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Master Thesis

**Designing an integrated ICT System for upgrading Conventional Maternity
Healthcare to Electronic Maternity Records with inclusion of Traditional
Birth Attendants in Ghana**

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Abstract

The rural community of Nyankpala in Ghana has two parallel maternity healthcare systems: traditional and conventional. Traditional birth attendants (TBAs) are healthcare providers in traditional system, while University for Development Studies (UDS) manages the conventional healthcare facility. At present, there is an absence of collaboration mechanism between two systems. TBAs rely on verbal methods to provide care and UDS maternity clinic follows paper records. In this research, an understanding of these healthcare systems is developed, to design and evaluate a prototype ICT4D platform for transitioning UDS maternity clinic to electronic maternity records (EMRs) and establish a communication channel with TBAs. Applying a user designed strategy and service development ICT4D framework, this research project develops and presents an ICT4D platform consisting of a web portal with EMRs and a voice service that connects TBAs to clinic. Evaluation of the platform is carried out after pilot testing by end-users in the field: midwives and TBAs. From results, we find that the prototype ICT4D platform is considered beneficial by all stakeholders and achieves its objectives. Further advancements with allocation of resources can enhance the utility of ICT4D platform for maternity healthcare in low resource environments and its full scale deployment.

Contents

List of Figures	iv
List of Tables	vi
1 Introduction	1
1.1 Parallel maternity healthcare systems in Ghana	1
1.2 Problem Statement	2
1.3 Aim of the research project	3
1.4 Research Question	4
1.5 Document Structure	4
2 Research Context	5
2.1 State of ICT in Ghana	5
2.2 Role of TBAs in maternity care	6
2.3 Transition from paper maternity records to EMRs	7
2.4 Service Development Framework for ICT4D	8
3 Research Strategy	10
3.1 Context Analysis	10
3.1.1 Stakeholder Identification	10
3.2 Methods	11
3.3 Interview Framework	11
3.3.1 UDS Maternity Clinic	12
3.3.1.1 Interview Structure for Doctors	12
3.3.1.2 Interview Structure for Nurses and Midwives	12
3.3.2 Interview Structure for TBAs	13
3.3.3 Interview Structure for Expectant Women	14
3.4 User-Centred Design Strategy	15

CONTENTS

3.5	Evaluation Method	15
3.6	Ethical and Legal Considerations	16
4	Designing the ICT4D platform	17
4.1	Paper based maternity records	18
4.1.1	Prenatal Paper Records	18
4.1.2	Delivery Paper Records	21
4.1.3	Postnatal Paper Records	22
4.2	Web Portal with EMRs	22
4.3	Voice Service	28
4.3.1	Technical & Financial Aspects of Voice Service	31
4.4	Integrated ICT4D Platform	31
5	Testing and Evaluation	33
5.1	Pilot Testing	33
5.2	Evaluation Process	33
5.2.1	Web Portal Evaluation	34
5.2.1.1	Prior Experience and Knowledge about EMRs	34
5.2.1.2	Web Portal Functionality	34
5.2.1.3	Web Portal's impact on clinical practices	36
5.2.1.4	Views about integration of TBAs in Web Portal	36
5.2.2	Voice Service Evaluation	38
5.2.2.1	Background, practices, views of TBAs	38
5.2.3	Voice Service Functionality	39
6	Results	41
6.1	Web Portal Results	41
6.1.1	Prior experience and knowledge about EMRs	41
6.1.2	Web Portal Functionality	43
6.1.2.1	Qualitative Results for Web Portal Functionality	49
6.1.3	Web Portal's Impact on Clinical Practices	53
6.1.4	Integration of TBAs through Web Portal	57
6.1.4.1	Qualitative Results for TBAs integration through Web Portal	60
6.2	Voice Service Results	65
6.2.1	Voice Service Functionality Assessment	65
6.2.2	Qualitative Results for Voice Service	71

CONTENTS

6.2.3	Background and views of TBAs	71
7	Discussion	77
7.1	Web Portal	77
7.2	Views of midwives about TBAs	78
7.3	Perspectives of TBAs	79
7.4	Voice Service	80
7.5	Feedback from Resource Person	81
8	Future Work	82
9	Conclusion	84
	References	86
9.1	Paper Records used by UDS	90
9.2	Voice Service Code	91

List of Figures

4.1	Key for Web Portal Diagram	24
4.2	Web Portal Functionality Diagram	25
4.3	Home Page of Web Portal designed	26
4.4	Web Page for recording Mother History fields	27
4.5	Web Page for displaying postnatal data	28
4.6	Key for Voice Service Interaction Diagram	29
4.7	Voice Service Interaction Diagram	30
4.8	Integrated ICT4D platform	32
6.1	Impression of EMRs on Midwives	43
6.2	Results for Web Portal Functionality	44
6.3	Results for Web Portal Functionality	45
6.4	Results for Web Portal Functionality	46
6.5	Results for Web Portal Functionality	47
6.6	Results for Web Portal Functionality	48
6.7	Web Portal’s impact on Clinical Practices	54
6.8	Web Portal’s impact on Clinical Practices	55
6.9	Views about integration of TBAs through Web Portal	57
6.10	Views about integration of TBAs through Web Portal	58
6.11	Views about integration of TBAs through Web Portal	59
6.12	Results for Voice Service Functionality	66
6.13	Results for Voice Service Functionality	67
6.14	Results for Voice Service Functionality	68
6.15	Results for Voice Service Functionality	69
6.16	Results for Voice Service Functionality	70
9.1	Family Identification fields in Paper Records	90

LIST OF FIGURES

9.2	Delivery Outcome fields in Paper Records	91
9.3	Postnatal fields in Paper Records	91

List of Tables

3.1	Stakeholders and Their Roles in Maternity Healthcare	11
4.1	Prenatal Records: Antenatal Visits and Immunizations	18
4.2	Prenatal Registration and Pregnancy History Data Fields	19
4.3	Prenatal Medical History and Investigation Data Fields	20
4.4	Delivery Records Data Fields	21
4.5	Postnatal Records Data Fields	22
5.1	Likert Scale for Web Portal Prototype	34
5.2	Likert Scale for impact assessment	36
5.3	Likert Scale for TBA integration	36
5.4	Likert Scale for Voice Service Evaluation	39

1

Introduction

1.1 Parallel maternity healthcare systems in Ghana

Maternity healthcare in Ghana consists of two parallel systems which co-exist with a limited interaction between the two . One of the systems is conventional healthcare which consists of modern health facilities where medical doctors and professionally trained midwives manage the services. Conventional maternity healthcare dominates the urban areas of Ghana (1). Proportion of women receiving antenatal care services in hospitals and clinics improved from 55% in 1988 to 89.5% in 2014, however, most of these women belong to urban areas only (2). Traditional maternity healthcare is the second system which is managed by Traditional Birth Attendants (TBAs). According to World Health Organisation (WHO), TBAs are individuals who assist a mother during pregnancy and childbirth based on the know-how and information they have acquired informally through traditions and practices of their local communities (3). Mostly practicing in rural areas, TBAs have assisted Ghanaian women in approximately one-third of all deliveries (1). The reasons for utilisation of TBA services by women in Ghana are wide ranging. Better quality of care, personalised services, cultural factors, flexibility in procedures, sense of spirituality, limited biomedical health facilities and poor experiences in biomedical facilities are some of the reasons (4). Absence of formal healthcare facilities and limited access to them is a factor (1) but in many communities, women prefer TBAs despite having hospitals and clinics in their areas (4). Being widely consulted by rural communities (5), Aborigo et al. recognises that role and importance of TBAs to persist in Ghana. Meanwhile, Government of Ghana is committed to provision of formal health facilities with maternal care, modern equipment and well trained staff (1). Existence of two parallel systems for maternal healthcare and limited interaction between them poses its own set of challenges for stakeholders

in maternity health services, expectant mothers and their families (6). In next chapter, the problems faced by maternal healthcare in Ghana in view of these parallel healthcare systems are examined.

1.2 Problem Statement

United Nation Millennium Declaration was signed by United Nations (UN) in 2000, launching 8 Millennium Development Goals (MDGs). MDG 5 was aimed at improving maternal health globally by setting a target of reduction in maternal mortality ratio across the world by 75% between 1990 and 2015. Ghana has been unable to achieve the targets of MDG 5 (1). In 2017, Ghana Maternal Health Survey was designed and carried out to provide data for monitoring maternal health situation in Ghana (6). One of the objectives of this survey was to acquire reliable estimates of maternal and neonatal mortality which is a major impediment in achieving the MDG 5 goal. With neonatal mortality rate at 25 deaths per 1000 live births, 1 in every 19 Ghanaian children does not survive to five years of age (6). Maternal mortality ratio (MMR) for Ghana was found to be at 310 deaths per 100,000 live births for a seven year period preceding this survey (6). The alarmingly high rates of maternal and neonatal mortality is a major problem faced by maternal healthcare in Ghana. While, Government of Ghana has been actively working to improve quality and outcomes of maternal healthcare by improving the provision of medical facilities (1), a significant proportion of women utilise traditional healthcare where a lack of latest medical knowledge, technologies and evidence-based scientific best practices exist (7). Since the expertise of TBAs is developed through cultural knowledge, experience, traditions, rituals and spiritual beliefs (8) (9), absence of safe medical practices services can compromise the safety and health of pregnant women and new born.

Provision of conventional health facilities alone will not solve the problems of maternal care in Ghana as the reasons for existence of traditional system are beyond their absence. Despite having access to conventional health facilities, Ghanaian women have preferred TBAs because they have better interpersonal skills which brings comfort; post-delivery baby care in form of special baths and massages; special food programs based on cultural beliefs surrounding good diet; allowing women to deliver through vagina which reflects strength in their culture; mistreatment at hospitals in the past; expensive list of items required for labour by hospitals and delays in care (1) (4) (2). Being totally different, these two healthcare systems work in isolation from each other (10). A disconnect and inadequate collaboration between these health systems causes many key problems such

1.3 Aim of the research project

as delayed access to emergency care, inconsistent knowledge and practices being carried out without supervision, limited referral system, inability of clinics to understand cultural context around pregnancy, under-utilisation of traditional knowledge. In turn, this has implications on the maternal care during prenatal, labour and postnatal periods.

Integration of traditional and conventional maternity care systems is essential for improving the overall quality of maternity services (10). Being resource constrained, Ghana has only limited number of formal health facilities, so integrating TBAs into health system can bridge the gap in provision of maternity services. Rates of visits by women to clinics can be improved by integrating TBAs, as they have a respected role in local communities and can convince women to utilise modern healthcare (11). Information capabilities of clinics could be enhanced by obtaining up-to-date information from TBAs which have interpersonal relations with pregnant women. Improved information will allow clinics to identify health complications on time and thus, allowing the opportunity to provide care and make interventions for saving lives (12). Integration of TBAs in conventional health systems also provides the opportunity to preserve cultural practices and traditional knowledge which are viewed with high importance in rural communities of Ghana (8) (4). These cultural practices could be documented and standardised to ensure safety of expectant women and their newborn. Hence, an integrated approach has the potential to solve challenges that are posed to the two coexisting and isolated maternity care systems in Ghana.

1.3 Aim of the research project

In Ghana, a rural community of around 20000 people in Nyankpala, has the presence of both conventional and traditional maternity healthcare which provides an opportunity to explore the solutions for integrating them. Conventional services are provided by a maternity clinic under the University for Development Studies (UDS), while TBAs provide traditional healthcare services for pregnant women in Nyankpala. UDS maternity clinic uses a paper based record system for documenting the provision of care provided to expectant mothers and their newborn. Usefulness of paper-based maternity health records has been recognised but they have a number of disadvantages (13) which include poor accessibility, inefficient record management, risk of loss and possibility of having incomplete data. Traditional maternity care provided by TBAs has no record keeping system due to illiteracy. At present, there exists no mechanism for collaboration between the two healthcare systems in Nyankpala, Ghana. Considering the significance of integrating traditional and conventional maternity healthcare, this research project aims to design and test an

ICT4D enabled platform for inclusion of TBAs in the clinic's system and transitioning UDS maternity clinic from paper based records to electronic maternity records (EMR).

1.4 Research Question

Designing an ICT enabled maternity healthcare platform which links TBAs to clinic and has electronic records will require identification of stakeholders, understanding the local context, state of ICT in Nyankpala, needs assessment of end users, analysing current condition of traditional and conventional healthcare services, finding potential areas for improvement in both systems and their collaboration. ICT4D deployments in developing regions (14) have observed a high rate of failure due to a mismatch between deployed technologies and local requirements (15) (16) (17). Keeping that in consideration, this research project will be guided by ICT4D framework proposed by Bon et al.(18) for low-resource environments. This research aims to answer the following research question (RQ):

RQ: How can we digitalize maternity healthcare in a rural environment such as northern Ghana, such that it allows integration of information from traditional maternal health delivery into the conventional health care?

1.5 Document Structure

This thesis project begins with a research context which attempts to analyse the local context and review literature to understand the state of ICT in Ghana, role of TBAs in maternity care and studying the transitions of healthcare systems around world from paper based records to EMRs. The research context ends with a service development framework for ICT4D projects. Then, we have a research strategy chapter comprising stakeholder identification, research methods, interview frameworks, platform design strategy, evaluation process and ethical and legal considerations. Next chapter details the design of ICT4D platform, followed by a testing and evaluation chapter. Then, results of this research are presented, which are analysed in discussion and conclusion summarises it.

2

Research Context

In the research context, existing literature in terms of sub-research questions is studied and analysed. First, the state of ICT in Ghana is looked at to understand local opportunities and limitations. Then, for inclusion of TBAs in conventional healthcare systems, the role and practices of TBAs is examined to ascertain their importance in maternity care and assessing if their inclusion in conventional healthcare systems is justified. Next, the transition from paper records to EMRs in different healthcare systems around the world is analysed to recognise challenges and benefits of EMR, followed by the lessons in implementing this transition. Lastly, the ICT4D framework for developing services aimed at low resource environments is explored as it best suits the objectives of this research.

2.1 State of ICT in Ghana

The first internet connection in Ghana was set up in 1989, since then public and private sector have collaborated for building the ICT infrastructure (19). ICT for Accelerated Development is a state backed program which has brought improvements but many challenges still remain (19). Ghana is directly connected to the world's first submarine fibre-optic cable system, SAT-3/WASC/SAFE, having full internet connectivity since 1995 but internet penetration rate outside urban areas is abysmally low at 1% (19). Even in urban areas, the internet subscriptions are usually held by corporations or internet cafes. Ownership of personal computers (PCs) in households stood very low at 5% in a survey conducted in 2011 (20), of which only 0.3% had internet connection. However, computing equipment with internet access are widely present in health facilities around Ghana (19). Most of these health facilities have a restricted approach due to financial constraints, which limits the availability of computers and internet access only to departments where it is highly

2.2 Role of TBAs in maternity care

needed. Mobile telephony is the dominant part of ICT services in Ghana (21), as Ghana ranked 4th in affordable prepaid mobile products out of 44 African countries in 2013. The quick expansion of mobile telephony took place over the whole continent of Africa (22). The rise in cellular subscriptions went from 4 out of 100 in 2002 to 69 out of 100 in 2014 (14). In rural Africa, 2G mobile network is the only widely available digital infrastructure (15). The use of ICTs in rural Africa is also impacted by low levels of literacy (23) and poor economic conditions (24). The design of ICT services must take these limitations into account for avoiding failure, which is usually the case for ICT4D projects (14).

2.2 Role of TBAs in maternity care

Concerning high rates of maternal mortality in developing countries in early 1950s led to recognition of TBAs as an important stakeholder in maternal healthcare (25). Their contribution to reduction of maternal mortality in developing countries is enormous (1). A global estimate by Fatmi et al. (26) attributes 60% to 80% of all deliveries to TBAs, especially in developing countries. WHO defines TBAs as individuals who assist the mother during pregnancy and childbirth based on knowledge and information acquired informally through traditions and practices of local communities (3). Mostly, TBAs are elderly women belonging to the local community in which they practice and are well known for good health outcomes and affordable prices (27) (28). By speaking local dialects, they have personal connections with people in the community and due to their advice based on cultural and spiritual context of community, they are considered trustworthy and respectable (29). The role of TBAs in the rural communities of developing countries begins right after a woman becomes pregnant (30). They are regarded as educators of pregnancy women on appropriate meals, taboos and looking after newborn children (31). In Ghana, TBAs usually practice in rural communities but their presence is also noted in urban areas where cultural factors play a part in the utilisation of their services (1). Around one-third of all deliveries in Ghana are assisted by TBAs (1).

Considering the importance of TBAs in rural communities, it is crucial to examine their initiation, practices and the reasons which make pregnant women utilise their services. A thorough examination of existing literature pertaining to these aspects was conducted in the literature study performed. The main findings of the literature review are presented. Majority of TBAs acquired their skills from an experienced family member or apprenticeship with an experienced TBA, but some of the TBAs attributed their skills to spiritual revelations and superstitious beliefs (9). This reflects the lack of required knowledge for

2.3 Transition from paper maternity records to EMRs

providing maternal care. TBAs enter this profession for different reasons including a revelation in dream, guidance by Holy Spirit, taking up the place of another TBA if not available. Such reasons to enter this profession shows random nature of their motivation and if they take up this profession without acquiring skills, it can compromise the safety of women and their newborn. Practices of TBAs begin with pregnancy and continue in postnatal period. Health education on nutrition, natural family planning methods, psychological support, counselling, home deliveries, flexibility allowed in body position during childbirth, special baths and massages for women and newborn are among the popular practices of TBAs (7). Reasons for utilisation of TBA by women services include socio-cultural beliefs, perception of better care, interpersonal skills, guaranteed vaginal mode of delivery, experiences of mistreatment in hospitals, financial constraints, limited availability of and access to health facilities (4).

In view of these findings, the crucial role of TBAs in resource constrained regions is well understood. However, despite their role, the lack of formal medical training and expertise, combined with reliance on spiritual and cultural beliefs for carrying out procedures during pregnancy and childbirth can lead to unsafe practices and have potential health risks for mothers and their newborn. Hence, integration of TBAs into conventional healthcare systems is necessary to ensure safety and improve the quality of care. Illiteracy is another challenge which must be considered by any ICT solution aimed at collaboration between TBAs and conventional maternity healthcare systems.

2.3 Transition from paper maternity records to EMRs

Pregnant women in Nyankpala, Ghana are given a Maternal Health Handbook which contains medical details about prenatal, labour and postnatal periods. A copy of these records is also maintained by UDS maternity clinic in form of registers provided by Ghana Health Service (GHS). Usefulness of paper-based maternity health records is recognised but they have a number of disadvantages (13) which include poor accessibility, inefficient record management, risk of loss, and possibility of having incomplete data. Electronic maternity records (EMRs) are a type of electronic health records (EHRs) which are used in maternal care (13). The benefits of EHRs were noted by Fridsma as they can “deliver complete and accurate health information to patients and their providers, allowing better access to that information and, ultimately, empowering patients to take an active role in their healthcare” (32). The advantages of EHRs are also highlighted in another study (33); "Paperless medical records were found to be more legible, understandable, and contained more information

2.4 Service Development Framework for ICT4D

than paper-based records". EMRs have been forecast to improve legibility, timeliness and access by multiple clinicians (34) (35).

The literature review examined and critically analyse use of EMRs, their design and development, implementation and transitions from paper maternity records to EMRs in various healthcare systems around the world to understand the benefits and challenges. Healthcare systems from different countries including UK, Australia, Kenya, Ghana were examined to analyse the application of electronic records and digital health tools. Recognising the benefits of EMR in these different healthcare systems, some factors crucial to the successful implementation of EMRs have been identified. A human-centered design approach is critical to understand the needs and barriers in context of the target health facilities. At all stages of design and development, engagement with end users and incorporating their feedback in improvements of digital solutions is vital. Adapting the four mechanisms of Normalisation Process Theory (NPT) (36) for structuring the implementation and feedback criteria is a beneficial approach, applicable to similar settings. "NPT identifies factors that promote and inhibit the routine incorporation of complex interventions into everyday practice. It also explains how these interventions work, looking not only at early implementation, but beyond this to the point where an intervention becomes so embedded into routine practice that it disappears from view. The NPT focuses on the work that individuals and groups do to enable an intervention to become normalised. There are four main components to NPT: coherence (or sense-making); cognitive participation (or engagement); collective action (work done to enable the intervention to happen); and reflexive monitoring (formal and informal appraisal of the benefits and costs of the intervention)" (36). The review article also explores the potential of using digital voice recorders in maternity care for recording real-time information while providing care to expectant mothers simultaneously.

Learning from the design and implementation of EMRs in healthcare systems around the world, this research project will focus on user-centric approach, accessing paper records used in UDS maternity clinic for a smooth transition to EMRs, exploring the use of voice recordings for capturing real-time data, regular feedback and improvement.

2.4 Service Development Framework for ICT4D

A framework has been proposed by Bon et al. (18) for developing ICT-enabled services for people in low-resource environments, covering the complete life cycle. Resulting from

2.4 Service Development Framework for ICT4D

an extensive field research in West Africa, including Ghana, this framework is highly valuable for designing and developing our ICT4D enabled platform to integrate traditional and conventional maternal healthcare. It identifies eight major concerns which must be addressed by an ICT service: local needs are unknown so the design must be informed by real needs of end users; context is unknown so it is important to understand the constrained environment for which service is designed; low literacy being prevalent requires service to cater this problem; state of available technology and infrastructure in rural regions must be assessed before designing the service; poor economic conditions severely restricts the purchasing power of end users; a lack of understanding about ICT technologies among end users; mismatch between donor-sponsor goals and end user goals; and finally sustainability concerns. The ICT4D service development framework (18) comprises five components of iterative nature to address these concerns: (i) context analysis, (ii) needs assessment, (iii) use case and requirements analysis, (iv) sustainability assessment, (v) developing, testing, deploying. As we aim to design an ICT service for integrating the the traditional and conventional maternity healthcare system in Ghana, this framework will guide the research strategy of this project.

3

Research Strategy

In this research, we apply the ICT4D framework (18) for designing and developing an ICT enabled platform for Nyankpala (Ghana) community that integrates TBAs in conventional healthcare and transitions UDS maternity from paper records to EMRs.

3.1 Context Analysis

Designing the ICT platform from Netherlands, required us to understand the local environment for which it is being designed. For that purpose, a resource person from University for Development Studies, Mr. Ali Gideon, was present in the field. Communication with Ali was done through Zoom meetings, beginning from the start of this research. The problem to be addressed was discussed which is the gap between traditional and conventional maternity healthcare in Nyankpala. Studying the problem from a local perspective demanded the identification of stakeholders for this project and establishing an effective and iterative communication strategy with them to recognise end user needs.

3.1.1 Stakeholder Identification

Three major stakeholders were identified, presented in table 3.1.

Table 3.1: Stakeholders and Their Roles in Maternity Healthcare

Stakeholder	Role
UDS Maternity Clinic	Providing conventional maternity healthcare
TBAs	Providing traditional maternity healthcare
Expectant women	Requiring maternity healthcare

3.2 Methods

After identification of stakeholders, a methodology had to be devised for selecting mode of communication and research to understand the local environment, assess needs and requirements of stakeholders. With Mr Ali being in the field, we decided to use in-person meetings with stakeholders as the mode of communication. This allowed us to have an effective communication having clarity, ability to build a comfortable environment for interviewees, clarifying any doubts immediately which participants might have about questions asked, higher level of engagement and attentiveness among participants leaving little or no room for distractions. A semi-structured qualitative research method was chosen for interviewing the stakeholders through different phases of this research project. Semi-structured qualitative research best suited the requirements of this project; as it allows flexibility for exploration and adaptability based on participant's responses; the intricacies of this multifaceted research project could be captured; letting participants share their views accommodates the complexity and diversity in perspectives; leading us to gather in-depth and rich qualitative data. These interviews were recorded with their consent and later, transcribed.

3.3 Interview Framework

The structure of interviews was formulated by keeping in consideration the various aspects which are important for developing the ICT platform to suit the needs of stakeholders. For each category stakeholder, a separate interview was designed to understand the current state of their work, familiarity with ICT, available infrastructure, ownership of technology, type of technology owned, willingness for integration of traditional and conventional maternity healthcare, expectations from the ICT enabled platform by identifying their requirements. The structure of interviews for each type of stakeholder is provided.

3.3.1 UDS Maternity Clinic

Medical staff at UDS maternity clinic consists of doctors, nurses and midwives.

3.3.1.1 Interview Structure for Doctors

Please briefly tell me about your self.

How long have you worked as a medical officer?

What are your duties as a medical officer

How do you keep patients records as a medical officer at the clinic?

What are your challenges in keeping and managing patients records?

What do you know about traditional medicine?

Have you encountered TBAs in your line of work s a medical officer?

What are your experiences with patients in relation to traditional birth attendants?

Do you think the services of TBAs is important?

What do you think are the challenges TBAs are posed to?

Would you like to work with TBAs as a medical Officer?

How would you like to work with TBAs?

Would you like to share information with TBAs about a client?

Do you own a mobile phone?

What type of mobile phone?

Would you like to have an ICT-platform to help you work with TBAs?

How would you like the ICT-platform to function?

What kind o information would you like to share with TBAs?

How would you like to get feedback from your patients?

How would you like the ICT-platform to be managed?

Do you have internet access?

What other issues do you think can help integrate conventional health care and TBAs?

3.3.1.2 Interview Structure for Nurses and Midwives

Please tell me briefly about yourself.

How long have you been a health worker or a midwife?

What are some of the duties you undertake as a midwife in this facility?

How do you keep patients records and generate reports as a midwife?

What are the challenges you face in terms of resources for your work?

What do you know about traditional Birth attendants?
Have you encountered TBAs in your line of work?
What are the experiences of your encounter with patients/clients in relation to TBAs?
Do you think the services of TBAs are important?
What do you think are the challenges TBAs are posed to?
Would you like to work with TBAs as a conventional midwife?
How would you like to work with TBAs?
Would you like to share information with TBAs about a client?
Do you own a mobile phone?
What type of mobile do you own?
Would you like to have any ICT-Platform that help you work with TBAs?
How would you like the ICT-Platform to work?
What information would you like to share with TBAs and vice versa?
How would you like clients to give you feedback on their health status?
How would you want the ICT-Platform to be managed?
Do you have internet access?
What other issues do you think having an ICT-Platform can help integrate TBAs into conventional healthcare system?

3.3.2 Interview Structure for TBAs

1. Please can you briefly tell me about yourself?
2. How long have you been practicing as a TBA?
3. Do you have any form of formal education?
4. How did you learn to practice as a TBA?
5. What services do you render as a TBA?
6. What issues do pregnant women usually bring to you?
7. What challenges do you have as a TBA?
8. Do you sometimes offer your patients any medication?
9. Do you work with conventional midwives?
10. How do you work with conventional midwives?
11. Do you sometimes refer your patients to conventional midwives for further treatment?
12. Have you ever received any training from conventional midwives?
13. If no, would you like to receive some training from the conventional midwives?
14. If yes, what is your working relationship with midwives?
15. How do you communicate with your clients and the midwives you work with?

16. Would you like to share information about the clients you attend to with midwives?
17. Do you own a mobile phone?
18. What type of mobile phone do you own?
19. Do you have internet access?
20. Would you like to have an ICT platform where you can share information with midwives?
21. If yes, how would you like to send information through the system?
22. What features would you like to see or have on the system?
23. Any other thing you want to say towards the purpose of this interview?

3.3.3 Interview Structure for Expectant Women

1. Please can you briefly tell me about yourself?
2. Are you married? How long have you been married?
3. How many children do you have?
4. What is your level of education?
5. How do you access healthcare?
6. What conditions do you normally present at the clinic or TBAs?
7. Do you think health facilities are far from you?
8. Do you know about TBAs in your community?
9. How did you get to know about the TBAs in your community?
10. Do you seek for the services of the TBAs in your community?
11. What services do you seek from TBAs?
12. How do you communicate with midwives and TBAs when you need their services?
13. How do you communicate with midwives or TBAs?
14. Do you own a mobile phone?
15. What type of mobile phone?
16. Do you use internet?
17. What kind of information would you want to receive from your midwives or TBAs?
18. Would you agree for TBAs and midwives to share information about you?
19. What kind of information would you like them to share about you?
20. Would you like to have an ICT platform where you can access healthcare information?
21. What kind of information would you like to have on the ICT platform?

3.4 User-Centred Design Strategy

Upon assessing the needs of stakeholders and understanding the local environment through semi-structured interviews conducted in person, it was decided to follow a user-centred design strategy for developing the ICT4D enabled platform to integrate traditional and conventional maternity healthcare for Nynakpala. Having a user-centred approach through all stages of design and development would ensure that the content, features and functionality of ICT4D platform matches the requirements, expectations of end users without disrupting their current nature of work and its quality. This increases the chances of successful adoption and utilisation of designed platform. By engaging with stakeholders on a continuous basis, generalisations about their environment can be avoided, which can negatively impact the usefulness of ICT solution. In first phase of interviews, we learnt that computers with internet connectivity are available at UDS maternity clinic and its medical staff is computer literate so a transition from paper based records to EMRs is possible by designing a web portal. However, communication with TBAs and expectant mothers revealed that illiteracy and lack of internet access are challenges which must be considered for any ICT solution, therefore, it was decided to explore voice service solutions for them as text based solutions will not have success. Realising the benefits of user-centred approach from the initial phase, we ensured that an iterative feedback process is applied in next stages of design, development and deployment.

3.5 Evaluation Method

Evaluation allows to assess the effectiveness, efficiency and overall impact of the designed ICT platform. Assessing performance of platform in terms of speed, reliability, scalability and security identifies the gaps for improvement. Documentation of user experience provides insight into usability, accessibility and user satisfaction. Furthermore, informed decision making, resource optimisation, identification of weaknesses are among many other benefits of evaluation. For our research project, an evaluation method based on semi-structured qualitative research was carefully designed after analysing questionnaires which evaluated similar ICT platforms having web based electronic records and voice services. Questionnaires for medical staff and TBAs were designed having open-ended questions and Likert scale questions to collect data for analysing prior experience (if any) with designed technologies, usability, functionality, impact of ICT platform, missing features and areas for improvement. Details of the evaluation method are provided in section 5.

3.6 Ethical and Legal Considerations

As this research is conducted in Europe, General Data Protection Regulation (GDPR) is the key legal framework which was taken into account. Participation in the interviews at all stages of this research was completely voluntarily. A thorough explanation of the objectives was this research was given to the participants. Data collection through questionnaires and audio recorded interviews was performed after obtaining explicit consent. Permissions were sought for further processing and storage of data. Participants were given the choice to opt for anonymity in case they did not want to reveal their identity. It was guaranteed that their data will not be used for any purposes outside the scope of this research. For testing and evaluation of ICT4D platform, participants were advised to use arbitrary data instead of real data of expectant women, TBAs and medical staff to ensure data security.

4

Designing the ICT4D platform

For user-centred design strategy, the findings of a comprehensive semi-structured qualitative research method 3.3 were analysed to understand critical aspects which form the basis of ICT4D platform design. Among many factors, the local context and environment was examined in terms of internet access, ownership of technology, type of technology owned, willingness to use an ICT solution for collaboration, literacy and computer literacy for all three stakeholders. UDS maternity clinics, TBAs and expectant women expressed their support for an ICT4D platform that improves flow of information between, integrates TBAs into conventional healthcare and transitions UDS maternity clinic from paper based records to EMRs. While the support for an ICT4D platform was unanimous among the three stakeholders, certain differences were observed with regard to other aspects that guide design choices. At the UDS maternity clinic, the medical staff is computer literate and has computers with internet access, use of mobile phones is also common. However, for the other two stakeholder, TBAs and expectant women, ownership of mobile phones with basic functionality is observed but internet access and illiteracy are the limitations to be considered. Considering these ground realities, a deliberative process was employed to find and decide the ICT technologies to be used in designing the platform. Computers with internet access present at the UDS maternity clinic, allows for designing a web portal which facilitates the transition from paper based records to EMRs. For TBAs and expectant women, lack of internet access and illiteracy requires the use of an innovative solution such as a voice service which allows them to interact with UDS maternity clinic and provide information. Data acquired from TBAs and expectant women through voice service can be incorporated into the web portal for further use by UDS maternity clinic. Thereby, the ICT4D platform was designed having two major components: (i) a web portal and (ii) a voice service. A complete design process given in following sections.

4.1 Paper based maternity records

For designing a web portal with EMR functionality, access to paper records used at UDS maternity clinic were requested. UDS maternity clinic uses registers provided by Ghana Health Service (GHS) which contain prenatal, labour and postnatal records. Each expectant mother is handed a Maternity Health Book which carries same information as the GHS register maintained by clinic. An examination of these paper records was carried out after access to them was granted. The paper records currently at use in UDS can be found in 9.1 section of appendix. Data fields in prenatal, delivery and postnatal periods were documented for designing the EMRs in web portal.

4.1.1 Prenatal Paper Records

Prenatal paper records have the following sections and fields of information:

Table 4.1: Prenatal Records: Antenatal Visits and Immunizations

Antenatal Visits Fields	Tetanus-Diphtheria Fields
Visit Number	Tetanus-Diphtheria Dost Number
Date	Date Given
Weight	Batch Number
BP	IPT Fields
Urine Protien	Dose Number
Urine SUGar	Date Given
Gestational Age in weeks	Gestational Age in Weeks
Fundal Height	Deworming date
Presentation	LLIN date
Descent	G6PD status
Fetal Heart Rate	Social Risk Fields
No. of days IFA supplied	Alcohol
Complaints/Remarks	Smoking
Name and Signature	Others
Date of Next Visit	

4.1 Paper based maternity records

Table 4.2: Prenatal Registration and Pregnancy History Data Fields

Registration Fields	Previous Pregnancy Fields
Serial No. for Mother	Pregnancy Number
Registration No. for Mother	Date of Delivery/Pregnancy Loss
Name of Health Facility	Place of Birth
Date of issue of this MCH Record Book	Problems during Pregnancy
NHIS No.	Gestational Age at Birth
Identity Fields	Mode of Delivery
Name	Outcome of Delivery
Date of birth	Labour/Postpartum Complications
Age	Sex of Child
Address	Child's weight at birth
Landmark	Child's Present Health
Sub District	Medical History Fields
District	Hypertension
Region	Heart Disease
Telephone No.	Sickle Cell Disease
Marital Status	Diabetes
Educational Status	Epilepsy
Occupation	HIV infection
Contact Person Fields	Asthma
Name of Contact Person	Allergies (Drug/Food)
Telephone No. for Emergency	Respiratory Disease
Telephone No. for Emergency Transportation	TB
Medical Staff Fields	Mental Illness
Name of Midwife	Other(specify)
Telephone No. of Midwife	Previous Surgery
Name of Doctor	Medication History
Telephone No. of Doctor	

4.1 Paper based maternity records

Table 4.3: Prenatal Medical History and Investigation Data Fields

Breastfeeding History Fields	Investigations
Did you breastfeed your last child?	Blood Group Test Date
Did you exclusively breastfeed your last child?	Blood Group Result
If yes, how long?	Rh typing Test Date
If less than 6 months, what was the reason?	Rh typing Result
If no, what was the reason?	HBsAg Test Date
Duration of breastfeeding	HBsAg Result
Family History Fields	Sickling Test Date
Hypertension	Sickling Result
Heart Disease	G6PD Test Date
Sickle Cell Disease	G6PD Result
Diabetes	VDRL/Syphilis Test Date
Multiple Pregnancies	VDRL/Syphilis Result
Birth Defects	HIV Antibody Test Date
Mental health disorder	HIV Antibody Result
Other	Blood Film for Malaria Test Date
Physical Examination Fields	Blood Film for Malaria Result
General Condition	Hb Test Date
Face	Hb Result
Head and Neck	Hb at 28 Weeks Test Date
Breasts	Hb 28 Weeks Result
Abdomen	Hb at 36 weeks Test Date
Heart	Hb 36 Weeks Result
Lung	Urine RE Test Date
Other	Urine RE Result
Current Pregnancy Fields	Stool RE Test Date
First day of Last Menstrual Period (LMP)	Stool RE Result
Estimated Date of Delivery (EDD)	Ultrasound Scan Fields
Height	Date
Weight at ANC1	Placenta Location
BMI at ANC1	Amniotic Fluid Volume
Estimated Desired Weight at EDD	Gestational Age
Type of contraception used before this pregnancy	Presentation/Abnormality

4.1 Paper based maternity records

4.1.2 Delivery Paper Records

Table 4.4: Delivery Records Data Fields

Delivery Outcome Fields	Mother's Discharge Fields
Weeks of Pregnancy	Date
Date of Delivery	BP
Time of Delivery	Pulse
Time of Placenta Delivery	Temperature
Duration of Labour and Delivery	Condition of Uterus
Type of Delivery	Fundal Height
Indication for Vacuum/Cesarean	Lochia Color
Anesthesia	Lochia Odour
Estimated Blood Loss	Incision Perineum/Cesarean
Blood Transfusion	Condition of Breast
State of Placenta and Membrane	Number of days IFA supplied
State of Perineum	Date of next visit
Labour and Delivery Complications	Planned PNC Dates Fields
Type of Birth Attendant	Planned Postnatal Visit 1 Date
Name of Birth Attendant	Planned Postnatal Visit 2 Date
Place of Delivery	Planned Postnatal Visit 3 Date
Name of Health Facility	Baby's Discharge Fields
Breastfeeding within 30 minutes?	Date
Skin-to-skin contact with mother?	Heart Rate
Baby's Birth Condition Fields	Respiratory Rate
Delivery Outcome	Temperature
Sex of Baby	Weight
Number of babies	Breastfeeding Initiation
Baby's Weight	Baby Suckling established
Baby's Length	Meconium Passed
Baby's Head Circumference	Urine Passed
APGAR Score 1 minute	Chloramphenicol/Tetracycline for eye care
APGAR Score 2 minute	Cord care
Resuscitation	Vitamin K
Congenital Malformation	BCG
Complications at Birth	Hepatitis B
Diagnosis of any complications	Oral Polio
Referred to	Baby's condition

4.1.3 Postnatal Paper Records

Table 4.5: Postnatal Records Data Fields

Postnatal Visits Fields	Child Growth Data Fields
Visit Number	Visit Number
Date of Visit	Date of visit
Weight	Age (months)
BP	Weight
Temperature	Height
Urine Protein	Remarks
Urine Sugar	Name and Signature
Fundal Height	Date of next visit
Lochia Color	Child's Immunization Fields
Lochia Odour	Age
Incision Perineum/Cesarean Status	Vaccine Name
Condition of Breast and Nipples	Vaccine V Number
Mood Changes	Vaccine D Number
Number of days IFA supplied	Place Given
Complaints/Remarks	Name and Signature
Name and Signature	Date of Next Visit
Mother Investigation Fields	Other Vaccines
Date of Investigation	Vitamin A Fields
Hb Value	Age
HIV Antibody Value	Date Given
Other	
Family Planning Fields	Child Deworming Fields
Date of Service	Age
Family Planning Counselling	Date Given
Method of Choice	
Remarks	

4.2 Web Portal with EMRs

A prototype web portal with Electronic Maternity Records (EMRs) was designed after documentation of data fields in paper records. Javascript programming language was used in Wix Editor for creating this web portal. Medical staff at UDS maternity clinic was engaged for designing the functionality and interface. With an iterative feedback

4.2 Web Portal with EMRs

mechanism in place, the web portal was designed having this functionality: data entry, data display, storing audio recordings, storing images, storing documents, playing audio recordings, displaying images and documents. An easy-to-learn and easy-to-use interface is designed as medical staff at UDS maternity clinic will be using web portal EMRs for the first time. Keeping in view their usage of paper records, a familiar design technique was used which allows them to enter and view records for each phase of pregnancy with data fields in the same order as paper records.

In addition to the sections and data fields in paper records, two new categories of records are included in web portal: (i) TBA records which will contain data about TBAs and the information shared about expectant women through voice service, (ii) Emergency records which store information about emergency situations provided through voice service. For data entry, in total, there are seven record categories each having their own sections. These seven record categories include (i) Registration Records, (ii) Prenatal Records, (iii) Delivery Records, (iv) Postnatal Records, (v) Lab Records, (vi) TBA Records and (vii) Emergency Records. Each category of records contains sections having relevant data fields. For instance, Delivery Record category consists of these sections: Delivery outcome, Mother's discharge condition, Planned dates for postnatal visits, Baby's birth condition, Baby's discharge condition. In turn, each section contains the relevant data fields based on paper records. Data entry in each section is indexed by registration number of the mother (a unique identifier assigned at the start of pregnancy). Viewing information is time efficient as it only requires the registration number of a mother to display information. Furthermore, the web portal has the functionality for storing and playing audio recordings. Audio recordings can be used by medical staff to capture real-time information during check up visits, it also stores information provided by TBAs and emergency callers through voice service. Medical images and documents can also be uploaded and displayed in the designed web portal. A functionality diagram in figure 4.2 provides the complete overview of the web portal designed for UDS maternity clinic. A key of for this functionality diagram is presented in figure 9.3.

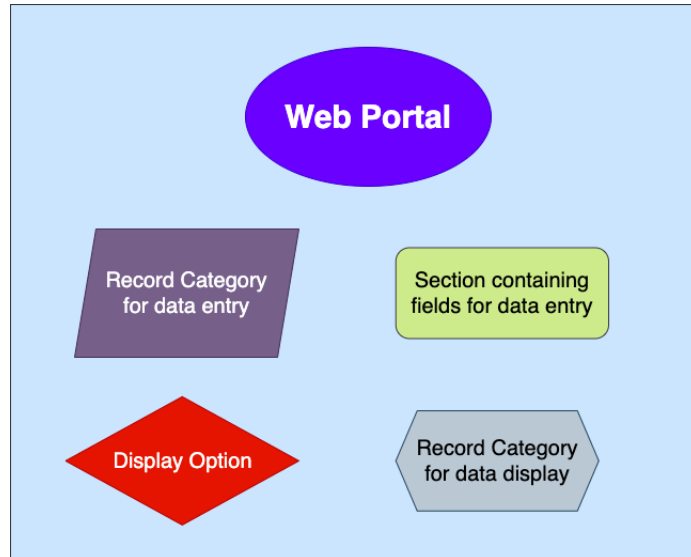


Figure 4.1: Key for Web Portal Diagram

4.2 Web Portal with EMRs

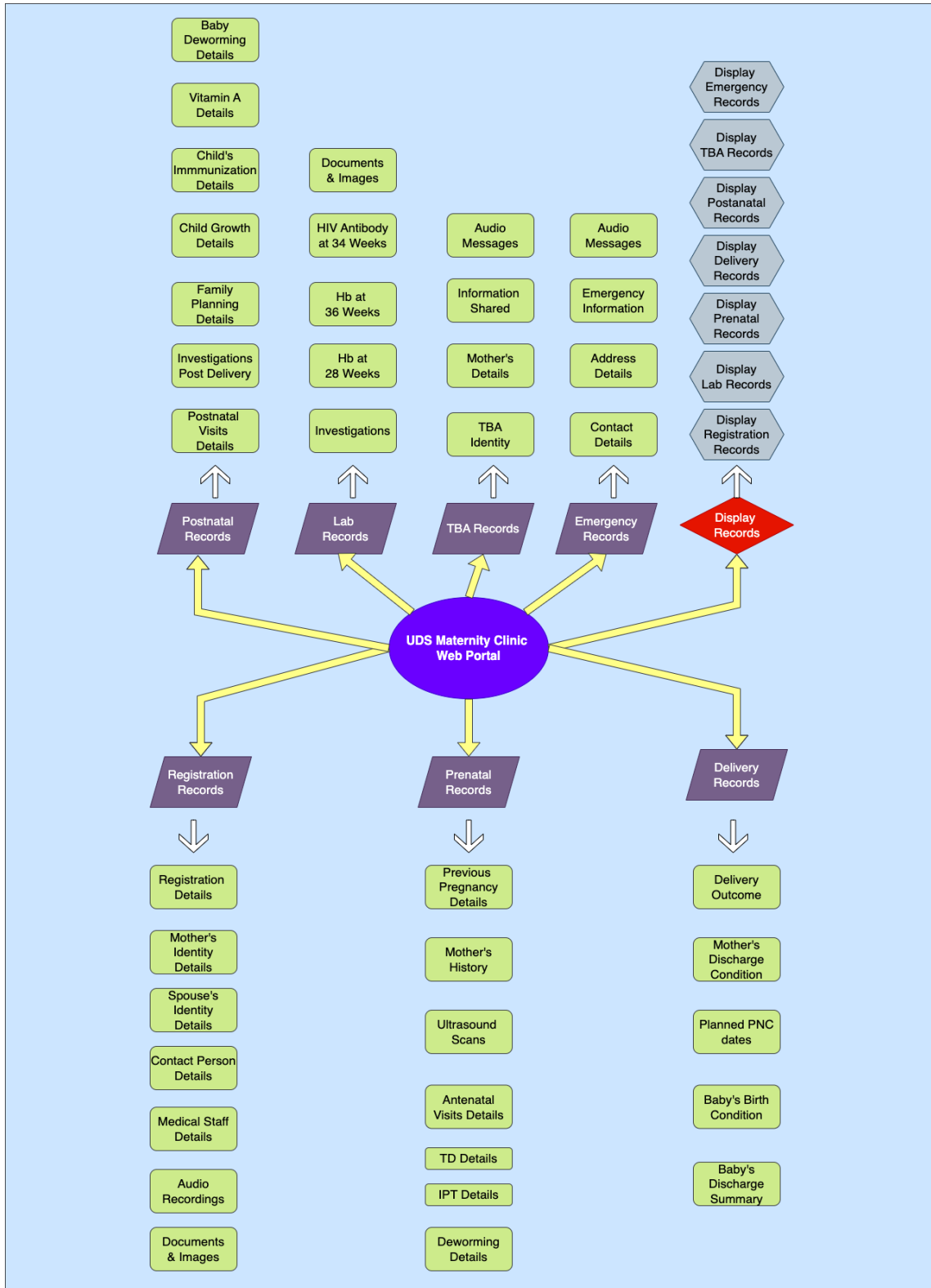


Figure 4.2: Web Portal Functionality Diagram



Figure 4.3: Home Page of Web Portal designed

Mother History

<input type="text" value="23/77a891"/> <input type="checkbox"/> Did you breastfeed your last child? <input checked="" type="checkbox"/> Did you exclusively breastfeed your last child? <input type="text" value="6 months"/> <input type="text" value="Not mentioned"/> <input type="text" value="Fed"/> <input type="text" value="7 months"/>	<input type="text" value="Allergies (Drug/Food)"/> <input type="text" value="Medication History"/> <input type="text" value="Other (specify)"/> <input type="text" value="Previous Surgery:"/> <input type="text" value="Alcohol"/> <input type="text" value="Smoking"/>
---	---

Hypertension Heart Disease

Family History:

Hypertension Heart Disease

Figure 4.4: Web Page for recording Mother History fields

Home | Registration | Lab Records | Prenatal Records | Delivery Records | Postnatal Records | TBA Records | Display Records

Enter registration no. of Mother

Display Mother Postnatal Visit Records

UDS Maternity Clinic

Figure 4.5: Web Page for displaying postnatal data

4.3 Voice Service

Illiteracy being prevalent and lack of internet access in rural areas of Ghana requires ICT solutions to use technologies that are not dependant on internet and are not text-based. While the medical staff at UDS maternity clinic is literate and has computers with internet access, this is not the case for other two stakeholders: TBAs and expectant women. To overcome these limitations, an Interactive Voice Response (IVR) call service in VXML language is programmed using Voxeo Evolution platform. The design of voice service is guided by the information requirements of UDS maternity clinic. Major objective of this voice service is to establish a communication link between UDS maternity clinic and TBAs so that crucial information regarding pregnant women can be shared about time, practices of TBAs are recorded, data of TBAs is collected. Information sharing can help UDS to make timely interventions, recordings of practices of TBAs can be analysed by UDS clinic for bringing improvements and safety, data collection shall allow for a formal record keeping of TBAs in the community.

Expectant women can also use voice service to contact UDS maternity clinic for providing information regarding their pregnancy in general, sharing details about visits to TBAs and reserving appointments. Lastly, the voice service has an emergency option which can be used by TBAs, expectant women or anyone to inform the clinic about emergency cases. Dagbani is the widely spoken language in Nyankpala, so voice service is programmed to

4.3 Voice Service

interact with callers in Dagbani. An English version of this voice service is also created for which the call flow and functionality is presented in interaction diagram in 4.7. The key for understanding interaction diagram is provided in figure 4.6.

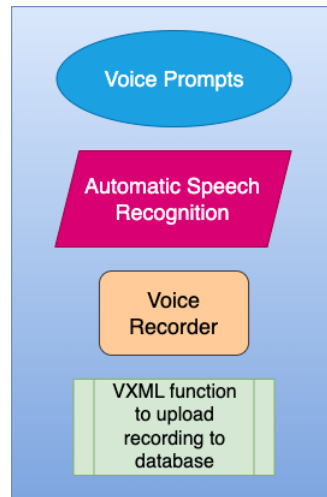


Figure 4.6: Key for Voice Service Interaction Diagram

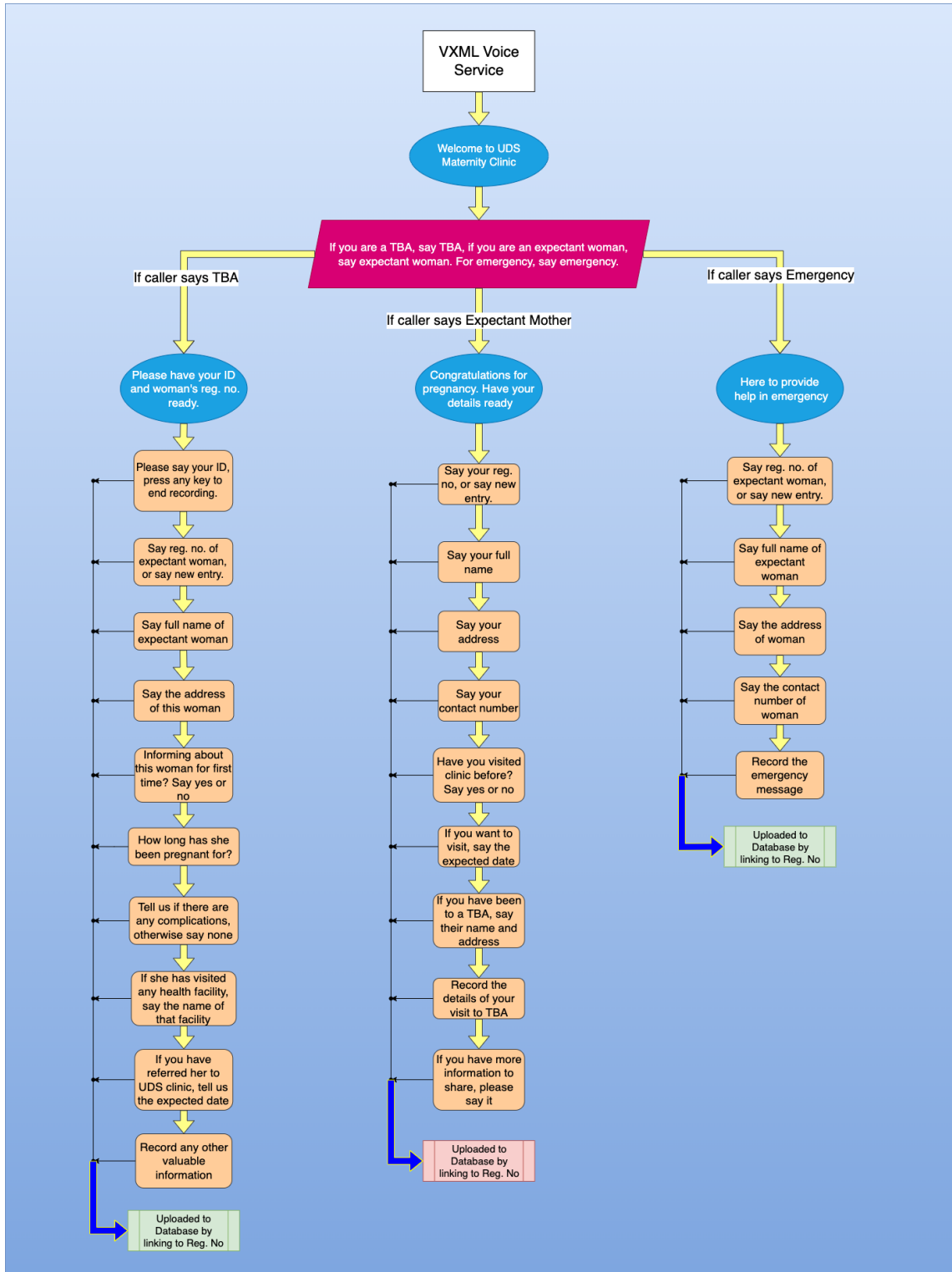


Figure 4.7: Voice Service Interaction Diagram

4.3.1 Technical & Financial Aspects of Voice Service

For voice service, Voxeo Evolution platform is utilised. The voice service is programmed in VXML language. Firstly, a VXML file is created and then code is programmed according to the desired functionality. Grammar in XML is used to recognise speech for choosing option during the voice call. All important information said by the voice caller is recorded into a XML variable which is used for further processing. At Voxeo Evolution website, tutorials are provided for understanding the XML syntax. Files written with VXML code are stored on Voxeo's platform. Upon completing the code of application, it can be tested by setting up a United States based number through Voxeo platform. A telephone number is provided by Voxeo with a pin which can then be used to test the voice service. For the voice service designed in this research, it can be tested by calling the following number +1 407 386 2174 and then entering the following PIN number 9991488456. If any errors are made while recording the information through voice service, the service can be restarted. Any information recorded is played for the user so that any errors can be corrected.

For this prototype voice service, a Skype monthly calls subscription was purchased at a nominal price. It is feasible for testing, however, deploying the voice service in field would require financial resources. Voxeo platform offers services for implementation and deployment of a voice service with paid options. For placing outbound calls or adding SMS functionality, a premium Voxeo account needs to be purchased. Having outbound call functionality can be helpful for many kinds of projects as it automates reminders, improves engagement with end user, does not require human effort. A documentation section at Voxeo platform contains information about technical knowledge required for writing VXML applications, details about services and limitations of the platform.

4.4 Integrated ICT4D Platform

As the objective of this research was to design a prototype ICT4D platform for integrating TBAs into conventional maternity healthcare and transitioning conventional healthcare system from paper records to EMRs, there were two major components: a web portal and a voice service. Both components were successfully created by applying a user-centred design strategy; web portal and voice service are fully functional. Using a free trial version of Voxeo Evolution, database integration was tested for uploading the voice recordings to open source MySQL database management system. Voice service records information and assigns it to variables, which were then uploaded to database. For connecting web portal designed in Wix Editor to the database, Zapier's free trial version was used. Web portal could then

4.4 Integrated ICT4D Platform

access and download the voice recordings, adding them to relevant data collection. The integrated ICT4D platform is depicted in the figure 4.8. Using trial versions of Voxeo and Zapier, integrating voice service and web portal through database was successfully tested. Thus, meeting the needs of prototype ICT4D solution we have designed. However, for a full scale deployment, long term paid subscriptions will be required for continuous database access by components of ICT4D platform.

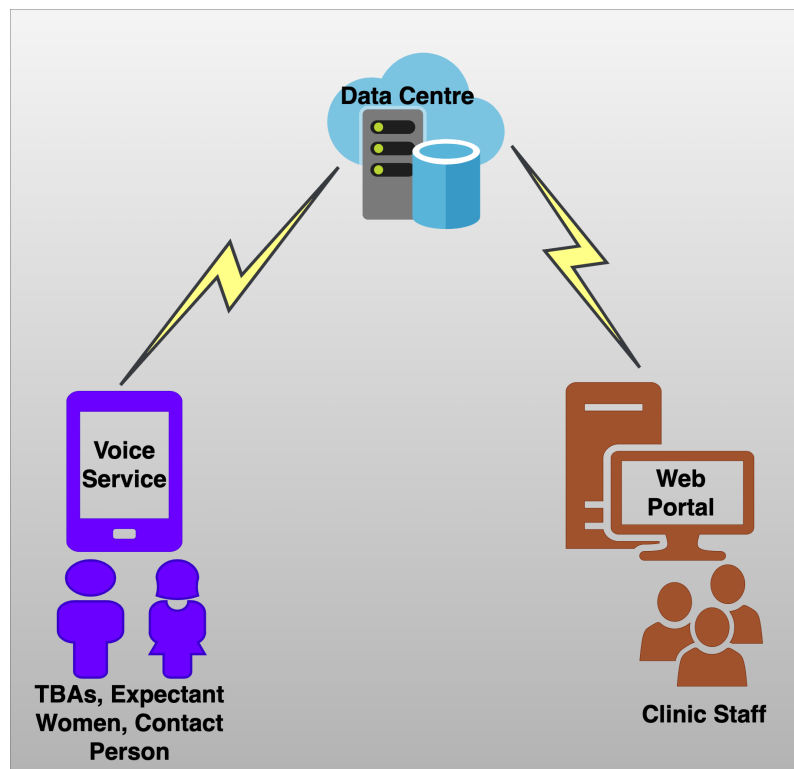


Figure 4.8: Integrated ICT4D platform

5

Testing and Evaluation

After designing, testing and evaluation of the ICT4D platform was carried out to ensure performance, functionality, reliability, suitability to local context; gaining insight into end-user experience, identifying missing features, documenting suggestions for improvement. A detailed testing and evaluation procedure is provided in next sections, followed by results.

5.1 Pilot Testing

The two major components of our ICT4D integrated platform, voice service and web portal, were first rigorously tested by the developer to fix any errors encountered, so that pilot testing could be performed. Testing ICT solutions in low-resource environments can be challenging as end users might not have a familiarity with ICT technologies (18). In that regard, we devised a training session for end users. Training was provided by Mr. Ali Gideon in person to the two main end users of our ICT4D platform: medical staff at clinic and TBAs. Medical staff at UDS maternity clinic were briefed about prototype web portal so that they can understand how it functions and get familiar with the interface. For TBAs, training session informed them about workings of voice service version in their local language. Upon being familiar with the ICT4D platform, pilot testing and evaluation of web portal and voice service were performed. In next section, evaluation strategy is given.

5.2 Evaluation Process

A semi-structured qualitative method was applied for formulating evaluation questionnaires for web portal and voice service. Pilot testing of both components was carried out in presence of Mr Ali Gideon, after which the questionnaires were filled by end users.

Questionnaires have open-ended questions and statements with Likert scale. For each component, the questionnaire is provided.

5.2.1 Web Portal Evaluation

Being the end users of web portal, this questionnaire was formulated for midwives to evaluate web portal and gain information about relevant aspects:

5.2.1.1 Prior Experience and Knowledge about EMRs

- Q1) Have you had any experience working with EMRs before?
- Q2) How was your experience, if any?
- Q3) How long did you use a digital system with EMRs, if any?
- Q4) In case, you have no experience with EMRs, do you have any knowledge about it?
- Q5) What is your impression about EMRs importance to maternity healthcare?
- Q6) Do you support the transition to EMR in UDS maternity clinic?
- Q7) Do you have any additional comments regarding EMRs?

5.2.1.2 Web Portal Functionality

Firstly, statements had to be assessed on a Likert scale with the following choices:

Table 5.1: Likert Scale for Web Portal Prototype

I don't know	Strongly Disagree	Disagree	Agree	Strongly Agree
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These statements were assessed by participants:

1. I am open to learning about this EMR Web Portal
2. I received adequate training on how to use this EMR portal
3. My questions about EMR portal use were properly answered
4. I need technical support while using the EMR portal
5. EMR portal responds to my clicks instantly
6. Our clinic has enough computers to access this portal by all staff
7. Data entry functions are easy to use
8. Data entry is faster than paper records
9. I can access the required information easily on portal
10. Information retrieval is faster than paper records
11. It is easy to learn the use of web portal

12. I can train other medical staff once I am familiar
13. User interface is friendly
14. Web portal has all functionalities that I expected
15. Having data of TBAs is helpful for clinic
16. Portal's feature to store voice messages of TBAs about patient visits is beneficial
17. I would recommend this web portal to other clinics
18. I understand the need for this web portal in our clinic
19. Using EMR web portal makes my work easy
20. Using EMR portal causes difficulty in my work
21. I have to do less work on web portal than paper records
22. I think EMR portal will improve the services of our clinic
23. I recommend shifting from paper records to EMR web portal
24. I prefer paper based records over EMR
25. Web portal should be included but paper record keeping shall continue as well
26. EMR web portal has better legibility than paper records
27. The clinic administration is supportive of EMR web portal
28. EMR will improve accuracy in data entry
29. EMR will improve data completeness
30. Ability to upload audio recordings is beneficial
31. Uploading audio recordings of patient interaction will improve documentation
32. In some circumstances (emergency, less time), recording audios is better than writing notes
33. Overall, my experience with EMR web portal is satisfactory

Next, for gaining further insight into web portal evaluation, these open ended questions were included:

- Q) What are the benefits of EMR Web Portal for maternity healthcare and your work?
- Q) What more functionalities do you want in the web portal?
- Q) Which problems have you noticed in the EMR Web Portal?
- Q) Which suggestions do you have for improving the EMR web portal?
- Q) After testing the EMR Web Portal, do you think it is better than paper records? If yes, why? If no, why?
- Q) What are the disadvantages of working with paper based records?
- Q) What are your views on the transition to EMR web portal from paper based records?

5.2.1.3 Web Portal’s impact on clinical practices

This part of the questionnaire measures impact of web portal usage on clinical practices by letting midwives assess statements on this Likert scale:

Table 5.2: Likert Scale for impact assessment

Highly Detrimental	Slightly Detrimental	Neutral	Slightly Beneficial	Highly Beneficial
-----------------------	-------------------------	---------	------------------------	----------------------

Statements assessed with the above Likert scale are:

1. Patient’s experience with clinical staff
2. Quality of maternity healthcare
3. Interactions amongst clinical staff
4. Staff’s stress level
5. Efficiency of clinicians
6. Clinicians access to data
7. Managing referrals to Doctors
8. Tracking important dates for providing care
9. Communication with pregnant women
10. Avoidance of errors
11. Overall, clinical experience

5.2.1.4 Views about integration of TBAs in Web Portal

Lastly, to evaluate the functionality of Web Portal for integration of TBAs and views of medical staff about TBAs in general, the following Likert scale was assessed on statements.

Table 5.3: Likert Scale for TBA integration

Strongly Disagree	Disagree	Neutral	Slightly Agree	Strongly Agree
----------------------	----------	---------	-------------------	-------------------

Statements assessed on the above Likert scale:

1. TBAs should be integrated in conventional healthcare
2. TBAs are useful for maternity healthcare
3. TBAs have a solid knowledge about pregnancy and related complications
4. TBAs follow a standardised practice

5.2 Evaluation Process

5. Society and women trust TBAs more than formal healthcare
6. TBAs are more culturally sensitive in maternity healthcare as compared to clinical staff
7. Role of TBAs in society should continue
8. I consider TBA practices to be safe
9. I think TBA services can be improved
10. Clinical staff can learn about cultural sensitivity from TBAs and their practices
11. I have negative perceptions about TBAs in general
12. Practices of TBAs cause problem for women
13. TBAs should be given proper medical training
14. I am ready to train TBAs at clinic
15. Clinic administration will facilitate the training of TBAs
16. Support from government is necessary for a proper training program
17. Integration of TBAs will improve quality of maternal healthcare
18. Integration of TBAS will improve outcomes of maternal healthcare
19. Outreach of clinic to patients will improve with integration of TBAs
20. Incorporating TBA voice recordings about patient visits will help clinic to understand their practices and improve them

Further, these open ended questions were designed for a deeper understanding of views of medical staff:

- Q) How many times have you interacted with TBAs in the past?
- Q) How was your experience while interacting with TBAs about expectant mothers?
- Q) What is your opinion about the importance of TBAs in society?
- Q) What steps need to be taken for integrating TBAs in maternal healthcare?
- Q) If you are against the integration of TBAs into maternity healthcare, why is it so?
- Q) If you support the integration of TBAs into maternity healthcare, what are the reasons?
- Q) What are the strengths of TBA practices, in your opinion?
- Q) What are the shortcomings/weaknesses of TBA practices, in your opinion?
- Q) Do you have any ideas for the training program aimed at improving the practices of TBAs and integrating them into maternity healthcare?
- Q) Do you have any reservations (they will take up your job, etc) if you are part of the training program which trains TBAs with best evidence based scientific medical practices?
- Q) What are your views on a voice-based service that will allow TBAs to contact clinic and record the patient information in voice messages for the clinic?

Q) If TBAs contact the clinic regularly and provide information about their practices and advices for visiting women, how do you think this information will help the clinic?

Q) What other functionality would you want to have in EMR system for integration of TBAs?

5.2.2 Voice Service Evaluation

The questionnaire for voice service evaluation was verbally answered by TBAs due to illiteracy and answers were recorded in form of audios which were later transcribed. Below we present the questionnaire for TBAs:

5.2.2.1 Background, practices, views of TBAs

This part consisted of the following open ended questions:

- Q) How long have you been practicing as a TBA?
- Q) How did you gain these skills for becoming a TBA?
- Q) Do you think pregnant women prefer TBAs over clinics? If yes, why is that?
- Q) What role does culture play in traditional maternity healthcare and your services?
- Q) Do you refer women to clinic? If yes, at what stages?
- Q) How do women respond when you refer them to clinics?
- Q) Do you recognise any limitations in your knowledge regarding pregnancy and child-birth?
- Q) On what basis do you provide a diet plan to pregnant women, if any?
- Q) Do women prefer visiting you or home service for pregnancy related matters?
- Q) How many times women visit or utilise your services in prenatal period?
- Q) Do you wish to work closely with conventional healthcare (hospitals/clinics) for maternal care?
- Q) Are you open to the idea of training programs conducted by healthcare facilities/government?
- Q) What kind of a training program will be suitable and helpful in your opinion?
- Q) Do you want to share the information related to services and advices provided to women with conventional healthcare facilities?
- Q) How do you compare conventional healthcare services with TBA services?
- Q) Do you consider clinic/conventional healthcare to be better or not for maternity services as compared to you?
- Q) What important steps need to be taken for integration of TBAs into conventional healthcare?

Q) Do you own a mobile phone? If yes, of what type?

Q) Are you open to the idea of a voice based service for sharing pregnancy related information with the clinics?

5.2.3 Voice Service Functionality

For evaluating the functionality of voice service, first a set of statements were assessed on the following Likert scale:

Table 5.4: Likert Scale for Voice Service Evaluation

Strongly Disagree	Disagree	Neutral	Slightly Agree	Strongly Agree
-------------------	----------	---------	----------------	----------------

The statements assessed on above Likert scale are:

1. I understand the need of integration with conventional healthcare
2. Integration will improve maternal healthcare
3. I am able to understand the working of voice service
4. I was provided adequate training of how to use the voice service
5. With consent of women, I am ready to share information with clinics
6. Voice service has required functionality for information sharing
7. Integration through voice service will improve quality of my work
8. Voice service will have a negative impact on my work
9. I have privacy concerns while sharing information
10. Pregnant women who utilise my service will support information sharing
11. If pregnant women have concerns, I can convince them to share information
12. I view clinics and their services positively
13. Referring women to clinics at right stages can improve health outcomes
14. I can provide care and simultaneously update clinic with voice service
15. Voice service is convenient than visiting clinics to provide information
16. I can adapt to any changes made in voice service later on
17. Voice service is easy to understand and self explanatory
18. If there are changes made in voice service, I will need technical assistance
19. Documentation of maternal care and services through writing is difficult
20. Clinics will welcome our information sharing
21. Through voice based information sharing, women can be better motivated to visit clinics

5.2 Evaluation Process

22. I don't have an issue with clinic or government processing the data provided in voice messages to clinics
23. I am open to learning better practices if clinics observe a malpractice in the information I provide and ask me to change it
24. I will prefer my experience and knowledge instead of accepting clinic's advice to change my practices
25. I have visited/interacted with clinical staff before
26. My experience with clinical staff good
27. My experience with clinical staff was really poor
28. Clinical staff have negative views about TBAs
29. Clinical staff does not respect TBAs
30. I have had a bad experience with clinic and that's why do not want to interact with clinic
31. If clinical staff has positive attitude, I am ready to interact with them through voice service
32. Apart from details of pregnancy, I can also share my expertise and knowledge with clinic
33. Voice service is a step in right direction for integration of TBAs into conventional healthcare
34. Overall, I have a positive impression and will use voice service if implemented

Finally, these open ended questions were also included in this part:

- Q) What other functionality would you want in the voice service?
- Q) What is your opinion on integration through voice service?
- Q) If you have faced any difficulty in voice service, please elaborate.
- Q) Let us know if you have any additional comments regarding the voice service and integration.

6

Results

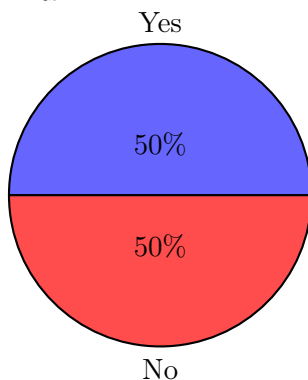
6.1 Web Portal Results

Evaluation of web portal was done based on semi-structured questionnaire in section 5.2.1, a total of 6 midwives participated in evaluation. It must be noted that at UDS maternity clinic, the total strength of midwives is 6. Results for web portal evaluation are presented in the same order as the questionnaire given in section 5.2.1. These midwives will be referred as Midwife 1, Midwife 2, Midwife 3, Midwife 4, Midwife 5 and Midwife 6.

6.1.1 Prior experience and knowledge about EMRs

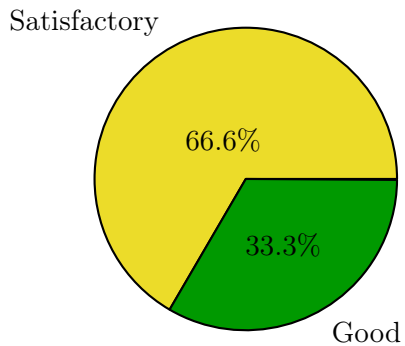
Q) Have you had any experience working with EMRs before?

3 midwives have experienced EMR in the past, while other 3 have no experience with EMRs.



Q) If yes, how was your experience?

The pie chart below only presents type of experience for 3 midwives who have experienced EMRs in the past.



Q) How long did you use a digital system with EMRs?

Midwife 1: No experience

Midwife 2: No experience

Midwife 3: 6 months

Midwife 4: Years

Midwife 5: 10 Months

Midwife 6: No experience

Q) In case, you have no experience with EMRs, do you have knowledge about EMRs?

Midwife 1: Yes

Midwife 2: Yes

Midwife 3: Have experienced

Midwife 4: Have experienced

Midwife 5: Have experienced

Midwife 6: No

Q) What is your impression about EMRs relating to maternity healthcare, based on your knowledge?

6.1 Web Portal Results

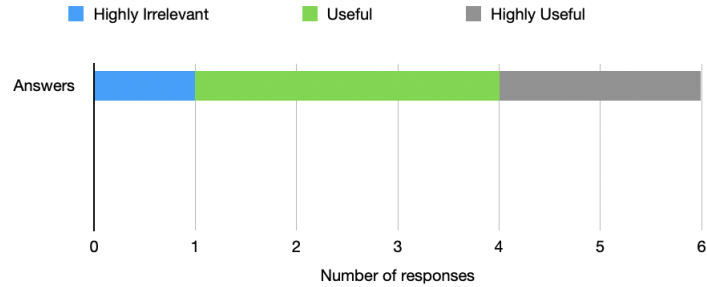
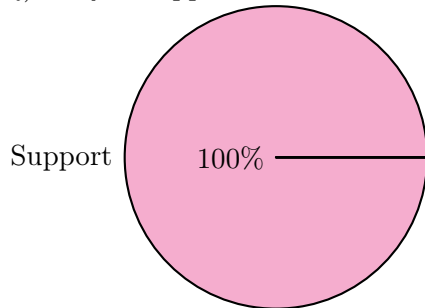


Figure 6.1: Impression of EMRs on Midwives

Q) Do you support the transition to EMR in this maternity clinic?



6.1.2 Web Portal Functionality

Now, results for web portal functionality are presented which consist of Likert scale statements in section 5.2.1.2 assessed by 6 midwives.

6.1 Web Portal Results

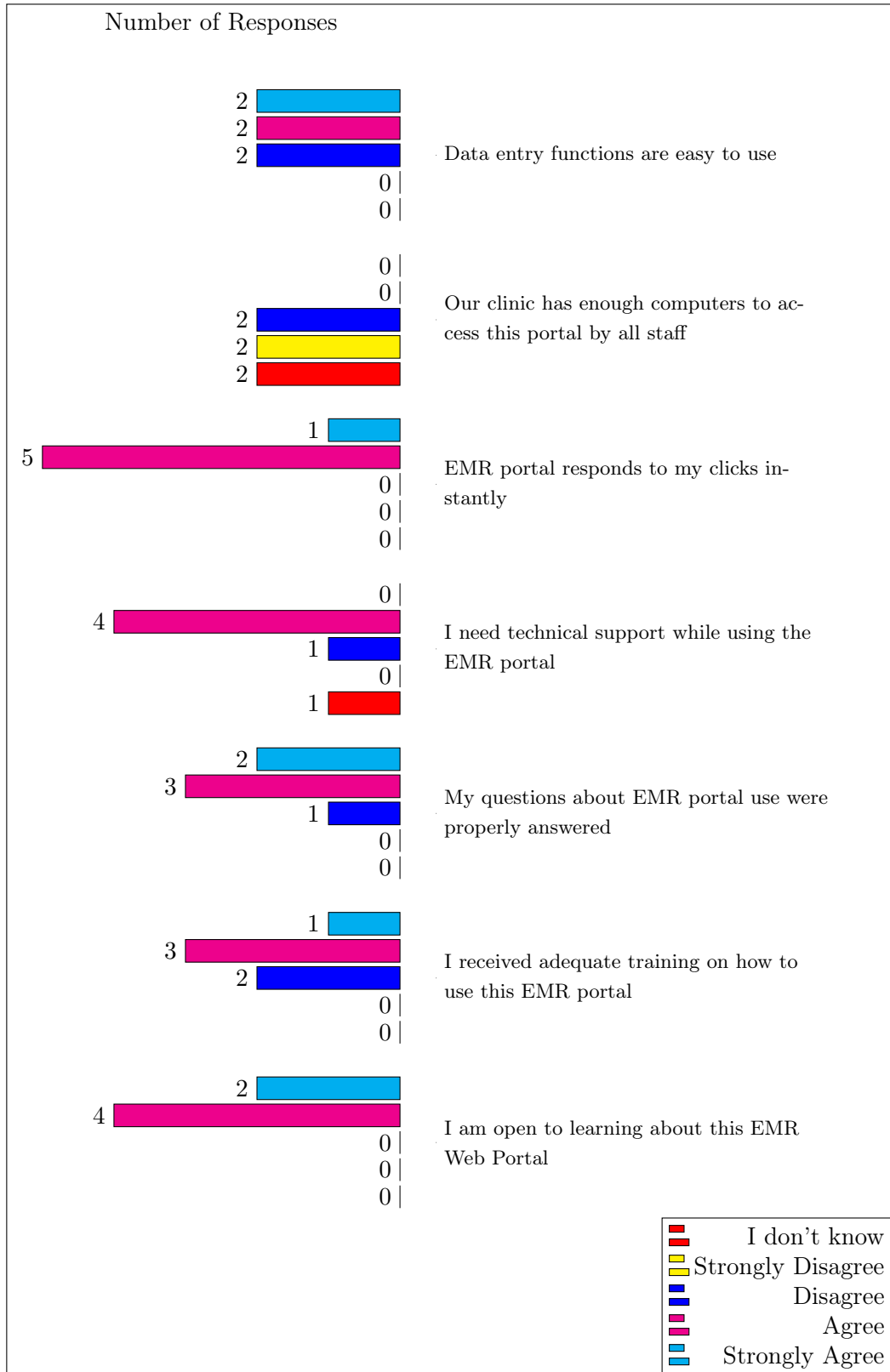


Figure 6.2: Results for Web Portal Functionality

6.1 Web Portal Results

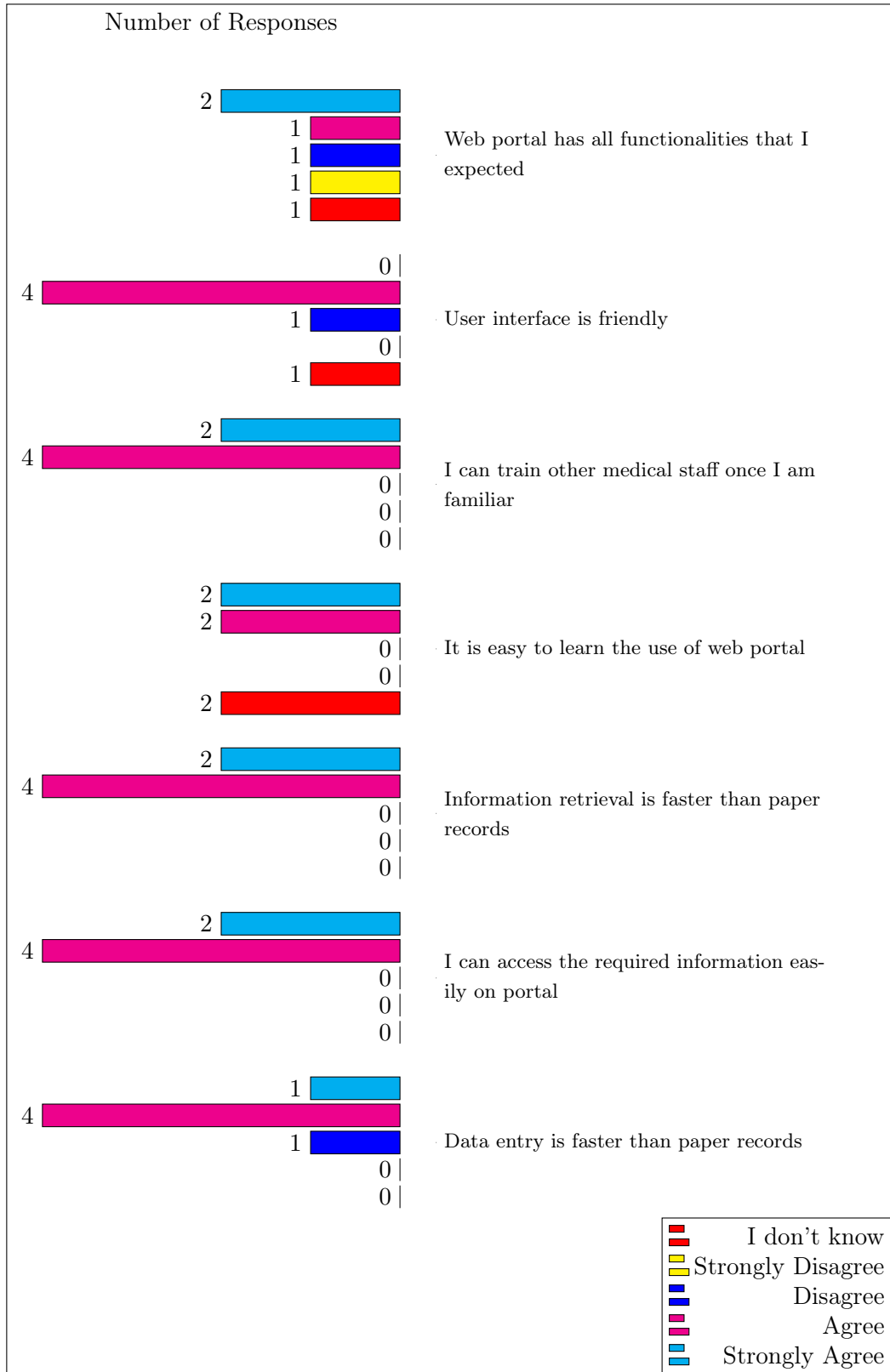


Figure 6.3: Results for Web Portal Functionality

6.1 Web Portal Results

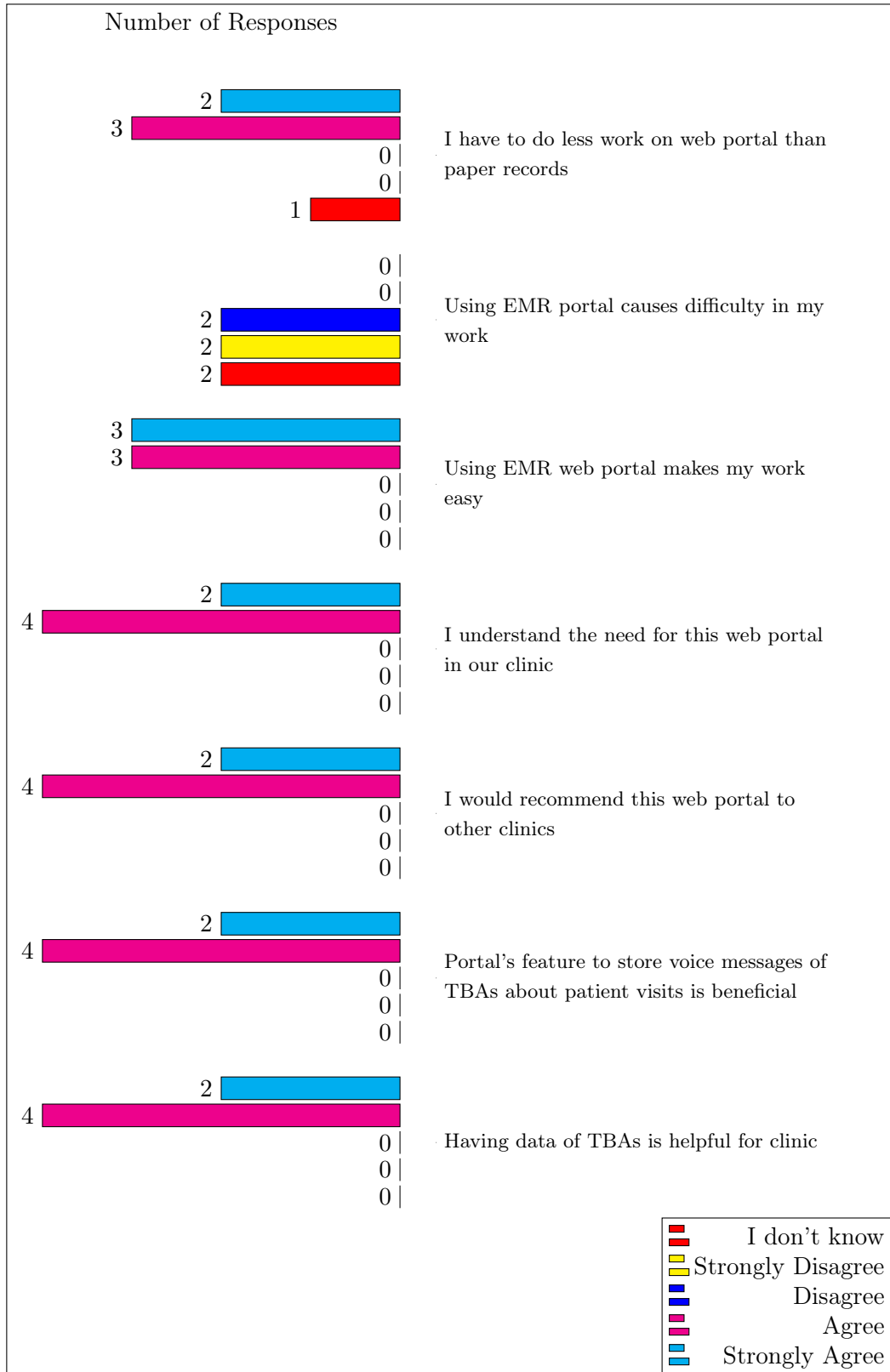


Figure 6.4: Results for Web Portal Functionality

6.1 Web Portal Results

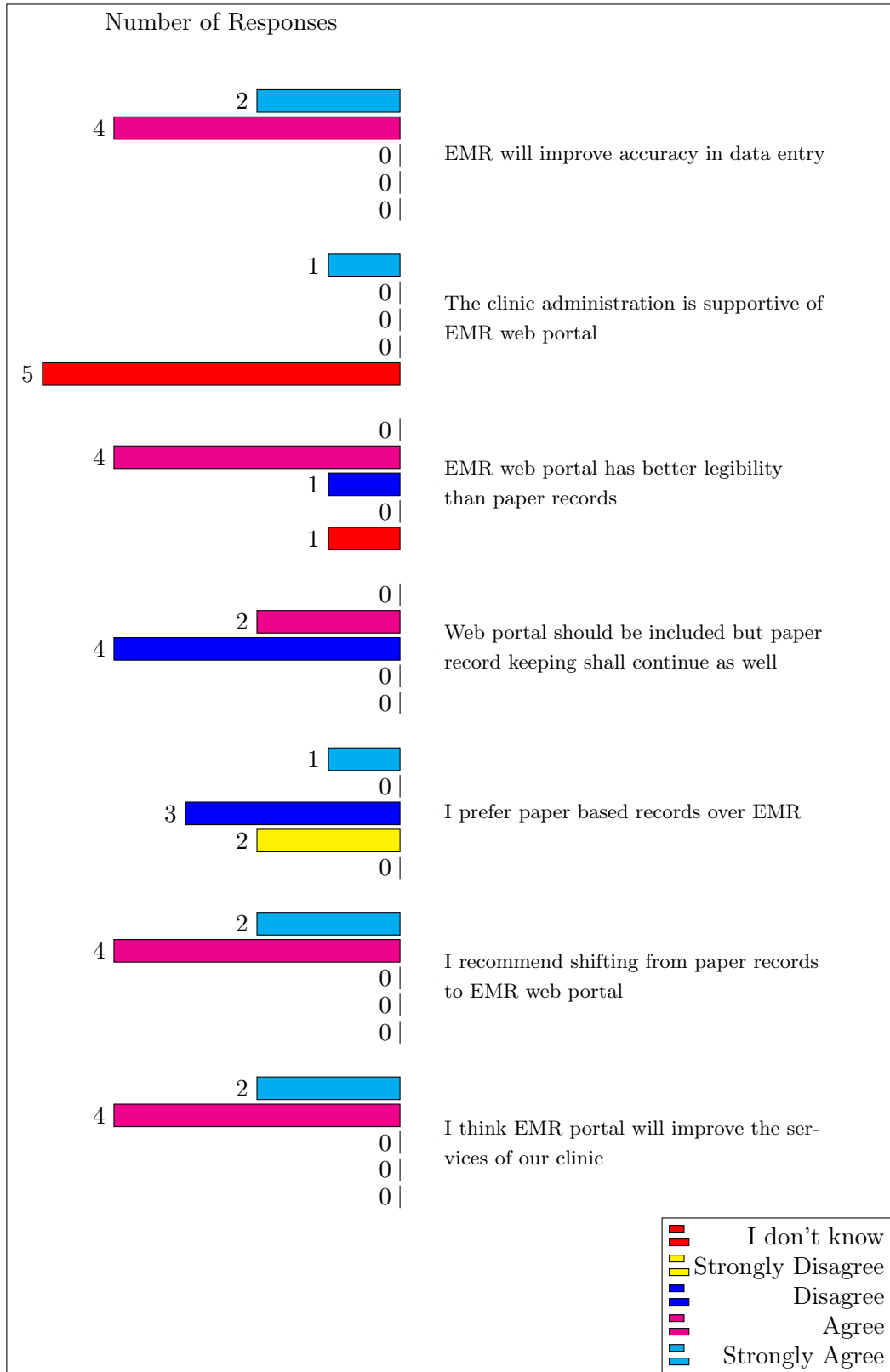


Figure 6.5: Results for Web Portal Functionality

6.1 Web Portal Results

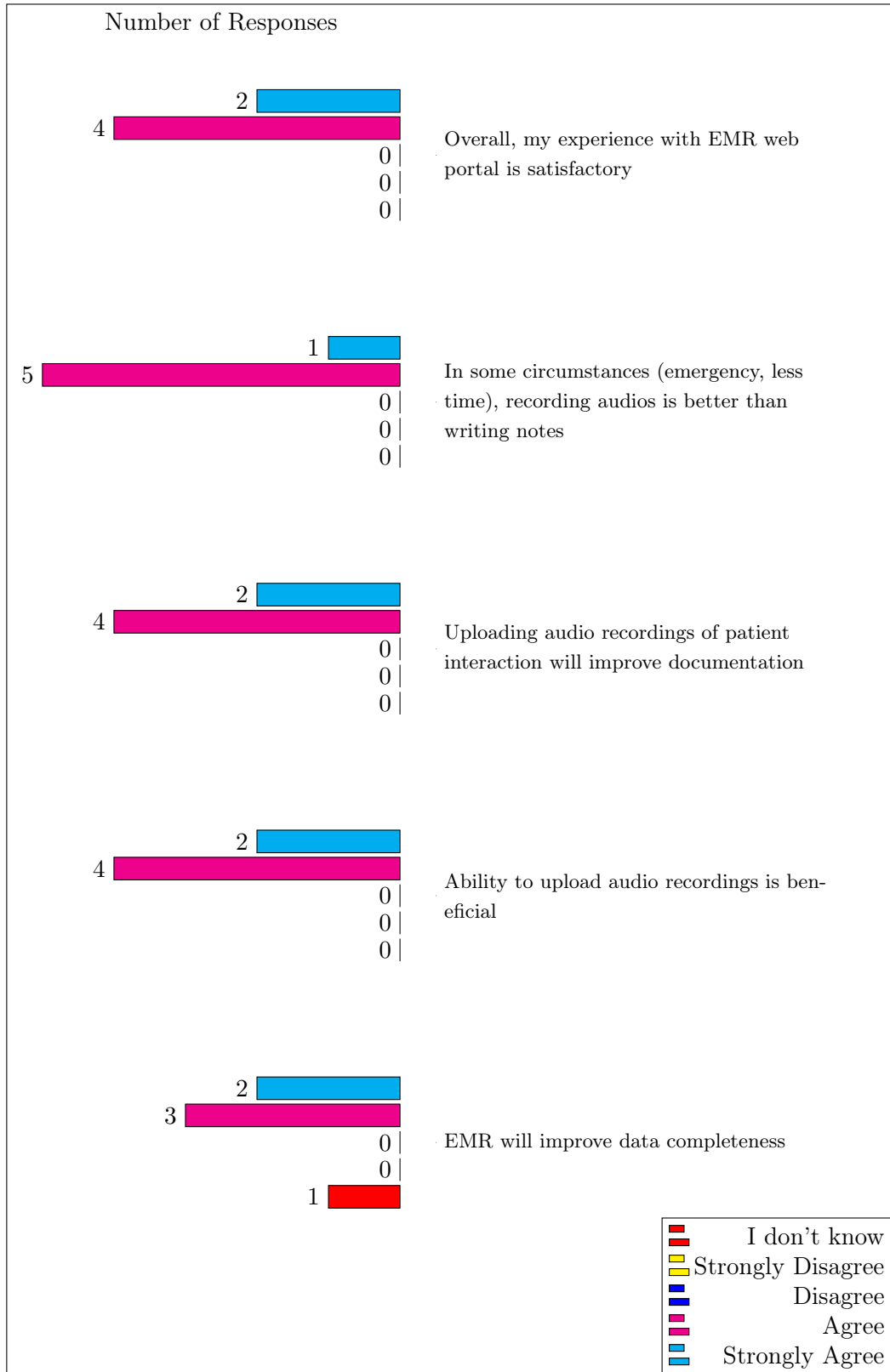


Figure 6.6: Results for Web Portal Functionality

6.1.2.1 Qualitative Results for Web Portal Functionality

For open ended questions in section 5.2.1.2, the answers of midwives are given below.

Q) What are the benefits of EMR Web Portal for maternity healthcare and your work?

Midwife 1: Data entry is better. Error reduction. It ensures data accuracy.

Midwife 2: Keeps record safe and accessible. Easy continuity of care amongst staff

Midwife 3: Quality care and assessment. Improved accessibility and efficient report generation.

Midwife 4: It makes work easier, faster and improves quality of work

Midwife 5: Quality health care delivery. Easy documentation of patients health details.

Midwife 6: Improves record keeping. Clients information/health records will be safe guarded in the event of an disaster like fire or flooding. Also rodents like mice rats squirrel will be prevented from damaging patient records. Easy access to clients records irrespective of place or time for timely medical interventions. Improves work efficiency

Q) What more functionalities do you want in the web portal?

Midwife 1: A function to generate monthly report

Midwife 2: Information is up to date

Midwife 3: A more colourful, friendlier interface design

Midwife 4: I do not know

Midwife 5: More colors and alert signals

Midwife 6: A tab where you can write important notes. For instance a client comes for her routine ANC visit but has to see a doctor for a medical condition or she presents come complaints to the midwife, there should be place on the portal where you can document patient complaints or referrals made.

Q) Which problems have you noticed in the EMR Web Portal?

Midwife 1: Some fields should have drop down menu

Midwife 2: None

Midwife 3: Repetition of some patient details for example registration number

Midwife 4: Network problems

Midwife 5: Patient registration number appearing on every page

Midwife 6: No problems

Q) Which suggestions do you have for improving the EMR web portal?

Midwife 1: Community health nurses and midwives should not have same access to the system since we have different scope of work

Midwife 2: Quality information or use of EMRs, availability of internet

Midwife 3: Coordinate administrative functions for smooth referrals, limit typing and increase options for check boxes

Midwife 4: Make network stable

Midwife 5: There should be more options for number selection

Midwife 6: None

Q) After testing the EMR Web Portal, do you think it is better than paper records? If yes, why? If no, why?

Midwife 1: Yes it makes data entry faster and easier

Midwife 2: They are both useful in different ways, the client is able to access her records on paper whereas the health care provider can access records on the EMR

Midwife 3: Yes it easy to use and reduces paperwork being captured in various registers

Midwife 4: It is better because it makes work easier and faster

Midwife 5: Yes it has the potential of reducing data loss and saves time

Midwife 6: Yes the EMR web portal unlike the paper based records keeping is safer in terms of confidentiality as a passcode is required to access patient information

Q) What are the disadvantages of working with paper based records?

Midwife 1: Loss of client data, incompleteness of client/patient records, difficulty in generating monthly report, unable to attend to patients if they do not report with their maternal health record book

Midwife 2: Records are easily lost

Midwife 3: Prone to damage and loss of data, limited security and privacy, errors in writing

Midwife 4: It waste a lot of time,, it makes work tedious

Midwife 5: Loss of data, errors in documentation, prolongs healthcare delivery

Midwife 6: Difficulty in keeping track of records, writing monthly reports are usually tedious

Q) What are your views on the transition to EMR web portal from paper based records?

Midwife 1: Improve care to patient, it will speed documentation process, improve client satisfaction

Midwife 2: Improves quality of work, makes work more easy

Midwife 3: If done properly will make work easier and faster

Midwife 4: Very good

Midwife 5: It will make provision of health care delivery faster, protect data of client

Midwife 6: Transitioning from paper based records system to EMR web portal will be of great help to midwives and other service providers in delivery quality care to patients/clients if implemented and used well

Q) How is the quality of internet in the clinic?

Midwife 1: It is good

Midwife 2: Very poor

Midwife 3: Fair

Midwife 4: Poor

Midwife 5: Good

Midwife 6: Relatively good

6.1 Web Portal Results

Q) What is the purchasing power of clinic? If the system is expanded with a dedicated server and database, is the clinic willing to spend on it?

Midwife 1: I do not have any idea on this

Midwife 2: I do not know

Midwife 3: No idea

Midwife 4: I do not know

Midwife 5: No idea

Midwife 6: I do not know

Q) Are there any local or foreign donors that support clinic in improving maternal healthcare?

Midwife 1: Yes

Midwife 2: None i know of

Midwife 3: No idea

Midwife 4: I do not know

Midwife 5: No idea

Midwife 6: To the best of my knowledge no

Q) How is the state of electricity in the clinic? Do you face power outages for a long time?

Midwife 1: No

Midwife 2: Occasionally

Midwife 3: No

Midwife 4: No

Midwife 5: No

Midwife 6: No, we do not usually face long time power outage

Q) In case of a power outage, are there alternative sources such as a generator or UPS to power up the computers and use electronic system?

Midwife 1: No

Midwife 2: No

Midwife 3: No

Midwife 4: No

Midwife 5: No

Midwife 6: No

Q) How is the state of internet in the clinic? Is it good or do you face interruptions quite often?

Midwife 1: Good

Midwife 2: Internet is unstable

Midwife 3: Fair

Midwife 4: Bad internet

Midwife 5: Fair

Midwife 6: The state of internet is good although there are days we face some challenges accessing the internet

6.1.3 Web Portal's Impact on Clinical Practices

In this section, the results for statements assessed on Likert scale in section 5.2.1.3 are given.

6.1 Web Portal Results

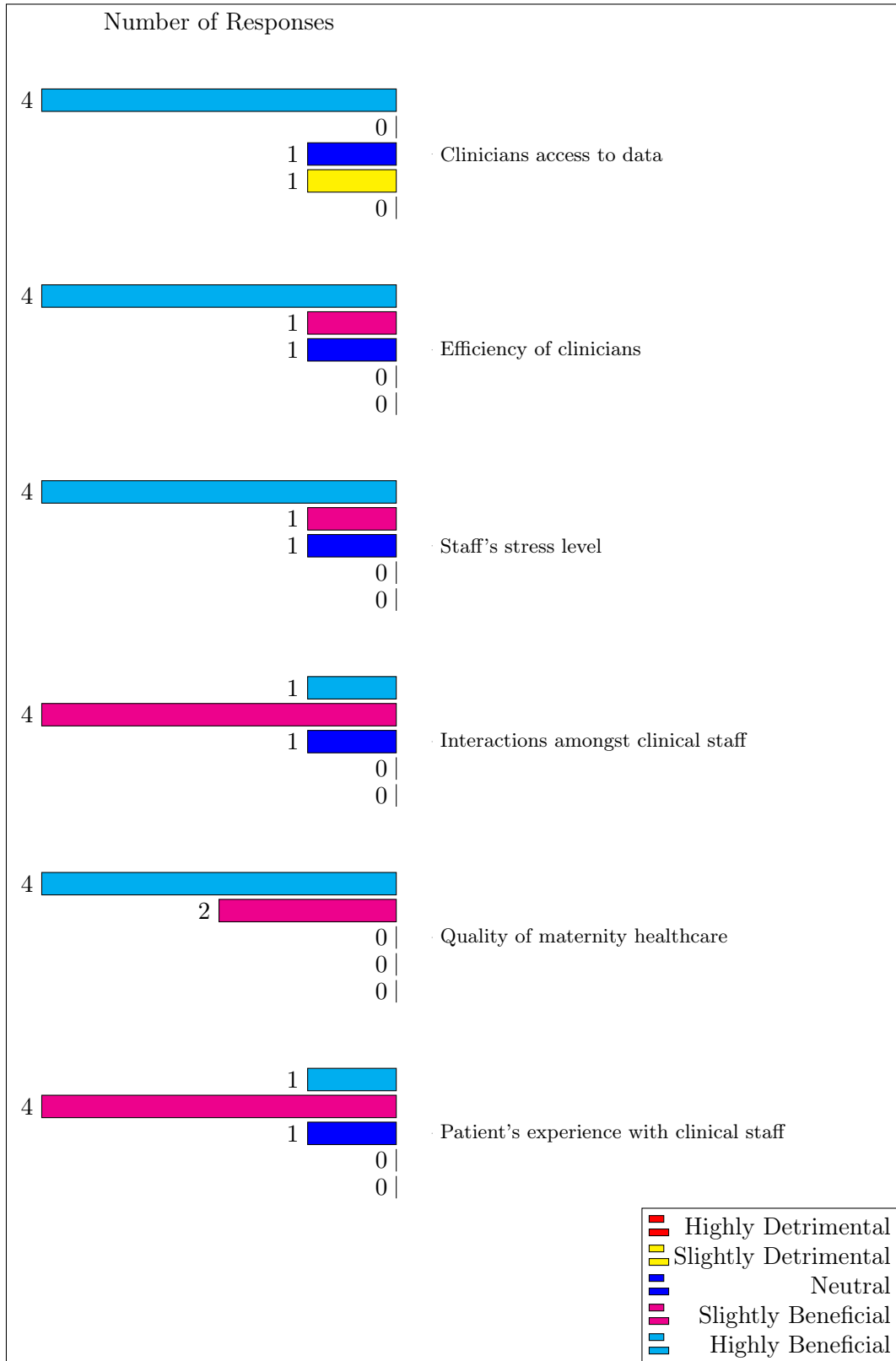


Figure 6.7: Web Portal's impact on Clinical Practices

6.1 Web Portal Results

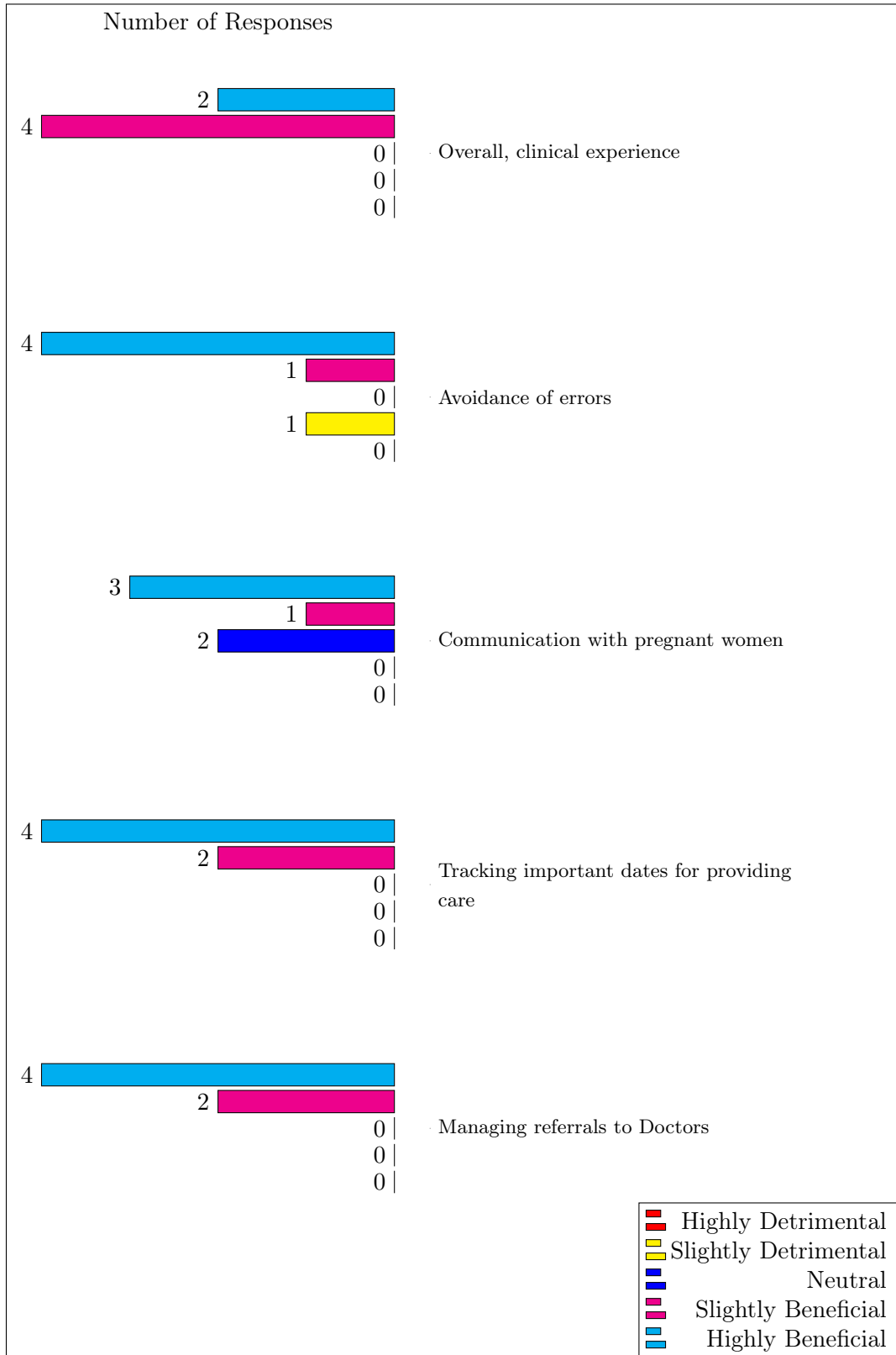


Figure 6.8: Web Portal's impact on Clinical Practices

6.1 Web Portal Results

6.1.4 Integration of TBAs through Web Portal

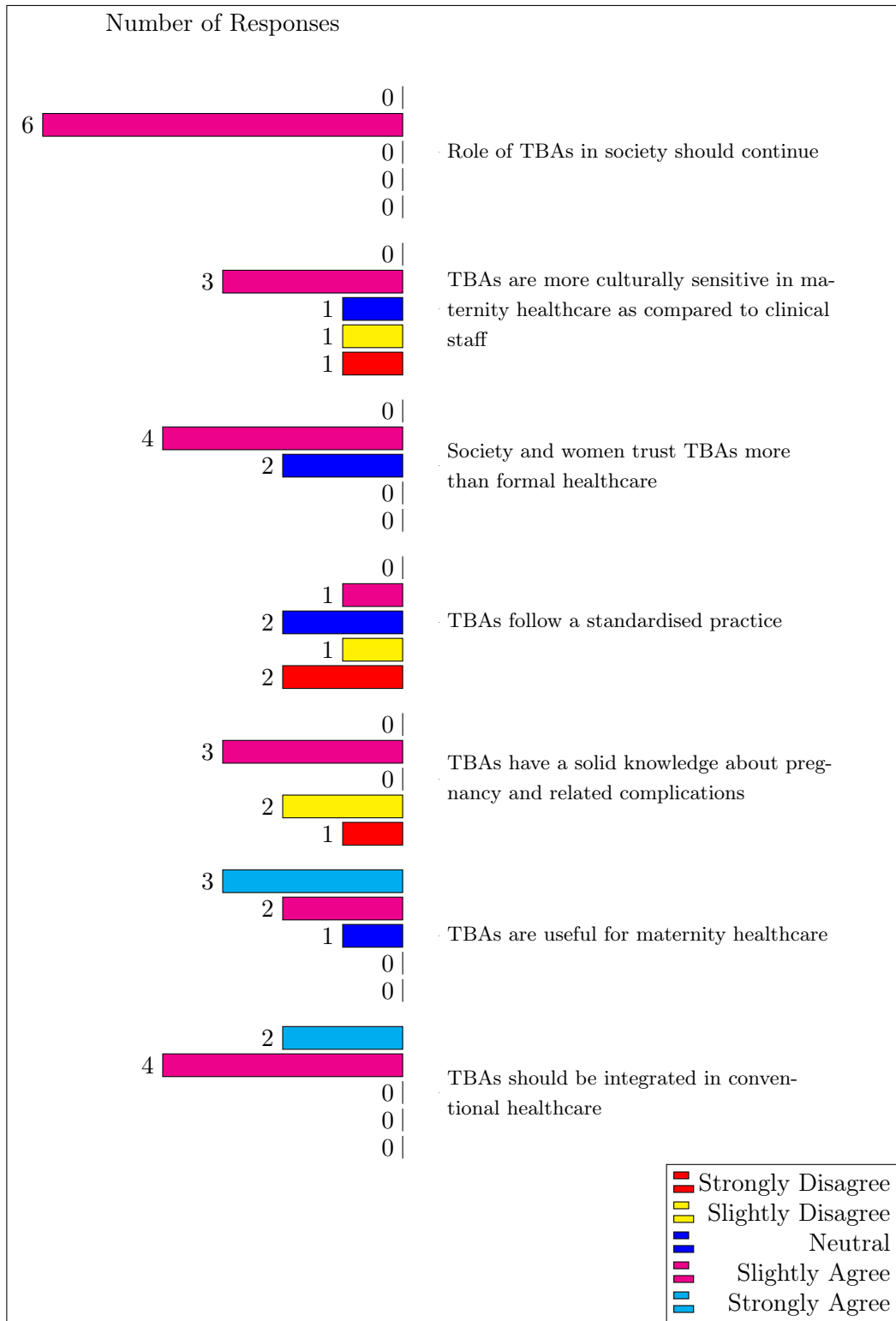


Figure 6.9: Views about integration of TBAs through Web Portal

6.1 Web Portal Results

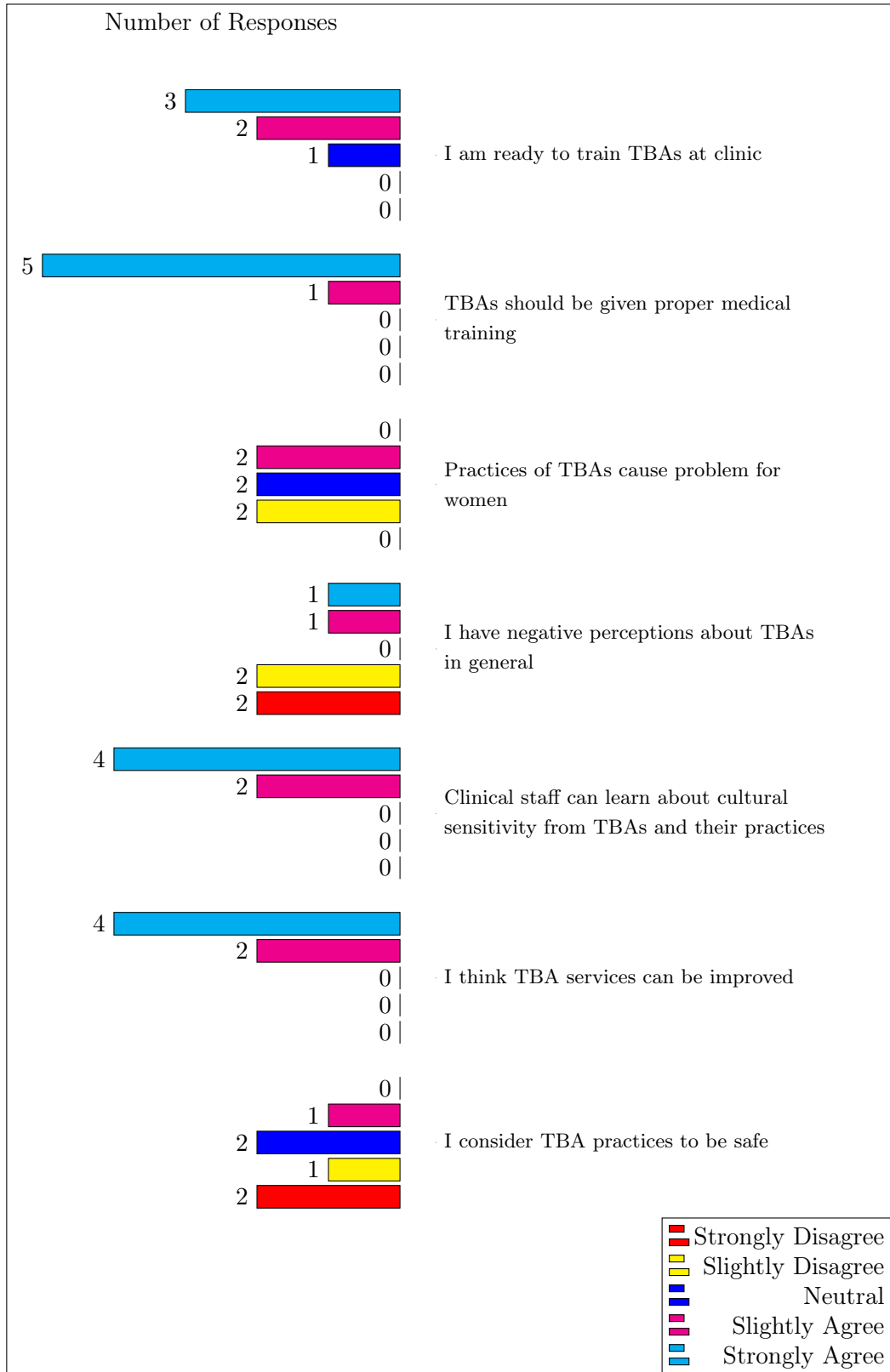


Figure 6.10: Views about integration of TBAs through Web Portal

6.1 Web Portal Results

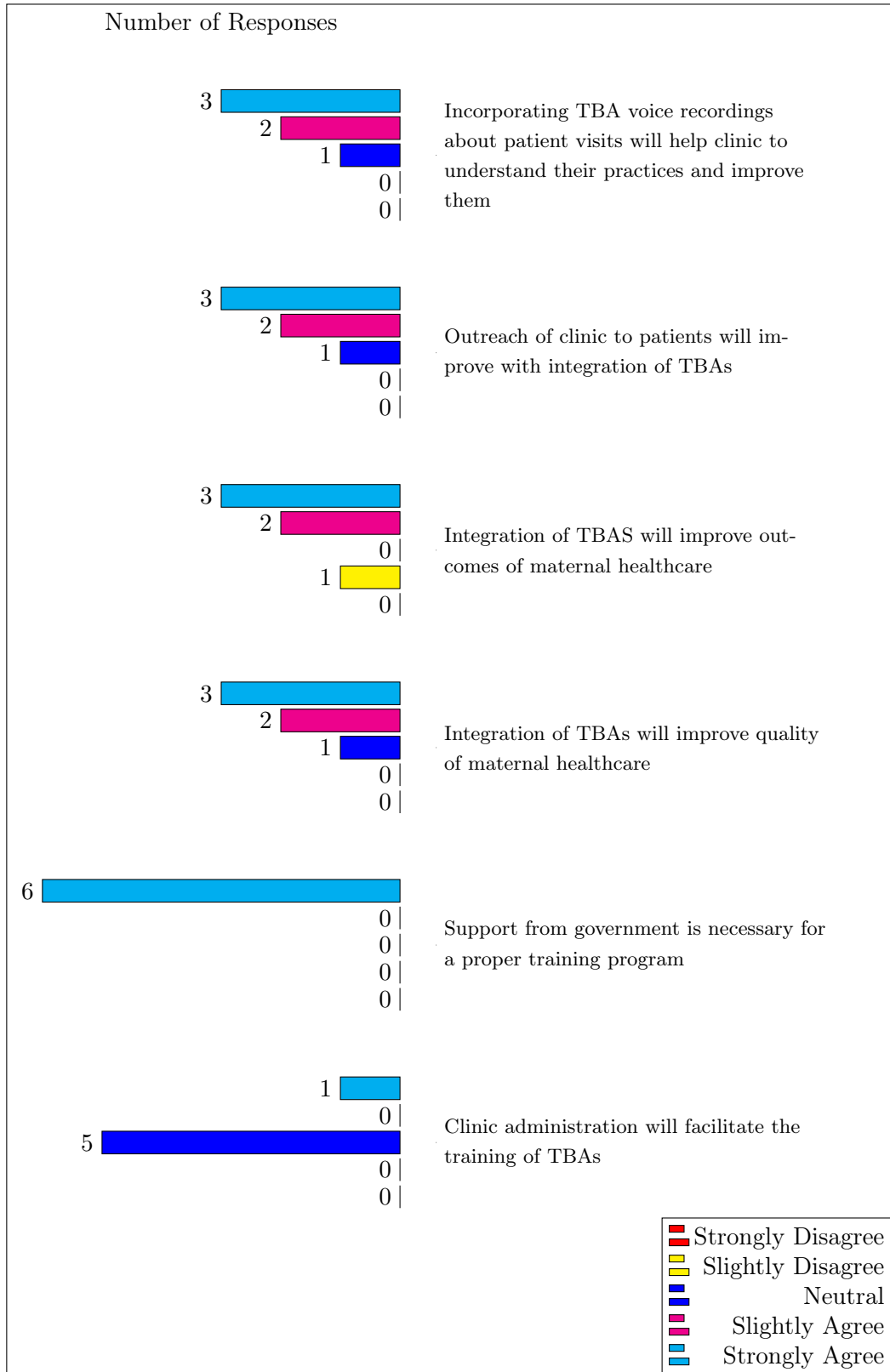


Figure 6.11: Views about integration of TBAs through Web Portal

6.1.4.1 Qualitative Results for TBAs integration through Web Portal

For further insight on perspectives of midwives about integration of TBAs through web portal, answers to open ended questions in section 5.2.1.4 are given below.

Q) How many times have you interacted with TBAs in the past?

Midwife 1: Few times

Midwife 2: Never

Midwife 3: Once

Midwife 4: On 3 occasions

Midwife 5: About 4 times

Midwife 6: Once

Q) How was your experience while interacting with TBAs about expectant mothers?

Midwife 1: Unanswered

Midwife 2: Never experienced

Midwife 3: She was very calm receptive and open to learn, she willingly shared knowledge gathered in her practice

Midwife 4: Good

Midwife 5: They are ready to learn new things and willing to share information

Midwife 6: I will describe my interaction with them as informative and enlightening, I picked up a few communication skills from them

Q) What is your opinion about the importance of TBAs in society?

Midwife 1: They play a vital role in providing maternal health

Midwife 2: They come in handy sometimes

Midwife 3: They have a unique relationship with members of the community hence have easier access to women and their cultural practices, ability to enhance health promotion and disease prevention

Midwife 4: Help attend to emergencies before arrival at the health facility

Midwife 5: Very good relationship with locals and families in the community

Midwife 6: In my opinion TBAs are a very important group in the society and with special training can help reduce maternal and child mortality and morbidity in the society and the nation as a whole

Q) What steps need to be taken for integrating TBAs in maternal healthcare?

Midwife 1: Training of TBAs in managing basic care of pregnant women, collaborating midwives and TBAs

Midwife 2: Proper communication between two parties

Midwife 3: Organise health seminars and training to equip them with clinical knowledge and protocols for better outcomes of health delivery, Develop an interactive/friendly relationship between TBAs and health care professionals, Mobilise funds and sponsorship, government support in delivering supplies for services

Midwife 4: Proper skilled training

Midwife 5: There should be training for all TBAs on how to manage basic obstetric cases and standard referral procedures

Midwife 6: First there is a the need to find out if TBAs are willing to be integrated into the program if they are, then extensive training should be given to them on maternal healthcare, Also there should be some form of evaluation done routinely to measure the success of TBAs after they have been taking thorough training

Q) If you are against the integration of TBAs into maternity healthcare, why is it so?

Midwife 1: Not against

Midwife 2: Not against

Midwife 3: Not against

Midwife 4: Not against

Midwife 5: Not against

Midwife 6: Not against

Q) If you support the integration of TBAs into maternity healthcare, what are the reasons?

Midwife 1: It will improve continuity of care at different levels

Midwife 2: No reasons

Midwife 3: TBAs when educated can change the views of most community members on various superstitious beliefs which prevent them from seeking adequate healthcare

Midwife 4: Help attend to emergencies and that helps improve the health care system in general

Midwife 5: When TBAs will integrate into maternal healthcare they will be able to improve health outcomes by providing initial support and referring cases at the right time

Midwife 6: I support the integration of TBAs into maternal healthcare because I believe with them (TBAs) working hand in hand with midwives, a wider population will be reached and we both can achieve our common goal of providing quality care to our expectant mothers

Q) What are the strengths of TBA practices, in your opinion?

Midwife 1: They are culturally sensitive and respect women and their families

Midwife 2: Conducting labour

Midwife 3: Ease of access to care and delivery of services in the community

Midwife 4: Good delivery practices

Midwife 5: They are culturally sensitive and family centred

Midwife 6: They are able to communicate effectively with pregnant women and also get them to follow their instructions to the letter

Q) What are the shortcomings/weaknesses of TBA practices, in your opinion?

Midwife 1: Their work is not well structured, they do not document the care provided, most of them do not have formal education

Midwife 2: Inadequate information on how to handle abnormal conditions

Midwife 3: Inadequate knowledge on infection preventive measures, inadequate skills in handling complications, lack modern equipment and services to ascertain laboratory findings and scans to efficiently track patients progress and address red flags.

Midwife 4: Inability to use aseptic techniques while discharging their duties

Midwife 5: Limited logistics and no/little knowledge on the use of basic obstetric equipment, inadequate knowledge in managing complications and reporting of care provided

Midwife 6: The fact that they lack scientific backings to some of their practices which sometimes leave our mothers with post delivery complications

Q) Do you have any ideas for the training program aimed at improving the practices of TBAs and integrating them into maternity healthcare?

Midwife 1: Training should be done in their local language

Midwife 2: Intensive collaboration between TBAs and midwives to facilitate proper care of clients

Midwife 3: Programs should be more practical based than theoretical, regular supervision should be done to evaluate them, TBAs should be equipped with necessary birth kit and supplies, a good and functioning referral system should be built for immediate response

Midwife 4: No

Midwife 5: A platform that can link midwives and TBAs should be developed, they should have knowledge in keeping the records of the care they provide to aid in continuity of care at the facility level

Midwife 6: Yes clinical meetings should be organised among TBAs and midwives so we can discuss issues pertaining to maternal health issues

Q) Do you have any reservations (they will take up your job, etc) if you are part of the training program which trains TBAs with best evidence based scientific medical practices?

Midwife 1: No

Midwife 2: No matter the training, TBAs can't fill the space of midwives

Midwife 3: Yes, to some extent

Midwife 4: No

Midwife 5: Not at all

Midwife 6: No I do not have any reservations

6.1 Web Portal Results

Q) What are your views on a voice-based service that will allow TBAs to contact clinic and record the patient information in voice messages for the clinic?

Midwife 1: It will help clinic staff (midwives) adequately prepare to receive patients referred to facility

Midwife 2: Since most TBAs are not fluent with English for writing they will be able to express themselves through voice based systems

Midwife 3: The system should be able to keep track of all voice messages and indicate if messages have been attended to

Midwife 4: It is good because it helps the health care provider understand everything the TBA would want to communicate

Midwife 5: The voice based service should notify system which will alert midwives to prepare and act quickly

Midwife 6: I think it is a good initiative

Q) If TBAs contact the clinic regularly and provide information about their practices and advices for visiting women, how do you think this information will help the clinic?

Midwife 1: It will help improve patient care and reduce complications

Midwife 2: It will help in accessing services by TBAs and ensure continuity of care for clients

Midwife 3: It gives an overview of community needs and shortfalls which helps in providing patient/community centred care from information gathered to meet these needs

Midwife 4: Improves the healthcare system, prevents maternal and infant mortality

Midwife 5: It will help the clinic by building good partnership between community members and the health facilities, it will also help the clinic to provide culturally sensitive care

Midwife 6: It will help in putting together accurate data about our clients

Q) What other functionality would you want to have in EMR system for integration of TBAs?

Midwife 1: Family planning records

Midwife 2: Nothing

Midwife 3: Monthly reviews and evaluation

Midwife 4: Voice recordings

Midwife 5: A system to generate reviews on monthly basis

Midwife 6: None

6.2 Voice Service Results

For voice service, evaluation process entailed in section 5.2.2 was applied to gain results by engaging three local TBAs in Nyankpala. First, quantitative results are presented, followed by answers to open ended questions.

6.2.1 Voice Service Functionality Assessment

Statements for testing voice service on basis of Likert Scale given in section 5.2.3 were assessed by three TBAs. Results are presented below.

6.2 Voice Service Results



Figure 6.12: Results for Voice Service Functionality

6.2 Voice Service Results

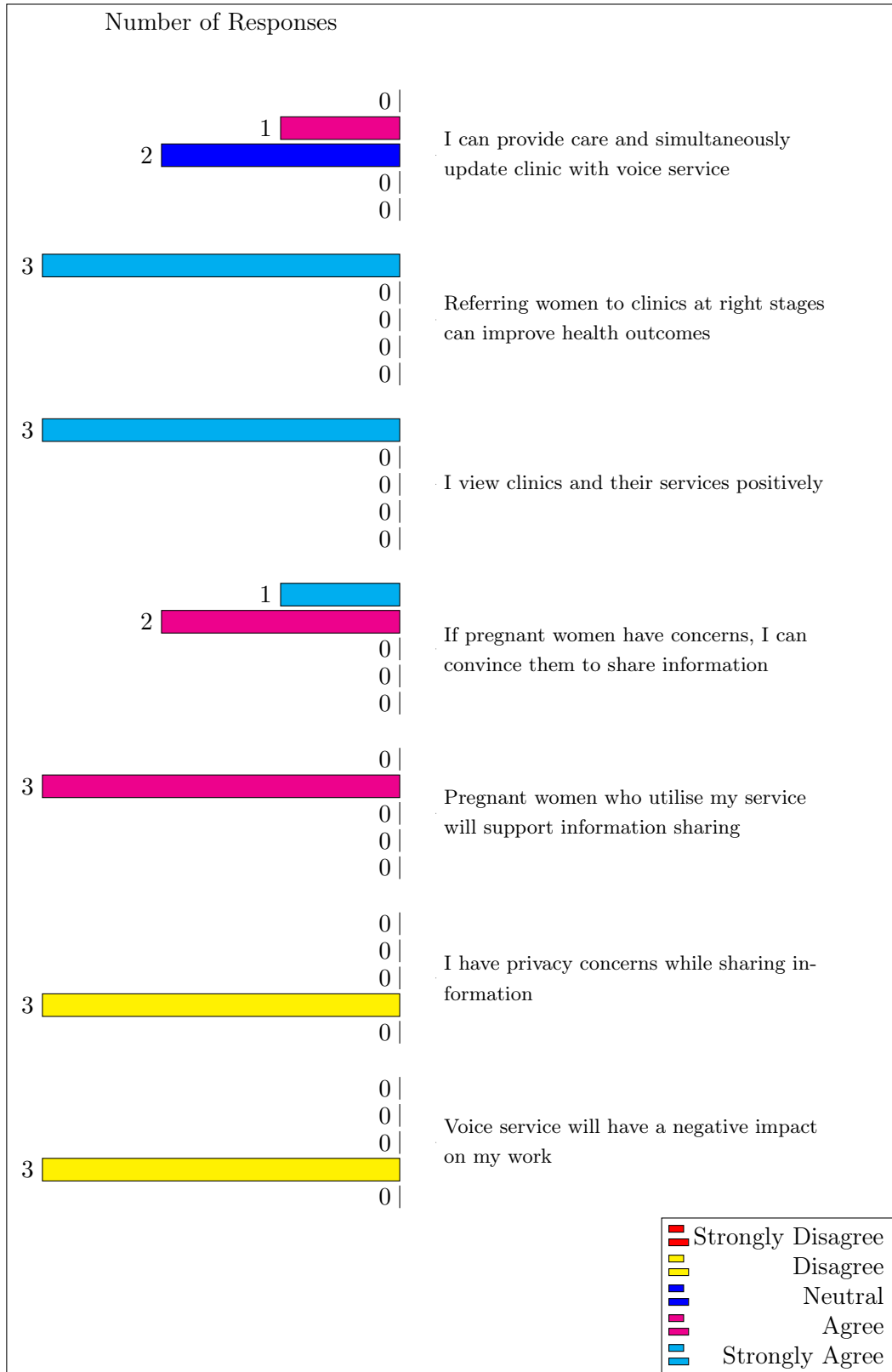


Figure 6.13: Results for Voice Service Functionality

6.2 Voice Service Results

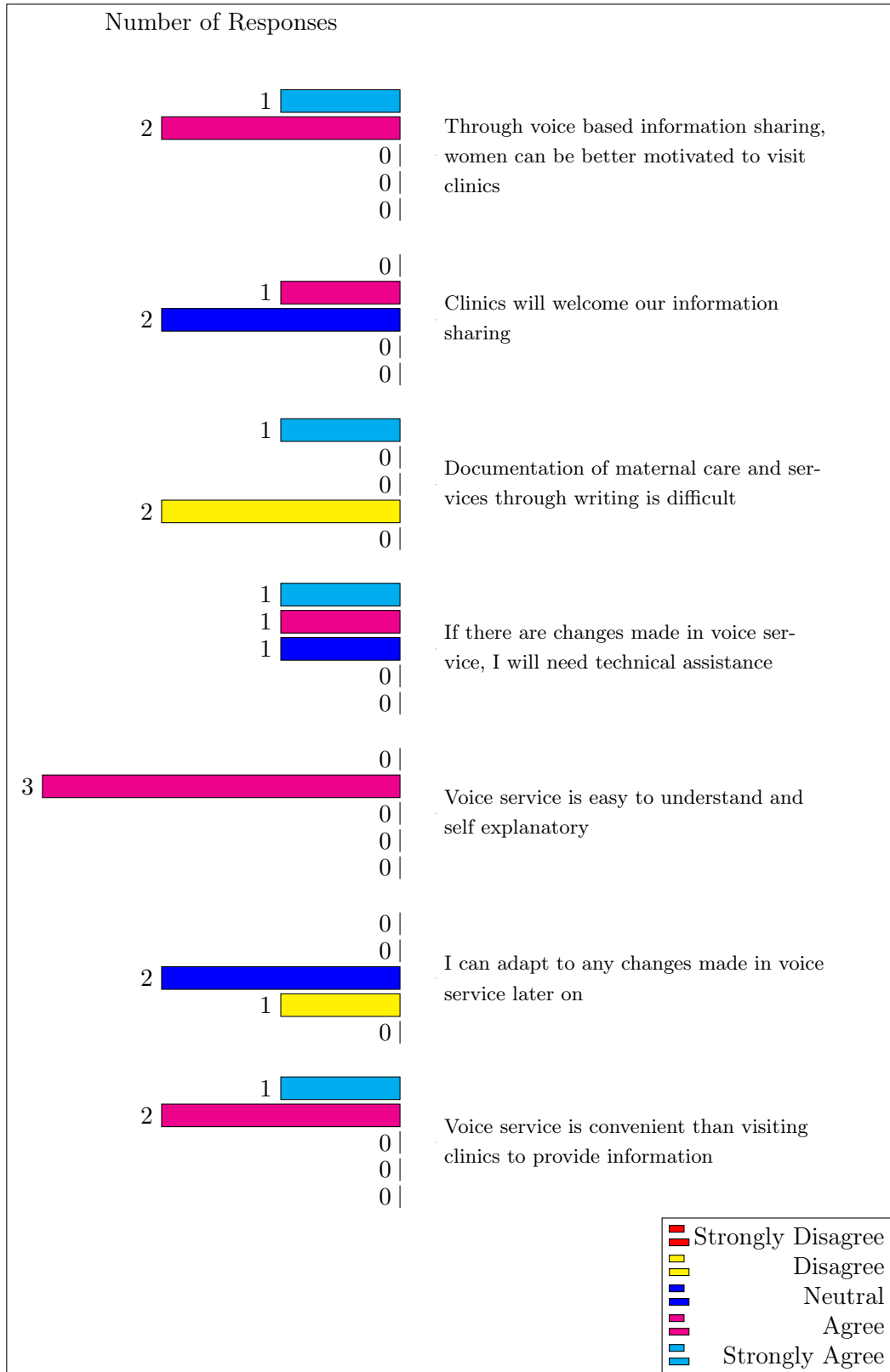


Figure 6.14: Results for Voice Service Functionality

6.2 Voice Service Results

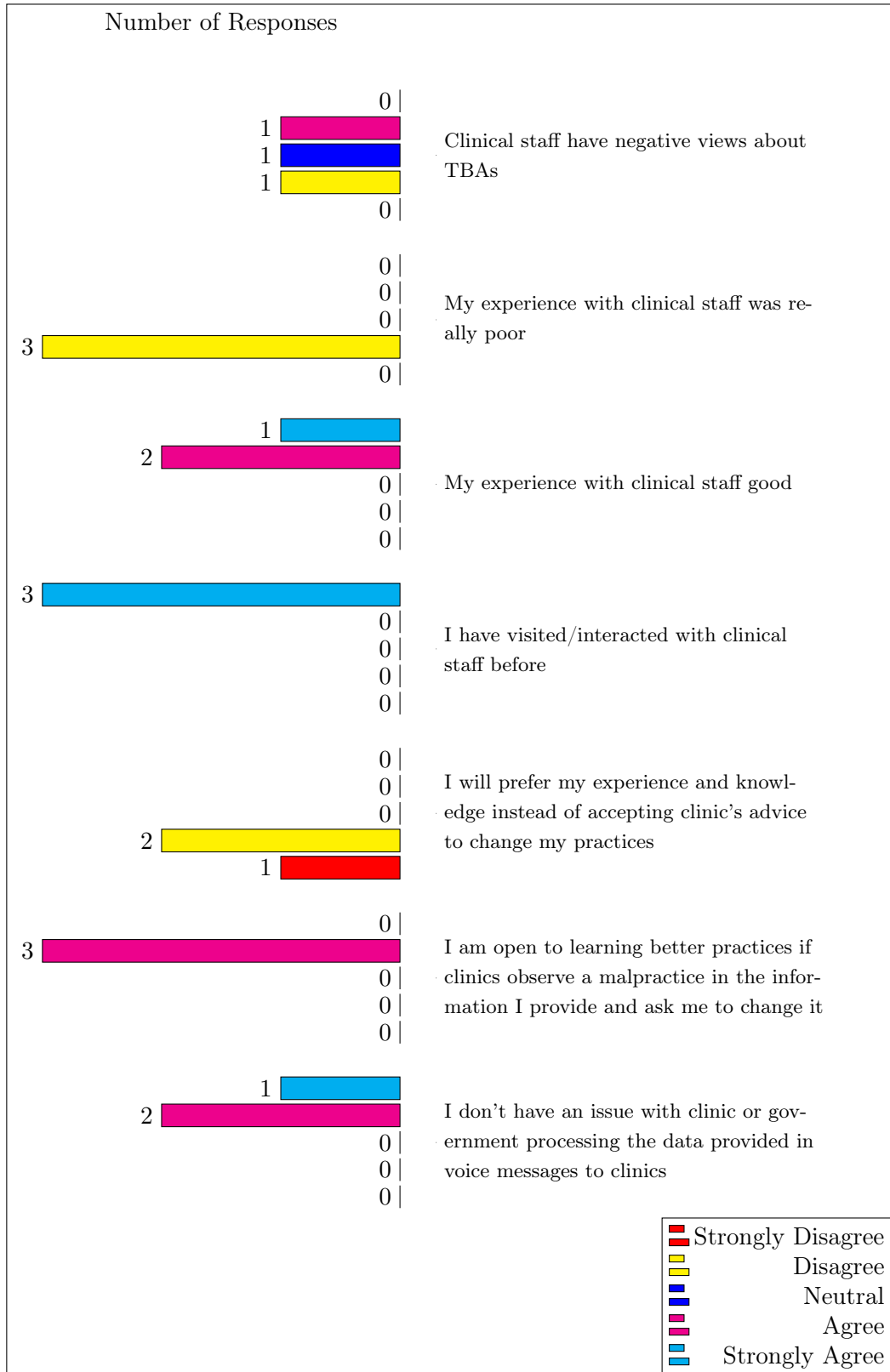


Figure 6.15: Results for Voice Service Functionality

6.2 Voice Service Results

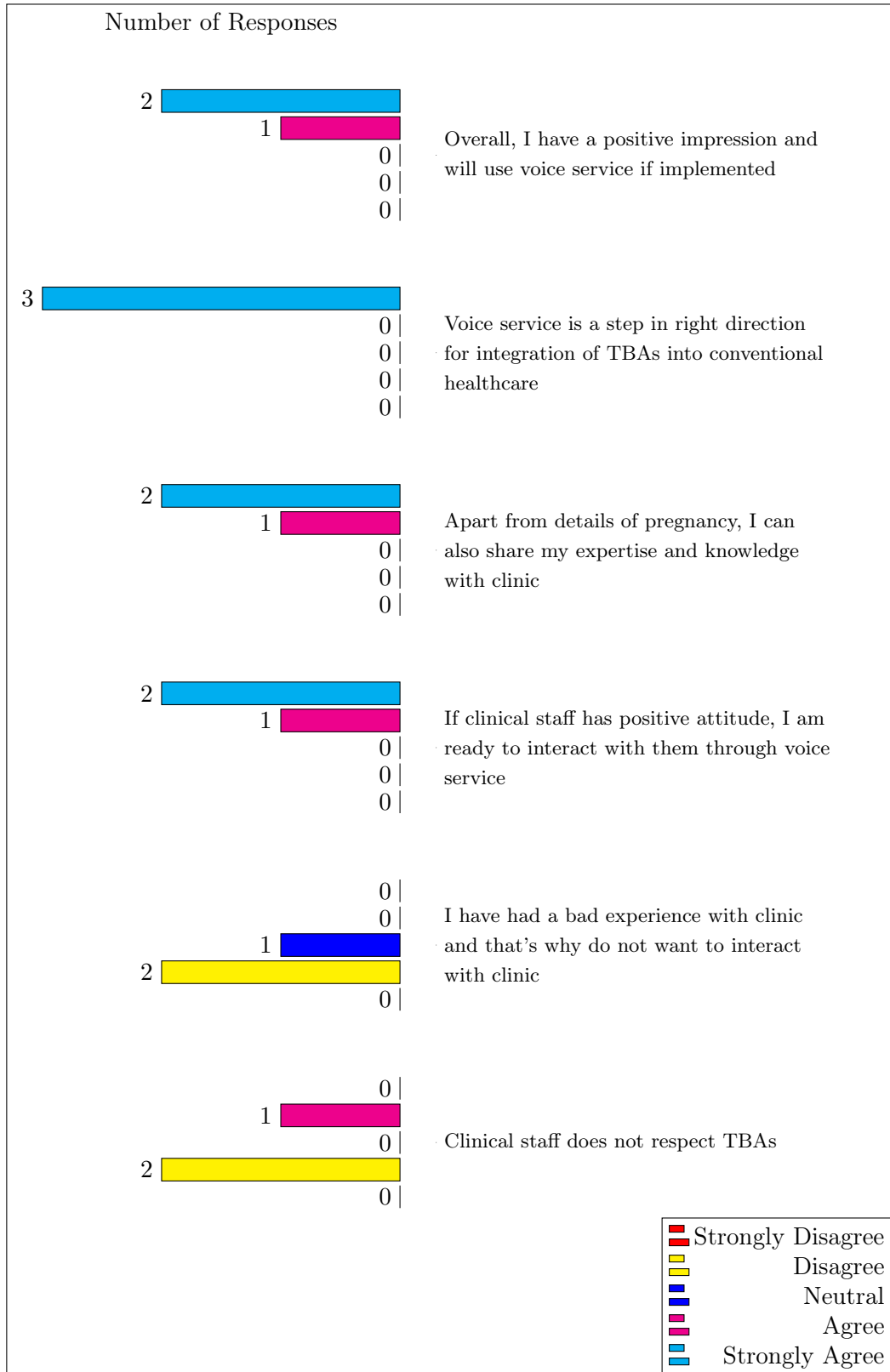


Figure 6.16: Results for Voice Service Functionality

6.2.2 Qualitative Results for Voice Service

In this part, the answers of TBAs to open ended questions related to the tested voice service are given.

Q) What other functionality would you want in the voice service?

TBA1: I do not know

TBA2: No idea

TBA3: No idea

Q) What is your opinion on integration through voice service?

TBA1: It is a very good initiative

TBA2: It will be easy for us

TBA3: Is a welcoming initiative

Q) If you have faced any difficulty in voice service, please elaborate.

TBA1: No

TBA2: No

TBA3: No

Q) Let us know if you have any additional comments regarding the voice service and integration.

TBA1: It should just be like our usual call

TBA2: No additional comment

TBA3: No additional comment

6.2.3 Background and views of TBAs

Q) How long have you been practicing as a TBA?

TBA1: I do not know exactly how long but it was after my first child. Now I have grandchildren. I am above 70 years old.

TBA2: I do not know the specific year but it is over 40 years now

TBA3: I do not know the exact number of years but I have practiced for over 20 years

Q) How did you gain these skills for becoming a TBA?

TBA1: I learnt it form my aunty who was a TBA. Later I was sent to live with my grandmother and she also was a TBA.

TBA2: My grandmother was a TBA. I was always with her any time she was attending to the women

TBA3: My mother was a TBA, but not until I finished giving birth to all my children I was not practicing. So I learnt it form my mother

Q) Do you think pregnant women prefer TBAs over clinics? If yes, why is that?

TBA1: The time that there were no conventional midwives, we were the only people in the community assisting women to give birth. They did not have a choice. Now midwives are there and there is education now so most women go to the midwives. Even we the TBAs encourage them to go to clinic.

TBA2: Times have changed now the women go to clinic more. Because there are more midwives now

TBA3: Some time ago they preferred coming to us but now they prefer the clinic because the community now has a clinic

Q) What role does culture play in traditional maternity healthcare and your services?

TBA1: Our culture is very unique, the women that are very strong want to give birth in the house to send a message to the rivals in the community. Most women also dont want younger midwives to see their privacy.

TBA2: Culture is still part of us. Some of the women still want to give birth at home because it is pride

TBA3: Women that give birth at home is preferred because it reduces financial cost, they are also considered healthy

Q) Do you refer women to clinic? If yes, at what stages?

TBA1: Yes I do. At any stage of the pregnancy when I think she needs further care.

TBA2: Yes I do that at any point in time they come to me for examination

TBA3: When the clinic started I was referring women. Even if I deliver them, the next thing is to send them to hospital for examinations.

Q) How do women respond when you refer them to clinics?

TBA1: Some of them listen to us because we are old people. Other will hesitate because of financial burden

TBA2: They are positive, they do what I ask them. Unless she doesn't have money and i see that her condition is not critical

TBA3: They are okay with it, when I ask them to visit the clinic.

Q) Do you recognise any limitations in your knowledge regarding pregnancy and child-birth?

TBA1: Yes, as a TBA. I dont know it all. That is why it is always good to have a second opinion.

TBA2: Yes, we are also limited because what we learnt from our grandmother is what we practice

TBA3: Yes, some times I would call some of my TBA colleagues to assist me when it is beyond my expertise.

Q) On what basis do you provide a diet plan to pregnant women, if any?

TBA1: When i see that the woman is anaemic

TBA2: When the pregnancy is in the early stages, there are certain goods she must be eating and others she must avoid, e.g oily foods

TBA3: When you realise the woman is not eating well or she is doing hard work with the pregnancy

Q) Do women prefer visiting you or home service for pregnancy related matters?

TBA1: Yes, some of them will come here first before they will go to the clinic. But now when it is time for delivery I tell them to go to clinic.

TBA2: Now the women will come to us when they are in distress at odd hours. If not they will always attend the clinic for ANC.

TBA3: The women will like clinic but sometimes because we live them, they prefer to come to us. But I always ask them to still go to clinic after I attend to them.

6.2 Voice Service Results

Q) How many times women visit or utilise your services in prenatal period?

TBA1: In a day I can get 3 to 4 women.

TBA2: Some come 5 to 6 times and some times even more when the pregnancy is worrying her.

TBA3: Most times 5 to 6 times depending on the stage of pregnancy

Q) Do you wish to work closely with conventional healthcare (hospitals/clinics) for maternal care?

TBA1: Yes I would like to work with them

TBA2: Yes I have worked with them before, so my doors are always open. Only that I am old now.

TBA3: Yes I was working with them some time ago but not anymore.

Q) Are you open to the idea of training programs conducted by healthcare facilities/government?

TBA1: If I am invited

TBA2: Yes since it has to do with saving lives why not

TBA3: Yes I will do

Q) What kind of a training program will be suitable and helpful in your opinion?

TBA1: Once it is assisting women in pregnancy

TBA2: Pregnancy and delivery, after delivery she continues the rest at clinic

TBA3: Just the general pregnancy care and delivery

Q) Do you want to share the information related to services and advices provided to women with conventional healthcare facilities?

TBA1: Yes we the TBA here share information

TBA2: Yes, we were also trained by someone, by sharing information you pass on knowledge

TBA3: We were already sharing information, so yes I will share

Q) How do you compare conventional healthcare services with TBA services?

6.2 Voice Service Results

TBA1: They are trained professionals with equipments but we the TBAs learnt it from here

TBA2: They both serve one purpose, we only learnt it differently

TBA3: Clinic is more advanced than us

Q) Do you consider clinic/conventional healthcare to be better or not for maternity services as compared to you?

TBA1: Yes they are better than us, they are professionals and have advanced knowledge

TBA2: Now the clinic is better for everyone. They have good training and machines to help them.

TBA3: Yes, that's why I always refer them to clinic because they have current knowledge on issues.

Q) What important steps need to be taken for integration of TBAs into conventional healthcare?

TBA1: Partnership will help

TBA2: Frequent communication is good, so that we get to know each other

TBA3: We should be meeting from time to time just like how we TBAs were working with them in past

Q) Being a TBA is the only work you do? Do you have a second job?

TBA1: Yes I used to farm groundnuts back in days but not anymore

TBA2: No. I use to sell food but now I dont work

TBA3: No, I was trading in the market but now I don't work

Q) Do you own a mobile phone? If yes, of what type?

TBA1: Yes, GSM

TBA2: Yes not a smart phone

TBA3: Yes, GSM

6.2 Voice Service Results

Q) Are you open to the idea of a voice based service for sharing pregnancy related information with the clinics?

TBA1: Yes I am

TBA2: Yes

TBA3: Yes

Q) How is the quality of mobile network in your area? Are you able to make calls without a problem?

TBA1: The network is good. I use MTN network

TBA2: The network is stable

TBA3: The network is good

Q) Are you familiar with the use of Internet?

TBA1: No

TBA2: No

TBA3: No

Q) Are you willing to spend on technology purchase for improving your knowledge and services?

TBA1: No these technologies are expensive

TBA2: I dont work now so I can't spend on it

TBA3: No, I dont even have the money

Q) What is your level of literacy? Did you take any formal education?

TBA1: No formal education

TBA2: No education at all

TBA3: No formal education

7

Discussion

The design and development of prototype ICT4D platform consisting of web portal and voice service was guided by user requirements. Its objectives were to upgrade UDS maternity clinic from paper records to EMRs and allow for linking TBAs in Nyankpala to UDS maternity clinic. Upon successful development, the prototype was evaluated on a carefully designed criteria. In chapter 6, results of this evaluation are given which will be discussed and analysed here.

7.1 Web Portal

All six midwives supported the transition to EMR in clinic, while only three of them had experienced EMRs in the past. Web portal was found to have a quick response to clicks by all midwives. Five out of six midwives found data entry to be faster than paper records, and all midwives rated information retrieval in web portal to be faster. Regarding functionalities in web portal, only three midwives found their expectations to be met, while two midwives could not have their expectation met. All midwives found TBA data collection to be helpful, web portal's voice recording feature beneficial, clinic work to be easy with web portal and recommendable to other clinics. Not a single midwife found the web portal to cause any difficulty in her work. Comparing load of work in web portal to paper record system, five out of six midwives reported a lesser load. Improvement in clinical services with adoption of web portal was considered true by all midwives, thus recommending it as well. Paper records were preferred by only one midwife, compared to EMR functionality in web portal. However, two midwives supported continuing the use of paper records despite adoption of web portal. Ability to upload audio recordings was considered useful and an improvement in documentation by all midwives.

7.2 Views of midwives about TBAs

Regarding benefits of EMR in web portal, the answers revolve around faster and accurate data entry; safety, accessibility, quick information retrieval; enhancing efficiency of work. Additional functionalities requested by midwives include monthly report generation, coordination of administrative functions, more drop down menus. Quality of internet was rated as good by four out of six midwives, while other two considered it to have poor quality. Provision of electricity was found to be good and stable for midwives, however all midwives reported no backup option in case of electricity outage. Thereby, having offline functionality in case of power outages will be advantageous.

Impact of web portal on clinical practices such as quality, staff's stress level, efficiency of clinicians, accessing data, managing referrals, tracking important dates, communication with expectant women, avoidance of errors was largely considered to be beneficial or highly beneficial by midwives. Only one midwife found the impact to be slightly detrimental when it came to accessing data and avoidance of errors. By large, web portal prototype was considered beneficial and with further advancements a full scale transition from paper records to EMRs can be achieved.

7.2 Views of midwives about TBAs

Integration of TBAs into conventional healthcare is supported by all midwives and considered useful to maternity healthcare. Giving importance to the factor of culture in local society, all six midwives agreed with learning cultural role in maternity from TBAs. Support for a proper medical training for TBAs was found in all midwives, while five out six were ready to train TBAs themselves. None of the midwives disagreed with improvement of maternity healthcare's quality with integration of TBAs. Outreach of clinic to local community was also expected to grow by all midwives with inclusion of TBAs. It was strongly agreed by all midwives that government support is necessary for a proper training program aimed at enhancing capabilities of TBAs. However, views of midwives were negative when it came to safety in TBA practices, standardisation of practices, general perception of TBAs. It is observed that a widespread support for integrating TBAs in conventional healthcare exists amongst participant midwives.

While one midwife reported no interaction with TBAs in the past, all others had a few interactions which were regarded as positive and helpful. TBAs were found to be important by all midwives due to their special relationship with community, ability to reach and help women in emergency, understanding of culture. At the same time, these midwives reported numerous shortcomings in TBA practices which include lack of structured work, absence of

documentation of care, illiteracy, unable to prevent infections, inadequate skills in handling complications, hygiene, limited logistics, causing post delivery complications due to lack of scientific based practices. Supporting the training of TBAs, five out of six midwives had no reservations about it, just one midwife feared TBAs taking up her job. Establishing a communication link between clinic and TBAs, the voice service was considered to be a highly useful component of prototype ICT4D platform. Provision of information through voice service was rated as beneficial by all midwives.

7.3 Perspectives of TBAs

In this research, we used a qualitative research method to understand the perspectives of TBAs around maternal healthcare, formal health facilities and their integration. Interaction with three TBAs belonging to Nyankpala was carried out in person to record their answers, given in chapter 6.

It is observed that all three TBAs have been practicing from decades and learnt these skills from their blood relations. One of TBAs is above 70 years of age. In their early days, all of them had a second job, but now they only practice as a TBA due to old age. This finding resonates with that of Kennedy et al. (37) which stated that TBAs usually have another job. None of the TBAs ever received a formal education in their life. Limitations in knowledge was openly accepted by them, which shows they recognise gaps in their skill set. Cultural factors were considered to play a role in their services as all of them pointed out giving birth at home is known as a sign of strength and pride. Relating strength to home births corroborates with results of another study (4). During pregnancy, frequency of visits by women stood at 5 to 6 times, this signifies reliance of community on traditional maternity healthcare. On daily basis, one TBA received three to four pregnant women. However, all TBAs indicated a change with time, as now more and more women are preferring local clinic. This changing trend was supported by TBAs as they accepted clinics to have better equipment and skills for handling pregnancy matters, thus they also convinced women at different stages to visit the clinic.

Regarding collaboration with conventional healthcare facilities, all TBAs indicated their willingness and were open to ideas of learning from clinics and participating in training programs aimed at improving their skill set. Interested in sharing information regarding their practices and expertise, these TBAs favoured a frequent communication with conventional healthcare facilities. GSM functionality mobile phones were owned by all TBAs and they supported the idea of a voice service for establishing a communication link with clinic.

Further, they termed quality of mobile network in Nyankpala to be good. From these findings we observe that TBAs are supportive of integration into conventional healthcare and infrastructure is suitable for interventions like voice service to establish communication between TBAs and clinics.

7.4 Voice Service

Upon familiarisation with voice service, testing was performed by three TBAs in presence of resource person Mr. Ali Gideon from UDS. Voice service for maternity care was considered useful and its working was understood by all three TBAs. Integration into conventional healthcare through voice service was expected to improve quality of their work by all TBAs. TBAs preferred using voice service over visiting clinics in person to share information. TBAs agreed that expectant women will be willing to share information required in voice service, and if they have any concerns, TBAs will be able to convince them. TBAs also agreed to sharing their own knowledge and expertise with clinic. Past interactions with clinic were rated as good by all TBAs. It is important to note that none of the TBAs agreed to preferring their knowledge over clinic's advice, which means they are willing to change their practices if taught better. Motivating women to access formal healthcare facilities would be easier through voice service, TBAs agreed. TBAs unanimously accepted that referring women to clinics at different stages of pregnancy will improve health outcomes. No data processing concern by clinic or government was found amongst TBAs, which means collection of their data could be used for analysis to inform health sector policies. Simultaneous use of voice service and provision of care was found doable by only one TBA, while other two were neutral about this. None of the TBAs agreed with being able to adapt to any changes made in voice service, thus requiring technical assistance. However, the current version of voice service was rated as easy to understand and self explanatory by all TBAs. Interestingly, the statement that voice service contains all expected functionality was rated as neutral by all TBAs, but all of them had no ideas when asked what other functionality would they want. No difficulty in use of voice service was faced by TBAs, which reinforces the design choice of voice calls for integrating them into conventional healthcare. Considered a step in the right direction, all TBAs found voice service to be a positive addition in their work and a communication link to connect with clinic.

7.5 Feedback from Resource Person

This research was carried out with help from a local resource person Mr. Ali Gideon from UDS. A regular contact through Zoom was maintained with Mr. Ali during different stages of the research project. The research was given positive feedback by Mr. Ali which is reflected in these remarks: "First of all, in my general opinion, it is interesting to know that the stakeholders in this research found it fascinating and gave their full support throughout the process of the research. Hasseeb did a great job considering the limited time he had, Midwives and TBAs are looking forward to the full implementation of the prototype outcome. Voice Service design and implementation is good but needs to be linked with webportal for midwives to have access and appreciate how it works and for their feedback. Generally, I am satisfied with the outcome of the system as it is proven to be a working prototype after testing the various aspects of the system in the field with users. After Evaluating the prototype system, there are few iterations indicated by the stakeholders for improvement. For example, (i) Considering dropdown menu and checkbox for most pages to reduce data entry fields. (ii) Restricting access levels for staff. (iii) Incorporating automated monthly report generation by midwives for management as this will be a motivation to use the system and (iv) Allow for Updates of previous information of patients. TBAs have welcomed the initiative and are willing to be engaged with the system, but personally I think we need to reconsider reducing the processes a TBA has to follow in order to deliver a message into the system. The current process seems lengthy. Hasseeb has indicated his interest to be part of this project going forward even after his graduation, so we could still work together to improve the prototype."

8

Future Work

For Nyankpala's community in Ghana, this research project marks the first ever ICT4D prototype platform developed, tested and evaluated to connect TBAs with conventional healthcare and upgrading UDS maternity clinic from paper records to electronic records. Voice service allows TBAs and expectant women to connect with UDS clinic for providing important information and caters for emergency cases. Shifting from paper records to EMRs has been made possible by the web portal, all sets of paper records can now be entered, stored and displayed electronically.

Being first in ICT solutions for maternity healthcare in Nyankpala, this pilot project sets the ground for further research and practical work. Expansion of this ICT4D integrated platform can be undertaken by putting in more time and securing financial assistance from donors. In web portal, functionality can be added which generates monthly data reports which have to be submitted to district health management in Ghana by clinics. With guidance from UDS maternity clinic, a training and live support program for TBAs can be documented and incorporated in web portal. Using a distant support method, TBAs can be assisted by informing them of standard medical responses to complications occurring during pregnancy. In future, if literacy rate in Ghana improves substantially, TBAs and expectant women can be allowed to access limited and relevant parts of web portal for viewing data. Then, self caring journals can also be incorporated in web portal so that expectant women and their families can learn valuable information for help in different phases of pregnancy. Data from electronic records can be processed for gaining insights into different factors such as maternal and neonatal mortality for timely interventions by government and private health contributors. Having a single web portal implemented in different hospitals and clinics can make patient records more accessible, reliable, legible;

reducing the burden on expectant women for safekeeping paper based records; improving information flow between health facilities and creating opportunities for collaboration.

In this project, voice service allows TBAs and expectant woman to make calls and recording crucial information, which can be accessed by UDS maternity clinic through an integrated database. However, for outbound calls by Voxeo's platform, a costly subscription has to be purchased. Due to financial limitations, it was not possible during this research project. In future, by having outbound call placing functionality, voice service can be used to send reminders to expectant women for clinical checkups and due lab investigations, invite TBAs for training sessions at local clinic, alert the medical staff for certain upcoming responsibilities if they are away from clinic. So, receiving system generated voice calls can be beneficial for all stakeholders.

Database integration was currently achieved using free versions of Zapier and Voxeo, which was sufficient to develop and test the prototype ICT4D platform. For further work, a continuous database access is crucial for ICT4D platform for uninterrupted connectivity between components, storing and retrieving large amounts of information as expansion of pilot project takes places.

Engagement with other actors relevant to maternal healthcare in Ghana such as Ghana Health Service (GHS) will be beneficial for furthering this research work, as local environment from government's perspective can be understood and analysed. Possibly, GHS could be connected in the ICT4D integrated platform which may aid them in policy making and interventions. In addition to that, research sample can be enlarged by engaging more TBAs, clinics and expectant women to understand user requirements at a large scale. ICT providers in Ghana may also be approached for introducing cost effective packages aimed at improving communication and collaboration between stakeholders of maternal healthcare through voice calls and integrated databases.

Hence, in Ghana's maternity healthcare, further research and practical work can be undertaken based on the ground established by this project for a full scale deployment of ICT4D enabled integrated platform.

9

Conclusion

The main goal of this project was to answer the research question: **How can we digitalize maternity healthcare in a rural environment such as northern Ghana, such that it allows integration of information from traditional maternal health delivery into the conventional health care?** To achieve this, the project focused on creating, testing, and evaluating a prototype platform that used information and communication technology for development (ICT4D). This platform consisted of a website and a voice service. The website aimed to transition from traditional paper records to electronic medical records (EMRs), and it facilitated better connections between traditional birth attendants (TBAs) and clinics through the voice service.

To build the ICT4D platform, a strategy that prioritized input from the actual users was employed. The platform was designed with the needs and preferences of the end-users in consideration. The evaluation of the platform yielded positive results: the web portal with EMRs showed faster response times and improved data management. Midwives, who were the primary users of the web portal, reported that it led to better clinical services, reduced workload, and an overall improvement in the quality of care they could provide.

With strong support from midwives and TBAs, the project explored ways to integrate traditional and modern healthcare practices by designing a voice service to facilitate communication. The voice service was chosen due to the existing infrastructure and the fact that many TBAs and expectant women might be illiterate. The voice service, presented in the local language, was evaluated by TBAs who found it promising for bridging the two healthcare systems. The TBAs also expressed interest in training programs, showing their willingness to adopt evidence-based medical practices. The data collected through the voice service was integrated into the EMRs on the web portal through a database.

Having successfully achieved its goal, this research contributes to the development of ICT solutions that can upgrade healthcare facilities with limited resources to EMRs and involve TBAs in modern healthcare practices. The findings emphasize the importance of a user-centered design approach, cultural context, infrastructure assessment, and an iterative feedback process in developing effective ICT4D solutions. Further improvements in the prototype platform could lead to broader implementation, bringing significant enhancements to the quality of maternal healthcare and facilitating effective communication between TBAs and conventional healthcare providers.

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Appendix

9.1 Paper Records used by UDS

A. Family Identification

Serial No. for Mother: _____
Registration No. for Mother: _____
Name of Health Facility: _____
Date of Issue of this MCH Record Book: _____
NHIS No.: _____

Mother's Name: _____
Date of Birth: _____ Age: _____
Address: _____
Landmark: _____ Sub District: _____
District: _____ Region: _____
Telephone No.: _____
Marital Status: _____ Single _____ Married _____ Other _____
Educational Status: None / Primary School / Junior High School / Senior High School / Tertiary
Occupation: _____

Spouse's Name: _____
Date of Birth: _____ Age: _____
Address: _____
Landmark: _____ Sub District: _____
District: _____ Region: _____
Telephone No.: _____
Educational Status: None / Primary School / Junior High School / Senior High School / Tertiary
Occupation: _____

Name of contact person: _____
Telephone No. for Emergency: _____
Telephone No. for Emergency Transportation: _____

Name of Midwife/Doctor: _____
Telephone No. of Midwife/Doctor: _____

3

Figure 9.1: Family Identification fields in Paper Records

9.2 Voice Service Code

Delivery Outcome	
Weeks of Pregnancy	Weeks
Date of Delivery	/ /
Time of Delivery	am / pm
Time of Placenta Delivery	am / pm
Duration of Labour & Delivery	Hours Minutes
Type of Delivery	Normal / Vacuum / Caesarean Section / Other:
Indication for Vacuum / CS	
Anesthesia	No / Yes: Epidural Anesthesia / Spinal Anesthesia / General Anesthesia
Estimated Blood Loss	ml
Blood Transfusion	No / Yes
State of Placenta and Membranes	Complete / Incomplete / Other (Specify):
State of Perineum	Intact / Tear / Episiotomy
Labour & Delivery Complications	
Birth Attendant	Doctor / Midwife / Nurse / TBA / Relative / Other:
Name of Birth Attendant	
Place of Delivery	Hospital / Health Centre / CHPS / Home / Other:
Name of Health Facility	
Did breastfeeding start within 30 minutes after delivery?	Yes / No
Was infant placed in skin-to-skin contact with mother?	Yes / No If no, why? ()

Figure 9.2: Delivery Outcome fields in Paper Records

F. Postnatal Records for Mother													
Name of Health Facility:													
Contact No.:													
Postnatal Records													
Date of Visit	Weight (kg)	BP (mmHg)	Pulse (b/min)	Temp (°C)	Urine* Protein Sugar	Fundal Height (cm)	Lochia Colour Odour	Incision Perineum/ CS	Condition of Breast and Nipple	Mood Changes**	Number of days IFA*** supplied	Complaints / Remarks	Name & Signature
/ /								Clean / Infected		No / Yes			
/ /								Clean / Infected		No / Yes			
/ /								Clean / Infected		No / Yes			
/ /								Clean / Infected		No / Yes			
* Urine Protein / Urine Sugar: Please write - / + / ++ / +++ ** Mood changes: Health worker should ask the mother that "Have you observed any unusual change in your mood?" If the mother says "Yes", please consult the doctor or midwife concerning these matters. *** IFA: Iron and Folic Acid													
Investigations for Mother after Delivery													
Date	/ /	/ /	/ /	/ /									
Hb													
HIV Antibody (offer if not done)													
Other													
Family Planning Service for Mother after Delivery													
Date	/ /	/ /	/ /	/ /									
Family Planning Counselling													
Method of Choice													
Remarks													

Figure 9.3: Postnatal fields in Paper Records

9.2 Voice Service Code

The code for prototype voice service is provided below:

```
<?xml version="1.0" encoding="UTF-8"?>
```

```
<vxml version="2.1" xmlns="http://www.w3.org/2001/vxml"
xmlns:voxeo="http://community.voxeo.com/xmlns/vxml">

<meta name="maintainer" content="YOUREMAILADDRESS@HERE.com"/>

<link next="#MainMenu">

  <!-- The XML grammar for the main menu. -->
  <grammar xml:lang="en-US" root = "LINKGRAM">
    <rule id="LINKGRAM" scope="public">
      <one-of>
        <item>main</item>
        <item>back</item>
        <item>begin</item>
      </one-of>

      </rule>
    </grammar>
  </link>

  <form id="MainMenu">
    <block>
      <prompt bargein="false">
        Hello. Welcome to University for Development Studies Maternity Clinic.
      </prompt>
    </block>

    <field name="TbaOrPreg">
      <prompt>
        You have three options, choose carefully.
        If you are a "Traditional Birth Attendant"
        say traditional attendant or if you are "An expectant mother"
        say expectant mother.
        In case you want to leave an emergency message, say emergency.
      </prompt>
```

```
<!-- Grammar for available responses for either "TBA related"
or "Pregnancy related".-->
<grammar xml:lang="en-US" root = "TBAPREG">
  <rule id="TBAPREG" scope="public">
    <one-of>
      <item>traditional attendant</item>
      <item>expectant mother</item>
      <item>emergency</item>
    </one-of>
  </rule>
</grammar>

<noinput>
  <prompt>
    I did not hear anything. Please try again.
  </prompt>
</noinput>

<nomatch>
  <prompt>
    I did not recognize that choice. Please try again.
  </prompt>
</nomatch>

</field>

<filled namelist="TbaOrPreg">
  <if cond="TbaOrPreg == 'traditional attendant'">
    <goto next="#Traditional"/>
  <elseif cond="TbaOrPreg == 'expectant mother'"/>
    <goto next="#Pregnant"/>
  <elseif cond="TbaOrPreg == 'emergency'"/>
    <goto next="#Emergency"/>
</if>
```

```

    </filled>
</form>

<!-- If the answer was "tba", it prompts the following statement. -->
<form id="Traditional">
  <block>
    <prompt>
      Please have your ID and name ready,
      as well as the name and registration number of patient.
    </prompt>
  </block>
  <record name="R_1" beep="true" maxtime="20s" finalsilence="3000ms">
    <prompt>
      Please say your name, and then press a DTMF key to end the recording.
    </prompt>

    <filled>
      <log expr="'*****'" />
      <log expr="'RECORD DURATION = ' + R_1$.duration" />
      <log expr="'RECORD FILESIZE = ' + R_1$.size" />
      <log expr="'RECORD TERMCHAR = ' + R_1$.termchar" />
      <log expr="'*****'" />
      <assign name="patientregno" expr="R_1" />
      <prompt>
        Your name is <value expr="R_1" />
      </prompt>
    </filled>
  </record>
  <record name="R_2" beep="true" maxtime="20s" finalsilence="3000ms">
    <prompt>
      Please say your ID, and then press a DTMF key to end the recording.
    </prompt>

    <filled>
      <log expr="'*****'" />
      <log expr="'RECORD DURATION = ' + R_2$.duration" />
      <log expr="'RECORD FILESIZE = ' + R_2$.size" />
      <log expr="'RECORD TERMCHAR = ' + R_2$.termchar" />

```

```
<log expr="'*****'" />

<prompt>
  Your ID is <value expr="R_2" />
</prompt>
</filled>
</record>
<record name="R_3" beep="true" maxtime="20s" finalsilence="3000ms">
  <prompt>
    Please say registration number of expectant mother if assigned,
    otherwise say new entry
    and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + R_3$.duration" />
    <log expr="'RECORD FILESIZE = ' + R_3$.size" />
    <log expr="'RECORD TERMCHAR = ' + R_3$.termchar" />
    <log expr="'*****'" />

    <prompt>
      The registration number of patient recorded by system is <value expr="R_3" />
    </prompt>
  </filled>
</record>
<record name="R_4" beep="true" maxtime="20s" finalsilence="3000ms">
  <prompt>
    Please say the full name of pregnant woman,
    and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + R_4$.duration" />
    <log expr="'RECORD FILESIZE = ' + R_4$.size" />
    <log expr="'RECORD TERMCHAR = ' + R_4$.termchar" />
    <log expr="'*****'" />
```

```
<prompt>
  The name of pregnant woman recorded by system is <value expr="R_4" />
</prompt>
</filled>
</record>
<record name="R_5" beep="true" maxtime="40s" finalsilence="3000ms">
  <prompt>
    Please say the address of this pregnant woman,
    and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + R_5$.duration" />
    <log expr="'RECORD FILESIZE = ' + R_5$.size" />
    <log expr="'RECORD TERMCHAR = ' + R_5$.termchar" />
    <log expr="'*****'" />

    <prompt>
      The address of woman recorded by system is <value expr="R_5" />.
    </prompt>
  </filled>
</record>
<record name="R_6" beep="true" maxtime="20s" finalsilence="3000ms">
  <prompt>
    If you are informing about this pregnant woman for the first time, say yes,

    otherwise say no, and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + R_6$.duration" />
    <log expr="'RECORD FILESIZE = ' + R_6$.size" />
    <log expr="'RECORD TERMCHAR = ' + R_6$.termchar" />
    <log expr="'*****'" />
```



```
<prompt>
  Your answer recorded by system is <value expr="R_6" />.
</prompt>
</filled>
</record>
<record name="R_7" beep="true" maxtime="30s" finalsilence="3000ms">
  <prompt>
    Please tell us how long she has been pregnant for,
    and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + R_7$.duration" />
    <log expr="'RECORD FILESIZE = ' + R_7$.size" />
    <log expr="'RECORD TERMCHAR = ' + R_7$.termchar" />
    <log expr="'*****'" />

    <prompt>
      The woman has been pregnant for <value expr="R_7" />.
    </prompt>
  </filled>
</record>
<record name="R_8" beep="true" maxtime="60s" finalsilence="3000ms">
  <prompt>
    Kindly inform us about the complications in her pregnancy,
    say none if no complications are there,
    and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + R_8$.duration" />
    <log expr="'RECORD FILESIZE = ' + R_8$.size" />
    <log expr="'RECORD TERMCHAR = ' + R_8$.termchar" />
    <log expr="'*****'" />

    <prompt>
```

9.2 Voice Service Code

```
    Complications recorded by system are <value expr="R_8" />.
  </prompt>
</filled>
</record>
<record name="R_9" beep="true" maxtime="30s" finalsilence="3000ms">
  <prompt>
    If she has visited a health facility say the name of that health facility,

    otherwise say no, and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + R_9$.duration" />
    <log expr="'RECORD FILESIZE = ' + R_9$.size" />
    <log expr="'RECORD TERMCHAR = ' + R_9$.termchar" />
    <log expr="'*****'" />

    <prompt>
      The name of health facility visited is <value expr="R_9" />.
    </prompt>
  </filled>
</record>
<record name="R_10" beep="true" maxtime="60s" finalsilence="3000ms">
  <prompt>
    If you are referring her to University for Development Studies Maternity Clinic,
    please say the expected date of her visit, or say not referred,
    and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + R_10$.duration" />
    <log expr="'RECORD FILESIZE = ' + R_10$.size" />
    <log expr="'RECORD TERMCHAR = ' + R_10$.termchar" />
    <log expr="'*****'" />

    <prompt>
```

```

    The expected date of visit recorded by system
    for this woman is <value expr="R_10" />.
  </prompt>
</filled>
</record>
<record name="R_11" beep="true" maxtime="120s" finalsilence="3000ms">
  <prompt>
    Please record any other valuable information for clinic about this pregnant woman,
    and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + R_11$.duration" />
    <log expr="'RECORD FILESIZE = ' + R_11$.size" />
    <log expr="'RECORD TERMCHAR = ' + R_11$.termchar" />
    <log expr="'*****'" />

    <prompt>
      The voice message recorded for clinic is <value expr="R_11" />.
      Thank you for providing all this valuable information.
    </prompt>
  </filled>
</record>
<field name="BackToMain">
  <prompt>
    If you are finished, ignore.
    If you wish to try again, please say "Main".
  </prompt>
</field>
<filled>
  <!-- This will never get hit. -->
</filled>
</form>

<!-- If the answer was "pregnant/mother", it prompts the following statement. -->
<form id="Pregnant">
  <block>

```

```

<prompt>
    Congratulations for your pregnancy. Please have your registration number ready.
</prompt>
</block>
<record name="PR_1" beep="true" maxtime="20s" finalsilence="3000ms">
    <prompt>
        If you have a registration number assigned please say it,
        otherwise say new entry, and then press a DTMF key to end the recording.
    </prompt>

    <filled>
        <log expr="'*****'" />
        <log expr="'RECORD DURATION = ' + PR_1$.duration" />
        <log expr="'RECORD FILESIZE = ' + PR_1$.size" />
        <log expr="'RECORD TERMCHAR = ' + PR_1$.termchar" />
        <log expr="'*****'" />

        <prompt>
            The registration number recorded by system is <value expr="PR_1" />
        </prompt>
    </filled>
</record>
<record name="PR_2" beep="true" maxtime="20s" finalsilence="3000ms">
    <prompt>
        Please say your full name, and then press a DTMF key to end the recording.
    </prompt>

    <filled>
        <log expr="'*****'" />
        <log expr="'RECORD DURATION = ' + PR_2$.duration" />
        <log expr="'RECORD FILESIZE = ' + PR_2$.size" />
        <log expr="'RECORD TERMCHAR = ' + PR_2$.termchar" />
        <log expr="'*****'" />

        <prompt>
            Your name that is recorded by system is <value expr="PR_2" />
        </prompt>
    </filled>

```

```
</record>
<record name="PR_3" beep="true" maxtime="40s" finalsilence="3000ms">
  <prompt>
    Please tell us your address, and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + PR_3$.duration" />
    <log expr="'RECORD FILESIZE = ' + PR_3$.size" />
    <log expr="'RECORD TERMCHAR = ' + PR_3$.termchar" />
    <log expr="'*****'" />

    <prompt>
      Your address recorded by system is <value expr="PR_3" />
    </prompt>
  </filled>
</record>
<record name="PR_4" beep="true" maxtime="40s" finalsilence="3000ms">
  <prompt>
    Please tell us your telephone number,
    and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + PR_4$.duration" />
    <log expr="'RECORD FILESIZE = ' + PR_4$.size" />
    <log expr="'RECORD TERMCHAR = ' + PR_4$.termchar" />
    <log expr="'*****'" />

    <prompt>
      Your telephone number recorded by system is <value expr="PR_4" />
    </prompt>
  </filled>
</record>
<record name="PR_5" beep="true" maxtime="20s" finalsilence="3000ms">
  <prompt>
```

If you have visited the clinic for a checkup before say yes,
 otherwise say no, and then press a DTMF key to end the recording.
 </prompt>

```
<filled>
  <log expr="'*****'" />
  <log expr="'RECORD DURATION = ' + PR_5$.duration" />
  <log expr="'RECORD FILESIZE = ' + PR_5$.size" />
  <log expr="'RECORD TERMCHAR = ' + PR_5$.termchar" />
  <log expr="'*****'" />
```

```
<prompt>
  Your answer recorded by system is <value expr="PR_5" />
</prompt>
</filled>
```

```
</record>
<record name="PR_6" beep="true" maxtime="40s" finalsilence="3000ms">
  <prompt>
    If you want to visit the clinic, kindly tell us the expected date,  

    and then press a DTMF key to end the recording.
  </prompt>
```

```
<filled>
  <log expr="'*****'" />
  <log expr="'RECORD DURATION = ' + PR_6$.duration" />
  <log expr="'RECORD FILESIZE = ' + PR_6$.size" />
  <log expr="'RECORD TERMCHAR = ' + PR_6$.termchar" />
  <log expr="'*****'" />
```

```
<prompt>
  Your expected date of visit is <value expr="PR_6" />
</prompt>
</filled>
```

```
</record>
<record name="PR_7" beep="true" maxtime="50s" finalsilence="3000ms">
  <prompt>
    During the course of your pregnancy if you have visited  

    a Traditional Birth Attendant, say the name and address
```

```

of that Traditional Birth Attendant,
otherwise say none and then press a DTMF key to end the recording.
</prompt>

<filled>
  <log expr="'*****'" />
  <log expr="'RECORD DURATION = ' + PR_7$.duration" />
  <log expr="'RECORD FILESIZE = ' + PR_7$.size" />
  <log expr="'RECORD TERMCHAR = ' + PR_7$.termchar" />
  <log expr="'*****'" />

  <prompt>
    The name and address of TBA recorded by system is <value expr="PR_7" />
  </prompt>
</filled>
</record>
<record name="PR_8" beep="true" maxtime="120s" finalsilence="3000ms">
  <prompt>
    Please share the details of your visit to Traditional Birth Attendant

    including the advices given and procedures performed,
    and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + PR_8$.duration" />
    <log expr="'RECORD FILESIZE = ' + PR_8$.size" />
    <log expr="'RECORD TERMCHAR = ' + PR_8$.termchar" />
    <log expr="'*****'" />

    <prompt>
      Details of the visit to TBA recorded by system is <value expr="PR_8" />
    </prompt>
  </filled>
</record>
<record name="PR_9" beep="true" maxtime="120s" finalsilence="3000ms">
  <prompt>

```

```
    If you want to share more information with clinic,
    kindly record the voice message,
    and then press a DTMF key to end the recording.
</prompt>

<filled>
  <log expr="'*****'" />
  <log expr="'RECORD DURATION = ' + PR_9$.duration" />
  <log expr="'RECORD FILESIZE = ' + PR_9$.size" />
  <log expr="'RECORD TERMCHAR = ' + PR_9$.termchar" />
  <log expr="'*****'" />

  <prompt>
    The voice message recorded for the clinic is <value expr="PR_9" />.
    Thank you for providing us all this information.
  </prompt>
</filled>
</record>
<field name="BackToMain">
  <prompt>
    If you are finished, then you may end the call.
    If you wish to try again, please say "Main".
  </prompt>
</field>
<filled>
  <!-- This will never get hit. -->
</filled>
</form>

<!-- If the answer was "pregnant/mother", it prompts the following statement. -->
<form id="Emergency">
  <block>
    <prompt>
      We are here to help as much as possible.
      Provide us the required information for emergency help.
    </prompt>
  </block>
  <record name="ER_1" beep="true" maxtime="20s" finalsilence="3000ms">
```



```
<prompt>
  Please say the registration number of expectant woman,
  or say new entry if not assigned yet,
  and then press a DTMF key to end the recording.
</prompt>

<filled>
  <log expr="'*****'" />
  <log expr="'RECORD DURATION = ' + ER_1$.duration" />
  <log expr="'RECORD FILESIZE = ' + ER_1$.size" />
  <log expr="'RECORD TERMCHAR = ' + ER_1$.termchar" />
  <log expr="'*****'" />

  <prompt>
    The registration number of expectant woman recorded
    by system is <value expr="ER_1" />
  </prompt>
</filled>
</record>
<record name="ER_2" beep="true" maxtime="40s" finalsilence="3000ms">
  <prompt>
    Kindly tell us the address of the expectant woman,
    and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + ER_2$.duration" />
    <log expr="'RECORD FILESIZE = ' + ER_2$.size" />
    <log expr="'RECORD TERMCHAR = ' + ER_2$.termchar" />
    <log expr="'*****'" />

    <prompt>
      The address recorded by system is <value expr="ER_2" />
    </prompt>
  </filled>
</record>
<record name="ER_3" beep="true" maxtime="30s" finalsilence="3000ms">
```

```
<prompt>
  Please record the contact number of expectant woman or a telephone number
  for us to reach her, and then press a DTMF key to end the recording.
</prompt>

<filled>
  <log expr="'*****'" />
  <log expr="'RECORD DURATION = ' + ER_3$.duration" />
  <log expr="'RECORD FILESIZE = ' + ER_3$.size" />
  <log expr="'RECORD TERMCHAR = ' + ER_3$.termchar" />
  <log expr="'*****'" />

  <prompt>
    Contact number recorded by system is <value expr="ER_3" />
  </prompt>
</filled>
</record>
<record name="ER_4" beep="true" maxtime="40s" finalsilence="3000ms">
  <prompt>
    Record the emergency message for clinic,
    and then press a DTMF key to end the recording.
  </prompt>

  <filled>
    <log expr="'*****'" />
    <log expr="'RECORD DURATION = ' + ER_4$.duration" />
    <log expr="'RECORD FILESIZE = ' + ER_4$.size" />
    <log expr="'RECORD TERMCHAR = ' + ER_4$.termchar" />
    <log expr="'*****'" />

    <prompt>
      Emergency message recorded by system is <value expr="ER_4" />.
      Thank you for informing us, the help will arrive soon.
    </prompt>
  </filled>
</record>

<field name="BackToMain">
```

```
<prompt>
  If you are finished, then you may end the call.
  If you wish to try again, please say "Main".
</prompt>
</field>
<filled>
<!-- This will never get hit. -->
</filled>
</form>

</vxml>
```