

## The Journey of Global Expansion of the Perinatal Management System and Mobile CTG Developed in Kagawa Prefecture

Kazuhiro Hara

Emeritus Professor at Kagawa University

Specially Appointed Professor of Seto Inland Sea Regional Research Center, Kagawa University

President of e-Health Care Innovation in Kagawa (e-HCIK)

President of Japanese Telemedicine and Telecare Association

### Introduction

The 10th International Conference on Maternal and Child Health (MCH) Handbook (Chair: Prof. Yasuhide Nakamura, Professor of Osaka University, Graduate School) was held at United Nation University in Shibuya-Ward, Tokyo and the research center of Japan International Cooperation Agency (JICA) located in Shinjuku-Ward from November 23 to 25, 2016. (Reference 1)

As reported on the Monthly Report of Hyakujyushi Bank Economic Research Institute issued in June 2014, Japanese maternal, fetal and neonatal mortality rates (perinatal mortality rate) mark the lowest in the world. As a factor of these lowest rates, MCH Handbook developed in Japan over 70 years ago is drawing attention. (Reference 2 and 3)

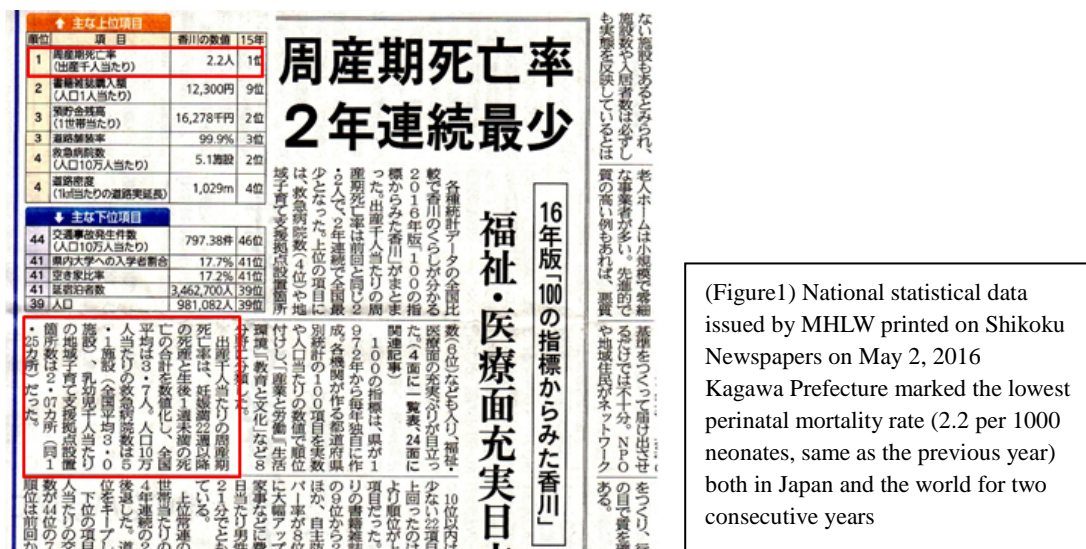
JICA has been supporting diffusion of MCH Handbook to reduce maternal mortality and perinatal mortality rate in the developing nations. The first International Conference on MCH Handbook was held in 1998 under the name of “The 1<sup>st</sup> International Symposium on MCH Handbook” at Tokyo University as a group research session of Ministry of Health, Labour and Welfare (MHLW). Five nations attended this first conference. Following that, the conference was held almost every two years mainly in ASEAN nations and African nations. In 2016, International Conference on MCH Handbook was held in Japan, and that was the third time that Japan hosted the conference. More and more nations participated in the conference every time, and about 400 people from 38 nations attended in 2016. We sensed high interest in MCH Handbook in the developing nations. The followings were main topics reported in the conference to study the history of MCH Handbook to learn new things; History of MCH Handbook, history of Japanese midwives’ activities and MCH Handbook, effectiveness of MCH Handbook at the time of disasters, needs for electric MCH Handbook and the

importance of standardization of the electric MCH Handbook, MCH Handbook for low-weight neonates, a case in Mongolia for continuous support to mothers and children with MCH Handbook, a case in Netherlands which is the only European nation where MCH Handbook including electric version is diffused, MCH Handbook for Palestine refugees, MCH Handbook for minorities, and methods to continue MCH Handbook efforts. Many important topics were presented.

Among these topics, cases from Netherlands and India about electric version of MCH Handbook drew attention. Also, our project of perinatal electric records and Mobile CTG with JICA’s Partnership Project in Chiang Mai, Thailand was recognized. Standardization and importance of collaboration were confirmed for the future use.

Those are achievements of Prof. Nakamura’s great efforts over the years.

<http://www.hands.or.jp/activity/mch/hb/conf/10th.html>



(Figure1) National statistical data issued by MHLW printed on Shikoku Newspapers on May 2, 2016 Kagawa Prefecture marked the lowest perinatal mortality rate (2.2 per 1000 neonates, same as the previous year) both in Japan and the world for two consecutive years

1. The journey of Kagawa Prefecture to realize the lowest perinatal mortality rate both domestically and internationally for two consecutive years

According to the annual statistical report by MHLW, Kagawa Prefecture marked the lowest perinatal mortality rate (2.2 per 1000 neonates, same as the previous year) both in Japan and the world for two years in row. (Figure 1) (Reference 4)

In the 1970s, Kagawa Prefecture’s perinatal mortality rate was always among the worst five in Japan. (In 1971, Kagawa’s perinatal mortality rate was 11.5 and was the worst in Japan.) Therefore, when Kagawa Medical School was founded in 1980, Kagawa Prefecture requested Ministry of Education, Culture, Sports, Science and

Technology to open a department enforcing efforts on perinatal management instead of a regular department of obstetrics and gynecology. Thus, establishment of Department of Perinatology and Gynecology, and Perinatal Medical Center for an actual clinical practice was approved. As a characteristics of Department of Perinatology and Gynecology, obstetricians and pediatrics in charge of neonates, and pediatric surgeons in charge of neonates continuously and seamlessly collaborate as a team. Currently in Japanese perinatal medicine, such a collaboration is nothing new. However, then, it was an ordinary case for obstetricians not to contact with pediatrics and pediatric surgeons in charge of neonates until abnormality was found with neonates after delivery.

When I first arrived in Kagawa Medical School in 1980, I put the most effort into continuous use of the fetal monitoring system (fetal heart monitor) from the pregnancy period until the delivery so that we could constantly monitor the fetal health condition, conduct a successful delivery of healthy neonates, and hand them to pediatricians in charge of neonates. Additionally, another point for which I made efforts was to transfer high risk expected mothers to core hospitals during their pregnancy prior to delivery (maternal transport) instead of emergent transfer of neonates to core hospitals after their birth (neonate transport). We could use private vehicles, taxis and so forth for maternal transport, and reduce the use of ambulances for neonate transport accompanied by a pediatrician in charge of neonates. By doing so, we could also reduce premature delivery cases, Cesarean sections, and loads of medical workers. Along with those reductions, we accomplished significant drop of perinatal mortality rate.

Taking Kagawa Prefecture's perinatal management as a model, MHLW intended to establish a perinatal care center for every 1 million people in each prefecture. (Reference 5)

Currently, Kagawa Prefecture has two perinatal care centers; one is located in Kagawa University Hospital, and another is Shikoku Medical Center for Children and Adults. Since Kagawa Prefecture has a perinatal care center per every 500 thousand people, Kagawa is the most ideal region for expected mothers domestically and internationally.

2. Perinatal mortality rate and maternal mortality rate in the developing nations are significantly high compared with those in Japan

第1-24表 諸外国の周産期死亡率(出生千対), 年次別

国名	年次別						平均値		
	1970	1980	1990	2000	2005	2010	1970-2010	1970-2010	1970-2010
日本	21.7	11.7	2.7	6.7	3.8	2.9	2.9	2.9	2.9
アメリカ合衆国	27.8	14.2	9.2	7.2	7.1	6.8	6.8	6.8	6.8
ドイツ	26.7	11.8	6.0	6.0	5.5	5.5	5.5	5.5	5.5
フランス	21.1	14.8	7.8	6.0	6.0	6.1	6.1	6.1	6.1
イギリス	18.8	11.1	8.7	8.8	7.8	7.6	7.6	7.6	7.6
イタリア	16.3	8.7	6.2	7.3	5.2	6.8	6.8	6.8	6.8
スペイン	19.2	12.2	8.2	6.8	6.8	6.8	6.8	6.8	6.8
インドネシア	19.2	11.2	7.2	5.7	2.7	2.8	2.8	2.8	2.8

注1) 諸外国の平均値は、WHOの「世界の周産期死亡率」報告書に基づいて算出されたものである。  
注2) 1970年以降のデータは、WHOの「世界の周産期死亡率」報告書に基づいて算出されたものである。  
注3) 1970年以降のデータは、WHOの「世界の周産期死亡率」報告書に基づいて算出されたものである。  
出典: WHO "World Health Statistics Quarterly" 2011  
注: 周産期死亡率(出生千対)

(Figure 2) Annual shift of perinatal mortality rate per 1000 deliveries in the world  
In 1970, perinatal mortality rate was 21.7 in Japan, 27.8 in U.S and 26.7 in Germany, and their figures were very close. However, 40 years later, in 2010, perinatal mortality rate was 2.9 in Japan, but it was 6.8 in U.S and 5.5 in Germany. Japan demonstrated significantly good results.

Figure 2 indicates annual shift of perinatal mortality rate per every thousand deliveries in the world. In 1970, perinatal mortality rate was 21.7 in Japan, 27.8 in U.S and 26.7 in Germany. Japan’s rate was slightly lower, but these figures were very close. However, 40 years later, in 2010, perinatal mortality rate was 2.9 in Japan, but it was 6.8 in U.S and 5.5 in Germany. Compared to the Japan’s rate, each rate of U.S and Germany was about double. We could see significantly reduction of Japan’s perinatal mortality rate. As for maternal mortality rate, Japan also marked the lowest compared with other advanced nations. Maternal mortality rare in developing nations such as Congo and Laos was more than 100 times higher than that of Japan.

The above indicates importance of perinatal medical support from advanced nations, especially from Japan. (Figure 3)

Japan has provided medical support to developing nations with Official Development Assistance (ODA) and JICA budget. However, the support was for hospital construction, medical equipment provision, or dispatch of physicians, public health nurses and nurses rather than for perinatal medicine. The most important support for developing nations is to decrease maternal mortality and perinatal mortality. Akihiko Tanaka, former president of JICA stated “Decrease of maternal mortality is an effective indicator in supporting developing nations.”



decrease of the number of obstetricians and gynecologists in Japan for over 15 years.

The achievement of this effort implemented in four regions was highly evaluated as “standardization and verification project of regional medical information collaboration system” of Ministry of Economy, Trade and Industry. (Reference 6, 7, 8)

This effort in Iwate Prefecture, especially, developed as Cloud-type perinatal electric record network called “Ihatov” by the budget of MHLW. Furthermore, when the Great East Japan Earthquake hit Iwate Prefecture, this network effectively functioned to reissue MCH Handbook to expected mothers in the destructed coastal region, to make a reference of the expected mothers to inland hospitals, and also to transport them to the inland hospitals. Thus, the network drew attention of the central government, and significantly influenced to develop Cloud-type regional medicine network.

Mobile CTG was originally developed for expected mothers living in isolated islands and remoted area without enough obstetricians and gynecologists. Thus, if Mobile CTG is introduced in the developing nations, it is expected to demonstrate its immense capability. Nevertheless, since this Mobile CTG had not shown achievement in foreign countries in the past, the governmental budget for this project was difficult to be approved. Additionally, since the Internet service, especially Mobile environment in developing nations was not well-established, it was considered too early to introduce Mobile CTG to those nations. However, recently, as a part of supports from advanced nations to developing nations, the Internet service, especially Mobile environment establishment has been advanced drastically. Mobile devices and smart phones use are available in major parts of developing nations. Once the Internet environment is established, the next point to draw attention is information delivered through the Internet. The most valuable among the information transmitted through the Internet is application for medical services.

#### 4. Supports for overseas from Ministry of Internal Affairs and Communications (MIC) and JICA for ASEAN nations and South Africa

MIC implemented ICT foundation establishment and personnel development supports for countries in Asia-Pacific regions through Asia-Pacific Telecommunity (APT). As a part of APT, the Mobile CTG project was adopted fortunately. The title of the project was “The Thai –Japan collaborative pilot system for rural e-Health development in Indochina region in honor of 84th anniversary of King Bhumibol Adulyadej Maharaja.” (2011, APT-J2/J3 Project). The first overseas verification experiment of the Mobile CTG was conducted in Phitsanulok Province in Thailand.

Furthermore, nearly coincidentally, the Mobile CTG was also adopted as “The Ubiquitous Alliance Project” of MIC, and its verification experiment was conducted in Vientiane, Laos.

In October 2013, when the 18<sup>th</sup> International Conference of Telemedicine was held at Sunport Takamatsu, which was really fortunate to hold this conference at this time, Japan’s advanced telemedicine technology drew attention from the world.

<http://www.j-telemed-s.jp/isfteh18/index.php>

Prime Minister Abe visited Vientiane, Laos in November 2013, and signed on the agreement to provide Japanese medical technology for Laos’s telemedicine and electric record development. (Figure 5) As a result of these events, Prime Minister Thongsing of Laos visited Kagawa Prefecture in December 2013. (Figure 6)

厚生労働省は安倍総理大臣のラオス訪問時に、保健・医療分野での協力に関する覚書に署名



写真：厚生労働省より



(Figure 5)  
Prime Minister Abe visited Laos in November 2013. Picture taken from the website of MHLW.  
MHLW signed on the agreement to provide Japanese medical technology for Laos’s telemedicine and electric record development when Prime Minister Abe visited Laos.

(Figure 6)  
Prime Minister Thongsing of Laos visited Kagawa Prefecture in December 2013. Prime Minister Thongsing visited Kagawa Medical Association.  
In the picture, Governor Hamada, the far left in the front line, Dr. Morishita, Chair of Kagawa Medical Association, next to Governor Hamada, and Prime Minister Thongsing, next to Dr. Morikawa.  
Telemedicine was introduced through teleconference system between Takamatsu and Vientiane, Laos.

Through the above two projects, the central government of Japan deepened its understanding about the perinatal electric record and Mobile CTG projects, and international development of the projects was suddenly advanced.

From 2011 to 2012, the central government of Japan launched “Comprehensive Special Zone System” to promote Japan’s revitalization and reconstruction. Kagawa

Prefecture applied for this system with the project, “Kagawa Medical and Welfare Comprehensive Special Zone, A Plan to build a safe town with Kagawa Medical Information eXchange (K-MIX)”, and its application was approved with positive evaluation. (Reference 11)

In addition, fortunately, it was later decided that the central government’s supplementary budget would provide financial support to projects which would also be beneficial to foreign nations. The budget was allocated to JICA Partnership Project. Therefore, with the advice from Governor Hamada, Kagawa Prefecture applied for this JICA project with “A Collaboration Project using ICT Telemedicine for Perinatal Care and Diabetes in Thailand”, and it was adopted fortunately.

To be approved by JICA, a trustable organization to support the project was necessary. Luckily, e-HCIK, non-profit organization which was founded for the comprehensive special zone system under Kagawa Prefecture already started its activities, then. Originally, applications for the comprehensive special zone system and JICA project were also Kagawa Prefecture’s intension as well as ours. Therefore, we feel very grateful to Kagawa Prefecture. Without coincidence of the above events, I do not think that international development of our Mobile CTG would have been advanced in a speedy manner.

- 1) The Thai –Japan collaborative pilot system for rural e-Health development in Indochina region in honor of 84th anniversary of King Bhumibol Adulyadej Maharaja

The above project was the first and memorable international project of our perinatal electric record and Mobile CTG. (APT-J2/J3 Project 2012-2014) This project was supported by Kagawa Prefecture, Kagawa University, Kagawa Medical Association, e-HCIK, non-profit organization, and C/O BHN Association from Japanese side and also Naresuan University from Thai side, and implemented in Phitsanulok Province in Thailand.

As for its actual operation, Chattrakan hospital located 130 km away from Buddha Chinaraj Hospital, Bang Klang clinic located 60 km away, and Bang Klang Clinic, a core hospital in the region were connected through optical fiber cables to transmit maternal information and fetal HR data to obstetricians and gynecologists. It was confirmed that this project was very effective for maternal management in the regions without obstetricians and gynecologists. (Figure 7)



タイ国王84歳記念インドシナ地域遠隔医療のパイロットシステム事業  
 【APT J3 PROJECT】 2012年-タイ・ピサヌローク県  
 モバイルCTGシステムの導入・試験運用



(Figure 7)  
 MIC “The Thai –Japan collaborative pilot system for rural e-Health development in Indochina region in honor of 84th anniversary of King Bhumibol Adulyadej Maharaja” (APT-J2/J3 Project)  
 Chattrakarn hospital, Bang Klang clinic, and Buddha Chinaraj Hospital were connected to transmit maternal information and fetus HR data to obstetricians and gynecologists. This project was confirmed very effective for maternal management in the regions without obstetricians and gynecologists.

(The exclusive server for our perinatal project located at STNet was used for this project in Thailand instead of directly connecting these three medical institutions.)

2) MIC’s project A project to support perinatal medicine in Laos, “The Ubiquitous Alliance Project”

We also implemented a project to support perinatal medicine in Laos at about the same time as the above Thai project (APT-J2/J3 project) in 2013. As for actual operation, Outhoumphone hospital, Savannakhet without obstetricians and gynecologists, Nambak Hospital, Luang Prabang, and Mittaphab Hospital, a core hospital in Vientiane were connected. The result of this project in Laos was also very successful. (Figure 8) (For this project, a server for tele-counseling established in Vientiane by Lao Ministry of Health was used.)



(Figure 8)  
 MIC’s project to support perinatal medicine in Laos, “The Ubiquitous Alliance Project”  
 Outhoumphone hospital, in Savannakhet Province without obstetricians and gynecologists, Nambak hospital, in Luang Prabang County, and Mittaphab hospital, Vientiane were connected. The result of this project in Laos was also very successful.

### 3) A Collaboration Project using ICT Telemedicine for Perinatal Care and Diabetes in Thailand by JICA Partnership Project (Regional Economic Activation Special Framework)

As mentioned previously, “A Collaboration Project using ICT Telemedicine for Perinatal Care and Diabetes in Thailand” was approved as JICA Partnership Project from 2013 to 2016 as successful results of APT-J2/J3 Project and “The Ubiquitous Alliance Project” of Ministry of Internal Affairs and Communications, and also a launch of Regional Economic Activation Special Framework, which was an international version of comprehensive special zone project.

Since Kagawa University and Chiang Mai University have been sister universities before the start of this project, it was very easy to proceed this project.

#### JICA草の根事業(周産期システム)状況①

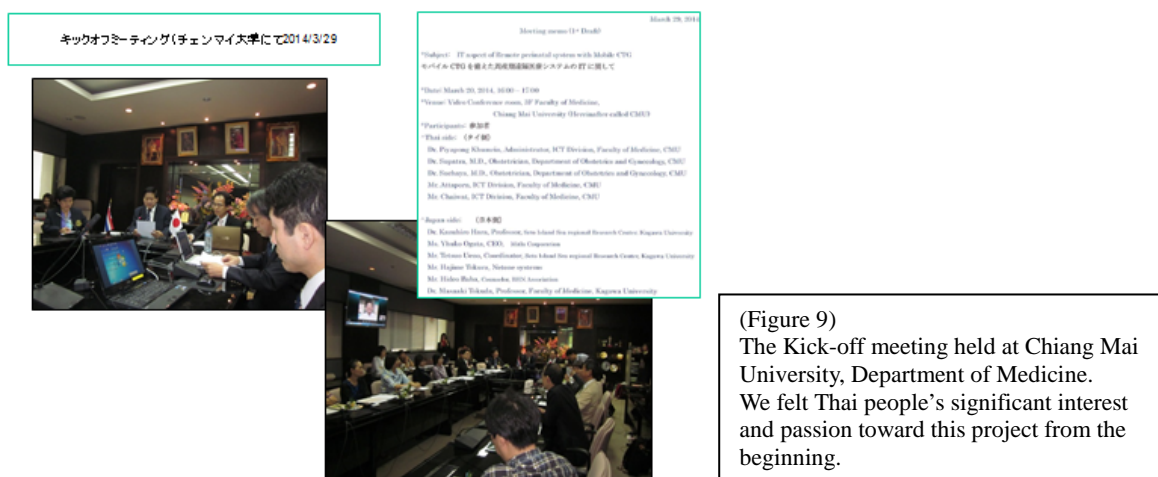
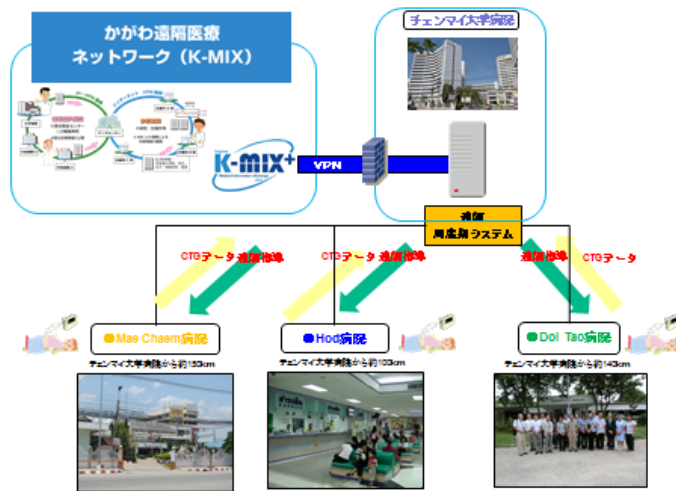


Figure 9 showed the Kick-off meeting held at Department of Medicine in Chiang Mai University. We felt Thai people's great interest and passion toward this project from the start.

In this project, we worked for DM management for expected mothers and research in hepatitis B in addition to perinatal ICT telemedicine supports. As for the perinatal ICT telemedicine supports, centering Chiang Mai University Hospital, department of obstetrics and gynecology, the following three medical facilities were connected; Mae Chaem Hospital where there were no obstetricians and gynecologist deployed, located 150 km away from Chiang Mai, Hod Hospital located 100 km away, and Doi Tao Hospital located 140 km away from Chiang Mai. (Figure 10)

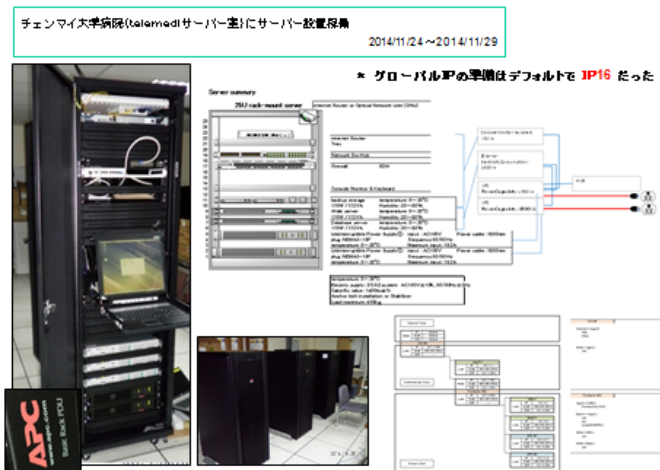
JICA草の根事業(周産期システム)将来構想



(Figure 10)  
The outline of Japanese technical cooperation under the JICA partnership program (Perinatal System) Chiang Mai University, Mae Chaem Hospital without obstetricians and gynecologist, located 150 km away from Chiang Mai, Hod Hospital located 100 km away, and Doi Tao Hospital located 140 km away from Chiang Mai were connected through mobile network.

Also, it was epochal that we could establish a datacenter at Chiang Mai University with JICA budget. Thus, we used the Thai datacenter instead of the data center located in Kagawa Prefecture. (Figure 11) This Thai datacenter will make a significant contribution to reduce operation cost to develop projects in ASEAN nations in the future.

チェンマイ大学病院に設置された周産期サーバ



(Figure 11)  
The perinatal data-server located in Chiang Mai University Hospital This datacenter will make a significant contribution to reduce operation cost to develop projects in ASEAN nations in the future.

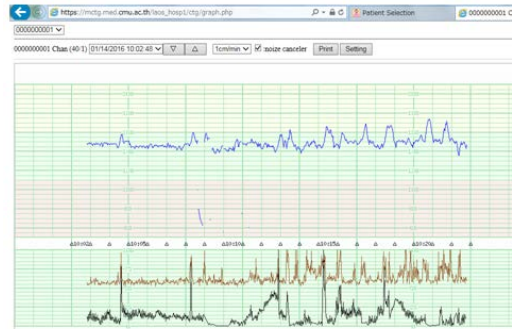
Figure 12 shows people actually using our system in hospitals in the regions. The system was very welcomed by not only expected mothers but also medical professionals. The fetal cardiogram can also be monitored from Japan when necessary. The upper indicates fetal cardiogram, the middle shows fetal movements, and the bottom is for uterine contraction. Since active fetal movement and fetal HR rise along with fetal movement were observed, it could be diagnosed that the fetus was healthy. (Figure13) Over 1500 of fetal HR totally was transmitted by Mobile CTG. The data

was constantly stable, and we could confirm that the Mobile CTG was beneficial for expected mothers in the regions without obstetricians and gynecologists.

**JICA草の根事業(周産期システム)状況**



(Figure 12)  
The pictures showing this system actually being used. It was welcomed by not only expected mothers but medical professionals.



(Figure 13)  
The fetal cardiogram can also be monitored from Japan when necessary. The upper indicates fetal cardiogram, the middle shows fetal movements, and the bottom is for uterine contraction. Since active fetal movement and fetal HR rise along with fetal movement were observed, it could be diagnosed that the fetus was healthy.

4) Collaboration with Luang Prabang Provincial Hospital in Laos by Takamatsu Central Rotary Club

Takamatsu Central Rotary Club donated Mobile CTG to Luang Prabang Provincial Hospital in Laos to support developing nations for JICA Partnership Project. The Internet environment in Luang Prabang Province was not sufficiently established yet, but collaboration was relatively easy with direct support from Chiang Mai University. Fetal HR waves were very steadily transmitted from Luang Prabang Provincial Hospital to the server located at Chiang Mai University.

5) Digital Health Management System for Mothers and Children in Indonesia (APT-J2/J3 Project)

Compared with other ASEAN nations, Indonesia has significantly large numbers of islands, and thus, early introduction of telemedicine is expected.

Fortunately, our project was adopted as MIC's APT-J2/J3 Project from 2014 to 2015, and we could work for digital health management system for mothers and children in Bandung. With collaboration of Kagawa University, Department of

Medicine, C/O BHN Association, Bajrang University, Department of Medicine, West Bandung Health Center, Indonesian Telecom and so forth, we worked for an alert system for mothers and midwives with application of MCH, teleconference system for midwives, obstetricians, and also to apply mobile health system for midwives and medical professionals. The results of our works were very highly evaluated. (Figure 14)

インドネシアでの母子健康管理システムのデジタル化事業  
 (APT-J2/J3プロジェクト)  
 ハッサンサドキン国立病院視察  
 産婦人科病棟、及び研究施設の視察



プロジェクト関係者(Dr. Agung Budi, 脳外科医・Dr. Ahmad Faried 神経外科医) Dr. との記念写真(ICU病棟前)

プロジェクト関係者(脳外科医・神経外科医、産婦人科教授(ITも担当)との記念写真、右から3人目の方がITのキーマン、産婦人科教授)

(Figure 14)  
 Digital Health Management System for Mothers and Children in Indonesia (APT-J2/J3 Project)

When the Internet environment is established in the islands in the future, Indonesia is expected to be an ideal model for telemedicine.

- 6) Under the JICA project “Feasibility Survey with the Private Sector for Utilizing Japanese Technologies in ODA Projects”  
 Feasibility Study for Maternal and Neonatal Telemedicine in the Republic of South Africa

Previously, we reported our projects in ASEAN nations. Maternal and perinatal mortality rates in African nations are further higher than those of ASEAN nations.

Accidental encounter at the international conference triggered our project with South Africa. When I presented our work at Mobile CTG at European Telemedicine Conference, Med@tel, which was held in April annually in Luxemburg in 2013, Dr. Bogosi Mogale, EU Minister at Belgium for the Republic of South Africa requested me to introduce excellent Japanese perinatal management system, especially Mobile CTG to South Africa. Public Health is Dr. Mogale’s expertise, and he has a very high interest in health of mothers and children. He is influential to the government of South

Africa, and is willing to cooperate to develop Mobile CTG not only in South Africa but also all over the African continent. Since Japanese government is enforcing support to African nations currently, I thought that his proposal was excellent. (Reference 12)

(Figure 15)



(Figure 15)  
Picture with Dr. Bogosi Mogale, EU Minister  
in Belgium for the Republic of South Africa  
at Mobile CTG at European Telemedicine  
Conference, Med@tel

Therefore, we made application to JICA SME overseas development support project research. Fortunately, our project of “Feasibility Survey with the Private Sector for Utilizing Japanese Technologies in ODA Projects” was adopted.

We conducted on-site survey at Gauteng State suffering from urban issues and Limpopo State with poverty issue. We visited JICA office, JETRO office, UNICEF, and Central Ministry of Health in South Africa to select medical facilities, and to find issues to introduce our system. We also visited Sunnywin Hengs Energy Pty Ltd which has worked for JICA project before to introduce medical equipment, and exchange opinions for business possibility in the future. We implemented maternal management at Mamelodi Hospital in Gauteng State and two related clinics, Pietersburg Academic Hospital in Limpopo State, Seshego District Hospital and two clinics using perinatal electric record and Mobile CTG.

In perinatal primary medical facilities in South Africa, their urgent assignments are early diagnosis of high risk expected mothers and division of patients based on their risks so that they can be allocated to suitable medical facilities which can provide necessary services. Therefore, maternal management enforcement is required, and introduction of Mobile CTG is confirmed very effective for their needs.

We would like to make achievements of our projects as well as some business aspects, and continue to develop our project all over Africa in the future.

## 5. Development of Super Small-size Mobile CTG (Petit CTG)

As previously reported, our perinatal electric record and Mobile CTG were highly evaluated in the verification projects in ASEAN nations and South Africa. However, we also received further improvement requests as follows. The perinatal electric record should be multi-lingual, reduce test items for simplification to be also used as MCH Handbook. Regarding Mobile CTG, we also heard requests of downsizing and cordless version.

Receiving such requests, Melody International Co. Ltd, which is a joint venture established through cooperation with Kagawa University, developed a completely new super small-sized Mobile CTG (Petit CTG). Development of Petit CTG was adopted by Ministry of Internal Affairs and Communications ICT Innovation Creation Challenge Program, and is highly expected from various sectors.

Conventional fetal HR monitoring equipment including Mobile CTG connects an ultrasound transducer and a uterine contraction transducer to main body with codes. However, in Petit CTG, its electric circuit itself is mounted within the ultrasound transducer. Fetal HR measured by the ultrasound transducer and uterine contraction measured by the uterine contraction transducer. Both data were transmitted wirelessly through Bluetooth to the tablet available in the market.

**超小型モバイルCTG(プチCTG)の開発**

香川県が積み重ねてきた  
遠隔医療ネットワークの実績

**K-mix+**  
Medical Information Exchange



電子母子健康手帳

医師のいらいへき地  
島嶼部・発展途上国への  
遠隔医療提供

**超音波胎児心拍計と陣痛計**

救急車に搭載すれば  
緊急搬送時の  
母子生存率をアップ

世界中の妊産婦  
一人に1台ずつ

遠野市・奄美大島・奥尻島  
タイ・ラオス・南アフリカ・イン  
ドネシアでの運用実績

(Figure 16)  
Development of Super Small-size Mobile CTG (Petit CTG)  
The electric circuit for fetal HR measurement is mounted within the ultrasound vibrator in Petit CTG. Fetal HR data is transmitted wirelessly through Bluetooth to the tablet. From the tablet, the data is accessed to Internet (by Wi-Fi or 3G, LTE depending on the location).

From the tablet, the data is transmitted to the conventional Mobile CTG data center via

Internet (Wi-Fi or 3G, LTE depending on the location). (Figure 16)

Currently, the servers for Mobile CTG are located at STNet in Kagawa Prefecture and Chiang Mai University. We are hoping to establish more datacenters in the world for mutual connection in the future.

We often hear the term of IoT, Internet of Things lately. We hope to realize a network for perinatal management for fetuses in the world and IoF, Internet of Fetuses in the future.

## Conclusion

I have presented a chronological summary of how MCH developed in Japan diffused globally, and the perinatal electric record, electric MCH, and Mobile CTG developed in Kagawa Prefecture were approved by Ministry of Internal Affairs and Communications and JICA to be introduced in the world. This paper reports some cases in ASEAN nations and South Africa, but we have received inquiries from Micronesia, Myanmar, Mongolia, Russia, and South American nations. Advanced nation's institutes such as Center for Strategic and International Studies (CSIS) and International Telecommunication Union (ITU) also show interest in our project. Especially, Mr. Yoshio Utsumi, a former general secretary of ITU is from Takamatsu City, and I feel a turn of fate. (Reference 13)

We would like to ask for your support to realize a network for perinatal management for fetuses in the world.

## Acknowledgement

I would like to extend my deep appreciation to the following people who have fully supported international development of our project.

Mr. Hachihei Kurematsu, Chairman of C/O BHN Association

Dr. Masaaki Tokuda, Vice President of Kagawa University, who is in charge of international strategy and special assignment

Mr. Jitsuo Matsuoka, Director General of e-Health Care Innovation in Kagawa (e-HCIK)

(This research was supported by Ministry of Internal Affairs and Communications, Ministry of Economy, Trade and Industry, Ministry of Health, Labour and Welfare, Japan International Cooperation Agency, Japan Society of Obstetrics and Gynecology, and Japanese Telemedicine and Telecare Association.)



## References:

- 1) Yasuhide Nakamura, *Boshi Techou: Kako, Genzai, Mirai, Shonika Rinshou*, 65 (8): 1745-1755, August 2012  
Mother and Child Health Handbook: The past, present and future, Clinical pediatrics 65 (8): 1745-1755, August 2012
- 2) Kazuhiro Hara, *Hideto Yokoi, Hiroki Okada, et al. Kagawa Enkaku Iryou Network kara Nihonban EHR no Jitsugen e Gekkan Shin Iryou*, 2008:35 (2) 48-53, 2008  
To realize Japanese version EHR from Telemedicine Network in Kagawa
- 3) Kazuhiro Hara, *IT ga Musubu Chiiki Iryou Renkei no Jitsuryoku, Chiiki Iryou Netto waku ga Iryou no Kyuuseishu to Naru Deshou Gekkan Shin Iryou*, 36 (2) 36-39, 2009  
The power of the regional medical collaboration connected by IT. The regional medical network will save Japan' medicine.
- 4) Kazuhiro Hara, *Chiiki Iryou Saisei Kikin ni yoru Kagawa Iryou Netto waaku (K-MIX) no Kinou Kyouka, Hyakujuushi Keizai Kenkyusho Chousa Geppou*, No. 331, 9, 12-20 2014  
The functional reinforcement of Kagawa Medical Information eXchange (K-MIX) by the regional foundation for reconstruction, 114 economic research survey monthly report
- 5) Kazuhiro Hara, *Shuusanki Denshi Karute Nettowaak to Boshi Techo no Denshika, Hyakujuushi Keizai Kenkyusho Chousa Geppou*, No.328, 6 2-10, 2014  
Perinatal electric record network and electric mother-child health handbook, 114 economic research survey monthly report
- 6) Kazuhiro Hara, *Nihon Sanfujinka Ikai ni yoru Boshi Techo no Hyoujunka to Gurobaru Tenkai – Shuusanki Iryou Jouhou Shisutemu kara Denshi Boshi Kenkou Techou e Bosei Eisei* 57, 1, 47-54, 2015  
Standardization and Global Development of Mother-Child Health Handbook by Japan Society of Obstetrics and Gynecology, - From Perinatal Medical Information System to Electric Mother-Child Health Handbook- Hygiene of Mother and Child
- 7) Kazuhiro Hara, *Tounyoubyou Chiiki Renkei Kurithikaru Pasu ni yoru Chiiki Zentai deno Tounyoubyou Kanri, Hyakujuushi Keizai Kenkyusho Chousa Geppou*, No. 365, 12, 11-19, 2015  
Management of Diabetes by the whole region through the critical path of the regional collaboration, 114 economic research survey monthly report

- 8) Kazuhiro Hara, *Kagawa Enkaku Iryou Nettowaaku (K-MIX) no Kaihatsu to Kongo no Tenkai- Denshi Shohousen Nettowaak, Denshi Okusuri Techou, Soshite Dokodemo MY Byouin Kousou no Jitugen e, Hyakujuushi Keizai Kenkyusho Chousa Geppou*, No. 322, 12, 2-8, 2013  
Development of telemedicine network (K-MIX) and the future development – Electric prescription network, Electric medicine handbook, and realization of “every hospital could be my hospital,” 114 economic research survey monthly report
- 9) Kazuhiro Hara, *Kokudo Koutsu Shou ni yoru Kenkou Iryou Bunya ni okeru Kouikiteki Chiiki kan Sougo Shien Suishin Projekuto, Hyakujuushi Keizai Kenkyusho Chousa Geppou*, No. 339, 6, 2-9, 2015  
The project to promote wide-range regional mutual support by the Ministry of Land, Infrastructure, Transportation and Tourism, 114 economic research survey monthly report
- 10) Kazuhiro Hara, *Houkai suru Shuusanki Iryou wo Sukuu IT, Jouhou Shori*, Vol. 15, 8, 1039-1048, 2010  
IT to save destruction of perinatal medicine, Information Processing
- 11) Kazuhiro Hara, *Kagawa Iryou Fukushi Sougou Tokku ga Mezasu Enkaku Iryou – Chiiki Iryou Renkei kara Guroobaru Tenkai Made, Nextcom KDDI Souken* Vol.15: 04-11, 2014  
Telemedicine as an aim of Kagawa Prefecture’s medical and welfare comprehensive special zone – From regional medical collaboration to global development  
Nextcom, KDDI Research
- 12) Kazuhiro Hara, *Network System of Electronic Patient Medical Record for Telemedicine and Telecare in Kagawa Prefecture and International Future Deployment*, Med-e-Tel vol.7. 2014, 483-488, 2014
- 13) The Hara-factor, Some lessons from innovations in governance in Japan , Jorrit de Jong and Arre Zuurmond<sup>1</sup>, *Transforming Asian Governance, Rethinking assumptions, challenging practices*, edited by M Ramesh and Scott Fritzen, Routledge London, 2008