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Telemedicine Support of Maternal and Newborn Health to Remote Provinces of Mongolia

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Abstract. The telemedicine approach is a very much relevant and effective strategy for the Mongolian context of a huge geographical area with a sparse population and huge disparities in quality and access to health services. Through this initiative, it was possible to strengthen the capacity of service providers to provide timely and appropriate care, especially to mothers with pregnancy and childbirth complications. All the way through this network, health staff had easy access to information and support from experts; this improved access to knowledge is a positive benefit of the program. The early detection of pregnancy complications and timely management with the distance consultation of an expert team had contributed significantly to the reduction of maternal and newborn morbidity and mortality in project-selected provinces compared to non-project areas. The effective use of a modern telemedicine approach has been demonstrated as being effective in addressing the remoteness and rural-urban discrepancy in the quality of health care in Mongolia.

Keywords. Telemedicine, childbirth complication, patient referral, Mongolia

Introduction

Mongolia is located in the heart of Central Asia, landlocked between China and the Russian Federation. The total population in 2011 is estimated at 2.8 million, living sparsely over a territory of 1 566 500 square kilometres, and this makes it the least densely populated country in the world with an overall population density of 1.7 per square kilometre. The sparse distribution of the population makes it challenging to deliver services (health, education) to rural and remote areas, especially to herders who lead a nomadic lifestyle. The low population density makes it difficult and inefficient to maintain quality specialist care facilities and qualified human resources in the countryside. Such discrepancy in the quality of health care aggravated by reduced income-generating opportunities in the countryside hinders the achievement of Mongolia's national health targets and health Millennium Development Goals. To address these discrepancies, the Mongolian government requested donors to introduce

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the most relevant approach, namely, telemedicine. The pioneering work in introducing telemedicine in Mongolia was conducted by the Cardiovascular Centre project which is financed by the Government of Luxembourg in the area of cardiovascular disease. This is one of the major public health problems in Mongolia. In 2007, the Government of Luxembourg and UNFPA commenced the second telemedicine project on Maternal and Newborn health in order to support the government MDGs in reducing maternal and newborn health problems. Using its technical expertise and complementing core funds, UNFPA was the grant recipient and executing agency that has been providing support for the project as an integral part of its Fourth Country Program in Mongolia (2007-2011).

The main objective of the project was to establish a fully functional maternal and newborn health telemedicine network and to build the capacity of health care providers to enable the Maternal and Child Health Research Centre (MCHRC) to effectively assist rural health care providers in delivering quality case management to remote populations of selected provinces.

Two main strategies used for achieving the above objective were:

1. setting up fully operational internet-based clinical decision-making support on
    - high-risk obstetrics based on patient information
    - prenatal ultrasound diagnostics
    - cervical pathology screening based on colposcopy and Pap-smear imaging.

2. Strengthening the capacity of the MCHRC and provincial hospitals through
    - upgrading of diagnostic and medical equipment
    - organizing serial clinical attachment training for service providers on new innovative approaches and techniques using updated clinical reference materials
    - sensitizing the national and provincial governments and health administration
    - enhancing professional networking between participating hospitals, national institutions and with professional societies and international partners.

1. Methods

At the level of policy making, the UNFPA technical staff worked with the Ministry of Health on the development of an eHealth Strategy for Mongolia. This strategy involved many other parties also involved in telemedicine initiatives. The project was implemented in eight of the most remote provinces from the capital city (Ulaanbaatar). The project began with a *needs assessmen*t addressing the knowledge of obstetricians concerning early identification of pregnancy complications, including high risk obstetrics case management, skills to diagnose foetal conditions and the use of modern equipment for treatment.

1.1. Technology Used

Under the project, modern diagnostic and telemedicine equipment such as 2D&3D digital ultrasound (US) machines with DICOM image processing, high-speed computer with audio visual accessories connected with internet and CTG and digital colposcopes were provided. The software platform was Campus Medicos (previously used IPATH), which is a collaborative platform for exchange of medical knowledge, distance consultations, forums and distant teaching in medicine, provided by the Mon Tel Net project by SST. Images can be uploaded in series and shared video allow doctors to view the same live scenario, talk to each other, write chats and store images in a patient case. Expert doctors (reference centre) write their diagnosis (first or second).

1.2. Capacity Building

Training involved upgrading computer skills, a course of basic and advanced ultrasound and improving clinical skills in obstetric (CTG interpretation, vacuum extraction, tocolytic use etc.) and advanced surgical skills (B-lynch stitch, big vessels ligation during emergencies, perineal tear repair, abdominal and vaginal hysterectomy, c-section and etc.). These skills were obtained through group workshops and one-on-one training interactions. The training sessions were led by international and local members of the reference centre and involved both didactic and practical sessions. A total of 36 gynaecologists were trained in basic and advanced ultrasound skills (Doppler application, first trimester screening) and high-risk obstetrics case management. Advanced surgical skill training sessions were conducted in their own hospitals by experts with hands-on demonstration and supervision. Each trainee had performed at least two hysterectomies and 3-4 c-sections under the direct supervision of experts. Vacuum extraction and HELPERR manoeuvres were taught by using obstetric manikins. Moreover, the project developed pocket-sized guide books on high risk obstetrics and newborn intensive care on design of decision-making trees (algorithms) which were printed as well as uploaded to the project website as continuing medical education, (CME).

Once the equipment was in place and personnel were trained, patients (pregnant women, newborns and gynaecological cases) were seen locally. If there were any questions raised about diagnosis and management, patients' information, ultrasound (US) images and other clinical test results were sent to the experts located at the centre.

2. Results

2.1. Improved Quality and Accessibility of the Maternal and Newborn Services, including Emergency Obstetric Care (EmOC) in Selected Areas

Under the project, emergency care units of general hospitals were upgraded to complement quality and accessible emergency obstetric care and services for the rural population. A distance communication of specialists between the reference and local hospitals via tele-consultation cases has obviously improved and resulted in increased strategic clinical judgement of local service providers for patient management.

Prior to this project, high quality ultrasound (US) machines with Doppler and digital cardiotocograph were not available for patients at rural and even in central

levels. Now rural doctors are able to perform a full series of obstetric ultrasound diagnosis including foetal abnormality, placental and vascular conditions, in the early age of gestation. Improved intra-partum foetal monitoring (continuous CTG monitoring) and the number of major surgical cases were increased in rural hospitals.

2.2. Improved Networking between Rural and Urban Health Professionals and Different Specialties

In total, 798 cases were group discussed on a tele-consultation platform, out of which, 64.2% of consulted cases were obstetric disorders, 21.7% were gynaecological cases and the remaining 14.7% were neonatal cases.

The percentage of the locally managed cases out of the total consulted cases accounted for 86% and the percentage of referred cases to upper level care in Ulaanbaatar city accounted for 14.1%. Therefore, networking between rural and urban health professionals has widely been improved based on telecommunication channels. Tele-consultation response times were as short as five minutes and the longest was 9-57 hours. Over the course of the project, therapeutic questions have become more focused. Prior to the project, cervical cytology assessments were only available in UB, and were not available in eight provinces.

2.3. Types of Consultation for Obtaining Second Opinion from Rural Physicians.

The most common type of consultation is prenatal diagnostics 287 (22.9%) followed by newborn complication (15.6%) and pregnancy complications (15.4%) for which remote physicians needed expert advice and second opinions.

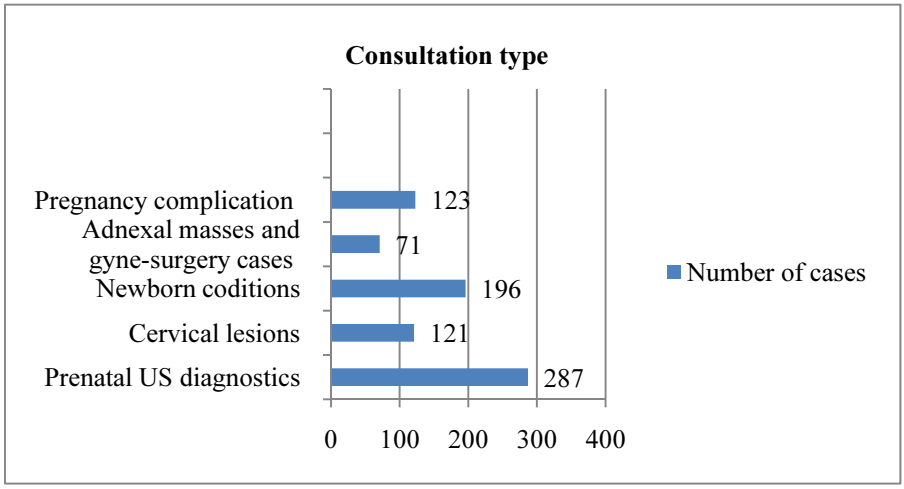

Figure 1. Type of consultation

Regarding the pregnancy complications, pregnancy associated medical conditions 59 (48.2%) are the major complications followed by pre-eclampsia / eclampsia 32 (26.4%) and multiple pregnancy and premature birth 32 (26.0%). Follow–up information about uploaded clinical cases was provided in only 50 (40.7%) cases out of 123 pregnancy complication cases.

2.4. Improved Diagnostic Capacity of Remote Physicians on Foetal Conditions.

There were 287 images sent for confirmation of diagnosis of foetal conditions and out of 287 images, 31 cases were of poor quality which made it impossible to make a diagnosis. In 256 cases rural physicians were able to diagnose the foetal condition in the correct way and the number of diagnoses increased year by year (Figure 2). Previously, foetal malformation was usually diagnosed only in the labour room after the delivery. However, local doctors are now able to diagnose it in the early period of pregnancy (before 22 weeks of gestation). This is an inspiring outcome of the training and also the quality of the machines that were provided.

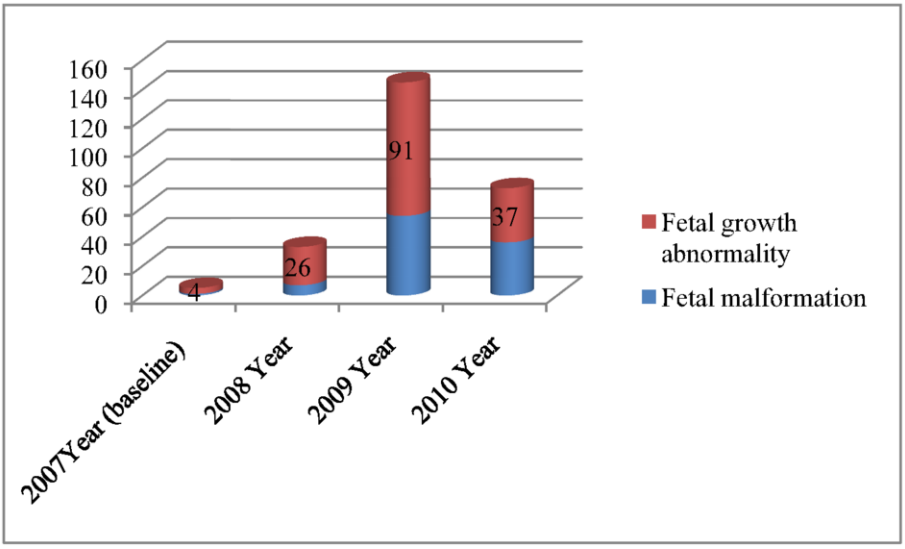

Figure 2. Number of ultrasound diagnostic images sent for foetal conditions.

2.5. Reduced Pregnancy and Child Birth Complication

Table 1 shows the number of clinical cases and their percentage of pregnancy complications out of total deliveries at general hospitals in project provinces (aimags) during the period of 2005-2009. Accordingly, pregnancy complications (severe pre-eclampsia, eclampsia and haemorrhage) have dropped off to 15.4% of total deliveries in 2009, from 19.1% in 2005. According to the nationwide health statistics in 2009, there were a total of 43 623 cases of complications of pregnancy registered, birth and post-partum period [1]. Out of all registered complications, 35.6% were complications of pregnancy, thus the level of pregnancy complications in all project aimags is two times lower than that of the national data in 2009. Therefore, data on pregnancy complications evidently supports the improvement of appropriately managed cases with the above disorders by the end of the project.

Table 2 presents the number of clinical cases and their percentage of childbirth complications out of the total deliveries at general hospitals in project aimags during the period of 2005-2009. According to the estimated values, childbirth complications sharply declined from 25.7% in 2007 to 9% in 2009.

Table 1. Pregnancy complications. Data showing total (t) number of deliveries; number (n) and proportion (%) of complications per specified province.

Aimags (Province)	2005			2006			2007			2008			2009		
	t	n	%	t	n	%	t	n	%	t	n	%	t	n	%
Darkhan-Uul	1423	158	11.1	1504	176	11.7	1884	179	9.5	2082	202	9.7	2490	269	10.8
Dornogobi	681	126	18.5	802	73	9.1	939	172	18.3	1000	65	6.5	1030	101	9.8
Dornod	1182	253	21.4	1271	323	25.4	1390	420	30.2	1798	428	23.8	1805	446	24.7
Orkhon	1385	158	11.4	1432	139	9.7	1870	217	11.6	2222	260	11.7	2465	318	12.9
Uvurkhangai	1166	470	40.3	1269	240	18.9	1454	352	24.2	1551	284	18.3	1708	463	27.1
Selenge	579	127	21.9	536	110	20.5	778	158	20.3	834	172	20.6	894	119	13.3
Khovd	938	277	29.5	1005	193	19.2	1233	206	16.7	1433	182	12.7	1448	184	12.7
Khuvsgul	1292	84	6.5	1340	59	4.4	1557	81	5.2	3054	226	7.4	3188	220	6.9
Overall total	**8654**	**1653**	**19.1**	**9118**	**1313**	**14.4**	**11086**	**1785**	**16.1**	**12631**	**1819**	**14.4**	**13766**	**2120**	**15.4**

(Project end – evaluation 2010)

Table 2. Childbirth complications. Data showing total (t) number of deliveries; number (n) and proportion (%) of complications per specified province.

Aimags (Province)	2005			2006			2007			2008			2009		
	t	n	%	t	n	%	t	n	%	t	n	%	t	n	%
Darkhan-Uul	1423	265	18.6	1504	275	18.2	1884	330	17.6	2082	209	10.1	2490	275	11.1
Dornogobi	681	143	21.0	802	257	31.9	939	183	19.5	1000	13	1.3	1030	1	0.9
Dornod	1182	52	4.4	1271	72	5.7	1390	62	4.5	1798	73	4.3	1805	68	3.7
Orkhon	1385	269	19.2	1432	244	17.0	1870	339	17.8	2222	226	10.2	2465	363	14.7
Uvurkhangai	1166	508	43.6	1269	438	34.4	1454	772	53.1	1551	224	14.4	1708	149	8.6
Selenge	579	11	1.9	536	6	1.1	778	14	1.8	834	25	2.9	894	15	1.7
Khovd	938	388	41.5	1005	476	47.5	1233	593	47.9	1433	353	24.5	1448	217	15
Khuvsgul	1292	68	5.3	1340	83	6.2	1557	99	6.3	3054	119	3.9	3188	149	4.7
Overall total	**8654**	**2164**	**25.0**	**9118**	**2282**	**25.0**	**11086**	**2754**	**24**	**12631**	**1242**	**9.8**	**13766**	**1237**	**8.98**

(Project end – evaluation 2010)

2.6. Reduced Numbers of Unnecessary and Costly Referrals and Emergency Calls

Table 3 illustrates the data on the number of cases referred to the upper level care in Ulaanbaatar from project aimags during the period 2005-2009. Although it shows a small increasing trend in some aimags, generally the number of referred cases has clearly decreased during the project's implementation period to 1,343 cases in 2009 from 1,892 in 2007. Therefore, Telemedicine has played an important role in the reduction of unnecessary referrals.

Table 3. Number of patients/cases (n) referred from project airmags to the MCHRC (2005-2009)

Airmags (Province)	**2005**		**2006**		**2007**		**2008**		**2009**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Darkhan-Uul	264	17.1	244	13.7	289	15.3	297	20.5	301	22.4
Dornogobi	223	14.4	241	13.5	270	14.3	245	17.0	230	17.1
Dornod	126	8.2	169	9.5	149	7.9	165	11.0	157	11.7
Orkhon	132	8.5	167	9.4	172	9.1	181	12.0	180	13.4
Uvurkhangai	189	12.2	200	11.2	232	12.3	107	7.0	106	7.9
Selenge	448	29.0	519	29.1	533	28.2	210	14.0	195	14.5
Khovd	57	3.7	86	4.8	85	4.5	83	6.0	15	1.1
Khuvsgul	107	6.9	157	8.8	162	8.6	163	11.2	159	11.8
Overall total	**1,546**	**100**	**1,783**	**100**	**1,892**	**100**	**1,451**	**100**	**1,343**	**100**

Other successes included: improved capacity of rural specialists to handle medical equipment, information technology applications and project implementation greatly contributed to a reduction in *maternal and neonatal mortality* in project sites compared to non-project aimags. Although the MMR level has decreased both in project and non-project aimag's general hospitals, the maternal mortality indicator has accounted for 41.7 at the general hospitals of project aimags while it was 80.7 in non- project aimags at the end of 2009.

The project has materially supported all the selected aimags' general hospitals by a significant amount of obstetric-gynaecological and neonatal equipment and specialized clinical training and seminars in 2007 and 2009, which have brought remarkable advancements in the delivery of quality maternal and newborn services for the rural population. Building up the capacity of relevant personnel at the MCHRC and selected general hospitals and providing high technology medical equipment have contributed remarkably to the provision of quality maternal and newborn care facilitated via a distance learning approach.

Some of the challenges reported from various end users included:

- equipment issues (i.e. electrical fluctuations damaged equipment in three provinces so surge protectors were procured
- equipment breakdown required the need for either trained biomedical staff or maintenance service agreements)

- Internet issues (i.e. problems connecting with the internet means there is a need for trained information technology support; slow internet speed requires involvement of MOH and the government to expedite policy decisions such as the eHealth platform; the high cost of internet connection requires involvement of the MOH to address this in their budgets for the hospitals)
- issues in passing on knowledge (i.e. rural-trained staff need to be motivated to share their knowledge and skills through a process such as the train-the-trainer model)
- on-going learning and problem solving (i.e. all staff need to upgrade computer skills and English language skills).

3. Discussion

Telemedicine has a great potential to improve the quality and delivery of health service to remote areas, allowing rural physicians to access more sources of updated clinical information. This paper presents the experience of conceptualizing and implementing a telemedicine platform in the context of Mongolia, which has unique geographical features. This project involved access to tele-consultation of either / both prenatal ultrasound diagnosis of foetal malformations and pregnancy complications due to maternal medical conditions. For the pregnant women at risk of complications, this technology frees them from the financial burden of travelling to the capital city just to access adequate diagnostic and treatment care. The most important achievement of this initiative was the reduction of pregnancy and child birth complications in remote hospitals, due to the early identification and proper management of cases using tele-consultation. In this way, the use of telemedicine may very much help rural doctors in preventing emergencies, which may occur during child birth.

In accordance with other studies on telemedicine utilization, the majority of analyses, which were attached by physicians, were of images [3]. Remote interpretation of digitized images transmitted over the network must have the potential to provide access to high-quality resolution [4]. Additionally, it requires more skills from remote physicians to send high quality images for consultation. Therefore, to obtain good skills in US diagnosis, more continuous training needs to be conducted with the experts. The findings from our experience suggest that standardization of medical equipment for Telemedicine centres is also one of the key issues to quality consultation.

The most common request for second opinions was for consultation on diagnosis or treatment options [5]. Experts' response rates, in most cases were average compared to some studies [6]. In some cases, where the expert's replies were not received, there was the possibility that they had replied using real time videoconferencing or the telephone, following the context of the physicians and experts' communication text. As Horwitz & Detsky (2011) found [7], asynchronous communication is almost never appropriate for urgent or complex situations in which the communicator needs to know instantaneously that the communication has been received. On the other hand, synchronous communication is highly inefficient for routine or non-urgent situations.

Conclusion

In general, the project has made contributions to the Government's action plan on e-Health, the National Program on Reproductive Health, the United Nations Development Aid frameworks (making social and economic services more accessible for vulnerable groups) and the UNFPA program # 4 (Increasing reproductive health services in remotely located areas of limited access to social services).

Regarding the sustainability, there are opportunities for a further continuation of these initiatives because of the growing skills and knowledge of the doctors. Moreover, the increasing capacity of provincial hospitals and the progress made in policy areas (national strategy, internet costs) are the valid reasons for the project's continuation. However, there might be potential challenges due to the dependency on technology and skills.

Although, telemedicine is a tool for delivering quality services to remote populations, it can never replace health services in provinces, but only serves as a support and educational mechanism. Therefore, the successful coordination of the parties is vital for a positive outcome.

The results of this project have shown that telemedicine is an excellent recourse for providing quality clinical management to women at risk of poor pregnancy outcomes in geographically remote regions.

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