qualitative themes vs. collaboration scale indicators

Collaboration factors	**Scale item themes**	**Associated/relevant collaboration scale items**
Inter-dependence	Joint planning	6. How frequently do you discuss the needs of patients or beneficiaries with each other?
	Coordinated service delivery	11. How frequently do you coordinate services based on the needs of your patients or beneficiaries?
	Interdependence	15. How frequently do you feel that working together is one of the main ways to serve your village better?
Interpersonal relationships	Communication	1. How frequently does she communicate openly?
	Respect	2. How frequently do you feel respected?
	Willingness to listen	5. How frequently do you feel she would be willing to listen to you if there is a problem?
	Power sharing	9. When working with her how often does she try to dominate the conversation?
Resource constraints/ Other obstacles	Enabling environment	12. How frequently do you encounter obstacles when trying to work together?
Diligence/ reliability	Help and support	3. How frequently do you feel you can get help and support?
	Information exchange	7. How frequently does she provide information to you about patients or beneficiaries when required?
	Accountability	13. How frequently does she complete her share of the work on time?

Collaboration factors	Scale item themes	Associated/relevant collaboration scale items
	Commitment/ motivation	16. How frequently is she willing to work together regardless of the constraints of her job?
**Mandated collaboration*	Leadership & incentives	18. When you attend trainings or meetings, how frequently do instructors or officials say that it is important for you to work together with the others?
Flexibility/ understanding	N/A	N/A
Role clarity	Role clarity	4. How frequently you have a clear understanding of each other's roles and responsibilities?
	Shared vision	10. How frequently do you agree with her regarding the best way to provide care to your patients or beneficiaries?
Guidance/ support	Training/ guidance	17. How frequently do you feel you have enough information and suggestions about how to work together?
Locus of control	N/A	N/A
N/A	Trust	8. How frequently do you feel the need to double-check information from the (other worker)?
Conflict resolution	Conflict management	14. How frequently do you feel satisfied with the way any disagreement is managed

*As described in Paper 2, AAA workers were asked during the IDI whether they were instructed to collaborate with each other as part of their official role or whether they arrived at the arrangement on their own; respondents in all villages unanimously commented that they had received official instructions to collaborate with each other. Thus, although mandated collaboration was not identified as a collaboration factor, the content of the scale item is highly relevant to AAA collaboration in the study context.

Of the eight collaboration factors with overlapping scale items, four – *interdependence*, *interpersonal relationships*, *diligence/reliability*, and *role clarity* – had multiple relevant scale items. This is consistent with observations noted in Paper 2 about the difficulty of differentiating some of the nuances in respondents' comments about certain factors. For instance, with respect to interdependence, it was noted that:

> "it was not always possible to clearly distinguish between a worker's perception of interdependence with other workers and their joint completion of tasks. When asked why they thought it was collaboration was important, some respondents explicitly stated something along the

> lines of "because I need her help in order to get my work done"; others answered the question by listing or describing the specific tasks they complete together. Additional interviews, further probing, and/or richer IDI transcripts may have resulted in a clearer distinction between the sub-concepts that were ultimately grouped within this factor (e.g., interdependence and coordinated tasks)." (Paper 2)

In the other direction, 16 out of 18 scale items conceptually overlapped with one of the identified collaboration factors. A 17th item, *leadership & incentives*, was identified in Paper 2 to be highly relevant to AAA collaboration in the study context even though it was not identified as a collaboration factor (i.e., all workers confirmed that they had received official instructions to collaborate with one another as part of their role). The remaining scale item, *trust*, has some plausible conceptual overlap with both *diligence/reliability* and *interpersonal relationships*, but the actual wording of the question does not quite match either one. Based on further review of the transcripts, with a deliberate search for comments relating to the "trust" question in the collaboration scale ("*How frequently do you feel the need to double-check information from the (other worker)?*"), there is some evidence to suggest that workers may have interpreted this question in different ways. For instance, one ANM talked about the importance of cross-checking records between workers to help each other fill in any information gaps:

> "(the ASHA and AWW) also need to have a due list. (The) due list of ASHA, Anganwadi and ANM should be same. If I missed out a new infant who is born yesterday but Anganwadi and ASHA know which child is recently born and the pregnant lady is registered with them and I will get this information from them. For example, (if) I have 15 names in my list and they have 16, I will get this 16th name from them." (IDI_ANM_02)

In other cases, workers underscored the importance of another worker submitting their monthly registers of village-level information:

> M: Any work of yours for which you need the Anganwadi?
> R: Yes, she has to make (the) list of kids and surrender it.
> M: List of kids means?
> R: Kids from 0 to 9 months, 10 months to 5 years and when I ask her, she will make a list for that.
> (IDI_ANM_06)

Both examples reflect a situation that a frontline worker could plausibly interpret as involving "double-checking information", but in different ways. Moreover, neither of these examples quite captures or reflects the *trust* indicator as intended. Thus, despite the fact that this particular wording of the *trust* item was developed based on two rounds of cognitive interviewing

and two rounds of pre-testing, no clearly associated respondent comments emerged from the qualitative analysis.

Finally, one of these scale items (enabling environment) was fairly broadly worded and overlapped with two separate, albeit closely related, themes (resource constraints and other obstacles). Given the wide variety of different constraints and obstacles that emerged from the qualitative analysis, it may be useful to consider dividing this item into two or more different types of obstacles.

4.4 Discussion

4.4.1 Relevance of the study

The overarching mixed method study of which this paper is the third and final research component aims to take a step toward strengthening the body of research on multi-sectoral collaboration, with a focus on collaboration between frontline workers in LMICs. Based on the premise that collaborations between organizations are often mediated by specific individuals, it follows that the functioning of multi-organizational collaborations (which also encompasses multi-sectoral collaborations) may be influenced by the strength or health of the collaboration between those key individuals. If so, a metric to assess their collaboration – such as the one assessed in this paper – could help fill in part of the "missing middle" in the

causal pathway toward intended outcomes. This is particularly relevant for India's ICDS scheme, which has consistently emphasized the importance of "convergence" across sectors since its inception over four decades ago, especially between the frontline workers, but has never systematically assessed it. This paper's assessment of the construct and content validity of the collaboration scale described in Paper 1 provides additional evidence of the scale's relevance and meaningfulness for studying frontline worker collaboration in the rural Indian context. The overarching research design itself provides an empirical example of an application of the mixed methods IDCV framework, including a novel adaptation to, as compared to other published applications of the framework (56,95), more fully separate the quantitative and qualitative strands of analysis prior to the mixed analysis phase.

4.4.2 Construct validity

The mixed analysis in this paper provided multiple pieces of evidence supporting both the construct and content validity of the collaboration scale described in Paper 1. With respect to construct validity, grouping of the qualitative data according to the "high collaboration" vs. "low collaboration" villages, as defined by the collaboration scale scores, revealed notable differences between the AAA workers' collaboration experiences, in the expected direction. This was reinforced by the comparison of the ratios of

coded facilitators to barriers between the high vs. low collaboration villages as well as at the individual village level, both of which were consistent with the hypothesis that higher quantitative collaboration scores would be associated with more positive AAA worker narratives about their collaboration. Taken together, these findings suggest that the 18-item scale described in Paper 1 does, in fact, have the potential to differentiate AAA worker triads within the study area based on their level of collaboration – or at least that the high and low total scores on the scale reflect substantively different collaboration experiences.

Despite the notable qualitative differences between the high and low collaboration villages – particularly in terms of *interdependence*, *interpersonal relationships*, *diligence/reliability*, *flexibility*, *guidance/support*, *locus of control*, and *conflict resolution* – there were other aspects of collaboration that were largely similar between the groups, including *resource constraints* and *role clarity*. This does not necessarily mean that these themes are not linked to collaboration or that they are not important, but it does suggest that they were not drivers of the variation in collaboration in the study area. AAA workers in all six villages noted multiple resource constraints and generally had a clear understanding of their respective roles and responsibilities.

4.4.3 Content validity

The high level of overlap between collaboration themes and scale items provides evidence to support the overall content validity of the scale. The fact that 8 of 10 factors from the qualitative analysis overlap with scale items suggests that the scale broadly covered the domain or "universe" of the collaboration construct as described by the AAA workers. This is reinforced by the fact that 16 of 18 scale items overlapped with the collaboration factors, and a 17th (*leadership & incentives*) was also found to be highly relevant to the study context even though it did not clearly align with any of the identified collaboration factors.

At the same time, the areas of non-overlap highlight potential areas for expansion or refinement of the scale. The *flexibility* and *locus of control* collaboration factors from the qualitative analysis are potential candidates for additional scale items. Conceptually, both of these factors also fit into the Emerson & Nabatchi Integrative Framework for Collaborative Governance (48). *Flexibility* overlaps to some extent with the collaboration dynamics of "principled engagement" (i.e., norms and processes of interaction between collaborators) and "shared motivation" (i.e., collaborators' perceived value and the relationships between them), even though it is not explicitly addressed. Of note, flexibility was explored as a possible indicator in one of the collaboration scale studies reviewed in Paper 1 (69), but was ultimately

determined to have a non-significant influence on interprofessional collaborative practice. Flexibility was not mentioned as a component or indicator of collaboration in any of the other scale studies or qualitative studies reviewed in that paper.

The *locus of control* factor conceptually overlaps with Emerson's and Nabatchi's "joint capacity" (i.e., the ability and opportunity to collaborate) collaboration dynamic (48), albeit with more of a focus on the subjective experience of individual collaborators rather than the presence of organizational and environmental factors, as in the Emerson and Nabatchi framework, including "procedural and institutional arrangements, leadership, knowledge, and resources" (48). This factor is perhaps most closely aligned with the 'enabling environment" item from the scale tested in the present study but differs in that the scale item focuses on obstacles to collaboration (*"How frequently do you encounter obstacles when trying to work together with the (other worker)?"*) whereas the factor focuses on the worker's perceived ability to influence the success of the collaboration. Similarly, the Stutsky et al. scale study mentioned "empowerment", which sounds like a potential overlap, but also focuses on external factors ("*Having access to information, support, resources, and the opportunity for growth and mobility*") (69). None of the other collaboration scales or qualitative studies reviewed mentioned or addressed a concept akin to locus of control.

While it seems clear that these two collaboration factors warrant further investigation in the study context as potential additional scale items, developing appropriate questions that will be clear and meaningful for the frontline workers may be challenging. Both concepts include a somewhat greater degree of nuance than the other collaboration factors that emerged from the qualitative analysis. At the same time, the social desirability bias observed in both the quantitative and qualitative strands of this overarching study should also be considered. Questions asking frontline workers directly about their ability to influence the success of their collaboration with other workers, for instance, may generate positive responses from some respondents simply because they believe they believe it is part of their job description. As noted in Paper 1, one possible option to mitigate this issue would be to test negatively worded questions (e.g., "*How frequently do you feel that collaboration with _____ is limited for reasons beyond your control?")*, which may implicitly indicate that it is acceptable for the worker to answer honestly.

Finally, there are two existing scale questions that may need to be refined. Although the scale item related to *trust* (8. "*When you work with the _____ how frequently do you feel the need to double-check information which she shares with you?")* was tested and refined through two rounds of cognitive interviewing and pre-testing and had acceptable and consistent factor

loadings for the AWW and ASHA scale responses (with factor loadings between 0.65-0.74, on the same factor each time), the findings from the qualitative analysis suggest that the wording may have produced some mixed interpretations. The scale question related to *enabling environment* (12. *How frequently do you encounter obstacles when trying to work together with the _____?*) overlapped with two separate collaboration themes (*resource constraints* and *other obstacles*), both of which encompassed multiple different issues. It may be worthwhile exploring whether this item should be broken into multiple, more specific questions.

4.4.4 Scale modifications

Table 18 summarizes the proposed modifications to the frontline worker collaboration scale. Of the 18 scale items, 14 demonstrated a good fit in both the quantitative and qualitative strands of the analysis and are recommended to be retained. *Leadership & incentives* had a good scale fit and was identified as highly relevant in the qualitative analysis even though it did not align clearly with one of the identified collaboration factors; this item is also recommended to be retained.

Conflict management had a good qualitative fit and a moderate to good scale fit for five of the six rater-target combinations (item loadings 0.43-0.78) but loaded poorly (0.34) for the AWW ratings of the ASHA; this item could be

retained or the wording could be refined through additional cognitive interviewing.

The *trust* item similarly had a moderate to good scale fit for five of the six rater-target combinations (item loadings 0.48-0.74) but a poor loading for the ANM ratings of the AWW (0.20) and, based on the qualitative analysis, the notion of "double-checking" another's work may have had an unclear or mixed interpretation among the respondents. It is recommended that this item be revised to more clearly and unambiguously reflect a meaningful aspect of trust among the AAA frontline workers.

The *enabling environment* item had a moderate scale fit (item loadings 0.48-0.64) for five of the six rater-target combinations but loaded poorly (0.19) on the ANM ratings of the AWW. Given that the qualitative analysis highlighted multiple distinct types of obstacles or challenges to AAA worker collaboration, this item may need to be spilt into two or more separate questions addressing conceptually different types of obstacles. Finally, it is recommended that new scale items be developed and tested related to the *flexibility* and *locus of control* collaboration factors identified from the qualitative analysis, with the understanding that this may not be a simple or straightforward undertaking.

Table 18: Summary of recommended actions for refining the collaboration scale

Item themes	Scale questions (short form)	Comment
Communication	1. How frequently does she communicate openly?	Good fit (scale + qualitative analysis); retain
Respect	2. How frequently do you feel respected?	
Help and support	3. How frequently do you feel you can get help and support?	
Role clarity	4. How frequently you have a clear understanding of each other's roles and responsibilities?	
Willingness to listen	5. How frequently do you feel she would be willing to listen to you if there is a problem?	
Joint planning	6. How frequently do you discuss the needs of patients or beneficiaries with each other?	
Information exchange	7. How frequently does she provide information to you about patients or beneficiaries when required?	
Power sharing	9. When working with her how often does she try to dominate the conversation?	
Shared vision	10. How frequently do you agree with her regarding the best way to provide care to your patients or beneficiaries?	
Coordinated service delivery	11. How frequently do you coordinate services based on the needs of your patients or beneficiaries?	
Accountability	13. How frequently does she complete her share of the work on time?	
Interdependence	15. How frequently do you feel that working together is one of the main ways to serve your village better?	
Commitment/ motivation	16. How frequently is she willing to work together regardless of the constraints of her job?	
Training/ guidance	17. How frequently do you feel you have enough information and suggestions about how to work together?	
Leadership & incentives	18. When you attend trainings or meetings, how frequently do instructors or officials say that it is important for you to work together with the others?	Good scale fit; identified as relevant in qual analysis; retain
Conflict management	14. How frequently do you feel satisfied with the way any disagreement is managed	Moderate scale fit; good qual fit; retain or refine wording
Trust	8. How frequently do you feel the need to double-check information from the (other worker)?	Moderate-good scale fit; unclear interpretation in qual analysis; revisit/revise item wording
Enabling environment	12. How frequently do you encounter obstacles when trying to work together?	Moderate scale fit; covers multiple factors in qual analysis; consider splitting item
Flexibility	N/A	Not present in scale; identified in qual analysis; consider adding
Locus of control	N/A	Not present in scale; identified in qual analysis; consider adding

4.4.5 Mixed methods instrument development and construct validation design

This study also serves as an example of an empirical application of the IDCV framework described by Onwuegbuzie et al. (56), which describes a 10-phase approach to enhance the validity of quantitative instruments through the use of mixed methods. As the authors of the framework noted, "more publications are needed that outline explicitly ways of optimizing the development of instruments by mixing qualitative and quantitative techniques" (56). This study offers a subtle but important variation of other published applications of the IDCV framework (56,95) in that the quantitative and qualitative strands of data collection in the present study were conducted with entirely different instruments, by different teams, at least one month apart.

In contrast, the two other published applications of the scale incorporate open-ended questions directly into the scale instrument, one after each scale item, to encourage respondents to react to the items in their own words (56,95). Such a structured approach to mixed methods data collection generates a parallel set of quantitative and qualitative measures that can be conveniently used for various types of "crossover analyses" (e.g., identifying emergent qualitative themes, factor analyzing them, and then assessing the correlation of those factors with the factors identified by an exploratory factor analysis of the quantitative scale (56)). It also provides a systematic

framework for applying cognitive interviewing to refine the wording of scale items (95). At the same time, this approach has important limitations from an instrument validation perspective. For one, this approach may induce bias in respondents' comments. By priming respondents with researcher-generated terms and ideas, this limits the potential for inductively identifying themes that are most relevant to the respondent. Relatedly, by constraining the qualitative data collection to targeted, discrete reactions to specific scale items, there is limited potential for the respondent to identify key themes that the researcher may not have considered. Both issues arguably undermine the potential value of using qualitative data to assess the construct and content validity of a quantitative instrument.

As exemplified by the present study, a clearer separation of the quantitative and qualitative strands of data collection, both in terms of timing and modality, enables a more inductive, and arguably more robust, approach for assessing construct and content validity of a scale instrument. Further elaboration of methodological options in this direction may provide a useful reference for researchers interested applying mixed methods for instrument development and construct validation.

4.4.6 Study limitations

Although this study's mixing of quantitative and qualitative methods following the Instrument Development and Construct Validation framework provides credible evidence supporting the construct and content validity of the collaboration scale, there does not yet exist a "gold standard" for this type of approach. Mixed methods as a field is still relatively early in its development and the application of the ICDV framework is fairly novel (95), which means that there is little discussion and no consensus about what might be considered best practice with respect to many of the methodological decisions made in this paper regarding the mixed analysis. To the extent possible, this paper attempts to clearly and transparently articulate why key decisions were made, referencing parallel or relevant methodological approaches by other researchers pursuing objectives. One of the unwritten aims of the overarching study, including Paper 1, Paper 2, and Paper 3, was to provide enough detail and contextual information to help interested readers glean their own insights and determine the extent to which these findings may be relevant for other settings.

While the presentation of code frequencies is intended to provide a rough picture for the reader about how much each topic was discussed by respondents, it does not necessarily equate to the importance of the topic. Such an assumption would require that all topics and all mentions of a given

topic are of equal weight in terms of their association with AAA collaboration, which is highly unlikely to be the case. In reality, some of the issues mentioned are likely more salient than others and would theoretically have a stronger association with collaboration. However, since assigning weights would have added a high degree of researcher subjectivity to the analysis, it was deemed preferable to apply the assumption of equal weighting, while providing detailed explanation and illustrative examples for each factor and theme to help the reader critically assess them. This is another area where further probing and follow-up, along with some form of respondent-based weighting or ranking, could have helped develop a sense of the relative magnitude or hierarchy of the issues discussed.

The relatively narrow geographic scope, limited to six administrative blocks in Hardoi and Sitapur, Uttar Pradesh may limit the generalizability of the findings. However, although the size of the study area is small relative to Uttar Pradesh state, it has similar sociodemographic attributes to other districts and to Uttar Pradesh as a whole. This, along with the administrative consistency in the individual roles and joint responsibilities in the AAA triads, suggest that the collaboration scale may have relevance in Uttar Pradesh beyond Hardoi and Sitapur, and possibly more broadly in the Indian context.

4.4.7 Study strengths

While there are a variety of scales measuring inter-professional collaboration between healthcare workers in hospitals and other advanced care settings in high-income countries (69–71,73), the scale tested in this study is the first, to the author's knowledge, to measure collaboration in a rural LMIC setting. Given the relative novelty of such an instrument in this context, the mixed analysis described in this paper is particularly useful, as the qualitative data provide critical contextual information and help make up for a shortage of relevant criterion variables or other metrics commonly used in quantitative instrument validation.

This complex and somewhat resource-intensive design was feasible because the study was embedded within a larger evaluation study that included both a frontline worker survey and substantial qualitative data collection at the village level. This study also benefited substantially from the input and expertise of the skilled, multi-disciplinary research team involved in the parent study, which included team members with extensive personal and professional experience in India as well as fluency in spoken and written Hindi.

The first author did four field months of field work in India for this study, including: consultation and close collaboration with the research team of the

data collection agency and local experts from Project Samuday; direct involvement in the development of data collection instruments, field manuals, training materials, and other associated documentation as well data collector training and field monitoring/supervision.

4.4.8 Next steps

The above analysis and discussion have outlined several areas in which the collaboration scale may be expanded and refined; these should be taken into account in future research applying or adapting the scale. At the same time, this paper and the overarching study of which it is a part have generated a substantial body of evidence supporting the validity of the scale in its current form. Even as the scale is further refined, subsequent research should ideally simultaneously explore other substantive questions, both quantitatively and qualitatively.

One area for exploration relates to whether there is any added value of complementing the individual-level scale scores with data representing other perspectives on frontline worker collaboration. For instance, objective indicators of collaboration (e.g., attendance at joint meetings, completion of highly interdependent specific tasks, such as conducting the monthly VHND with the full set of services; consistency in record-keeping, such as in the ASHA and AWW registers) may serve as a useful complement to the

subjective experience of the frontline workers in a composite metric. Relatedly, the growing emphasis on integrated, person-centered care within the health sector suggests that the beneficiary perspective may also have an important role to play. Further research should consider the extent to which these other perspectives are necessary to complement the subjective, provider-side perspective represented in the current scale.

There is also a need to explore the extent to which an adaptation of the collaboration scale may be useful for measuring collaborative governance dynamics at higher levels (e.g., national, state, district), which are also critically important for program effectiveness. This would entail identification of key variations in the collaboration construct and its measurement (including the selection of scale items, question wording, modality of administration, etc.) at different organizational or administrative levels.

4.4.9 Conclusion

The findings from this study broadly support the construct and content validity of the collaboration scale, while also identifying several areas for further development. With some minor refinement, this scale may have applications not only for measuring and improving collaboration between

frontline workers in India's ICDS and NRHM, but also as a prototype to adapt for other programs in India and elsewhere.

Chapter 5: Conclusion and future direction

5.1 Research purpose

Given that human health is influenced by factors far beyond the traditional scope of public health and healthcare interventions, the global health community has long recognized the importance of collaboration across organizational and sectoral boundaries in order to improve health and development outcomes (1–5,78). Although the level of global attention paid to multi-sectoral collaboration (MSC) has fluctuated over the course of the past century (8), the recent introduction of the SDGs (4) and growing commitment of governments around the world to achieve Universal Health Coverage (9) has renewed interest in MSC (5).

Despite this growing interest in MSC and its clear rationale, there remain substantial theoretical and empirical gaps regarding what constitutes effective MSC and how it affects population health outcomes (1,5,6). Causal links between the MSC initiation and intended outcomes are often not measured and not well understood (1,10,59), undermining rigorous evaluations of MSCs (1,6), and leaving a substantial knowledge gap about the types of strategies and interventions that may be most effective in establishing or improving such collaborations (5,6). This limited understanding and measuring of the intermediate steps between the

establishment of a collaborative structure or process and the improvement of population health outcomes has been described in this study as the "missing middle" of MSC.

This "missing middle" issue is particularly apparent in India's Integrated Child Development Services (ICDS) scheme, a multi-sectoral initiative led by the Ministry of Women and Child Development (MWCD), in close collaboration with the National Rural Health Mission (NRHM) of the Ministry of Health and Family Welfare (MoHFW), to deliver essential maternal and child health and nutrition services, along with early childhood education, in nearly one million villages across rural India (33,34). Despite widespread national coverage in terms of frontline worker staffing and community-based "anganwadi" centers, results to date have been mixed: some evaluations have demonstrated reduced stunting among individual children receiving services (12,13), while others have failed to show village- or population-level impact, due in part to implementation gaps and uneven funding (13,14). One gap that has been consistently identified but still largely underexplored in research and evaluations to date is the scheme's "convergence" across sectors at the village level, where a team of three frontline workers representing both ministries collaborate to deliver services to eligible residents: the anganwadi worker (AWW), accredited social health activist (ASHA), and auxiliary nurse midwife (ANM), sometimes referred to

as the “AAA” workers (15). As a result, there is relatively little documentation of what collaboration between these workers looks like in practice and what is needed in order to improve it (18).

This dissertation has sought to take a step toward addressing this gap through a mixed methods study to develop a metric for measuring frontline worker collaboration in the ICDS scheme. This includes a quantitative strand focusing on the development and testing of a collaboration scale (Paper 1), a qualitative strand to identify key factors affecting frontline worker collaboration (Paper 2), and a mixed analysis of the findings from the quantitative and qualitative strands to further assess the construct and content validity of the scale and to identify areas for refinement. The remainder of this concluding chapter summarizes key points relating to the significance of this study and outlines a research agenda for further work in this area.

5.2 Significance of this study

Taken together, the three papers included in this dissertation highlight six key points related to the quantitative measurement of collaboration between key individuals working across organizational boundaries. These remarks are of most direct and immediate relevance to the AAA frontline workers delivering basic maternal and child health and nutrition services in rural

Uttar Pradesh, India, but may also have relevance for the measurement of collaboration in other initiatives, in other locations (elsewhere in India and possibly other LMICs), and at other administrative levels of collaborative initiative. Finally, one of the take-aways relates more generally to the IDCV framework and the use of mixed methods to validate scale instruments.

First, this study represents the first application of a collaboration scale for frontline workers in rural India and possibly the first collaboration scale for frontline workers or community health workers in LMICs more broadly. Application of this scale in the ICDS scheme or an adaptation of the scale for other multi-sectoral initiatives involving frontline workers in India or elsewhere would represent a step toward greater recognition that collaboration among frontline workers is: a) not an automatic byproduct of clear policies, adequate training, supportive supervision, and sufficient resources; b) possible to measure in a practical, meaningful way; and c) important enough to program implementation to be explicitly monitored and supported.

Second, the analyses described in this dissertation provide clear evidence supporting the validity of the collaboration scale in the study context and, by extension, as a proof of concept for possible adaptation and application elsewhere. The specific recommendations for refining the scale that are

outlined in this dissertation (summarized in Table 19 below) will further strengthen the relevance and validity of the current scale and are also relevant considerations for future efforts to adapt the scale to other contexts.

Table 19: Summary of recommendations for refining the collaboration scale

1) Refine the *conflict management* item through cognitive interviewing
2) Revise the wording of the *trust* item to increase its meaningfulness to frontline workers
3) Split the *enabling environment* item into two or more distinct obstacles or challenges
4) Develop and test new items for *flexibility* and *locus of control* for potential inclusion
5) Test negatively worded variations of scale items to reduce social desirability bias and skew

Third, the frontline worker collaboration scale may be considered for inclusion in the planned expansion of ICDS monitoring and evaluation as part of India's 2017 National Nutrition Strategy (16), which aims to expand on previous efforts through the development of a "very robust convergence mechanism" and "intense monitoring and Convergence Action Plans right up to the grass root level" (17). The scheme's continued emphasis on convergence and increased focus on monitoring at the frontline level both point to the potential value of the collaboration scale to support the updated strategy. One possible application would be to administer the scale to AAA workers in each village periodically (e.g., once every six months) in order to identify the highest- and lowest-scoring villages, which could then be visited by the relevant supervisors or managers to observe firsthand how the workers are collaborating, talk with the AAA workers informally about their collaboration experience, and identify any best practices or challenges that may be useful

for improving AAA collaboration in other villages. For this type of approach to be successful, however, it most likely would require that: 1) the collaboration scores are not in any way used as a performance assessment – and that the AAA workers are assured of this; 2) village collaboration scores are kept confidential; and 3) site visits are conducted as part of a planned visit or are conducted in such a way that they resemble routine visits.

Fourth, the collaboration scale developed and tested in this study is, to the author's knowledge, the first quantitative measure of the "collaboration dynamics" component of the Integrative Framework for Collaborative Governance. The authors of that framework outline possible performance measurement dimensions and illustrative indicators for the actions or outputs (e.g. securing endorsements or resources; enacting policy measures), outcomes (e.g., an improved public good, more efficient delivery of a public service), and adaptation (e.g., development of a new mandate) of governance systems for collaborative initiatives (referred to as "collaborative governance regimes"), but there are no recommended measures for the "collaboration dynamics", which is a logical antecedent to the above indicators. The collaboration scale from this study may thus serve as a starting point or prototype for adaptation in other studies applying the same theoretical framework to assess or evaluate collaborative initiatives, particularly those

involving collaboration between frontline workers involved in some form of direct service delivery.

Fifth, while the collaboration scale was developed for frontline workers, there is potential for adaptation of the scale approach for other levels of multi-sectoral or inter-organizational collaborations, including the administrative/managerial or policymaking levels. In essence, in any collaboration in which there is a subset of individuals whose ongoing, cross-boundary professional relationships serve as a major part of the "glue" between the organizations, there is potential value in using this type of psychometric scale to measure the collaboration between them. Adaptations of the scale for substantially different contexts and actors would likely require substantial revisions to certain items (e.g., those related to sharing information about patients or beneficiaries) but potentially more minor changes for other questions (e.g., those related to open communication and respect). Given that collaborators at the managerial and policymaking levels would be expected to have a higher level of education than the target respondents for the frontline worker collaboration scale, they should be able to respond to a longer scale with more nuanced items. This would allow for a substantially larger initial item pool, enabling more expansive content coverage of the collaboration construct in the draft instrument and, consequently, a more optimal selection of items in the final scale.

Sixth, this overarching study serves as an example of the IDCV mixed methods design and demonstrates the value of using qualitative data for validating a quantitative scale following this design. The approach followed in this study represents an important variation from previously published applications of the IDCV framework in that it more deliberately separates the quantitative and qualitative strands of analysis prior to the mixed analysis phase, both in terms of timing and modality. This arguably enables more robust assessment of the construct and content validity of a quantitative scale than existing examples of using the IDCV framework for instrument development.

5.4 Future research

The research presented in this dissertation highlights multiple topics for further investigation. These topics are briefly outlined here, grouped into four broad areas: elaborating the collaboration construct; refining the collaboration scale; generating a group-level collaboration variable from individual-level data; and measuring the impact of collaboration on key outcomes.

1) Elaborating the collaboration construct

Given the complexity of collaboration, there are multiple important aspects of the construct that were not explored in this dissertation but that may have implications for designing, managing, and measuring collaboration in the future. These include: determining the relative weight or importance of constituent factors or sub-domains of collaboration in terms of characterizing the overall construct; exploring possible causal relationships or dependencies within/between various collaboration factors or sub-domains; and exploring variations in the collaboration construct at different administrative levels (e.g., at the managerial/administrative or policymaking level).

2) Refining the collaboration scale

With respect to the collaboration scale itself, there are several areas of investigation that may be useful for guiding further refinement. These include: assessing the test-retest reliability of the scale over a period of several weeks; testing the psychometric properties of a refined scale incorporating the recommended item changes outlined in Paper 3; and investigation of variations in the response distribution and model fit when comparing negatively versus positively worded questions for individual scale items and for the scale overall (e.g., with varying proportions of negatively worded to positively worded items). Given that negatively worded items may help respondents answer more openly about problems or issues with their

colleagues (Schwarz 1995; Schwarz and Oyserman 2001, in Kenaszchuk et al. (73)), this latter topic may be useful in mitigating some of the inherent challenges with the social desirability bias for this type of scale.

3) Generating a group-level collaboration variable from individual-level data

Since collaboration is conceptualized as a group-level phenomenon, it follows that a collaboration metric should also be at the group level. However, the fact that data are collected from individuals raises questions about the appropriate methodological approach for converting the individual-level scores to a group-level variable. Past research on a variety of organizational group-level constructs, including team climate (96), trust (97), and others, often generated a group variable by averaging the relevant data across all the individuals within the group, based on an implicit assumption that individual experiences within the group are fundamentally similar.

More recently, however, there has been growing agreement that "consensus may well be the exception rather than the norm when it comes to collective team phenomena" (98) and that the failure to account for divergent experiences is likely to result in underspecified models and biased results (Cole, Bedeian, Hirschfeld, & Vogel, 2011 in (97)). As a result, researchers are increasingly calculating measures of agreement (or deviation) between

members to determine whether between-member agreement is sufficiently high to justify summing or averaging individual scores (as opposed to an alternative approach, such as selecting a minimum or maximum individual score to represent the group) or, alternatively, treating divergence as an independent variable (96,98).

One of the less-explored threads within this broader discussion is how to methodologically treat constructs that originate between dyads of informants, such as trust (97) or, as proposed in this study, collaboration (i.e., as opposed to individual reports of their personal experience or their perceptions of the group), which imply the need for an additional intermediate analytical step at the dyadic level before the analysis can be extended to the group. While this dissertation applied the default aggregation approach (i.e., summing individual collaboration scores to generate a team- or group-level score), further theoretical and empirical work is needed in this area in order to explore and compare alternative approaches to generating a group-level collaboration variable. There is scope for additional analysis of this methodological issue based on the data collected in this study.

4) Measuring the impact of collaboration on key outcomes

With the establishment of a valid scale to serve as an indicator of the level of multi-sectoral "convergence" or collaboration at the frontline of the ICDS

scheme, a next logical step would be to explore associations between levels of collaboration and key service delivery outputs (e.g., supplementary food distribution) and outcomes (e.g., immunization coverage), while also taking into account potential confounding factors (e.g., village demographics, funding, staffing, infrastructure, supplies, etc.). In this direction, it may be most useful to proceed in a stepwise approach, starting with the most proximal outputs and gradually progressing to more distal outcomes, which may require a longitudinal approach with multiple time points of collaboration data. Demonstration of a positive association between frontline worker collaboration and key service delivery outcomes would also point to the value of testing the effectiveness of various types of interventions aimed at improving collaboration between the frontline workers.

5.5 Conclusion

The ICDS model, like many other multi-sectoral collaborations, is dependent upon effective collaboration between specific units, cadres, and individuals at multiple administrative levels. Policies, plans, procedures, and job descriptions are written to ensure collaboration at these key points of interaction. These alone, however, cannot generate respect, open communication, a willingness to listen, to lend a helping hand when needed, or many of the other feelings or actions that are increasingly seen as universal aspects of collaboration. Though humans have been collaborating

even before the first civilization, we still struggle to understand this complex social phenomenon; we know collaboration is essential to many of our endeavors, but we often fall short when trying to create it or improve it, especially when it involves collaborating across organizational or sectoral (or cultural) boundaries. This dissertation has summarized several recent advances in this area, both in terms of theoretical elaboration and measurement, and built on them to develop a simple, meaningful measure of collaboration between the three key frontline worker cadres in India who are responsible for delivering basic health and nutrition services to over 100 million women and children each year.

Appendices

A1: Health and sociodemographic indicators in Hardoi, Sitapur and Uttar Pradesh

Uttar Pradesh is both the country's most populous state, as well as one of the least well off in terms of economic development and health outcomes. Among the seventy-five districts in the state, Hardoi and Sitapur tend to fare slightly worse than the average on a variety of health and social indicators, but they tend not to be outliers (i.e., both districts tend to be closer to the middle rather than the ends of the distribution).

Table 20: Sociodemographic indicators in Hardoi, Sitapur, and Uttar Pradesh state

Indicator	Hardoi 2013	Sitapur 2013	Uttar Pradesh 2013
Total population	52567	50237	4808503
Rural population, %	89.29%	90.50%	80.76%
Avg. HH size - scheduled caste (SC)	5	5.1	5.2
Avg. HH size - scheduled tribe (ST)	4.7	4.9	5.3
Avg. HH size - all	5.2	5.4	5.5
Population below 15 years (%)	36.7	37.8	34.9
Dependency Ratio	82.2	83.9	75.8
Children 5-14 yrs engaged in work (%)	5.7	4.1	3.2
Males 5-14 yrs engaged in work (%)	6.2	5.9	4
Females 5-14 yrs engaged in work (%)	5.2	2.1	2.2
Work participation rate 15yrs+ (%)	44.5	45.1	41.6
Male work participation 15yrs+ (%)	80.3	80.5	73.8
Female work participation 15yrs+ (%)	4.3	4.4	9.2
Persons w/acute illness (any) per 100,000	6326	8157	12184
Persons w/chronic illness per 100,000	8608	10812	12258
Diagnosed w/diabetes per 100,000	196	221	479
Crude birth rate (CBR)	27.8	28	24.8
Total fertility rate	4.2	4.4	3.3
Modern FP use (currently married women), %	31.7	26.4	37.6
Mothers who receive any ANC, %	73.9	70	85.2
Mothers who had ANC in 1st trimester, %	40.2	41.2	50.5
Mothers who had 3+ ANC visits, %	27.9	29	37.8
Mothers who had full ANC check-up, %	5.1	10.3	6.8
Institutional delivery, %	51.6	56.1	56.7
Safe delivery, %	66.4	69.9	63.3
Mothers receiving PNC within 48hrs, %	54.3	68.4	77.6
Newborns checked up within 24hrs, %	58.1	67.7	77.7
Mothers who used fin assistance for birth, %	40	45.4	36.4

Indicator	Hardoi 2013	Sitapur 2013	Uttar Pradesh 2013
Children 12-23 mos w/immunization card, %	78.7	58.9	71.7
Children 12-23 mos fully immunized, %	51.8	35.4	52.7
Children whose birth weight was taken, %	36	21.4	33.6
Children w/birth weight less than 2.5kg, %	34.5	25.9	24.8
Children 6-35mos excl. breastfed for 6 mos, %	46.7	23.8	20.8
Infant mortality ratio (IMR)	81	80	68
Neonatal mortality rate	52	54	49
Under 5 mortality rate (U5MR)	118	114	90

Source: Annual Health Survey 2012-13 Fact Sheet: Uttar Pradesh

A2: Ethical considerations

Frontline health worker surveys

Data for this study were derived from questions piggybacked onto a health worker survey implemented by Project Samuday as part of a baseline study for a broader evaluation of the initiative. Since the health component of Project Samuday focused on maternal, newborn and child health, the targeted frontline workers were the ASHAs, AWWs, and ANMs – the same respondents targeted for the development of the collaboration scale. Broadly, the health worker survey was intended to assess community-based and facility-based health worker's knowledge, attitudes and practices about a variety of topics, including institutional context, including education, training, hours and duties, motivation, satisfaction, supervision, salary/payment, facility infrastructure, and others.

Participants

- Accredited Social Health Activists (ASHAs)
- Anganwadi workers (AWWs)
- Auxiliary Nurse Midwives (ANMs)

Inclusion criteria

- Frontline worker surveys were conducted in all six administrative blocks of the Project Samuday baseline study area, including three blocks in Hardoi district (Behadar, Kachhauna, Kothawan) and three blocks in Sitapur district (Kasmanda, Machhrehta, Sidhauli)
- ASHAs and AWWs serving the population residing in each of the primary sampling units (PSUs) of a household survey conducted by JHSPH for Project Samuday as part of the baseline study.
- ANMs in all functional sub-centers within the study area of the household survey that serve the catchment areas in which the PSUs are located.

Recruitment and informed consent

- Oral consent was obtained from the participants only in Hindi, the local language. Consent was recorded in the tablet-based Computer-Assisted Personal Interviewing (CAPI) platform.
- Data collectors had a university degree or training in healthcare, social work or economics with at least 1 year of experience in field-based quantitative data collection in the public health field. They also all completed a formal training on research ethics that was administered by the data collection agency Kantar Public, which is comparable to the JHSPH Human Subjects Research Ethics Training Guide.

Questionnaire content

- Since the questionnaires were administered as part of the Project Samuday baseline study, they covered a variety of topics relevant to that research, including education, training, hours and duties, motivation, satisfaction, supervision,

salary/payment, current versus past jobs (ANM only), secondary or supplemental jobs (ANM only), facility infrastructure (AWW only), and a knowledge assessment (ANM and ASHA only)
- The additional questions for this study focused specifically on collaboration with other workers.

Study implementation

- Upon receiving consent, a trained data collector asked a series of close-ended questions, to which frontline workers answered verbally. Interviewer recorded the responses using an electronic tablet.
- Interviews included a structured questionnaire with questions covering the topics listed above. The interview was completed in each case within 1 to 1.5 hours.
- The interview for most workers happened during the afternoon (or another scheduled time) to minimize disruption of services. In situations where it was not possible to interview without interruption of service provision during duty hours, data collectors interviewed the frontline workers after completion of their shift or at another convenient time.
- Data collectors sought to maintain auditory privacy during the interview process to the maximum extent possible. If others interacted with the respondent or sought to join the conversation, the data collector paused the interview and waited until the respondent was alone to resume.

Data security and confidentiality

- Personally identifiable information collected included: respondent name; name of village or facility where the respondent works; and contact number (for the purpose of following up with those who agreed to be contacted for a subsequent in-depth interview approximately one month after the quantitative survey).
- Once the data collected is cross-checked with the data collection plan to verify linkages between the triads of AAA frontline workers working in the same catchment areas, this personally identifiable information will be removed from the database and replaced with a linking code.
- No names of specific workers or villages will be reported in the study.

Risks

- It was determined that this study exposed human subjects to no more than minimal risk. Topics of data collection were the same as those included in routine care. It is possible that frontline health workers were concerned that the information they provided may affect their evaluation or future work in some way, although data collectors explicitly sought to reassure them about the purpose of the study and confidentiality of their responses. It was not expected that respondents would experience any emotional discomfort during the interview but they were informed that they were free to discontinue the interview at any time for any reason.

Compensation

- Respondents were not provided with any compensation for their participation in the study.

In-depth interviews

Participants

- In-depth interviews (IDIs) were conducted with:
    - Accredited Social Health Activists (ASHAs)
    - Anganwadi workers (AWWs)
    - Auxiliary Nurse Midwives (ANMs)
    - Medical Officers (MOs)

Inclusion criteria

- Qualitative data collection was only conducted in the three Project Samuday blocks within Hardoi district (Behadar, Kachhauna, Kothawan). Although the three study blocks in Sitapur district were included in the frontline worker survey, they were not included in the qualitative data collection.
- Specific villages were selected for inclusion in the qualitative data collection based on a purposive sampling design intended to achieve maximum variation in the lived experience of frontline worker collaboration at the village level.
- To achieve this, all PSUs in each of the three blocks of Hardoi were ranked according to an aggregated collaboration score (derived from the responses to the Likert-style questions from all three frontline workers) and the PSUs with the highest and lowest total aggregate collaboration scores were selected for inclusion in the qualitative component of the study. Thus, there was one "high collaboration" and one "low collaboration" PSU included from each block in Hardoi, for a total of six villages included in the qualitative data collection.
- ASHAs, AWWs, and ANMs had to be working in the selected villages for at least four months prior to the data collection date.
- All community members participating in IDIs had to have lived in their current village for at least 12 months prior to the data collection date.
- All participants had to be at least 18 years of age and capable of providing informed consent

Recruitment and informed consent

- Since the local staff of Project Samuday had already spent 12-18 months working in one block of Hardoi prior to the baseline study had developed contacts in all their intervention communities, they acted as a liaison to introduce to the study coordinated and study team members to the health system and community leaders. The study coordinator and team members then introduced themselves and sought permission from the locally elected officials (panchayat) and Medical Officer.

- Potential respondents (as identified above) were approached and asked a series of simple question to ensure that they meet the study inclusion criteria and to gauge their interest. Depending on the respondent, the interviewer or focus group moderator asked whether the participant would like to read the informed consent document for him/herself, or whether he/she would like it read aloud by the interviewer or moderator.
- Informed consent was then administered in the format chosen by the participant, and the interviewer or moderator asked if the participant had any questions about participating in the study and addressed any queries. The study staff signed and dated the consent form to indicate verbal consent, and offered to provide the participant with a hard copy of the signed informed consent form if desired.
- All interviewers received training in research ethics as stipulated by the JHSPH IRB.

Interview content

- The in-depth interviews (IDIs) were conducted using topical guides. These guides set out themes to be discussed, listed major questions to be addressed, and included specific probes to prompt elaboration of specific topics, depending on the interests and knowledge of the informant or group.
- As with the frontline worker survey, topics covered were largely determined based on the needs of the Project Samuday baseline study. These included perspectives about community health, water, sanitation, and nutrition needs; factors that influence care-seeking decisions and level of satisfaction with health system; and (for frontline workers only) strengths of and challenges to the health system, particularly regarding ability to provide quality maternal, neonatal, and child health services.
- For this study, several questions and probes were added to focus specifically on the collaboration between frontline workers and other actors in the community as well as (for the community leaders and member) community perceptions and experience of the collaboration of the frontline workers.
- No major changes were made in the content of the IDIs throughout the study process.

Study implementation

- The IDIs were conducted by trained interviewers from the data collection agency, with technical input from JHSPH. IDIs were conducted in Hindi.
- IDIs were conducted by a single interviewer or by an interviewer with a note-taker, and, with consent of the interviewee, were digitally recorded. IDIs lasted between 60 and 90 minutes.
- The interview for most workers happened during the afternoon (or another scheduled time) to minimize disruption of services. In situations where it was not possible to interview without interruption of service provision during duty hours,

data collectors interviewed the frontline workers after completion of their shift or at another convenient time.

- Data collectors sought to maintain auditory privacy during the interview process to the maximum extent possible. If others interacted with the respondent or sought to join the conversation, the data collector paused the interview and waited until the respondent was alone to resume.

Data security and confidentiality

- No identifying information was collected from participants. Once transcription is complete, the names of the villages will be removed and replaced with the block name and whether the village was considered as "high collaboration" or "low collaboration"; audio recordings and transcripts will be assigned a unique code linked to a separate, securely stored file (in JHBox) containing the village names which will be available to confirm correct matching with the quantitative data from the frontline worker surveys.

Risks

- It was determined that participation in the interviews and focus groups should present no more than minimal risk to participants. IDIs were conducted individually and in a setting that protected anonymity and confidentiality. There was a slight risk that some participants may have felt uncomfortable discussing some material, but all participants were advised during the consent process that they were free not to respond to any question that made them feel uncomfortable and that they could withdraw from the interview at any time.

Compensation

- Respondents were not provided with any compensation for their participation in the study.

Institutional Review Boards

Ethical review and approval of the protocols for all components of this study, including the frontline worker surveys and the qualitative data collection with the frontline workers and community members, were obtained both from the Johns Hopkins Bloomberg School of Public Health Institutional Review Board, Expedited Committee (IRB-X) as well as from an India-based IRB that review social science research protocols involving household, health worker and facility surveys. The contact information for both IRBs is listed below:

JHSPH IRB Office
615 N. Wolfe Street
Suite E1100
Baltimore, Maryland 21205
Ph. +1 410-955-3193
JHSPH.irboffice@jhu.edu

Institutional Review Board
Center for Media Studies (IORG0005178; IRB00006230)
34 B, Research House,
Community Centre,
Saket, New Delhi – 110017
Ph. +91-11-26851660
Dr. Alok Srivastava
cms-irb@cmsindia.org

A3: Cognitive Interviewing

Overview

For surveys to yield valid, accurate and meaningful responses, the questions must be clear and comprehensible to respondents, relevant and meaningful to the key topics and issues of interest, and useful for informing key policy and/or programmatic questions of interest. One approach commonly used during pre-testing to improve the quality of questions is "cognitive interviewing", which is defined as "the administration of draft survey questions while collecting additional verbal information about the survey responses, which is used to evaluate the quality of the response or to help determine whether the question is generating the information that its author intends" (63).

In this process, participants are asked to provide additional information about their thoughts and reactions to the questions posed. This may take the form of thinking aloud and narrating their thought process for each question or responding to specific probe questions by the interviewer after the original question has been asked. This process can yield insight into participant understanding of questions, which in turn can be used to refine and improve the question wording, phrasing and examples if relevant. In full form, this process can be quite time consuming. For that reason, this study applied "rapid cognitive interviewing", which is a streamlined version of the full cognitive interviewing approach, with a more abbreviated discussion process and a specific focus on a subset of questions rather than a full questionnaire.

Participants

As part of the overall pre-testing process, participants were recruited based on the study eligibility criteria from a village demographically similar but not included within the study area. Pre-testing respondents were deliberately selected to represent diversity in respondent type (e.g., in socioeconomic status, religion, caste). Similar to qualitative data collection, the aim was not to reach a certain sample size, but to reach "saturation" in terms of the variation of response types and interpretations of the questions.

In order to minimize the time burden on any one respondent, rapid cognitive interviewing was done with separate respondents from those who were administered the full questionnaires. Instead, respondents for the RCI were only asked a basic set of demographic questions (age, religion, caste, education, etc.) and the specific focus questions to be explored.

Procedure

As part of the overall pre-testing process, the head of the data collection team first approached leaders in the relevant institution or community to seek

their permission to recruit respondents for pre-testing. Once permission was received, the head of the data collection team (with facilitation support from the local leader as needed/appropriate) approached prospective participants to seek their consent to participate. This included respondents for the full questionnaire as well as separate respondents specifically for the RCI.

After the verbal informed consent process was completed, those who agreed to participate were administered either the full questionnaire or the RCI focus questions. For both types of interviews (full and RCI), the enumerator asked the questions as they would in the actual interview while another member of the research team observed and recorded the total time taken for each section/sub-section as well as any apparent confusion, uncertainty, or discomfort on the part of the participant during the interview process. Upon completion of the interview, the enumerator asked the respondent about the interview experience overall, including whether there were any particular items that were not clear, confusing or uncomfortable.

For the RCI, there are generally two options: 1) asking the respondent to think out loud about their experience hearing and responding to the question; 2) use of verbal probing. For this study, the latter option (verbal probing) was used, as exemplified by the illustrative example in Table 21 below.

Table 21: Key steps for rapid cognitive interviewing

Rapid cognitive interviewing (RCI) verbal probing steps:

- After administering the full set of questions:
  - Ask the respondent the first original question again in full form

  <u>Comprehension/interpretation</u>
  - Ask: *"Can you explain what these words mean to you: What is the meaning of ____? What about ____? And ____?"* (ask about key words in the question; specific phrasing should be asked to frame the term within a specific, relatable context rather than just asking about the respondent's understanding of the term in isolation)

  <u>Paraphrasing</u>
  - Ask: *"If you were asking this question to your neighbor, how would you say it?"*

  <u>General</u>
  - Ask: *"Would this question be easy or hard for your neighbor to answer?"* (If hard) *"Why would it be hard to answer?"*

- Researcher writes down the responses (responses may also be audio-recorded), as well as any other observations about the interaction

- After the pre-testing, questions are discussed and refined by the research team in consultation with the enumerators based on participant reactions and feedback.

- RCI continues until "saturation" is reached and no further changes to the questions are required (i.e., the respondents understand the questions easily, consistently, and correctly)

A4: Collaboration questionnaire revisions

Table 22: Original and revised questions in the frontline worker collaboration scale

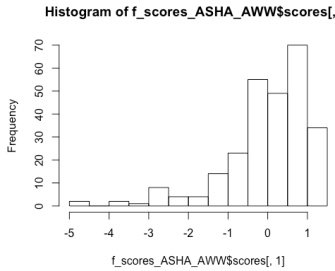
#	**Original scale item** When you work together with the ____ and ____, how frequently do you…	**Final revised scale item**
1	Have clear communication with each other?	When you interact with the _____ for work how frequently does she communicate openly with you?
2	Treat each other with respect?	When you interact with the _____ for work how frequently do you feel respected?
3	Feel you can get help and social support from the other workers?	When you work with the _____ how frequently do you think that you can get help and support from her?
4	Feel unclear about the roles and responsibilities of the others?	When you work with the _____ how frequently do you feel that both of you have a clear understanding of each other's roles and responsibilities?
5	Feel that the others are willing to listen to you if you have a problem?	When you interact with the _____ for work how frequently do you feel that she would be willing to listen to you if there is a problem?
6	Talk together about the needs of the patients or beneficiaries?	When you work with the _____ how frequently do you discuss the needs of the patients or beneficiaries with each other?
7	Share information with each other about patients or beneficiaries?	How frequently does the _____ provide information to you about patients or beneficiaries when required?
8	Have to double-check information given to you by other workers?	When you work with the _____ how frequently do you feel the need to double-check information which she shares with you?
9	Have difficulties because one person is more dominant than the others in the team?	When working with the _____ how frequently do you feel that she tries to dominate the conversation?
10	Agree with each other on priorities for patient or beneficiary care?	How frequently do you agree with the _____ regarding the best possible way to provide care to your patients or beneficiaries?
11	Coordinate health and social services for patients or beneficiaries based on their needs?	How frequently do you coordinate services with the _____ based on the needs of your patients or beneficiaries?
12	Experience frustration or problems working together?	How frequently do you encounter obstacles when trying to work together with the _____?
13	Hold each other accountable for your respective tasks and responsibilities?	When working together with the _____ on a common task, how frequently does she complete her share of the work on time?
14	Feel satisfied with how disagreements get resolved?	How frequently do you feel satisfied with the way any disagreement between you and the _____ is managed?
15	Think that collaboration with the others is important for you to do your job effectively?	How frequently do you feel that working together with _____ is one of the main ways to serve your village better?
16	Feel that others are committed to working as a team?	How frequently do you feel that the _____ is willing to work together with you to serve your village better regardless of the constraints of her job?
17	Receive guidance or feedback on how to work together as a team?	How frequently do you feel that you have enough information and suggestions about how to work together effectively with the _____?
18	Feel that collaboration is a priority of leaders in your organization?	When you attend trainings or meetings for work, how frequently do the instructors or other officials say that it is important for you to work together with the _____?

A5: Distribution of factor scores from EFA by dyadic vector

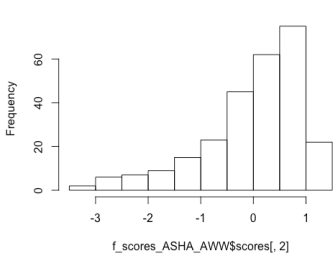
Figure 17: Distribution of factor scores by dyadic vector

AWW←ASHA

Factor 1: all except 8,9,12

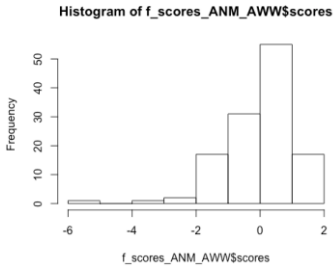


Factor 2: 8,9,12



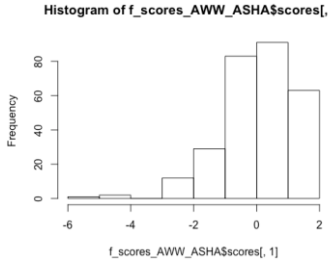
AWW←ANM

Factor 1: all items

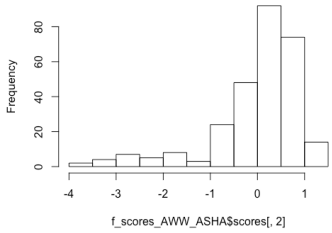


ASHA←AWW

Factor 1: all except 8,9,12

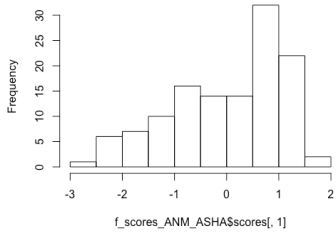


Factor 2: 8,9,12

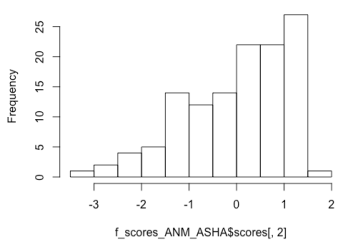


ASHA←ANM

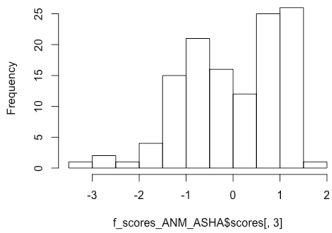
Factor 1 (2,8,9,12,16-18)



Factor 2 (10,11,13,14)

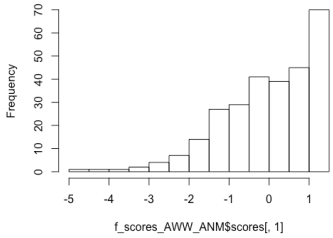


Factor 3 (3-7)

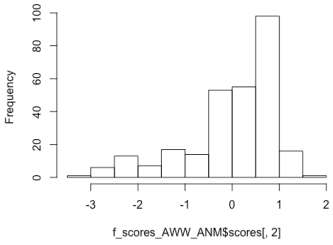


ANM←AWW

Factor 1: all except 8,9,12

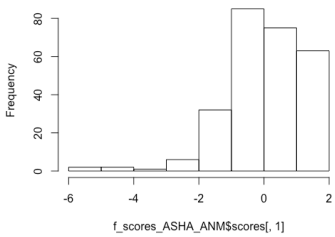


Factor 2: 8,9,12

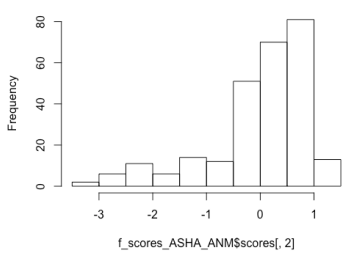


ANM←ASHA

Factor 1: all except 8,9,12



Factor 2: 8,9,12



A6: Interview guide for in-depth interviews with ASHA

COVER SHEET

Data	Respondent	Number	Date	Initials	Wave
IDI	ANM				
FGD	ASHA	____	___ ___ ___	___	1
	AWW		YY MM DD		2
	MO				
	LEAD				
	HEVE				
	COM				

Unique ID code (e.g. FGD_COM_04_170517_MM): _____

Time of IDI (HH:MM – HH:MM)	
Notes about the respondent 1. Gender 2. Age 3. Occupation 4. Caste/religion	1. 2. 3. 4.
Place *1. Location (office, home, etc)* *2. Village* *3. Panchayat* *4. Block*	1. 2. 3. 4.
Note taker / other researchers present	
Transcriber	

REFLECTION NOTES

A. IDI setting: How private was it? How "neutral" was this space? How comfortable was it? Were there interruptions?

B. About the interviewee: What did she/he look like? Did she/he seem comfortable? Was there anything noteworthy about this interviewee (something that will help you remember him/her later)?

C. Why was this person chosen for the IDI?

D. Interview summary points: What were the main points discussed?

E. Reflection on quality of the IDI: What were the challenges? Successes?

F. What would you like to follow up on if you could conduct another IDI with this person?

IN-DEPTH INTERVIEW GUIDE

Domain/topic	Questions and probes
1. **Job context**	To start off, could you tell me a bit about your daily routine as an ASHA? ***Probe:*** - What are some challenges you've faced in doing your ASHA work?
2. **Health needs/ care-seeking**	What would you say are some of the major health problems in this community? ***Probe:*** - Newborn babies - Young children (under 5 years) - Women during pregnancy, delivery, after delivery **Health care seeking for pregnancy & delivery**: You mentioned some of the health needs that women have while pregnant, when delivering the baby, and right after delivery. Can you tell us about where women can get care to meet these needs? ***Probe:*** - Differences by social groups (poverty, caste, religious group, whether they live far or near the health center) - What are some problems might families face when seeking care? (Availability. Access. Cost. Quality.) **Health care seeking for children:** You mentioned some of the health problems facing babies and children. What has been your experience of how people manage sickness in children? ***Probe :*** - Where can children be taken for health services? - Differences by social groups (gender, poverty, caste, religious group, whether they live far or near the health center) - What are some issues families might face when seeking care? (Availability. Access. Cost. Quality).
3. **Health infrastructure**	**Facilities:** As an ASHA you refer women to health facilities. Can you tell me about the health facilities? **Probe :** - What is good / bad about them? - How does this affect your work as an ASHA?
4. **Nutrition, water and sanitation**	To be healthy, people need good food and a clean environment. We'd like to learn about nutrition and sanitation here. **Nutrition**: Could you please tell me about any problems people here face in getting enough good food? **Latrines**: Could you please tell me about any problems people here face using latrines / ending open defecation

	Drinking water: Could you please tell me about any problems people here face accessing safe drinking water
5. Action to improve health and nutrition	You've mentioned a number of challenges about health, water, sanitation and nutrition. What are some things that need to be done to improve the situation? ***Probe :*** - **Community's role**: What are some activities that you hope the community could begin to do? How could the VHSNC be involved in this? Untied fund? - **Government's role**: What do you hope the government could begin to do? Why isn't the government currently doing this? - **Role for other actors**: What about any other players (NGOs or companies)? [In Kachhauna, probe about Samuday] **Locus of control:** Who do you think is the most responsible to resolve these issues? Why? Who do you think has the most power among all these actors? Why?
6a. Collaboration with ANM	We'd like to learn about your work with ANM. **Importance of collaboration**: Why do you work together with ANM? What would happen if you didn't work together with ANM? **Positives/negatives**: What are the good and difficult things about working with ANM? ***Probe:*** - How does ANM listen to you and talk to you? How comfortable are you interacting with ANM? - Can you give me an example of a time you felt good or bad when you interacted with ANM? - What would ANM do if you told them about a problem? Can you give me an example? **Improving collaboration**: What recommendations would you make, if any, to improve your relationship or work with ANM? **Directives**: Is this an arrangement you arrived at on your own, or is this a part of your official role assigned as the ASHA of your village?
6b. Collaboration with anganwadi worker	We'd like to learn about your work with anganwadi worker. **Importance of collaboration**: Why do you work together with AWW? What would happen if you didn't work together with AWW? **Positives/negatives**: What are the good and difficult things about working with AWW? ***Probe:***

	- How does AWW listen to you and talk to you? How comfortable are you interacting with AWW? - Can you give me an example of a time you felt good or bad when you interacted with AWW? - What would AWW do if you told them about a problem? Can you give me an example? **Improving collaboration**: What recommendations would you make, if any, to improve your relationship or work with AWW? **Directives**: Is this an arrangement you arrived at on your own, or is this a part of your official role assigned as the ASHA of your village?
6c. AAA meeting	We've heard that the government is encouraging ASHA, AWW and ANM to meet together monthly. Do you have meetings with the AWW and ANM? *If the meetings are occurring*: Can you tell me anything about these meetings? What are some of the issues you discuss? Could you share examples of times when you felt these meetings were most fruitful? *If the meetings are not occurring*: What are some of the reasons these meetings aren't happening?
6d. Other key collaborators	In addition to AWW and ANM, who else do you mainly work with in order to do your job? Why is it important that you work with [insert name of person or group mentioned previously]?
7. Closing	Is there anything that I didn't ask you that you want to add?

A7: Interview guide for in-depth interviews with AWW

COVER SHEET

Data	Respondent	Number	Date	Initials	Wave
IDI	ANM				
FGD	ASHA	____	___ ___ ___	___	1
	AWW		YY MM DD		2
	MO				
	LEAD				
	HEVE				
	COM				

Unique ID code (e.g. FGD_COM_04_170517_MM): _____

Time of IDI (HH:MM – HH:MM)	
Notes about the respondent 1. Gender 2. Age 3. Occupation 4. Caste/religion	1. 2. 3. 4.
Place *1. Location (office, home, etc)* *2. Village* *3. Panchayat* *4. Block*	1. 2. 3. 4.
Note taker / other researchers present	
Transcriber	

REFLECTION NOTES

A. IDI setting: How private was it? How "neutral" was this space? How comfortable was it? Were there interruptions?

B. About the interviewee: What did she/he look like? Did she/he seem comfortable? Was there anything noteworthy about this interviewee (something that will help you remember him/her later)?

C. Why was this person chosen for the IDI?

D. Interview summary points: What were the main points discussed?

E. Reflection on quality of the IDI: What were the challenges? Successes?

F. What would you like to follow up on if you could conduct another IDI with this person?

IN-DEPTH INTERVIEW GUIDE

Domain/topic	Questions and probes
1. **Job context**	To start off, could you tell me a bit about your daily routine as an AWW? ***Probe:*** - What are some challenges you've faced in doing your AWW work?
2. **Anganwadi infrastructure**	**Facilities:** We'd like to learn about the anganwadi facilities here. Can you tell us about your anganwadi center – the good things and the problems? **Supplies:** We've heard that AWWs sometimes struggle because of shortages of supplies (cooking fuel, RUTF, food, rugs, education materials, IFA tablets). Can you tell us about any struggles related to these shortages? **Probe :** - How did these challenges make you feel? - How did this influence your work?
3. **Nutrition**	**Reasons for undernutrition**: Despite all the good work that the anganwadi center does, there is still children, adolescent girls, and women who are undernourished. Why do you think the problem continues to exist? **Probe :** - Eating habits / feeding behavior - Accessing food **Access to nutrition services:** We've heard that in some places, certain people access the anganwadi center and certain people do not. What are some reasons why only some people access the anganwadi center? **Probe :** - How are the people who come to the AWC different from who do not? - What would have to happen for everyone in the community to use the anganwadi center? **Nutritional rehabilitation:** We've heard that the government has rehabilitation programs for children who are quite under nourished / weak / small. What do people here think about these programs?
4. **Water and sanitation**	To be healthy, people need a clean environment. We'd like to learn about water and sanitation here. **Latrines**: Could you please tell me about any problems people here face using latrines / ending open defecation

	Drinking water: Could you please tell me about any problems people here face accessing safe drinking water
5. Action to improve health and nutrition	You've mentioned a number of challenges about water, sanitation and nutrition. What are some things that need to be done to improve the situation? ***Probe :*** - **Community's role**: What are some activities that you hope the community could begin to do? How could the VHSNC be involved in this? Untied fund? - **Government's role**: What do you hope the government could begin to do? Why isn't the government currently doing this? - **Role for other actors**: What about any other players (NGOs or companies)? [In Kachhauna, probe about Samuday] **Locus of control:** Who do you think is the most responsible to resolve these issues? Why? Who do you think has the most power among all these actors? Why?
6a. Collaboration with ASHA	We'd like to learn about your work with the ASHA. **Importance of collaboration**: Why do you work together with ASHA? What would happen if you didn't work together with ASHA? **Positives/negatives**: What are the good and difficult things about working with ASHA? ***Probe:*** - How does ASHA listen to you and talk to you? How comfortable are you interacting with ASHA? - Can you give me an example of a time you felt good or bad when you interacted with ASHA? - What would ASHA do if you told her about a problem? Can you give me an example? **Improving collaboration**: What recommendations would you make, if any, to improve your relationship or work with ASHA? **Directives**: Is this an arrangement you arrived at on your own, or is this a part of your official role assigned as the ANM?
6b. Collaboration with ANM	We'd like to learn about your work with the ANM. **Importance of collaboration**: Why do you work together with ANM? What would happen if you didn't work together with ANM? **Positives/negatives**: What are the good and difficult things about working with ANM? ***Probe:*** - How does ANM listen to you and talk to you? How comfortable are

	you interacting with ANM? - Can you give me an example of a time you felt good or bad when you interacted with ANM? - What would ANM do if you told them about a problem? Can you give me an example? **Improving collaboration**: What recommendations would you make, if any, to improve your relationship or work with ANM? **Directives**: Is this an arrangement you arrived at on your own, or is this a part of your official role assigned as the ANM of your village?
6c. AAA meeting	We've heard that the government is encouraging ASHA, AWW and ANM to meet together monthly. Do you have meetings with the ASHA and ANM? *If the meetings are occurring*: Can you tell me anything about these meetings? What are some of the issues you discuss? Could you share examples of times when you felt these meetings were most fruitful? *If the meetings are not occurring*: What are some of the reasons these meetings aren't happening?
6d. Other key collaborators	In addition to ASHA and ANM, who else do you mainly work with in order to do your job? Why is it important that you work with [insert name of person or group mentioned previously]?
7. Closing	Is there anything that I didn't ask you that you want to add?

A8: Interview guide for in-depth interviews with ANM

COVER SHEET

Data	Respondent	Number	Date	Initials	Wave
IDI	ANM				
FGD	ASHA	____	___ ___ ___	___	1
	AWW		YY MM DD		2
	MO				
	LEAD				
	HEVE				
	COM				

Unique ID code (e.g. FGD_COM_04_170517_MM): _____

Time of IDI (HH:MM – HH:MM)	
Notes about the respondent 5. Gender 6. Age 7. Occupation 8. Caste/religion	1. 2. 3. 4.
Place *1. Location (office, home, etc)* *2. Village* *3. Panchayat* *4. Block*	1. 2. 3. 4.
Note taker / other researchers present	
Transcriber	

REFLECTION NOTES

G. IDI setting: How private was it? How "neutral" was this space? How comfortable was it? Were there interruptions?

H. About the interviewee: What did she/he look like? Did she/he seem comfortable? Was there anything noteworthy about this interviewee (something that will help you remember him/her later)?

I. Why was this person chosen for the IDI?

J. Interview summary points: What were the main points discussed?

K. Reflection on quality of the IDI: What were the challenges? Successes?

L. What would you like to follow up on if you could conduct another IDI with this person?

IN-DEPTH INTERVIEW GUIDE

Domain/topic	Questions and probes
1. Job context	To start off, could you tell me a bit about your daily routine as an ANM? ***Probe:*** - What are some challenges you've faced in doing your ANM work?
2. Health needs/ care-seeking	What would you say are some of the major health problems in this community? ***Probe:*** - Newborn babies - Young children (under 5 years) - Women during pregnancy, delivery, after delivery **Health care seeking for pregnancy & delivery**: You mentioned some of the health needs that women have while pregnant, when delivering the baby, and right after delivery. Can you tell us about where women can get care to meet these needs? ***Probe:*** - Differences by social groups (poverty, caste, religious group, whether they live far or near the health center) - What are some problems might families face when seeking care? (Availability. Access. Cost. Quality.) **Health care seeking for children:** You mentioned some of the health problems facing babies and children. What has been your experience of how people manage sickness in children? ***Probe :*** - Where can children be taken for health services? - Differences by social groups (gender, poverty, caste, religious group, whether they live far or near the health center) - What are some issues families might face when seeking care? (Availability. Access. Cost. Quality).
3. Health infrastructure	**Facilities:** We'd like to learn about the government health facilities here. Can you tell us about the health facilities here – the good things and the problems? **Probe :** - How about the availability of staff, medicines and supplies? - How does this affect your work as an ANM?

4. Nutrition, water and sanitation	To be healthy, people need good food and a clean environment. We'd like to learn about nutrition and sanitation here. **Nutrition**: Could you please tell me about any problems people here face in getting enough good food? **Latrines**: Could you please tell me about any problems people here face using latrines / ending open defecation **Drinking water**: Could you please tell me about any problems people here face accessing safe drinking water
5. Action to improve health and nutrition	You've mentioned a number of challenges about health, water, sanitation and nutrition. What are some things that need to be done to improve the situation? ***Probe :*** - **Community's role**: What are some activities that you hope the community could begin to do? How could the VHSNC be involved in this? Untied fund? - **Government's role**: What do you hope the government could begin to do? Why isn't the government currently doing this? - **Role for other actors**: What about any other players (NGOs or companies)? [In Kachhauna, probe about Samuday] **Locus of control:** Who do you think is the most responsible to resolve these issues? Why? Who do you think has the most power among all these actors? Why?
6a. Collaboration with ASHA	We'd like to learn about your work with the ASHA. **Importance of collaboration**: Why do you work together with ASHA? What would happen if you didn't work together with ASHA? **Positives/negatives**: What are the good and difficult things about working with ASHA? ***Probe:*** - How does ASHA listen to you and talk to you? How comfortable are you interacting with ASHA? - Can you give me an example of a time you felt good or bad when you interacted with ASHA? - What would ASHA do if you told her about a problem? Can

	you give me an example? **Improving collaboration**: What recommendations would you make, if any, to improve your relationship or work with ASHA? **Directives**: Is this an arrangement you arrived at on your own, or is this a part of your official role assigned as the ANM?
6b. Collaboration with anganwadi worker	We'd like to learn about your work with anganwadi worker. **Importance of collaboration**: Why do you work together with AWW? What would happen if you didn't work together with AWW? **Positives/negatives**: What are the good and difficult things about working with AWW? ***Probe:*** - How does AWW listen to you and talk to you? How comfortable are you interacting with AWW? - Can you give me an example of a time you felt good or bad when you interacted with AWW? - What would AWW do if you told them about a problem? Can you give me an example? **Improving collaboration**: What recommendations would you make, if any, to improve your relationship or work with AWW? **Directives**: Is this an arrangement you arrived at on your own, or is this a part of your official role assigned as the ASHA of your village?
6c. AAA meeting	We've heard that the government is encouraging ASHA, AWW and ANM to meet together monthly. Do you have meetings with the ASHA and AWW? *If the meetings are occurring*: Can you tell me anything about these meetings? What are some of the issues you discuss? Could you share examples of times when you felt these meetings were most fruitful? *If the meetings are not occurring*: What are some of the reasons these meetings aren't happening?

6d. Other key collaborators	In addition to ASHA and AWW, who else do you mainly work with in order to do your job? Why is it important that you work with [insert name of person or group mentioned previously]?
7. Closing	Is there anything that I didn't ask you that you want to add?

A9: Interview guide for in-depth interviews with medical officers

COVER SHEET

Data	Respondent	Number	Date	Initials	Wave
IDI	ANM				
FGD	ASHA	____	___ ___ ___	___	1
	AWW		YY MM DD		2
	MO				
	LEAD				
	HEVE				
	COM				

Unique ID code (e.g. FGD_COM_04_170517_MM): _____

Time of IDI (HH:MM – HH:MM)	
Notes about the respondent 9. Gender 10. Age 11. Occupation 12. Caste/religion	1. 2. 3. 4.
Place *1. Location (office, home, etc)* *2. Village* *3. Panchayat* *4. Block*	1. 2. 3. 4.
Note taker / other researchers present	
Transcriber	

REFLECTION NOTES

M. IDI setting: How private was it? How "neutral" was this space? How comfortable was it? Were there interruptions?

N. About the interviewee: What did she/he look like? Did she/he seem comfortable? Was there anything noteworthy about this interviewee (something that will help you remember him/her later)?

O. Why was this person chosen for the IDI?

P. Interview summary points: What were the main points discussed?

Q. Reflection on quality of the IDI: What were the challenges? Successes?

R. What would you like to follow up on if you could conduct another IDI with this person?

IN-DEPTH INTERVIEW GUIDE

Domain/topic	Questions and probes
1. Job context	To start off, could you tell me a bit about your daily routine as a medical officer here? ***Probe:*** - What are some challenges you've faced as a medical officer?
2. Health needs/ care-seeking	What would you say are some of the major health problems in this community? ***Probe:*** - Newborn babies - Young children (under 5 years) - Women during pregnancy, delivery, after delivery **Health care seeking for pregnancy & delivery**: You mentioned some of the health needs that women have while pregnant, when delivering the baby, and right after delivery. Can you tell us about where women can get care to meet these needs? ***Probe:*** - Differences by social groups (poverty, caste, religious group, whether they live far or near the health center) - What are some problems might families face when seeking care? (Availability. Access. Cost. Quality.) **Health care seeking for children:** You mentioned some of the health problems facing babies and children. What has been your experience of how people manage sickness in children? ***Probe :*** - Where can children be taken for health services? - Differences by social groups (gender, poverty, caste, religious group, whether they live far or near the health center) - What are some issues families might face when seeking care? (Availability. Access. Cost. Quality).
3. Health infrastructure	**Facilities:** We would like to understand the good and bad things about the health facility you work at and the referral facilities here. Are there any issues specific to the health facility you work at or the referral facilities available in this area? **Drugs and supplies**: We've heard that medical officers sometimes struggle because of shortages of supplies and drugs.

	Have you experienced any struggles related to these shortages? **Vacancies**: We've heard that MO's often struggle to manage their work because there are many vacant positions, including not enough ANMs, pharmacists and other staff. Have you experienced any challenges related to there not being enough healthcare staff?
4. Nutrition, water and sanitation	To be healthy, people need good food and a clean environment. We'd like to learn about nutrition and sanitation here. **Nutrition**: Could you please tell me about any problems people here face in getting enough good food? **Latrines**: Could you please tell me about any problems people here face using latrines / ending open defecation **Drinking water**: Could you please tell me about any problems people here face accessing safe drinking water
5. Action to improve health and nutrition	You've mentioned a number of challenges about health, water, sanitation and nutrition. What are some things that need to be done to improve the situation? ***Probe :*** - **Community's role**: What are some activities that you hope the community could begin to do? How could the VHSNC be involved in this? Untied fund? - **Government's role**: What do you hope the government could begin to do? Why isn't the government currently doing this? - **Role for other actors**: What about any other players (NGOs or companies)? [In Kachhauna, probe about Samuday]
6. Collaboration	**AAA collaboration**: We've heard that the government is encouraging ASHA, AWW and ANM to work together. What do you think about this? How has this affected the health services obtained by people in this community? *Probe on:* ● Medical officer's collaboration with ANM ● Medical officer's collaboration with ASHA ● Medical officer's collaboration with AWW
7. Closing	Is there anything that I didn't ask you that you want to add?

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Curriculum Vitae

DOUGLAS M. GLANDON

March 2019

Key Qualifications

Douglas M. Glandon, PhD, MPH, has over 12 years of experience in health systems governance and financing, strategic and operational planning, organizational development, and performance management in 18 countries. At the Johns Hopkins Bloomberg School of Public Health, Glandon provided design, analysis, and writing support for a variety health systems research projects while he led his own doctoral research to develop and test a collaboration metric to fill a methodological gap in outcome evaluations of multi-sectoral health and nutrition service delivery schemes in India (with a combined USD 6+ billion annual budget). With Abt JTA, Glandon advised the Fiji Ministry of Health and Medical Services and the Australian Aid-funded Fiji Health Sector Support Program (FHSSP) on strategic and operational planning as well as monitoring, evaluation, research and learning (MERL), resulting in improved alignment between the ministry's strategic and operational frameworks and performance management processes and contributing to improved organizational performance ratings from the Office of the Prime Minister. While at Abt Associates, Glandon led a $10+ million portfolio of work on health systems strengthening and reform, including health financing and resource tracking, while also contributing technical expertise on health financing, information systems, MERL, and sustainability analysis to national health ministries in 13 countries. Key clients included USAID, DFID, WHO, and the World Bank. Prior to working at Abt Associates, Glandon was the inaugural program coordinator at the Institute for Global Leadership at Tufts University, where he improved operational efficiency and coordination of programs, including setting up and managing program-level MERL processes and developing and maintaining institutional partnerships. Country field experience includes Benin, Botswana, Cote d'Ivoire, Democratic Republic of the Congo, Ethiopia, Fiji, Haiti, India, Kenya, Liberia, Nicaragua, Papua New Guinea, Rwanda, Senegal, Tanzania, United States, Vietnam & Zambia.

Education

PhD in Health Systems, International Health Department, Johns Hopkins Bloomberg School of Public Health *(GPA: 4.0)*
MPH with concentration in Global Health, Tufts University School of Medicine *(GPA: 4.0)*
BA double major International Relations & Community Health, Tufts University *(GPA: 3.98; Summa Cum Laude)*

Relevant Professional Experience

May-Oct 2018 **Consultant, Public-Private Partnerships. ThinkWell Global.**
Research and analysis of public-private partnership (PPP) models, key attributes, and applications across multiple sectors inform a major pharmaceutical company's global strategy for sustainable immunization financing and health systems strengthening. Developed and implemented research design and analytical methodology for an intensive desk review of peer-reviewed and grey literature in order to: a) develop a classification framework for public-private partnerships; b) conduct a deep dive analysis of five to six PPP models most relevant to health and sustainable development in low- and middle-income countries; c) derive insights and implications to inform

the client policies, strategy, and operational planning in priority countries and regions.

2016 – present **Senior Research Officer. Johns Hopkins Bloomberg School of Public Health.**
Currently leading human-centered design component of WHO-funded toolkit to help subnational governments assess and improve integrated, people-centered health services.
Previously provided technical assistance and quality control in research design and implementation at all phases within an evaluation study of a donor-funded multi-sectoral health, social and economic development and systems strengthening project in rural Uttar Pradesh state, India, including mixed methods research design, client engagement, study protocol, IRB processes, development of instruments with computer-assisted personal interviewing (CAPI), preparation of training materials, field manuals and field implementation plans, pre- and pilot-testing, data collection and management, analysis, report-writing, and dissemination.

2012 – 2017 **Advisor for Planning, Monitoring & Evaluation. Fiji Ministry of Health & Medical Services**. Guided and facilitated national-level strategic and operational planning, monitoring and evaluation in the Fiji Ministry of Health (MoH) and the Fiji Health Sector Support Program (FHSSP). Advised MoH and FHSSP technical program managers in establishing, reporting, and using progress and performance indicators linked to a clearly articulated theory of change. Collaborated with Ministry senior leadership to: strengthen data accuracy, completeness, and timeliness in key MoH information systems and use for decision-making and program management at the national, divisional and sub-divisional levels. Established and institutionalized a robust M&E capacity building approach to enhance and sustain policy development, planning, monitoring, evaluation, and research capacity among all relevant worker cadres in the MoH.

2009 – 2012 **Associate (2012); Senior Analyst (2010-2012); Analyst (2009-2010). Abt Associates.** Led and provided technical assistance for health systems strengthening initiatives and policy analysis, including national health financing, costing, resource tracking, information systems and sustainability analysis in sub-Saharan Africa and Southeast Asia. Provided monitoring & evaluation support for health projects, including framework design, development of data capture and management systems, and use of data for decision-making. Coordinated and supervised USD $10+ million portfolio of activities within USAID's Health Systems 20/20 Project, including client engagement, guidance for work plan development, financial and technical performance tracking, progress/performance reporting, quality assurance, and maintaining partnerships with technical counterparts in the World Health Organization, World Bank, and other organizations. Led project management and technical development of the Health Accounts Production Tool, hosted online by WHO.

2007 – 2008 **Program Coordinator. Institute for Global Leadership, Tufts University.** Designed and implemented monitoring, evaluation, and reporting tools, increasing program accountability and visibility; Clarified, streamlined, and disseminated operational procedures, improving efficiency of

logistical and financial support for over ten student group projects and activities, representing over 200 students; Developed distribution channels with local retailers for Institute publications, increasing profitability; Led health assessment in Balan, Haiti, transferring research skills to Haitian team and advising on development strategy.

2006 – 2007 **Research Intern. Henry R. Luce Program in Science and Humanitarianism, Tufts University**. Conducted study on psychosocial resilience and coping among 41 New Orleans residents hardest hit by Hurricane Katrina in collaboration with a local grassroots organization to inform organization's strategy and program implementation.

2006 – 2007 **Global Health Fellow, Tufts University School of Medicine. Muhimbili University College of Health Sciences (Dar es Salaam, Tanzania)**. Enacted National Institutes of Health grant through online course development and professor training, resulting in widespread recognition of improved student-teacher interface and medical education within the university; conducted study on effects of water usage, hygiene behavior, and water-related disease in peri-urban Dar es Salaam.

Software Experience

Microsoft Office (Word, Excel, Power Point); Excel Visual Basic for Applications (VBA); R; Stata; ArcGIS; Vensim (systems models); UCINET (social network analysis).

Papers, Publications, Presentations

Sutkowski, A., Glandon, D., Madan, Y., Coe, M., Rajkotia, Y. (2018). Public-Private Partnerships (PPPs): Why, What, and How for Sustainable Immunization Financing. Washington, DC: ThinkWell.

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Honors and Awards

Phi Beta Kappa Society; National Merit Scholar; Delta Omega Honorary Society in Public Health; Global Health Fellowship, Tufts University; Sigma Iota Rho Honor Society for International Studies; Tufts University School of Medicine Academic Achievement Award; Tufts University President's Award for Citizenship & Public Service; Tufts University Alumni Association Senior Award; Anne E. Borghesani Memorial Prize for international research, Tufts University; Richard H. Morrow Endowed Scholarship in Health Systems, Johns Hopkins Bloomberg School of Public Health (JHSPH); Health Systems Award for doctoral research, JHSPH; Nancy Stephens Award, International Health Department, JHSPH.