Professional advice networks of community-based health workers in Ethiopia

Study Protocol

Table of Contents

List of Figures

List of Tables

Abstract

This cross-sectional, mixed-methods observational study will compare professional advice networks of healthcare workers in 8 primary health care units (PHCUs) across four regions of Ethiopia. PHCUs include a health centre and 5 satellite health posts staffed by a total of approximately 21 healthcare workers. The data collection tool will include health care worker advice seeking and giving for the provision of four areas along the continuum of maternal and newborn care: antenatal care, childbirth care, postnatal care and newborn care. The following network metrics will be calculated using UCINET: advice network size (number of nodes), frequency and direction of advice exchange, advice network density, centrality, betweenness, distance and reachability. Additional information will be captured regarding professional advice exchange beyond the roster of health care workers in the PHCU. Network metrics will be qualitatively compared to continuum of care coverage data as a secondary analysis. Qualitative interviews of purposively selected subjects will follow the collection of quantitative network data to interpret and explain network roles and patterns observed.

The study could provide foundational information for identifying how these advice networks can be strengthened to support healthcare workers in the provision of health services. Understanding professional advice networks may inform a pathway for supporting the scale up, integrity and implementation strength of health programs.

Abbreviations

ANC	Antenatal Care
BEmONC	Basic Emergency Obstetric & Newborn Care
CBNC	Community Based Newborn Care
CHP	Community Health Promoter
CMAM	Community Management of Acute Malnutrition
CSTWG	Child Survival Technical Working Group
ENAP	Every Newborn Action Plan
FANC	Focused Antenatal Care
HC	Health Centre
HDA	Health Development Army
HEP	Health Extension Programme
HEW	Health Extension Worker
HMIS	Health Management Information Systems
HP	Health Post
HSDP	Health Sector Development Plan
iCCM	Integrated Community Case Management
ICU	Intensive Care Unit
IDEAS	Informed Decision for Action
IMNCI	Integrated Management of newborn and childhood illness
IRB	Institutional Review Board
MDG	Millennium Development Goal
MLE	Measurement, Learning and Evaluation
MMR	Maternal Mortality Ratio
MNH	Maternal and Newborn Health
PHCU	Primary Health Care Unit
PNC	Postnatal care
PPH	Post Partum Haemorrhage
PRCMM	Program Review and Clinical Mentoring Meeting
SNA	Social Network Analysis
SNNP(R)	Southern National Nationalities Peoples (Region)
TFP	Therapeutic Food Programme
ToT	Training of trainers
vCHW	Volunteer Community Health Worker
WHDT	Women's Health Development Team

Background and Rationale

Informed Decisions for Action (IDEAS) is a London School of Hygiene and Tropical Medicine-based research group engaged with measurement, learning and evaluation of Bill and Melinda Gates Foundation (BMGF) supported maternal and newborn health programs in Ethiopia, North-East Nigeria and Uttar Pradesh, India. IDEAS aims to improve the health and survival of mothers and babies through using measurement, learning and evaluation to determine what works, why and how in maternal and newborn health programmes. IDEAS articulated the following learning questions to guide their research:

- To what degree do community-based maternal & newborn health innovations enhance interactions between families and frontline workers, and intervention coverage, in districts where implementation grantees work directly? Are they cost-effective? Through what mechanisms do enhanced interactions (i.e. more, better and equitable) affect coverage of critical interventions?
- What helps and what hinders scale-up of community-based maternal and newborn health innovations, both within and beyond grantee areas, and how can scale-up be catalysed?
- Where community-based maternal and newborn health innovations have been implemented on a large scale beyond grantee areas, what is the effect on coverage of critical interventions and how does this depend on implementation strength? What survival impact can be expected?

The proposed cross-sectional, mixed-methods observational study aims to look at interactions between healthcare workers, specifically professional advice exchange. This cuts across IDEAS' work. To date IDEAS' research on interactions has been limited to those between families and frontline workers. This study would shift to look at another set of important interactions—those between frontline workers. This has potential to be useful to catalyze scale-up and improve implementation strength of critical interventions, other focuses of IDEAS' work.

Little is known about professional advice networks among frontline workers in Ethiopia. This exploratory study would describe the range of professional advice networks properties, the context in which advice exchanges and the extent to which advice networks meet health care worker needs.

How is this information useful? The study could provide foundational information for identifying how these advice networks can be strengthened to support healthcare workers in the provision of health services. Understanding professional advice networks may inform a pathway for supporting the scale up, integrity and implementation strength of health programs.

Study Setting

Ethiopian Newborn Health Background

Ethiopia is a landlocked state in the horn of Africa neighbouring Kenya, Somalia, Eritrea, Djibouti, Sudan and South Sudan. Administratively Ethiopia is divided into 9 regions (plus 2 administrative cities), 85 zones, 817 woredas, and 16,253 kebeles.[1] While major progress has been made in addressing under 5 mortality, with achievement of the associated MDG met three years early, neonatal deaths account for approximately 42% of under 5 deaths.[2] According to the Ethiopian government, major causes of neonatal mortality are preterm birth (17%), asphyxia or intrapartum related deaths (25%) and infection (36%).[3] A recent study of the past three demographic health

surveys in Ethiopia (2000, 2005, 2011) found the following statistically significant associations with neonatal mortality: neonate male gender, maternal age less than 18, neonates born within two years of preceding birth, winter births and the following protective associations: maternal education, maternal receipt of two doses of tetanus toxoid prior to birth. [4] The Ethiopian Health Sector Development Plan IV (2010-2015), indicates that MNH is a priority. In 2014 the Federal Ministry of Health launched Phase 1 of a new national program, Community-Based Newborn Care (CBNC) which aims to improve the health outcomes of mothers and newborns. One aspect that sets this program apart from previous community based efforts to date in Ethiopia is the active case detection and follow-up by the community based health workers. This program introduces community based management of neonatal sepsis by Health Extension Workers (HEWs) in the event referral is not possible. The linkages within the Primary Health Care Unit (PHCU) between the health-centre based health care workers and health post-based Health Extension Workers (HEWs) and the volunteer Women Health Development Team (WHDT)[1] are the foundation for the delivery of Community Based Newborn Care.

Healthcare delivery context in Ethiopia

Ethiopia has a decentralized model for the delivery of healthcare with the Federal Ministry of Health as the policy-setting body and regional health bureaus exerting managerial control. Tertiary care is provided at zonal and regional level, while primary health care is delivered closer to the community through the PHCUs, comprised of approximately five health posts and a referral health centre with a network of Health Extension Workers and Women's Health Development Team volunteers to connect people to the healthcare system.

Figure 1: Ethiopia's Four-Tiered Health System and associated catchment populations
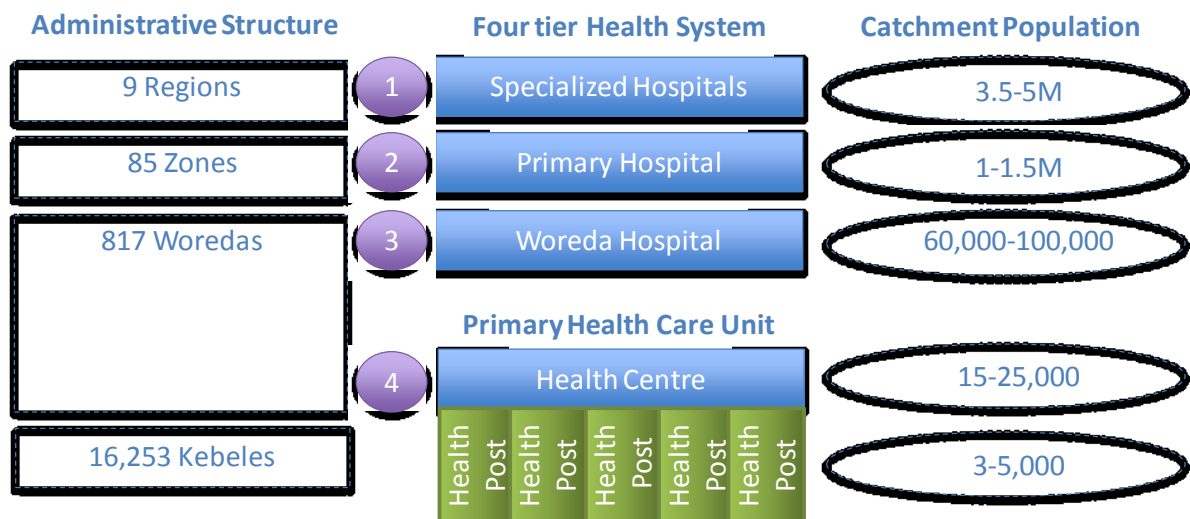
In 2003, Ethiopia introduced the Health Extension Program, an ambitious plan to improve delivery of primary health care through the introduction of a new cadre of 30,000 community based Health Extension Workers (HEWs) to deliver care at 15,000 health posts.[5] HEWs are government salaried women, 18 years or older, who completed 10th grade, recruited from the kebele where they are

___

[1] Formerly known as the Women's Development Army or Health Development Army

assigned to work, who have received one year of training.[5]   HEWs are trained to deliver a package of 17 essential health services including both preventive and curative services spanning 4 major areas of care 1) family health 2) disease prevention and control, 3) hygiene and environmental sanitation and 4) health education and communication.[5]   Services include: family planning, ANC, maternity and PNC services, newborn care, immunizations, nutrition, deworming, and treatment of childhood illnesses through Integrated Community Case Management (iCCM).[5] Studies of HEWs acknowledge their achievements but report further potential through additional training and resources.[5-8]

Research Objectives

Table 1: Research Aims and Objectives

Research Aim	• How do community-based health workers' professional advice networks affect implementation of health programs in rural Ethiopia?
Specific Objectives	**Primary** 1. Are there differences in the network structure, composition and use of professional advice networks of Primary Health Care Unit healthcare workers? 2. What is the range of Primary Health Care Unit health care worker advice network structures? 3. What kind of professional advice is commonly sought by these healthcare workers? Who is sought for advice? Are they able to provide advice, why or why not? When and where does this advice exchange take place? 4. Who seeks professional advice from these healthcare workers? Under what circumstances? Are they able to provide advice? Why or why not? When and where does this advice exchange take place? 5. Do existing professional advice networks meet the needs of the healthcare workers? What are the barriers and facilitators to seeking, receiving or providing advice? **Secondary** 6. How do PHCU healthcare worker advice network measures relate to coverage across the continuum of care (ANC, Delivery services, PNC and newborn care)? 7. Are HCW professional advice networks restricted to the PHCU? If not, who are these individuals (qualification, place of work)? Under what circumstances are they engaged?

Conceptual Framework

Figure 2: Conceptual Framework for Professional Advice Network Study
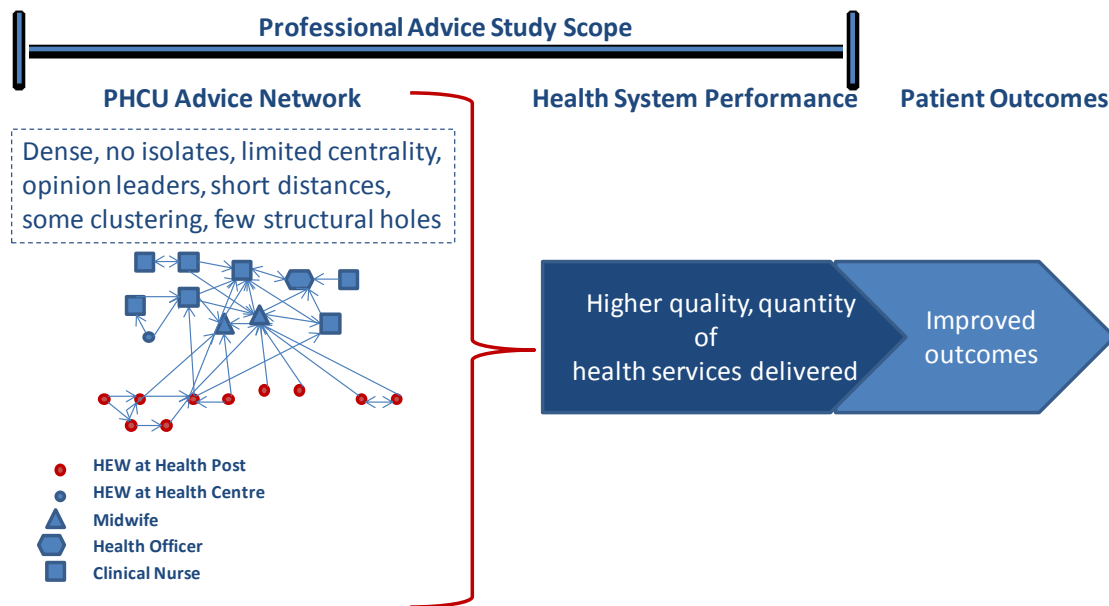
Network Metric Hypotheses

We hypothesize that healthcare workers through dense, active advice networks are influencing each others' professional behaviours, reinforcing best practices and that this leads to better outcomes for patients. Networks with the following properties are hypothesized to perform better in the delivery of community based newborn care:

- Large networks, with most of the approximately 21 HCWs participating, no or few isolates
- Relatively dense networks (density between .15-.5)[21], with nodes having multiple people they seek advice from regularly
- Network centrality metrics will be limited (networks will not be focused solely on one or two people), ideally with centrality less than .25.[21] However individual centrality measures will likely indicate the presence of some opinion leaders within the PHCU networks. HEWs will nominate individuals who lead trainings and individuals at the health centre with more educational background such as midwives with greater experience of treating septic patients. More experienced HEWs may be sought for advice by other HEWs or WHDT members. At the HC level advice may be sought from healthcare workers who conduct supportive supervision from the woreda or higher level or ToT instructors. Outside the PHCU roster there may be key members of the community who function as opinion leaders or who are important to consult to reach pregnant women or sick newborns.
- Distances between nodes will be limited, with low average path lengths and cohesion (greater than .50)

Other metrics that will be captured that will have a more complicated relationship with health outcomes are

- Homophily/Clustering/Brokers/Bridges. Intracluster homophily coupled with intercluster heterophily, or clusters containing similar individuals linked via bridges to clusters of

individuals different to the original cluster, but all similar to each other would be a beneficial subgroup configuration to facilitate information flow. We suspect these will be hierarchical with clusters forming around cadres, for example HEW to cluster together, midwives to cluster together, but bridges linking the two clusters. Gender and educational background will follow similar patterns. If clustering exists but is inversely related to health outcomes then these clusters may lack the bridges connecting them.

- Absence of a core-periphery structure
- Reciprocity and transivity will be relatively low between cadres as these will be primarily hierarchical advice seeking/giving interactions. Within cadres reciprocity may be high.
- Extra-roster advice seeking will take place and these individuals will be opinion leaders within the community, such as traditional birth attendants with significant experience.

Methodology

Study design

This will be an observational, cross-sectional and mixed-method study. There will be two stages of data collection: network data captured through surveys, followed by qualitative interviews seeking to explain differences between networks, and roles identified within networks.

For network data collection, all health care workers working at health centres and health posts within eight PHCUs will be potential study subjects. We plan that 32 directed, valued whole networks will be captured through a structured questionnaire to an estimated 168 healthcare workers. The primary analysis will focus on advice seeking and giving among PHCU staff. However this will not be a pure whole network study, but rather a hybrid, allowing respondents to nominate those not appearing on the roster. These data will be used for a secondary analysis of advice networks outside of the PHCU to answer research question 7. The network tool will capture who each health care worker seeks advice from regarding providing antenatal care, childbirth care, postnatal care and newborn care. The network tool will also capture who each health care worker advises in the provision of antenatal care, delivery services, postnatal care and newborn care. The following network metrics will be calculated: advice network size (number of nodes), frequency and direction of advice exchange, advice network density, centrality, betweenness, distance and reachability. These analyses will be used to answer research questions 1,2, 6 and 7. To capture and associate network data with health service coverage data regarding ANC, delivery, PNC and newborn health service coverage will be asked at health posts and health centres.

Following analysis of network data, semi-structured qualitative interviews will be conducted with network study participants selected to explain the variation across and within networks. Participants will be purposively selected to capture the range of network roles identified in the network analysis. The purpose of these interviews will be used to both validate and explain patterns in the quantitative network analysis and answer research questions 3, 4, 5 and 7.

PHCU Selection Criteria

PHCUs selected for the CBNC implementation zones for Phase I will form the pool of PHCUs from which to sample for this study. Two PHCUs per region implementing CBNC will be selected. Data on coverage of key maternal and newborn health services (if available) will be used as well as a metric

akin to "distance from the zonal hospital" to select a diverse sample of PHCUs, as PHCUs closer to hospitals may be atypical in their professional communication networks and health service coverage.

Study participants

All healthcare workers (HCWs) and Health Extension Workers (HEWs) within the selected PHCUs are potential participants. Data available to IDEAS from a baseline survey of CBNC were used to estimate the average number of HCWS per PHCU (see table 6); the estimated 168 study subjects across the 8 PHCUs is derived from that average.

Table 2: Average Number of Healthcare Workers per PHCU

Region	Average number of Healthcare workers at a health centre (one health centre per PHCU)	Average number of health posts within a PHCU	Average total number of Health Extension Workers per PHCU (across all Health Posts)	Average total number of Health care workers per PHCU
Amhara	11	5	10	21
Oromia	11	6	12	23
SNNP	11	6	11	22
Tigray	11	4	7	18
Average across all Four Regions	11	5	10	21

Data collection tools

Network Analysis survey tool

Three tools have been developed—one to capture the roster of HCWs within the PHCU, one to capture network data and one to capture health service coverage data. The network data collection tool focuses on advice seeking and giving among those listed on the PHCU roster. It is a hybrid model and includes a follow up question for advice seeking/giving exchanges with individuals not included in the roster. The advantage of this approach is that it captures interactions that should happen more regularly than if the tool were limited to a vignette crafted around a specific condition. Therefore capturing frequency is potentially more meaningful. It utilizes a roster, but is not limited by it.

Attributes to be collected include: name, age, gender, cadre, years of experience, years of experience at facility, region, PHCU, facility, timing of CBNC training or orientation.

The tool capturing health service coverage data will capture indicators related to each of the four areas of service covering the continuum of care from ANC through newborn care. Separate versions for health posts and health centres have been developed to accommodate referred cases and received referrals if the distinction is known.

Careful pilot testing of the interview guide and of the feasibility of capturing health service coverage data within the PHCU is planned.

Qualitative Data Collection Tool

A semi-structured qualitative interview guide will be developed following the analysis of network data. This will evolve over time as the additional understanding is gained and new questions emerge. The interview guide will be tailored to the cadre or network position of individual interviewed.

Data collection procedures

Data collection tools will undergo pre-testing. Subsequently a field procedures guide will be developed to train data enumerators for the pilot. Data collection will begin immediately following the pilot, with two teams. The teams will have a slightly staggered start to allow Kate Sabot, the study coordinator, to supervise and support initial data collection efforts.

Quantitative data

Data will be collected through structured interviews using paper-based questionnaires. Data enumerators will be trained and managed in conjunction with JaRco Consulting.

Questionnaires will be translated into relevant local languages, back-translated into English, and field-tested prior to data collection.

Data enumerators will travel to the selected PHCUs and request a current roster of health care workers. Each PHCU will have a unique roster for use in administering the survey tool. All health care workers at the health centres will be interviewed. Subsequently all HEWs at each of the health posts within the PHCU will be interviewed. The sepsis management tool will be administered once per health facility. Repeat visits during the period of time within the PHCU to capture data from absent staff will take place as needed.

Dates will be recorded using the Ethiopian calendar and converted to the Gregorian calendar after data collection.

Qualitative data

Interviews will be conducted and recorded by the study coordinator, working through an interpreter. During each interview detailed field notes will be taken, immediately after which expanded field notes will be written in Microsoft Word. Sampling will be purposive and depend on the SNA findings to be explored. Respondents will be selected to represent the range of network roles. Data quality will be carefully checked by the study coordinator through an inquiry audit, with additional interviews will be conducted as appropriate.

Analytical Plan

Data management and analysis

Quality control measures

Data quality is important to all research endeavours; however, certain data quality issues are a particular problem for SNA studies. Missing data reflect not only the nodes directly in question, but the broader network as well. If there is a systematic bias underlying the missing data, this is even more difficult, if not impossible to address. Since these data quality issues are easier to prevent rather than control for after the fact, the study aims to be prospective in its approach to data quality.

It is not always standard practice to recollect a sample of the data given that networks evolve, therefore discrepancies between collected and recollected network data are to be expected. Rather, the focus is typically on applying best practices for data collection and management and having a sufficiently large sample size to observe consistent patterns. One of the means of determining consistency is looking at the reciprocation of ties (for example, if Person A says they give Person B advice, checking to see that Person B says they seek advice from Person A).[13] On a daily basis supervisors will review data collected. Approximately 10% of the data will be recollected by these supervisors, as we do not anticipate professional advice networks to change within a few days. However as these networks are based on healthcare provider recall we would expect some minor variation and not 100% alignment. For the first PHCUs surveyed the study teams will be accompanied by the study coordinator, who will do an unannounced spot check at some point during data collection. Validity, relating to whether the study is measuring what it intends to, can be maximised by carefully selecting and testing the question used to generate the network.[13] Pilot testing tools is particularly important and this study is pre-testing more than one data collection tool to address this concern.

Quality control measures will focus on best practices for pre-testing and piloting data collection tools, ensuring complete data sets, data entry and data management practices. To reduce data entry errors, double entry will take place with the two versions compared and any differences resolved with reference to the original forms. Data entry forms will have range checks and consistency checks.

Lincoln & Guba's criterion of qualitative data quality guided development of quality control measures.[60] Table 7 describes these criterion and efforts in place.[61]

Table 3: Qualitative Data Quality Control Measures [61, 62]

Quality Criterion	Techniques
Credibility Confidence in 'truth' of findings	Triangulation—with quantitative methods & respondents from different PHCUs Negative case analysis Peer debriefing sessions with IDEAS team
Transferability Applicability in other contexts	Thick description of context
Dependability Consistency/repeatability of finding	Inquiry audit—external researcher review process and product after preliminary findings; assess need for additional data collection
Confirmability Degree of neutrality	Inquiry audit Triangulation Maintain reflective diary Recognizing limitations to methodology

Data entry

All paper questionnaires will be transported to Addis Ababa for data entry. Each network data questionnaire will be entered twice and discrepancies reviewed. All coverage tools administered within a PHCU will be double entered into a single database per PHCU and discrepancies reviewed.

Each PHCU will have their own four valued adjacency matrices, an attribute table which will include health service coverage data. Data will be imported and analysed using UCINET software.[63]

For qualitative data, only expanded notes will be entered and analyzed. Recordings will be consulted only as needed for direct quotes.

Data Analysis

Network Visualization

UCINET's NetDraw will be used to conduct preliminary explorations by visualizing the raw adjacency matrix data for each of the 8 PHCUs. Subsequently attribute data will be imported to overlay select variables onto digraphs. After additional analyses are conducted in UCINET, metrics will be visualized in NetDraw in varying combinations to assist in identifying and characterizing patterns.

Basic Network Analyses

At a minimum, the following basic network descriptive metrics will be calculated for each PHCU network separately:

- Centrality (degree, closeness, betweenness)
- Density
- Distance
- Reachability
- Network size (number of nodes)
- Isolates

Where appropriate these metrics will be calculated at the whole network level, subgroup and actor level. Specific subgroup and position/role based analyses will be considered after review of the data.

Qualitative Analysis

Qualitative data will be analyzed for a combination of a priori and emerging themes. Axial coding, the systematic creation of categories and relating categories to their subcategories through the process described below will assist in understanding the context around advice seeking:

- Laying out the properties of a category and their dimensions, beginning with open coding
- Identifying the variety of conditions, actions/interactions and consequences associated with a phenomenon
- Relating a category to its subcategories
- Looking for how major categories relate to each other.[64]

The codes and memos will be developed and applied to the data using NVivo software. Through this process a deeper understanding of the network data, as well as the context for when and who a community based health care worker approaches to for advice and when and who comes to them for advice will be achieved.

Coordination and Staffing

JaRco Consulting PLC[2], working in partnership with the IDEAS[3] team from London School of Hygiene & Tropical Medicine will conduct this study.

IDEAS Country Coordinator for Ethiopia, Dr. Della Berhanu, is referred to throughout this document as the study manager. Kate Sabot, who is the lead researcher on this study, is referred to as the study coordinator. They will jointly be responsible for the overall study management. Dr. Berhanu, as the IDEAS primary contact person for any communication with the FMoH will continue in that role for this study. Mr. Tsegahun Tessema, JaRco's Director, will work closely with the study team and provide logistical oversight and technical support as needed. He will also be responsible for ensuring that JaRco's assigned tasks are achieved in accordance with the approved work plan. Joanna Schellenberg, Professor in Epidemiology and International Health at the London School of Health and Tropical Medicine, is overall Principal Investigator for this project. Please see the attached CVs in Appendix for details related to qualifications and experience of staff who will be involved in this assignment.

Network Analysis Technical Lead
Kate Sabot, the IDEAS Research Fellow and network analysis technical lead will lead the training, pre-testing, field operations and day to day management of the study. The quantitative analysis, qualitative interviews and qualitative analysis will be conducted by Kate Sabot under the guidance of an advisory committee comprised of Drs. Joanna Schellenberg, Neil Spicer, Elizabeth Allen, Della Berhanu and Karl Blanchet.

Data Enumerator
Four data enumerators will be identified by JaRco. One of the considerations for selection will be fluency in at least two of the study languages: Amharic, Oromiffa and Tigrigna. They will be responsible for the collection of quantitative network data and sepsis management data within the 8 PHCUs. They will be divided into two teams, each with one supervisor.

Supervisors
Two supervisors will be identified by JaRco. One of the considerations for selection will be fluency in English and at least two of the study languages: Amharic, Ofomiffa and Tigrigna. Each supervisor will oversee the network data collected within four PHCUs over the course of a month. They will be responsible for ensuring that the data enumerators are following the procedures set forth in the field guide. In particular they will ensure enumerators use the same, standardized roster for each PHCU. At the end of each day they will review the data collected by each data enumerator for completeness.

---

[2] JaRco Consulting PLC is a registered and licensed consulting firm based in Ethiopia and specializes in providing technical support to government, NGOs and donor agencies in areas of social and development studies and research works in Ethiopia and in other African countries. JaRco is working in partnership with the London School of Hygiene and Tropical Medicine on the IDEAS (Informed Decisions for Actions to improve maternal and newborn health) project.

[3] IDEAS (Informed Decisions for Actions) aims to improve the health and survival of mothers and babies through generating evidence to inform policy and practice. Working in Ethiopia, North-Eastern Nigeria and in India, IDEAS uses measurement and evaluation to find out what works, why and how in maternal and newborn health programmes. The project is led by Dr Joanna Schellenberg and is funded between 2010 and 2016 by a grant from the Bill & Melinda Gates Foundation to the London School of Hygiene & Tropical Medicine.

They will recollect approximately 10% of the data (likely two interviews) to check for major discrepancies.

Translators

Translators will be used to facilitate the SNA lead's qualitative interviews. More than one may be required given the need for translation from Amharic, Oromiffa and Tigrigna into English and vice versa.

Training and Orientation

A three-day training will take place in Addis immediately preceding data collection. Data enumerators and supervisors will take part. The training sessions will cover the following key topics:

- Study objectives
- Organization of the study teams and division of responsibilities
- Managing study logistics
- Standardization of clarifications
- Ethical handling of data
- Lines of communication within JaRco Core Team, IDEAS and other partners during fieldwork
- Pre-test of the data collection tools

The training will involve a practical for the data enumerators and supervisors, where the data collection tools will be pre-tested. Following the training, Study team 1 will immediately proceed to the field with Kate Sabot as an additional level of supervision. Study team 2 will proceed to the field a few days later and Kate Sabot will join them for their first few days to ensure consistency across the teams.

Prior to the qualitative interviews, Kate Sabot will orient the translators to the study objectives and discuss the topic guide and specific questions to be asked of each potential participant.

Ethical Considerations

Ethical Clearance & considerations

Ethical clearance will be sought from the Institutional Review Boards of LSHTM, the Ethiopian Science and Technology Ministry and Oromia, Amhara, SNNP and Tigray Regional Health Bureaus.

Written informed consent will be sought for each study participant. Every effort will be made to anonymize the data through use of ID numbers, and not identifying the PHCUs beyond their regional affiliations in any public forum. However, it is still theoretically possible that individual health care workers could be identified based on their attributes and network data. It is believe that professional advice networks will not be a particularly sensitive topic relative to other public health subjects that have applied SNA methods in the past (for example, sexual networks). We will make every effort to protect the confidentiality of study subjects.

No patient names will be captured through the health service coverage data tool, so there will be no need to anonymize those data as they will only be reported in aggregate based on their outcomes per PHCU.

Risks / benefits to subjects

Risks to study participants for involvement in this study are minimal. Participants will also be informed of their right to refuse answering any questions with which they are uncomfortable. Respondents will not gain any direct benefits by participating in the study. However, information obtained will be used to improve health service delivery.

Costs and compensation

Respondents will not receive monetary compensation and they will not incur any out-of-pocket costs.

Confidentiality assurances

PHCUs will be assigned a unique numeric code. During data collection, all study subjects will be assigned unique numeric codes linked to their PHCU. A code book will be used to maintain confidentiality. During data entry the code book will be expanded to accommodate individuals named by study subjects who were not originally included in the network and therefore do not already have a unique code. These same unique codes will be used in place of names when typing expanded field notes in word for the qualitative data. Paper questionnaires and signed informed consents will be maintained at in secure, locked location at JaRco for a period of 5 years.

The raw data (reconciled data entry files for quantitative SNA data, recordings, Word documents with expanded field notes for qualitative data) and the code book will be stored in an encrypted location.

Backups for the raw electronic data files and electronic code book will be stored on a secure server at LSHTM accessible only to IDEAS staff. Further backups will be kept on an external hard drive kept in a locked fire-proof cabinet.

Only fully anonymized data will be imported into UCINET or NVivo software, analyzed and reported. As per Bill & Melinda Gates Foundation data access policies cleaned, fully anonymized, aggregate quantitative data sets will be made publicly available.

Conflict of interest

There are no other gains from taking part in this study other than the normal scholarly gains.

Dissemination

Dissemination of Findings

Results will be shared with a range of stakeholders within Ethiopia including government partners and national level stakeholders. The exact mechanism will be tailored to the specific audience and timed to coincide with other dissemination events or planned meetings. At the international level dissemination will primarily occur through publications and presentations at conferences.

Study Limitations

This study relies upon recall of study respondents which can be distorted by study participants either attempting to present themselves in a better light or by study participants misinterpreting the question or the response categories.[65] While the qualitative interviews are expected to overcome some of the inherent limitations with the survey method, they introduce their own limitations as fewer individuals will be included and recall bias will still be a potential issue.

A more fundamental limitation of the study is that professional advice networks are likely only one of many— albeit proposed here, important—contextual factor that influences health care worker professional practice. It may be possible that we will not find substantive differences between the networks or any relationship with health service coverage.

Appendices

Literature Review

The literature presented below includes background on social network analysis (SNA) and SNA studies in health. Comprehensive overviews of SNA methods already exist,[9, 10] this review focuses on what is most relevant to the study. In particular, the review focuses on what is known about the association between SNA metrics and other network properties and health outcomes.

Social Network Analysis

"Social network analysis (SNA) offers a means of mapping and exposing the hidden channels of communication and information flow, collaboration and disconnects between people."[11] "It is a structuralist paradigm: it conceptualizes social life in terms of structures of relationships among actors, rather than in terms of categories of actors…as a paradigm it is composed of a theory or theories, a methodology or set of commonly employed methods, and a body of empirical research."[12]

Social Network Analysis Theoretical Frameworks

There are six core theoretical frameworks that have been developed or applied to guide SNA studies: social capital, network exchange/social exchange, biased net theory, social influences, social selection network theory and diffusion of innovations.[13]

There are varying theoretical foundations for understanding the roots of professional advice seeking and giving within organizations. According to Agneessens, the social exchange framework has two slightly competing theories- social status and social capital. Social status argues that advice giving generates prestige and advice asking decreases standing, whereas with social capital advice is seen as a currency with giving generating a future obligation and seeking incurring a debt. These theories have network implications as you would expect non-reciprocal dyads and non-cyclical triadic structures if social status is the motivation and you would expect more reciprocity if social capital is the foundation of advice networks.[14] Alternatively social influences theory can be applied to understand and hypothesize around professional advice communication. Social influences theory looks at how actors influence each others' thought processes and behaviours. While each of these theories offer compelling rationales for advice seeking and giving, within the context of professional advice seeking and giving among PHCU health care workers I suspect motivations for such communication are more nuanced and reflect a combination of these motivations depending on the

individuals involved and the specific exchange. This study will seek to explore that further and push these theories in their application to this context.

What is a social network?

A social network is a set of socially relevant nodes, representing either individuals or organizations, connected by one or more relations.[15] The lines between the nodes are referred to as either ties or relations and reflect the relationship of interest.

In SNA, it is the patterns in the relations between actors that are of interest; this is distinct from much public health research which looks at the relationship between variables and outcomes of interest. Thus SNA requires analytical tools that do not rely on independence of observations, or relations.[16]

Social Network Analysis Metrics

Below are standard SNA metrics typically calculated in SNA health systems research studies.[17] Some of these can be calculated at the sub group or actor level, noted in the table below.

Table 4: Network Metrics for Health Systems Research

SNA Metric	Level	Definition	Comments on Use
Density	Network/ subgroup	Existing ties divided by the number of possible ties	Assesses cohesion in combination with other metrics. Sensitive to variations in network size.
Centrality	Actor/Network	*Degree centrality:* Number of immediate contacts a node has in a network; eigenvector centrality (expands and weights according to alter's centrality); in-degree and out-degree centrality relate to the direction of the nominations.[13]	Central actors and centralized networks can quickly interact with all members.[18] Network measure useful for identifying core-periphery structures.[13] Not useful for comparing networks unless identical in size.
	Actor	*Betweeness Centrality:* Captures frequency of a node being located between other nodes	Measures potential control an actor has over network information flow. Calculated on binary (unvalued) data.[13]
Distance	Actor	Number of ties between two actors. Directly connected nodes have a distance of one	Captures efficiency of transmission of information through network[13]
	Network		

		Various indexes created from actor-closeness ex: Freeman's[18] Closeness Centrality: Average distance actors are from all other actors[19]	Important to calculate variance
Reachability	Network	Number of steps maximally needed to reach from one node to any other node in the network	Captures fragmentation/cohesion.

A number of definitions and algorithms have been developed to explore and quantify the presence of subgroup structures. Common subgroup structures include: dyads, triads, clusters, cliques, components and bridges. [20] Individual actor's positions within the network can be analysed to identify presence of brokers (gatekeepers), core-periphery location and isolates.

Gesell, et al recommends calculating the following actor level metrics: isolates, degree and reciprocity and these network level metrics: sub-groups, density, centralization, transivity and cohesion as the metrics most likely to have immediate effects on individual and group processes.[21]

Social Network Properties and Professional Advice Network
Studies that go beyond describing professional advice networks and seek to associate network metrics with outcomes are limited. Those studies that do so within the health sector form an even smaller subset and most look at associations with adoption of best practices rather than linking to health outcomes. There is a growing body of literature around network interventions for health, asserting that certain network configurations yield improved outcomes.[21, 22] Much of that literature focuses on patient networks and behaviour change. Below is a summary the link between these SNA metrics and outcomes—and where available—focusing on health and/or advice network applications.

Density Dense networks provide more pathways for communication than sparse ones, which facilitates information exchange and decision making.[19] Network density in its extreme can be a liability because it can reinforce insularity and impede connections to external information.[19] A SNA of a substance abuse community coalition found lower network density associated with the adoption of evidence based practices, further supporting that higher network density will not necessarily yield desired results.[23] A network diagnostic tool proposes that ideal network density should be between 0.15 -0.50.[21] A network intervention within community groups aiming to prevent childhood obesity among their members using the diagnostic tool found density of advice and discussion networks increased from one time point to another, which was described as a positive effect, although there was no explicit link between network properties and health outcomes.[21]

Centrality Shaw's 1970s studies showed that more centralized networks complete tasks more efficiently, however since then debates continue regarding centralization and network outcomes.[19] Rogers asserts that organizational innovativeness is inversely associated with centrality. Fujimoto

studied health coalition networks and found centralization positively associated with adoption of evidence based practices.[24]

In-degree centrality, the mostly frequently used actor level network measure of opinion leadership, has been associated with adoption.[19, 25, 26] Rogers' found opinion leaders were more likely to be earlier adopters than non-opinion leaders.[27] Several studies found physician opinion leaders effective tools for speeding up network adoption of guidelines.[28-30]

However, Fattore, *et al* found no relationship between an Italian doctor's degree centrality and outcomes.[31] In spite of previous literature indicating more central actors have information advantages that positively influence individual outcomes.[32-35]

Distance/Reachability Average path length (APL), a slightly different metric than reachability or distance, is the average of the distances between all nodes in a network. A low APL indicates cohesion within the network, with little clustering. Clustering can accelerate intragroup spread (of diseases, behaviours, information), but inhibit intergroup spread.[19] Mascia, *et al*. found that cohesion may hamper self-reported physician adoption of evidence based medicine in Italian doctors.[36]

Network size Rogers reports that organizational size is highly correlated with innovativeness.[27] A larger network may provide more opportunities for the introduction of new ideas, however it is inversely related to density, which may impede communication throughout the network.

Core-periphery This structure involves a group of densely connected nodes, the core and a group of less densely connected nodes, the periphery.   The degree to which the data exhibit this structure is determined by fitting a core-periphery model to the data.[19] Gainforth, *et al.* found a core-periphery structure among staff at a community based organization serving spinal cord injury patients, with membership to the core associated with knowledge of guidelines.[26]

Brokerage/Tie Strength Weak ties are important for diffusing new information and strong ties reinforce adoption, therefore both have roles in information sharing. [27, 37-39] Explicit knowledge is best shared through networks with high levels of brokerage and hierarchy, while tacit knowledge is best shared through highly dense networks. [37, 40] A recent systematic review of brokerage in collaborative networks found few examples in healthcare contexts, however did conclude that brokers who can span a structural hole and bring information to otherwise isolated clusters would be valuable in collaborative healthcare contexts with divides across cadres and sites. [41] That said, brokers across structural holes are a less efficient route to information sharing than densely connected networks.[27, 41] A systematic review identified 13 studies looking at structural holes in health care networks, only one of which linked structural holes to improved outcomes.[42, 43] However most studies do not link to outcomes, for example: Creswick used betweenness centrality to identify strategic individuals who can act as brokers in a descriptive study of medical advice seeking among healthcare workers in a renal ward of an Australian teaching hospital, however there was no link to health outcomes.[44]

Homophily Information flows more readily between individuals of similar background and networks are prone to homophily.[45, 46] Zheng, *et al* found the importance of homophily and friendship networks in physician adoption of electronic health records systems. [47] However novel information typically originates from those outside your immediate network who are more likely to be different

from you and have different knowledge.[27] A recent study of health policy networks in Burkina Faso surprisingly found homophily not to be a factor relevant for evidence sharing.[48]

While much research has been done to identify network properties, roles and information flow, the evidence base for specific network properties association with health outcomes is weak. This body of work aims to explore the literature futher and conduct a study that will contribute towards addressing that gap.

Social Network Analysis in Health

There is a long standing history of social network analysis in health,[17] with some of the seminal articles being health related. Coleman, Katz and Menzel looked at the adoption of tetracycline by US physicians.[49] Yet some suggest that social network analysis has not fully realized its potential in health, particularly in applications outside of traditional hospital settings, among community based healthcare workers, in health systems research and in low and middle income contexts.[11]

A review of SNA history, methods and applications to health in 2007 found that much of the work to date focused on spread of disease, diffusion of ideas, impact of social networks on individual health behaviour and inter-organizational structure of health systems.[50] Luke & Harris grouped use of network analysis in public health into three categories: transmission networks, social networks and organizational networks. Transmission networks could be further broken down into disease and information transmission networks with disease transmission focusing on STDs, STIs and outbreak applications. SNA studies were further subdivided into those studying network associations with individual health behaviours, and the roles of social support and social capital in health outcomes. These findings are supported by literature reviewed in preparing this protocol. Health SNA studies have looked at peer groups to influence health behaviours such as smoking[51] [21], drug use,[52] mammography uptake[53], family planning uptake[54] and mental health service uptake. Luke & Harris noted in their recommendations for future research that outside of diffusion of innovations, we know little about how social networks shape professional communication among health professionals.[50] We do know from a systematic review focusing on health professional networks and quality and safety that cliques, professional and gender homophily and over-reliance on central agencies or individuals to be counterproductive.[46] See above for more information regarding SNA metrics and health professional advice networks.

Research on health care worker advice networks has mostly been descriptive. [55] [44, 56, 57] Van Beek looked at the association of advice networks with HCW job satisfaction. [58] Rangachari looked at communication networks of low performing ICUs, but in the absence of comparing to higher performing ICU it is not possible to connect outcomes to SNA networks. [40] Meltzer used hypotheses about network metrics to develop hypothetically superior quality improvement teams based on network principles, but in the absence of testing these teams there is no explicit link to health outcomes.[59]   Shearer looked at 3 health policy networks in Burkina Faso and assessed network properties and their use of evidence, they found hierarchical information flow, evidence use positively associated with actor centrality and surprisingly, a lack of homophily .[48]

In sum, the link between health care worker professional network metrics and health outcome is an area for additional research particularly in low income, African, community based and primary health care settings.

Timeline for Study

Data collection will be coordinated with the existing IDEAS data collection plans. These activities are expected to primarily take place in 2015, with data collection completed by Q1 2016 and dissemination events from Q2-Q4.
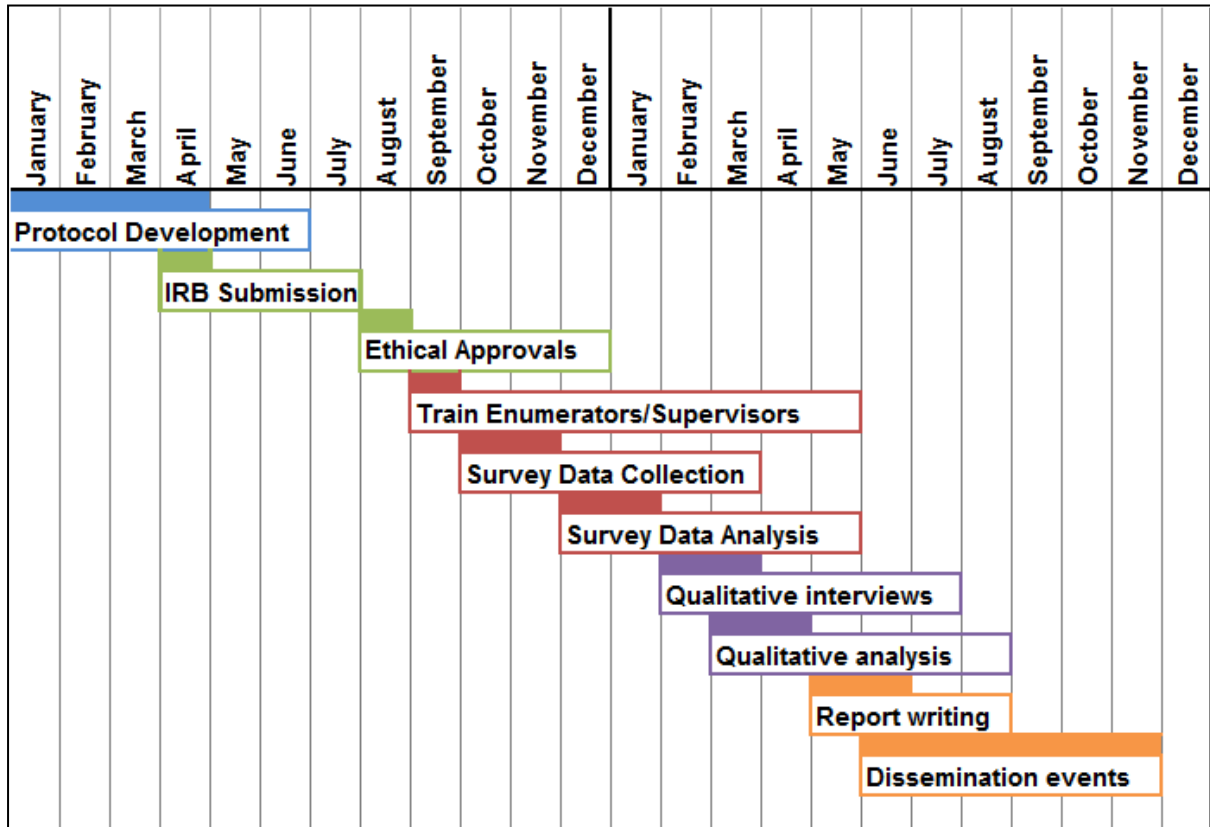
Data Collection Tools: Roster Generator

PHCU Roster Generator Tool

Enumerator Name _____   Date _____

Region   _____   Health Post Names   _____
Zone   _____   _____
Woreda   _____   _____
Health Center: _____   _____
Health posts: _____   _____
When did CBNC training happen?   _____
Have there been any mentorship programs in the last year?   _____
Describe: _____
                                                             _____
                                                             _____

Code	Name of Health Care Worker	Health Facility	Cadre
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			

Data Collection Tools: Network Data

Enumerator Name:	Date:	Start time:	End time:

Attributes		
Name	**Cadre**	**Region**
Age	**Total Years of experience**	**PHCU Code**
Gender	**Years at this health facility**	**Health Facility**
Ask HEW only: **Have you received training on CBNC?**	**Yes/ No**	**If yes, Date CBNC training conducted (mm/yy)**

Antenatal Care Advice Network Question			Frequency				

In the last year, who on this list came to you for advice on providing antenatal care?
Show them the roster
How frequently did they come to you for advice on providing antenatal care?

Roster Number	No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5

Is there anyone not on this list who came to you for advice on providing antenatal care in the last year?
What is their name, occupation and where do they work?
How frequently did they come to you for advice on providing antenatal care?

Name	Occupation	Place of work/ Community	No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5

Antenatal Care Advice Network Question		Frequency					
In the last year, who on this list did you go to for advice on providing antenatal care?		No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
Show them the roster							
How frequently did you go to them for such advice?							
Roster Number							
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5

Is there anyone not on this list who you went to for advice on providing antenatal care in the last year?

What is their name, occupation and where do they work?

How frequently did you go to them for advice on providing antenatal care?

Name	Occupation	Place of work/ Community	No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5

Delivery Care Advice Network Question		Frequency					
In the last year, who on this list came to you for advice on providing delivery care?		No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
Show them the roster							
How frequently did they come to you for advice on providing delivery care?							
Roster Number							
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5
_____		0	1	2	3	4	5

Is there anyone not on this list who came to you for advice on providing delivery care in the last year?

What is their name, occupation and where do they work?

How frequently did they come to you for advice on providing delivery care?

Name	Occupation	Place of work/ Community	No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5

Delivery Care Advice Network Question				Frequency			
In the last year, who on this list did you go to for advice on providing delivery care?		No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
Show them the roster							
How frequently did you go to them for such advice?							
	Roster Number						
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5

Is there anyone not on this list who you went to for advice on providing delivery care in the last year?

What is their name, occupation and where do they work?

How frequently did you go to them for advice on providing delivery care?

Name	Occupation	Place of work/ Community	No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5

Postnatal Care Advice Network Question				Frequency			
In the last year, who on this list came to you for advice on providing postnatal care?		No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
Show them the roster							
How frequently did they come to you for advice on providing postnatal care?							
	Roster Number						
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5
	_____	0	1	2	3	4	5

Is there anyone not on this list who came to you for advice on providing postnatal care in the last year?

What is their name, occupation and where do they work?

How frequently did they come to you for advice on providing postnatal care?

Name	Occupation	Place of work/ Community	No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5

Postnatal Care Advice Network Question

	Frequency					

In the last year, who on this list have you gone to you for advice on providing postnatal care?
Show them the roster

How frequently have you gone to them for such advice?

Roster Number	No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5

Is there anyone not on this list who you went to for advice on providing postnatal care in the last year?

What is their name, occupation and where do they work?

How frequently did you go to them for advice on providing postnatal care?

Name	Occupation	Place of work/ Community	No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5

Newborn Care Advice Network Question

	Frequency					

In the last year, who on this list came to you for advice on providing newborn care?
Show them the roster

How frequently did they come to you for advice on providing newborn care?

Roster Number	No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5

Is there anyone not on this list who came to you for advice on providing newborn care in the last year?

What is their name, occupation and where do they work?

How frequently did they come to you for advice on providing newborn care?

Name	Occupation	Place of work/ Community	No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5

Newborn Care Advice Network Question			No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
In the last year, who on this list did you go to for advice on providing newborn care?							Frequency	
Show them the roster								
How frequently did you go to them for such advice?								
	Roster Number							
	_____		0	1	2	3	4	5
	_____		0	1	2	3	4	5
	_____		0	1	2	3	4	5
	_____		0	1	2	3	4	5
	_____		0	1	2	3	4	5
	_____		0	1	2	3	4	5
	_____		0	1	2	3	4	5
	_____		0	1	2	3	4	5
	_____		0	1	2	3	4	5
	_____		0	1	2	3	4	5

Is there anyone not on this list who you went to for advice on providing newborn care in the last year?

What is their name, occupation and where do they work?

How frequently did you go to them for advice on providing newborn care?

Name	Occupation	Place of work/ Community	No Contact	Semi-annually	Quarterly	Monthly	Weekly	Daily
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5
_____	_____	_____	0	1	2	3	4	5

Data Collection Tools: Health Service Coverage at Health Posts

Enumerator Name: _____   Date: _____

PHCU Code: _____

Facility Code: _____

Antenatal Care

	Total
How many mothers attended their first Antenatal care visit in the past 3 months?	
How many mothers attended their third Antenatal care visit in the past 3 months?	

Delivery care

	Total
How many mothers delivered at the health post in the past 3 months?	

Postnatal Care

	Total
How many mothers had a postnatal care visit in the past 3 months?	
How many mothers were diagnosed with sepsis in the past year?	
How many did you refer to another facility?	
Of those referred, how many do you know received no treatment?	
Of those referred, how many do you know received partial treatment	
Of those referred, how many do you know finished treatment?	
Of those referred, how many do you not know if they received any treatment?	
How many did you treat either at their homes or at the Health Post?	
Of those not referred, how many do you know received no treatment?	
Of those not referred, how many do you know received partial treatment	
Of those not referred, how many do you know finished treatment?	
Of those not referred, how many do you not know if they received any treatment?	

Newborn Care

	Total
How many newborns did you diagnosis with sepsis in the past year?	
How many did you refer to another facility?	
Of those referred, how many do you know received no treatment?	
Of those referred, how many do you know received partial treatment	
Of those referred, how many do you know finished treatment?	
Of those referred, how many do you not know if they received any treatment?	
How many did you treat either at their homes or at the Health Post?	
Of those not referred, how many do you know received no treatment?	
Of those not referred, how many do you know received partial treatment	
Of those not referred, how many do you know finished treatment?	
Of those not referred, how many do you not know if they received any treatment?	

Data Collection Tools: Health Service Coverage at Health Centres

Enumerator Name: _____   Date: _____

PHCU Code: _____

Facility Code: _____

Antenatal Care	Total
How many mothers attended their first Antenatal care visit in the past 3 months?	
How many mothers attended their third Antenatal care visit in the past 3 months?	

Delivery care	Total
How many mothers delivered at the health center in the past 3 months?	

Postnatal Care	Total
How many mothers had a postnatal care visit in the past 3 months?	
How many mothers were diagnosed with sepsis in the past year?	
How many did you refer to another facility?	
Of those referred, how many do you know received no treatment?	
Of those referred, how many do you know received partial treatment	
Of those referred, how many do you know finished treatment?	
Of those referred, how many do you not know if they received any treatment?	
How many did you treat at the Health Center?	
Of those not referred, how many do you know received no treatment?	
Of those not referred, how many do you know received partial treatment	
Of those not referred, how many do you know finished treatment?	
Of those not referred, how many do you not know if they received any treatment?	
How many were referred from the Health Post and treated at the Health Center?	
Of these, how many do you know received no treatment?	
Of these, how many do you know received partial treatment	
Of these, how many do you know finished treatment?	
Of these, how many do you not know if they received any treatment?	

Newborn Care	Total
How many newborns did you diagnosis with sepsis in the past year?	
How many did you refer to another facility?	
Of those referred, how many do you know received no treatment?	
Of those referred, how many do you know received partial treatment	
Of those referred, how many do you know finished treatment?	
Of those referred, how many do you not know if they received any treatment?	
How many did you treat at the Health Center?	
Of those not referred, how many do you know received no treatment?	
Of those not referred, how many do you know received partial treatment	
Of those not referred, how many do you know finished treatment?	
Of those not referred, how many do you not know if they received any treatment?	
How many were referred from the Health Post and treated at the Health Center?	
Of these, how many do you know received no treatment?	
Of these, how many do you know received partial treatment	
Of these, how many do you know finished treatment?	
Of these, how many do you not know if they received any treatment?	

Informed Consent

IDEAS Professional Advice Study
Information Sheet

What is the purpose of this interview?

You are invited to participate in a research study about healthcare worker professional advice for providing maternal and newborn care in Amhara, Oromiya, Tigray and SNNPR. This study is being conducted by the London School of Hygiene & Tropical Medicine and JaRco Consulting in Ethiopia

Why am I selected for this interview?

We would like to hear about who you go to for advice when you have questions or complicated cases. Specifically we are interested in the advice you seek about providing antenatal, delivery, postnatal and newborn care. We are also interested in who comes to you for such advice. Specifically we are interested in healthcare workers exchanging advice. For this study we are not interested in mothers who come to you for advice. All healthcare workers who provide antenatal, delivery, postnatal and newborn care in your PHCU have been selected for an interview. The interview will last approximately 45 min.

What is expected from me?

We would like to learn about your professional advice network—who you go to and who comes to you for advice on providing antenatal, delivery, postnatal and newborn care. Participating in this study may not benefit you directly, but it will help us learn about professional advice networks. You may skip any questions you don't want to answer and you may end the interview at any time. If you agree, your answers will be recorded with a tape recorder: The recording will be used to listen again to your descriptions at a later time, but will be deleted at the end of the study.

How will you use my interview answers?

Your experiences and views will be very important for the success of the study and greatly help in understanding the care of pregnant women, new mothers, and newborns in Ethiopia. We will not talk about your answers to your colleagues if they will be interviewed after you. Please ask anything which is not clear to you.

We will produce a range of reports, papers and presentations based on this work in Ethiopia.. However, all your responses will be anonymized and your name would not be used in any report.

Participation is completely voluntary: if you prefer to not take part we thank you very much for you time so far: it will not in any way affect your work.

Who can I contact if I have more questions?

For more information please contact:

Dr Della Berhanu (LSHTM):

0926783038

IDEAS Professional Advice Study

Informed Consent

Please tick all boxes that apply:

I have read the study information sheet and/or have been given a clear overview of the study	
I am happy for you to write about what I have said during our interviewon the understanding that you will not reveal my identify in any study outputs	
I am happy for the interview to be sound recorded	
I am happy for you to include quotations from this interview	
I am happy for the information collected in our interview to be transferred to London, UK	
I am willing to be interviewed	

Interviewee

Name (in BLOCK CAPITALS)

_____

Signature   Date

Researcher

Name (in BLOCK CAPITALS)

_____

Signature   Date

Definition of Network Analysis Terms

Alter/Alteri. The connection(s) of the ego.

Bridges. A connector, a point that links two components.

Cliques. A maximally connected and complete subgroup that does not contain any other clique.[66]

Components. A maximally connected subgroup—all points are linked together, although unlike cliques they may not all be adjacent, or directly linked. [66]

Dichotomous networks. Coded with only two response options: ties either exist or do not exist. The relations are not valued.

Directed network. Ties have arrowheads on either end or both ends if the ties are reciprocal.

Dyad. A subgraph formed by 2 nodes.

Ego. In ego-centred networks, the egos are the nodes whose immediate networks are captured.

Isolates. Points that have no connections at all (degree 0).[66]

Mode. Most SNA studies are limited to one mode—involving one set of actors or events—although methods exist for analyzing up to two modes.[66]

Nominate. The action of indicating the existence of a tie or relation. An actor who nominates another actor indicates they have a relationship which can be captured as either existing or directed towards the other actor.

Reciprocity. In social network analysis this refers to returned directed relations. For example if Node A nominates Node B, and Node B nominates Node A there is reciprocity.

Triads. A subgraph formed by 3 nodes.

Undirected networks. These do not specify which actor nominated the other; the tie just exists or does not exist.

Valued networks. Capture the intensity of the tie, which can refer to either the frequency of contact or some other factor expressed as either a continuous variable or by multiple, ordered measures (for example a Likert-scale).

References

1. Federal Democratic Republic of Ethiopia Ministry of Health, *Health Sector Development Plan IV*, 2011.

2. Central Statistical Authority and ICF International, *Ethiopia Demographic and Health Survey 2011*, 2012, Central Statistics Agency: Addis Ababa, Ethiopia and Calverton, Maryland, USA.

3. Federal Ministry of Health, *CBNC Implementation Guide*, 2013: Addis Ababa.

4. Mekonnen, Y., et al., *Neonatal mortality in Ethiopia: trends and determinants.* BMC public health, 2013. **13**(483).

5. Teklehaimanot, H. and A. Teklehaimanot, *Human resource development for a community-based health extension program: a case study from Ethiopia.* Human Resources for Health, 2013. **11**(1): p. 39.

6. Medhanyie, A., et al., *Knowledge and performance of the Ethiopian health extension workers on antenatal and delivery care: a cross-sectional study.* Human Resources for Health, 2012. **10**(1): p. 44.

7. Gebrehiwot, T., et al., *Health workers' perceptions of facilitators of and barriers to institutional delivery in Tigray, Northern Ethiopia.* BMC Pregnancy and Childbirth, 2014. **14**(1): p. 137.

8. Medhanyie, A., et al., *The role of health extension workers in improving utilization of maternal health services in rural areas in Ethiopia: a cross sectional study.* BMC Health Services Research, 2012. **12**(1): p. 352.

9. Borgatti, S.P., et al., *Network Analysis in the Social Sciences.* Science, 2009. **323**(5916): p. 892-895.

10. Freeman, L.C., *The Development of Social Network Analysis: A Study in the Sociology of Science*, 2004, Empirical Press: Vancouver.

11. Chambers, D., et al., *Social Network Analysis in Healthcare Settings: A Systematic Scoping Review.* PLoS One, 2012. **7**(8).

12. Scott, J. and P.J. Carrington, eds. *The SAGE Handbook of Social Network Analysis*. 2011, SAGE: London. 622.

13. Prell, C., *Social Network Analysis: History, theory & methodology*. 2012, London: SAGE Publications, Ltd.

14. Agneessens, F. and R. Wittek, *Where do intra-organizational advice relations come from? The role of informal status and social capital in social exchange.* Social Networks, 2012. **34**(3): p. 333-345.

15. Marin, A. and B. Wellman, *Social Network Analysis: An Introduction*, in *The SAGE Handbook of Social Network Analysis*, J. Scott and P.J. Carrington, Editors. 2011, SAGE: London. p. 622.

16. Hennig, M., et al., *Studying Social Networks: A Guide to Empirical Research*. 2012, Frankfurt: Campus Verlag.

17. Blanchet, K. and P. James, *How to do (or not to do) ... a social network analysis in health systems research.* Health policy and planning, 2012. **27**(5): p. 438-46.

18. Wasserman, S. and K. Faust, *Social Network Analysis Methods and Applications*. Structural Analysis in the Social Sciences, ed. M. Granovetter. 2009, Cambridge: Cambridge University Press.

19. Valente, T.W., *Social networks and health: models, methods and applications*. 2010, New York: Oxford University Press.

20. Hanneman, R.A. and M. Riddle, *Concepts and Measures for Basic Network Analyis*, in *The SAGE handbook of Social Network Analysis*, J. Scott and P.J. Carrington, Editors. 2011, SAGE: London. p. 340-369.

21. Gesell, S.B., S.L. Barkin, and T.W. Valente, *Social network diagnostics: a tool for monitoring group interventions.* Implementation Science, 2013. **8**.

22. Valente, T.W., *Network Interventions.* Science, 2012. **337**(6090): p. 49-53.

23. Valente, T.W., C.P. Chou, and M.A. Pentz, *Community Coalitions as a System: Effects of Network Change on Adoption of Evidence-Based Substance Abuse Prevention.* American Journal of Public Health, 2007. **97**(5): p. 880-6.

24. Fujimoto, K., T.W. Valente, and M.A. Pentz, *Network structural influences on the adoption of evidence-based prevention in communities.* Journal of Community Psychology, 2009. **37**(7): p. 830-845.

25. Rogers, E.M. and D.L. Kincaid, *Communication networks: Toward a new paradigm for research.* 1981.

26. Gainforth, H., et al., *The role of interpersonal communication in the process of knowledge mobilization within a community-based organization: a network analysis.* Implementation Science, 2014. **9**(1): p. 59.

27. Rogers, E., *Diffusion of Innovations*. 5th ed. 2003, New York, NY: Free Press.

28. Lomas J, E.M., Anderson GM, Hannah WJ, Vayda E, Singer J, *Opinion leaders vs audit and feedback to implement practice guidelines Delivery after previous cesarean section.* JAMA, 1991. **265**: p. 2202-7.

29. Gifford, D.R. and R.G. Holloway, *Improving adherence to dementia guidelines through education and opinion leaders.* Annals of Internal Medicine, 1999. **131**(4): p. 237.

30. Soumerai, S.B., et al., *Effect of local medical opinion leaders on quality of care for acute myocardial infarction: a randomized controlled trial.* JAMA, 1998. **279**: p. 1358-63.

31. Fattore, G., et al., *Social network analysis in primary care: the impact of interactions on prescribing behaviour.* Health policy (Amsterdam, Netherlands), 2009. **92**(2-3): p. 141-8.

32. Sparrowe, R.T., et al., *SOCIAL NETWORKS AND THE PERFORMANCE OF INDIVIDUALS AND GROUPS.* Academy of Management Journal, 2001. **44**(2): p. 316-325.

33. Tsai, W., *KNOWLEDGE TRANSFER IN INTRAORGANIZATIONAL NETWORKS: EFFECTS OF NETWORK POSITION AND ABSORPTIVE CAPACITY ON BUSINESS UNIT INNOVATION AND PERFORMANCE.* Academy of Management Journal, 2001. **44**(5): p. 996-1004.

34. Cross, R. and J.N. Cummings, *TIE AND NETWORK CORRELATES OF INDIVIDUAL PERFORMANCE IN KNOWLEDGE-INTENSIVE WORK.* Academy of Management Journal, 2004. **47**(6): p. 928-937.

35. Mehra, A., M. Kilduff, and D.J. Brass, *The social networks of high and low self-monitors: implications for workplace performance.* Administrative Science Quarterly, 2001. **46**(1): p. 121-146.

36. Mascia, D. and A. Cicchetti, *Physician social capital and the reported adoption of evidence-based medicine: exploring the role of structural holes.* Social science & medicine (1982), 2011. **72**(5): p. 798-805.

37. Byosiere, P., et al., *Diffusion of organisational innovation: knowledge transfer through social networks.* International Journal of Technology Management, 2010. **49**(4): p. 401-420.

38. Burt, R.S., *Structural Holes and Good Ideas.* American Journal of Sociology, 2004. **110**(2): p. 349-399.

39. Granovetter, M., *The Impact of Social Structure on Economic Outcomes.* The Journal of Economic Perspectives, 2005. **19**(1): p. 33-50.

40. Rangachari, P., et al., *A baseline study of communication networks related to evidence-based infection prevention practices in an intensive care unit.* Quality management in health care, 2010. **19**(4): p. 330-48.

41. Long, J.C., F.C. Cunningham, and J. Braithwaite, *Bridges, brokers and boundary spanners in collaborative networks: a systematic review.* BMC health services research, 2013. **13**: p. 158.

42. Braithwaite, J., *Between-group behaviour in health care: gaps, edges, boundaries, disconnections, weak ties, spaces and holes. A systematic review.* BMC Health Services Research, 2010. **10**: p. 330-340.

43. Rangachari, P., *Knowledge sharing networks related to hospital quality measurement and reporting.* Health Care Management Review, 2008. **33**: p. 253-263.

44.   Creswick, N. and J.I. Westbrook, *Social network analysis of medication advice-seeking interactions among staff in an Australian hospital.* International journal of medical informatics, 2010. **79**(6): p. e116-25.

45.   McPherson, M., L. Smith-Lovin, and J.M. Cook, *Birds of a Feather: Homophily in Social Networks.* Annual Review of Sociology, 2001. **27**: p. 415-444.

46.   Cunningham, F.C., et al., *Health professional networks as a vector for improving healthcare quality and safety: a systematic review.* BMJ quality & safety, 2012. **21**(3): p. 239-49.

47.   Zheng, K., et al., *Social networks and physician adoption of electronic health records: insights from an empirical study.* Journal of the American Medical Informatics Association : JAMIA, 2010. **17**(3): p. 328-36.

48.   Shearer, J., M. Dion, and J. Lavis, *Exchanging and using research evidence in health policy networks: a statistical network analysis.* Implementation Science, 2014. **9**(1): p. 126.

49.   Coleman, J., E. Katz, and H. Menzel, *The diffusion of innovations among physicians.* Sociometry 1957. **20**(4): p. 253-70.

50.   Luke, D.A. and J.K. Harris, *Network Analysis in Public Health: History, Methods and Applications.* Annual Review of Public Health, 2007. **28**: p. 69-93.

51.   Ennett, S.T., et al., *Peer smoking, other peer attributes, and adolescent cigarette smoking: A social network analysis.* Prevention Science, 2008. **9**(2): p. 88-98.

52.   Li, J., et al., *A social network approach to demonstrate the diffusion and change process of intervention from peer health advocates to the drug using community.* Substance use & misuse, 2012. **47**(5): p. 474-90.

53.   Allen, J.D., A.M. Stoddard, and G. Sorensen, *Do social network characteristics predict mammography screening practices?* Health education & behavior : the official publication of the Society for Public Health Education, 2008. **35**(6): p. 763-76.

54.   Blackstock, O., A. Mba-Jonas, and G. Sacajiu. *Family planning knowledge: The role of primary care providers and social networks as information sources for African American women*. 2010 [cited 25 (Blackstock) Harlem Hospital Center, New York, NY, United States]; S278]. Available from:
        http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed9&NEWS=N&AN=7031 4943.

55.   Wensing, M., et al., *Connectedness of healthcare professionals involved in the treatment of patients with Parkinson's disease: a social networks study.* Implementation science 2011. **6**(67).

56.   Creswick, N. and J.I. Westbrook, *The medication advice-seeking network of staff in an Australian hospital renal ward.* Studies in health technology and informatics, 2007. **130**(217-231).

57.   Wagter, J., G. van de Bunt, and M. Honing, *Informal interprofessional learning : visualizing the clinical workplace.* Journal of Interprofessional Care, 2012. **26**: p. 173-182.

58.   van Beek, A.P.A., et al., *Communication, advice exchange and job satisfaction of nursing staff: a social network analyses of 35 long-term care units.* BMC health services research, 2011. **11**: p. 140.

59.   Meltzer, D., et al. *Exploring the use of social network methods in designing healthcare quality improvement teams*. 2010 [cited 71 (Meltzer, Chung, Khalili, Marlow, Arora, Burt) The University of Chicago, Chicago, IL, United States]; 6:[1119-1130]. Available from:
        http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed9&NEWS=N&AN=2010 439725.

60.   Lincoln, Y.S. and E.G. Guba, *Naturalistic Inquiry*. 1985, Newbury Park, CA: SAGE Publications.

61.   Shenton, A.K., *Strategies for ensuring trustworthiness in qualitative research projects.* Education for Information, 2004. **22**: p. 63-75.

62.   Cohen, D. and B. Crabtree. *Qualitative Research Guidelines Project*. 2006 [cited 2014 15 October 2014]; Available from: http://www.qualres.org/HomeLinc-3684.html.

63.   Borgatti, S., M. Everett, and L. Freeman, *UCINET for Windows: Software for Social Network Analysis.* Analytic Technologies, 2002.

64.   Straus, A. and J. Corbin, *The Basics of Qualitative Research Techniques and Procedures for Developing Grounded Theory*. 2 ed. 1998, London: SAGE Publications.

65.   Marsden, P.V., *Survey Methods for Network Data*, in *The SAGE Handbook on Social Network Analysis*, J. Scott and P.J. Carrington, Editors. 2011, SAGE: London. p. 370-388.

66.   Scott, J., *Social Network Analysis*. 2013, London: SAGE Publications.