Describing the current state of health information management and sharing:
The case of maternity pathway in Weifang Community Health Centre and East Hospital, Shanghai, in 2007

Irmeli Luukkonen\textsuperscript{1}, Jiechen Jiang\textsuperscript{1}, Mikko Korpela\textsuperscript{1}, Anja Mursu\textsuperscript{3}, Juha Mykkänen\textsuperscript{1}, Joonas Mäkinen\textsuperscript{2}, Pirkko Nykänen\textsuperscript{2}, Antto Seppälä\textsuperscript{2}, Hellevi Ruonamaa\textsuperscript{1}, Hannu Virkanen\textsuperscript{1}

\textsuperscript{1} University of Kuopio, Healthcare Information Systems Research and Development (HIS R&D) Unit
\textsuperscript{2} University of Tampere, Department of Computer Sciences
\textsuperscript{3} Salivirta Oy

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Summary

The China-Finland e-Health Partnership is a joint research project between Finnish and Chinese counterparts. The aim of the project is to improve information sharing in healthcare. The project was approved as part of the bilateral governmental China-Finland Science and Technology Programme. The research institutions in Finland are the University of Kuopio (UKu, coordinator) and the University of Tampere (UTa). This project is organized with four main research themes: 1) Needs and requirements, 2) Architectures, interoperability and standards, 3) Data set definition for electronic health records, and 4) Evaluation. Within each theme, the Finnish counterparts’ research findings from the ZipIT (www.uku.fi/zipit/english/), SerAPI (www.serapi.fi/), eHP Finland, and EBMeds projects are applied to benefit the project. All the themes concentrate on the same case domain, to ensure better use of resources and mutual understanding of the pilot sites: the working groups and the projects’ counterparts. The maternity care chain, or maternity pathway, was selected as a case study, and two healthcare organizations, Weifang Community Health Centre (CHC) and East Hospital, were selected as target organizations in the Pudong New Area. Data were gathered mostly in empirical studies in the hospitals during November 2007 and January 2008.

In this report the state of maternity care in Weifang CHC and East Hospital is studied from the viewpoint of the maternity healthcare chain, emphasizing healthcare professionals’ information needs in their work.

In chapter 2 we provide basic information about the healthcare organizations, current information flows between them, and the health information standards used in the Shanghai area. In chapter 3, we describe a basic maternity pathway by identifying the main activities and actors in both case organizations. The information currently needed and used within the pathway is also described.

In chapter 4 we discuss the aspects of information sharing that need developing. Most of the maternity-related information is paper based. In the Weifang CHC and East Hospital the basic HIS includes appointment management and invoicing systems; LIS, PACS, EPR and EHR are also used through doctors’ workstations. Some systems are integrated with each other inside the hospitals, but not all. Integration between different hospitals and between the hospital and CDC is also needed. Lack of integration often causes duplicate work and information inconsistency. The question of a unified personal ID also needs to be solved.

This report serves as a starting point for guidelines for integrating Health Information Systems and for evaluating the solutions implemented.
Acknowledgements

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The 12th Joint Session under the Agreement on Scientific and Technological Cooperation between the People’s Republic of China and the Republic of Finland, in Beijing on 24 May 2006, approved the Cn-Fi eHP project and its sister project Researching on the strategy of construction & evolution in digital hospital (Guidelines for information interoperability), by the Health Information Centre of Shanghai Municipal Health Bureau, to the Sino-Finnish Scientific and Technological Cooperation Programme as project no. AM12:08.

The authors wish to gratefully acknowledge the invaluable contributions of the Health Information Centre of Shanghai Municipal Health Bureau, the Pudong Health Authority of the Social Development Bureau of the Pudong New Area District, all participants of the sister project and particularly members of staff of the Weifang Community Health Centre and the East Hospital.

Abbreviations:

- BDSS  Basic Data Set Standard
- CDC   Centre for Disease Control and Prevention
- CHC   Community Healthcare Centre
- CHIMA  Chinese Hospital Information Management Association
- CHSI  Centre for Health Statistics Information (under MOH)
- DICOM3 Digital Imaging and Communications in Medicine, version 3 -standard
- EHR   Electronic Health Record
- EPR   Electronic Patient Record
- GP    General Practitioner (working in CHC)
- ICT   Information and Communication Technology
- HIBDSS Hospital Information Basic Data Set Standard
- HIS   Hospital Information System
- HL7   Health Level 7 standard
- ISD   Information Systems Development
- MCH   Maternity and Child HealthcareCentre
- MOH   Ministry of Health
- PACS  Picture Archiving and Communication System
- RHIN  Regional Health Information Networks
- SMHB  Shanghai Municipal Health Bureau
- UKu   University of Kuopio
- UTa   University of Tampere
- KTL   Kansanterveyslaitos, National Public Health Institute in Finland
1. Introduction

The China-Finland e-Health Partnership was a Finnish and Chinese joint research project, which aimed to improve information sharing in healthcare. This report describes the current state and identifies aspects that need development in health information management and information sharing in the Case maternity pathway in the Weifang CHC and East Hospital. This report serves as a starting point for guidelines for integrating Health Information Systems and evaluating the solutions implemented. Data for this report were gathered mostly in field studies in the hospitals during November 2007 and January 2008.

The report is organized as follows. The introduction provides background information about the China-Finland-eHealth Partnership project and presents the research flow. The results of the research are presented in the rest of the report. Chapter 2 gives an overview of Chinese Healthcare organizations and current information flows between them. Chapter 3 explains the maternity pathway and related information in details in the Weifang CHC and East Hospital, Chapter 4 identifies the aspects of information sharing in the maternity pathway that need development.. In chapter 5 we provide a summary and discussion.

1.1. China-Finland e-Health Partnership research project

China is the biggest fresh market for the e-health industry in the world. There are more than 18,000 hospitals in China, about 500 of which are in the Shanghai Municipality (metropolitan area), which is the economically most advanced area. Currently about 85% of the hospitals nationwide have basic hospital management information systems and 15% are building clinical information systems; the figures are significantly higher in Shanghai. ICT in healthcare is developing very fast in China at present, especially electronic health record (EHR) systems and regional health information sharing. However, the large number of systems designed by different software companies and the lack of standards lead to information isolation and many projects in China are starting to study regional information sharing. For example, the main target of the Pudong New Area district government in Shanghai is to establish a regional health platform, based on the existing systems, to fulfill information sharing between all the healthcare organizations. For this purpose, they have established the ‘Pudong 3+3+1’ project, the goal of which is to establish a regional health information platform for the pilot hospitals (East Hospital, Gong Li Hospital, Pudong MCH, Weifang CHC, Tang Qiao CHC, Lu Jiazui CHC and Pu Dong Birth Control Office).

Since early 2006 the government of China has emphasized the role of primary care (Community Healthcare Centres) to address the inequality of access to healthcare services. Correspondingly, information sharing and regional health information networks (RHIN) are the hot topics for research and development.

The joint China-Finland e-health research project was approved as part of the bilateral governmental China-Finland Science and Technology Programme. The Finnish research institutions involved are the University of Kuopio (UKu, coordinator) and the University of Tampere (UTa). The Finnish side of the project was funded by Finnish Funding Agency for Technology and Innovation, Tekes, and participating Finnish companies. The main goal of the Finnish project was to study the applicability of ISD methods, developed in previous research projects, in different socio-economic and cultural healthcare systems, comparing experiences in China and Finland. The research project contributed to the Pudong pilot project and aimed at generalizing the experiences for wider application. The research groups collaborated with the Information Centre of the Shanghai Municipal Health Bureau and the Social Development Bureau of the Pudong New Area District to analyze the needs for e-health systems, develop architectural guidelines and data standards, and evaluate the progress. The research groups also interacted with the National EHR Workgroups of the Chinese Ministry of Health.

This project was organized with four main research themes: 1) Needs and requirements, 2) Architectures, interoperability and standards, 3) Data set definition for electronic health records,
and 4) Evaluation. Within each theme, the Finnish partners’ research results from ZipIT (www.uku.fi/zipit/english/), SerAPI (www.serapi.fi/), eHP Finland, and EBMeDS projects were used in the project. All the themes concentrated on the same case domain, to ensure better use of resources and mutual understanding of the pilot sites, the working groups and project partners. The maternity care chain, or the maternity pathway, was selected for a case study, and two healthcare organizations, the Weifang Community Health Centre (CHC) and East Hospital, were selected as target organizations in the Pudong New area.

The project main outcome is constructed from three reports, which are in line with each other:

- **Report 1 (“Before”):** Current situation of the case (Theme Needs and Requirements)
- **Report 2 (“After”):** Evaluation of the case after the implementation of the new system(s) (Theme Evaluation)
- **Report 3 (“Future”):** Principles of integrating regional and added-value applications to the existing base, with examples applied to the case (Theme Architectures, Interoperability and Standards).

This report is the main outcome of the Needs and Requirements theme, a description of the current state of health information management and sharing in the Case maternity pathway in the Weifang CHC and East Hospital.

### 1.2. Theme Needs and Requirements: research methods and timetable

The activity-driven needs analysis is based on the Activity-driven Information Systems Development Model, which was developed through action research and case studies in several practical ISD projects, hosted by different healthcare organizations in Finland. The emphasis of the model is on domain analysis and description, and requirements elicitation. The model has three levels of analysis and descriptions, traceable with each other: individual level (actions), group/activity level (work processes), and organizational level (network of activities). At each level the work, linked up with information system, is analyzed with different degrees of detail.

The research was conducted in a participatory manner using workshops, story telling, interactive writing, and group interviews. In the analysis phases multidisciplinary (e.g. software engineering, ISD, and work development) knowledge was exploited to achieve results. Materials for this report were collected mostly in empirical studies in November 2007 in the Weifang CHC and East Hospital, and refined during January 2008. Some background and context information was collected from reports of previous trips and other documents. Several researchers’ workshops were held before and after the field studies to achieve mutual understanding of the case and the project goals from the viewpoint of different themes. The viewpoint of our participating companies was also an important input to our work. The main research activities of the Needs and Requirements theme are summarized in Table 1.

The maternity pathway story is used to illustrate the maternity health care processes in different levels of description. The earlier versions of the same story were used to capture first the understanding of the Chinese maternity pathway, and further in interviews and walking through the maternity pathway in the Weifang CHC and East Hospital. For the field studies, the story was translated into Chinese and used as a discussion facilitator. Unclear parts were clarified, and answers were used to complete the story.
Table 1. Research workflow and outputs of the Needs and Requirements theme

<table>
<thead>
<tr>
<th>Timeslot and phase</th>
<th>Activity</th>
<th>Output</th>
</tr>
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<tbody>
<tr>
<td>September - October:</td>
<td>Reading, researchers’ workshops, interactive writing</td>
<td>Pre-understanding about Chinese healthcare, maternity story with questions</td>
</tr>
<tr>
<td>Starting project</td>
<td></td>
<td></td>
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<tr>
<td>November: data gathering</td>
<td>Interviews and maternity pathway walk through in Weifang CHC and East</td>
<td>Gathered data</td>
</tr>
<tr>
<td></td>
<td>Hospital, other visits</td>
<td></td>
</tr>
<tr>
<td>December: analysis and</td>
<td>researchers’ workshops, analytical writing</td>
<td>First draft of this report, field study reports, travel reports</td>
</tr>
<tr>
<td>reporting</td>
<td></td>
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<tr>
<td>January: data gathering</td>
<td>Workshop with companies, workshop with Shanghai partners, other visits</td>
<td>completed data (questions answered)</td>
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<tr>
<td>and validation</td>
<td></td>
<td></td>
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<tr>
<td>February- May: analysis</td>
<td>researchers’ workshops, workshop with companies, analytical writing,</td>
<td>Report 1, baselines of report 2 and 3</td>
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<tr>
<td>and reporting</td>
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2. Context

There are three levels of governance in China: the national, municipal (e.g. Shanghai) and district levels (e.g. Pudong New Area).

In this chapter we give an overview of healthcare organizations, managerial and statistical information flows and current standards and standardization activities in health information managing in Shanghai.

2.1. Overview of healthcare organizations in Shanghai

Shanghai Health Administration is divided into 2 parts. One is the Shanghai Municipal Health Bureau (SMHB), which is in charge of making health policy and regulations, unifying the guidelines and standards etc. for the whole Shanghai Area. The other is the Shen Kang Hospital Authority, which is in charge of the management of most teaching hospitals at the third level in Shanghai, and it also grants funding for development projects. The Shen Kang Hospital Authority provides the funding for the Health Information System development project for these hospitals.

There are 19 districts in Shanghai, and Pudong New Area is the biggest and leading district. Pudong was the first district to set up the Pudong Hospital Authority at the beginning of 2007. As a result, the Pudong Social Development Bureau has two Health Administrations to manage the health organizations in Pudong, the Health Sector of the Social Development Bureau and the Pudong Hospital Authority, which is in charge of all the 29 Community Health Centres in Pudong, and might manage all the general hospitals (second level) in Pudong in the next two years.

There are three levels of hospitals:
1. Community Healthcare Centres (CHC, level 1, under which there are Community Health Stations),
2. General Hospitals (level 2), and
3. Specialist Hospitals and Teaching Hospitals (both level 3).

Citizens are free to choose a hospital of any level when they need health services. Major funding for hospitals comes from citizens’ payments (for doctor’s visits, laboratory tests, drugs etc.). Only ~10% of the funding comes from the government through the public health insurance organizations, which are found at municipal and national levels.

Apart from these hospitals, there are four other main public health organizations in Pudong. The most important is the Centre for Disease Control and Prevention (CDC), similar to the National Public Health Institute (KTL) in Finland, which is in charge of collecting public health data from hospitals and health Centres. The other three organizations are the Maternity & Child Healthcare Centre (MCH) (within the Maternity & Child Hospital), the Mental Healthcare Centre and the Health Supervision Institution. The Birth Control Office is the place where women who do not have residence in Shanghai can register when they are pregnant.

The general network and relationships between the Healthcare Organizations in Pudong are shown in Figure 1 (see legend for Figures 1 and 2 below).
Figure 1. Healthcare organizations in Shanghai
2.2. Managerial and statistical information flows between organizations

The **Health Information Web/Portal** is established in the Pudong Region, and the **Regional Data Centre** is set up in the Zhangjiang Area, and they are remotely controlled at the Pudong CDC. Moreover, the Pudong government has invested a huge amount of money to complete the network for all the health organization in the whole Pudong region, all of which can connect with the Health Information Web/Portal. The Data Centre collects mainly public health data. The Web portal is not used in every hospital, and most information for different reports is still collected manually from different sources, both digital and paper based. The reports are sent either by post (paper-based collection) or by e-mail (see Figure 2).

**Reporting diseases** (for disease control and prevention): In the Pudong area, the CHCs and hospitals send reports about diseases to the Pudong CDC, which summarizes the data and reports further to the CDC in Shanghai. The reporting frequency depends on the disease: reports can be sent daily, weekly, monthly or quarterly.

**Reporting patient volumes** (for healthcare quality management and decision making): In the Pudong area, the CHCs and hospitals send reports about patient volumes, numbers of laboratory tests taken etc. to the Health Sector of the Social Development Bureau in Pudong.

**Reporting maternity issues:** In the Pudong area, the CHCs and hospitals send reports concerning maternity issues, e.g. number of pregnant women and babies delivered in the community, to the Pudong Maternity and Child Healthcare Centre, which collects the data and reports further to the Health Sector of the Social Development Bureau in Pudong and the MCH in Shanghai.

**Insurance information:** Hospitals of all levels send summaries of payment information to the insurance office. The insurance offices return a small percentage of hospital payments to the citizens, except in the case of pregnant women. The amount returned to them depends on the size of the pregnant woman’s salary. Information about salaries is obtained from the tax authority. Within the maternity pathway, pregnant women pay for their healthcare services all along the pathway, collect all the receipts and send them to the insurance organization all at once only after delivery.
Figure 2. Information flows upwards between healthcare organizations
Clinical healthcare information is not shared between different healthcare-providing organizations in Pudong: the clinical data are still isolated at each hospital. To explain the need for sharing clinical information within the maternity healthcare chain, we describe the maternity pathway through different organizations in Chapter 3.

2.3. Standards

In recent years, under the Centre for Health Statistics Information (CHSI) of the MOH, health information standardization work has achieved a great deal in China. In 2002, the ‘Basic function norm of the hospital information system (HIS)’ was issued by the MOH, which was regarded as the admission rule and annual appraisal regulation of setting up HIS for the local organizations, hospitals (users), and companies (suppliers). In 2003, the ‘National Health Information Development Plan (2003-2010)’ was published, which contains the general healthcare information development plan for China. The MOH asked national experts to make a standard for PACS in 2003, called ‘CPACS’. They selected DICOM3 as the reference to establish a set of standards such as image architecture, data repository, workflow, quality control and communication. In addition, the MOH appointed the Chinese Hospital Information Management Association (CHIMA) to set up a ‘Hospital information Basic Data Set Standard (HIBDSS)’, and CHIMA planned to use the HL7 as the reference to fulfill the information exchange between hospitals and other health organizations. ‘Structure and Standard of Electronic Patient Record (EPR)’ and ‘Structure and Standard of Electronic Health Record (EHR)’ are being planned by the MOH, to be developed in these years; drafts of the Basic Data Set in Public Health Information and Community Health Information have been made available for discussion.

The MOH assigned the Centre of Disease Prevention and Control (CDC) and the China health information institute (public health) to study and build the BDSS for public health information. The aim of the project was to ensure that the public health information systems at different levels are interoperable, and that data can be exchanged across the public health information systems.

The China Public Health Information Classification and Basic Data Set Standard version 1 was released in 2007.

3. Maternity pathway

By the maternity pathway we mean a path through which a pregnant woman contacts different healthcare organizations for maternity healthcare and to deliver the baby. The maternity pathway takes place in the time slot beginning when a woman who thinks that she might be pregnant makes the first contact with a healthcare organization, and ending when all follow-ups with the new mother and her new-born baby have been completed.

In this section we identify and describe the actors, workflows and information flows, as well as the information systems used in the Weifang CHC and East Hospital in the maternity case. What information and data are used within the maternity pathway? Who is using the information and for what purpose? Where are the data recorded and in what form? What information tools are used, both paper based and digital? Possible bottlenecks and development points in the maternity pathway are identified. The description provides detailed information for an implementation plan concerning the maternity case. The information needs can be further studied in relation to the core dataset and centralized database. The impact of new systems and changes in the work flows can be identified.

The basic flow of the maternity pathway is described in three levels. 1. The maternity pathway overview provides a roadmap to show the care chain as a whole. 2. The Maternity processes of early pregnancy, late pregnancy, and after delivery relate information used and needed within the processes and information sharing between the facilities. 3. Detailed information about workflows connects actors, information, information tools and information systems. The levels are traceable with each other. The maternity pathway is described in sections 3.1 and 3.2 and in Figures 3-16. The relationship between the Figures is shown in the map in Appendix 1.
3.1. Maternity pathway overview

Overview: Maternity care services are given in CHCs and hospitals. Women are advised to visit a CHC (level 1 hospital) in the community where they live, but they can freely choose higher level hospitals. Women visit hospital mostly to confirm that they are pregnant, but pregnancy can also be confirmed in a CHC. Floating women are advised to register pregnancy at the Birth Control Office.

Women often visit a CHC during the first 16 weeks of pregnancy, then level 2 or 3 hospitals after 16 weeks. If the woman has a high risk of hypertension or diabetes, the health provider of the CHC will recommend that she visits a special hospital. Delivery takes place in level 2 or 3 hospitals, in the maternity department. The CHC takes care of follow-ups after delivery. Public health providers of the CHC visit homes twice 3-7 days after delivery. When the baby is 1 month old, the mother must bring the baby to the maternity and child health centre for examination. The mother goes for a check up in the delivery hospital 42 days after delivery.

Figure 3 shows an example of the maternity pathway. Hospitals are depicted with rectangles, activities with ovals, and the actors involved are named inside the ovals. Under the hospitals there is a timeline depicting the duration of the pregnancy.

Example of maternity pathway: Mrs. Yang visits East Hospital to confirm her pregnancy. Because she has no regular residence in Shanghai, she registers her pregnancy in the Birth Control Office. She visits the Weifang CHC for the first four months for regular examinations, including lab tests and medication when necessary. The GP sets up a Maternity Card for her (to keep with her during the pregnancy), and a paper-based maternity health record to be kept in the Weifang CHC. From week 16 Mrs. Yang visits East Hospital for regular examinations, including laboratory tests and medication when necessary. A new paper-based maternity health record is set up and kept in East Hospital. She delivers her baby in East Hospital and stays for a few days in the maternity department as an inpatient. She goes home with her baby and the Weifang CHC’s public health providers take care of follow-ups: two or three home visits and checks on the baby (immunization etc.) in the CHC. After all that is necessary has been done, the GP ‘closes the case’, writes a summary in the electronic maternity IS and archives the paper-based maternity health record. After 42 days from delivery, Mrs. Yang goes to East Hospital for a physical checkup.

Figure 3. Activities related to maternity care in the CHC and East Hospital
3.2. Maternity processes and related information in Weifang CHC and East Hospital

The maternity pathway is divided here into three processes: Early pregnancy in the Weifang CHC (sub-section 3.2.1), Late pregnancy and delivery in East Hospital (sub-section 3.2.2), and Follow-ups in the Weifang CHC and Mrs.Yang's home and East Hospital (sub-section 3.2.3). Activities, information, information tools, and information systems are described; and development points in information sharing are identified. Each process description has three parts: firstly, the processes are described with narrative texts (parts of the maternity story) and a summary of paper-based maternity information, digital information systems and development points in the process is provided after the story. Then the processes are illustrated with swim line diagrams at the end of each description. Basic workflows of outpatient-visit in both hospitals are described in more details in sub-sections 3.2.1.1 and 3.2.2.1, and work flows for arranging follow-ups, home visit and case closing in subsection 3.2.3.1. This chapter focuses on information within the maternity pathway and information sharing points, and information sharing needs from the healthcare actors’ viewpoint.

3.2.1. Early pregnancy: Weifang CHC

Mrs. Yang visits the Weifang Community Health Centre (Weifang CHC) regularly for first four months of the pregnancy. In the first visit, the maternity health provider, a general practitioner (GP), sets up the Maternity Card for her. Mrs. Yang’s personal information, clinical information and results of regular tests will be written in the card during the CHC and hospital visits. The card also contains guidelines for nutrition and healthy habits, etc. The GP creates a paper-based maternity health record, kept in CHC. If Mrs. Yang has a high risk of hypertension or diabetes, the health provider recommends that she go to a special hospital, and writes three copies of referral letters. If there is a need for special tests that cannot be done in the Weifang CHC, the samples will be collected and then sent to another hospital by mailing service staff at CHC. Samples are sent weekly or every two or three days, and the test results are sent back by mail or phone call. After the first 4 months of pregnancy, Mrs. Yang chooses a hospital to visit for the rest of the pregnancy including delivery of her baby. She can tell the CHC the name of the delivery hospital, to help contacting. Figure 4 shows the process for the early part of the pregnancy. Yellow boxes depict development points in information sharing. Regular examinations are described in more detail in the outpatient workflow description in subsection 3.2.1.1.

Digital information systems: HIS with basic functions: outpatient registration and payment (invoice), admission and discharging management, pharmacy management, hospital manager inquiry system; EHR system; doctor and nurse work stations; LIS; RIS and Mini PACS; other systems related to Public Health field.

Paper-based maternity information:
- Confirmation note of the pregnancy, given in East Hospital
- Registration note from the Birth Control Office
- Patient Card which is used to record clinical information such as test results, kept by mother
- Maternity Card created in the CHC, kept by mother
- Maternity health record, kept in the CHC
- Referral letter, sent to a higher level hospital when necessary
- Manually written or printed prescription for the patient
- Laboratory test order to higher level hospital and test results, when needed

Development points in information sharing:
• No information transfer between facilities, e.g. between East Hospital and the Weifang CHC (pregnancy confirmation), or between the Birth Control office and Weifang CHC (pregnancy registration).

• EHR, LIS, etc should be integrated with each other

• Paper-based maternity health record is used in the Weifang CHC, and no information is shared with other facilities

• Laboratory test results from higher level hospitals come by mail or by phone call, so information can be delayed

Legend for swim line diagrams
Legend

- Institution, formal organization
- E-card
- Paper-based document
- Action
- Actor
- Computer-based information system
- Telephone
- Development point
- Information flow
- Missing information flow
Early pregnancy

- Week 16 of pregnancy

Figure 4. Early pregnancy process
3.2.1.1 Basic workflow in regular visits to Weifang CHC

The activities identified in the basic outpatient workflow in regular visits are: Entering the CHC, GP examination, Laboratory tests and Medication (Figure 5). Each activity is described in this section with a short narrative text (part of the maternity story) including location of activity, actors, information tools, information and information systems in use. Activities are also described in one or several diagrams (Figures 6-11).

Figure 5. Activities in Outpatient workflow in regular visits in Weifang CHC

Legend for diagrams
Registration desk: Making an appointment

Waiting hall: Waiting for one’s turn

Mrs. Yang goes to the CHC, and first she goes to the reception desk. The reception nurse asks her what she wants. Then she chooses an available GP, or the nurse chooses a GP for her if she is visiting for the first time. The reception nurse collects her data using the card reader (health insurance card) or types the basic information into the system when she visits for the first time. The registration fee and other fees during the visit are collected in the electronic system, and she can pay everything when she is leaving the CHC (at the end of the visit). She waits outside the doctor’s room for her turn. There is a screen on the wall, which lists the patient’s name, the GP’s name and the number of the room. The GP can see the list of his/her patients at the doctor’s workstation system and the GP will call Mrs. Yang when it is her turn (Figure 6).

Information tools: insurance card, hospital card which can be reused only at the Weifang CHC (given to Mrs. Yang if she has no insurance card), paper-based Patient Card, big screen

Information: personal data (name, sex, age, address, telephone and other contact information etc.), insurance data (type of insurance), appointment number, doctor’s name, clinic room

Information systems: card reader, outpatient registration system, wall screen connected to the GP’s doctor’s workstation system and outpatient registration system (the nurse operates the screen).
Mrs. Yang visits Weifang CHC: making appointment

Actors:

Reception nurse  Mrs. Yang  GP

Information tools:

Card reader  Nurse’s workstation  Appointment wall screen  Payment wall screen  Doctor’s workstation

Information systems:

HIS: outpatient registration and payment; pharmacy management; admission and discharge management; hospital management inquiry

Information:

Insurance data  Personal data  Appointment data  Invoice data

Figure 6. Making an appointment
The GP’s office: The GP examination

The GP examines Mrs. Yang according to the regular visiting program. The GP can see previous events and test results from Mrs. Yang’s Maternity and Patient Cards. The GP writes down the examination results in the Maternity Card and maternity health record (Figure 7).

- **Information tools:** paper-based Patient Card and Maternity Card (given in the first visit, also used later).
- **Information:** personal data, clinical data and previous test results, disease history, pregnancy and childbirth history, husband and family history, hereditary diseases, expected date of delivery.
- **Information systems:** paper-based maternity health record
- **Development points:** duplicate work in writing examination results
In Weifang CHC, GP examines Mrs. Yang and records her clinical information.

Figure 7. Information produced in the GP examination is paper-based.
Medication

- If Mrs. Yang needs medication, the GP gives an e-prescription through the doctor’s workstation, which is connected with the HIS. The GP also writes a paper-based prescription in case Mrs. Yang wants to buy her medicine from another hospital. The GP writes medication information also in Mrs. Yang’s Patient Card. Mrs. Yang goes to the reception desk to pay for the drugs. The nurse at the reception desk sees the e-prescription and the price of the drug in the nurse’s workstation. Mrs. Yang is identified with the hospital e-card by the card-reader. If she owes money, this can also be seen on the payment screen. The nurse gives Mrs. Yang a receipt. The pharmacist can see the prescriptions from the nurse’s workstation, and collects the drugs in advance. Mrs. Yang gets her medicine from the pharmacy window (Figure 8).

Information tools: PC to write an e-prescription, paper-based Patient Card, manually written prescription for the mother.

- Information: personal data, prescription, previous medication
- Information systems: Doctor’s workstation system connected with the pharmacy management system and billing system.
- Development points: option to print an e-prescription instead of manually writing; duplicate work.
In Weifang CHC, GP gives a prescription to Mrs. Yang, she pays the bill and pharmacist gives the drugs.

Figure 8. Medication
The GP’s office: The GP orders a test

During the visit, the GP sees clinical data and ongoing pregnancy information from the Maternity and Patient Cards. On the basis of the previous pregnancy history and physical examinations, the GP decides whether some laboratory tests are needed. The GP order a test through the doctor’s workstation system to the LIS, where the blood-collecting nurse and the laboratory technician can see it. The GP also prints the test order for Mrs. Yang. A paper-based test order is used if Mrs. Yang is not giving the sample in the same day (Figure 9).

- **Information tools**: PC to write a test order by the doctor’s workstation system, printed test order, paper-based Patient Card and Maternity Card
- **Information**: personal data, information about the pregnancy, clinical information (results from previous tests), test order, type of sample
- **Information systems**: doctor’s workstation system, connected with the LIS
- **Development points**: a printed test order is needed because test orders are difficult to find in the digital IS if Mrs. Yang gives a sample later than the day order has been given
Lab test order In Weifang CHC: 
GP makes lab test order with doctor’s workstation system (connected to LIS), and prints a paper copy for Mrs. Yang. Blood collecting nurse and lab technician see order from LIS.

Figure 9. Laboratory test order
Sample collecting window: Taking a sample

The blood-collecting nurse uses a card reader (health insurance card, or the hospital’s own card) to identify Mrs. Yang and gets the test order data either from the LIS or from the paper-based test order. The nurse takes the tests and then marks the samples with the card reader. The nurse attaches a paper-based code on the tube (see Figure 10, left side).

- **Information tools**: e-card and card-reader, e-test order, printed test order, PC, paper-based code on the tube.
- **Information**: personal data, test order data (what type and amount of sample)
- **Information systems**: LIS, HIS

Laboratory: Sample examination and recording of result

The laboratory technician examines the samples and records the results in the LIS (see Figure 10, right side). The results can be seen in the reception desk and doctor’s workstation system through the LIS.

- **Information tools**: e-test order, paper-based code on the tube
- **Information**: test order, results, identification
- **Information systems**: LIS
In Weifang CHC lab test is taken by nurse, examined by technician; the result is recorded by technician into LIS.

Figure 10. Laboratory test
**GP’s office:** GP reads the results on the PC and records them on paper-based cards

After the test results are recorded in the LIS, the GP can see the results on his/her own workstation system. Next time Mrs. Yang visits the GP, the GP writes the test results in the Patient Card and Maternity Card (Figure 11, left side).

- **Information tools:** PC, paper-based Patient Card, and Maternity Card
- **Information:** test results, identification
- **Information systems:** LIS system, doctor’s workstation system

**Reception desk:** Mrs. Yang asks for the results.

After the test results are recorded in the LIS, Mrs. Yang can go to the reception desk and ask for her test results. The reception nurse identifies Mrs. Yang with the e-card and prints the test results from the LIS through the nurse’s workstation (Figure 11, right side).

- **Information tools:** insurance card, e-card, printed results are given to Mrs. Yang
- **Information:** personal data, laboratory test results
- **Information systems:** LIS, nurse’s workstation
In Weifang CHC, GP records test results on Patient Card and Maternity Card. Test results can be obtained from reception desk.

Figure 11. Laboratory test results
3.2.2. Late pregnancy and delivery: East Hospital

From the 16th week on, Mrs. Yang visits East Hospital for regular examinations, including laboratory tests and medication if necessary. The basic flow of regular visits is described in more detail in subsection 3.2.2.1. To arrange the follow-ups after delivery, the public health provider from the Weifang CHC calls Mrs. Yang a few days before the expected date of delivery. Mrs. Yang delivers her baby in East Hospital and stays for a few days in the maternity department as an inpatient. The last pages of the Maternity Card, containing basic information about the delivery and the newborn, are sent to the MCH by post after delivery (or taken to the CHC by the mother herself). A copy of the discharge summary is given to Mrs. Yang. Figure 12 shows the basic process for late pregnancy and delivery.

The CHC takes care of the follow-ups after delivery. The maternity health provider calls Mrs. Yang a few days before the estimated time of birth, and asks how she feels. The maternity health provider also asks where Mrs. Yang will stay after the delivery. In China, it is usual that after delivery the mothers go to their mothers’ places for some time. In such cases the Weifang CHC send a referral letter to the Maternity & child centre, which collects all such letters and posts them to the corresponding CHC at once to tell them to take care of the mother.

Delivery and staying in East Hospital as an inpatient was not studied in detail.

The doctor and nurse give advice about health promotion, breast feeding and nutrition to Mrs. Yang. Nurses tell her to come back to the hospital to have the baby checked after 30 days. She is also advised to come back to the hospital for a physical check 42 days after delivery.

The information about the mother and baby (basic physical check, temperature, blood pressure, weights of mother and baby etc.) is collected and written on the two last pages of the Maternity Card. These pages are then sent to the MCH by mail and the same information is typed into the maternity management system (public health system). The information is sent further to the centralized data base via the maternity management system for reporting to the CDC.

The process for late pregnancy and delivery is shown in Figure 12.

Paper-based maternity information:

- Patient Card is used to record clinical information such as test results, and it is kept by the mother
- Maternity Card is created in the CHC, and kept by the mother.
- List of regular tests
- Examination form of pregnant women: regular examination results. This is kept by the hospital
- Visiting schedule of each pregnant woman helps nurses remind the mother by phone to visit, if she does not come in time. If the mother cannot be reached by phone, the nurse calls the public health provider at the CHC and asks how to contact the mother.
- Printed prescription for the patient
- Laboratory test order to a higher level hospital and test results, when needed

Information systems: HIS : appointment system, outpatient registration and payment (invoice), admission and discharging management, pharmacy management, hospital manager inquiry system; EPR system; doctor’s works station system, nurse work station; LIS; RIS and PACS.

Development points in information sharing:

- There is no information transfer between East Hospital and the Weifang CHC (about Weifang CHC’s early pregnancy examination notes to East Hospital; clinical or date information about delivery from East Hospital to Weifang CHC)
• EPR, LIS, doctor’s workstation system etc. should be integrated with each other: now some information is collected and copy-pasted by the nurses between the different systems
• EPR should have an interface with CDC systems
• Paper-based maternity health record is used in East Hospital, and no information is shared with other facilities
• Laboratory test results from higher level hospitals come by mail or by phone call, so information can be delayed
• EPR cannot be used to share information between the inpatient and the outpatient departments.
• If a pregnant woman does not come to the hospital for regular tests according to the visiting schedule, a nurse at the hospital contacts her by phone. If the nurse cannot reach her, the nurse contacts the public health provider at the CHC by phone and asks how to contact the mother. It is not clear who should be called, or even which CHC
• The maternity management system is used to record delivery information in a centralized database, but the other facilities cannot utilize this information
Figure 12. Process for late pregnancy and delivery
3.2.2.1 Basic workflow in regular visits in East Hospital

Reception desk: entering East Hospital

Mrs. Yang goes to the reception desk and tells the nurse that she would like to see a gynaecologist, or names the specialist she would like to see. The nurse gives her the serial hospital number for an outpatient and may ask her about her problem and chooses an available specialist for her. There is no information system at the reception desk. There is a machine in the lobby for patients to check their own status and guideline information.

- Information tools: Patient Card
- Information: appointment serial number, hospital serial number, knowledge of how to choose specialists for patients

Appointment Desk: making an appointment

If Mrs. Yang has not made an appointment beforehand, she can make one here. The nurse at the appointment desk uses the appointment system and gives Mrs. Yang an appointment.

- Information tools: PC to make an appointment, insurance card, hospital card given if no insurance card (reuse at East Hospital), big screen
- Information: personal data of the patient, name of the specialist, department, data and time, appointment number
- Information systems: appointment system, which is connected with the doctor’s workstation system, with which the doctor can make a new appointment with the patient during the appointment.

Registration and payment window: Paying the registration fee

Mrs. Yang goes to the registration and payment window to pay the registration fee. The staff collects her data using the card reader (from the health insurance card or hospital card) or by typing the personal data into the system if she is visiting for the first time and has no insurance card. The health insurance organization and the hospital need insurance information, e.g. the type of insurance, for billing.

- Information tools: insurance card, hospital card (reuse at East Hospital), card reader
- Information: personal data (name, sex, age, address, telephone and other contact information etc.), insurance data (type of insurance)
- Information systems: outpatient registration and payment system

Waiting hall: waiting for one’s turn

Each special department has a waiting hall and a big screen on the wall. Mrs. Yang gives her Maternity Card to the ‘calling nurse’ at the waiting hall desk and waits outside the gynaecology outpatient department. The patients’ names and the numbers of the rooms can be seen on the wall screen. The nurse calls Mrs. Yang when it is her turn. The wall screen is connected to the doctor’s workstation system and outpatient registration system, and the nurse operates the screen. Mrs. Yang gets her Maternity Card and goes to see the doctor.

- Information tools: big screen on the wall, Maternity Card
- Information: personal data, doctor’s name, number of the clinic room
- Information systems: calling system

The doctor’s office: The examination
The doctor examines Mrs. Yang according to the regular visiting program. The doctor can get the historical data from the Maternity Card and Patient Card (kept by the mother), and from the examination form (kept by East Hospital). The regular examination results are recorded on the Examination form of pregnant women. All these data are also recorded on the Maternity Card.

- **Information tools**: insurance e-card, hospital e-card, card reader, paper-based Patient Card and Maternity Card (kept by the mother, given in the Weifang CHC). Examination form of pregnant women (kept at East Hospital)

- **Information**: personal data, examination results, Mrs. Yang’s history, pregnancy and childbirth history, husband and family history, hereditary diseases, expected date of delivery.

- **Information systems**: EPR system is used only in the inpatient department, not in the outpatient department. Outpatient department maternity information is paper-based (Maternity Card), as is Mrs. Yang's disease and treatment history (Patient Card)

**The doctor’s office: The doctor gives an e-prescription**

If Mrs. Yang needs medication, the doctor gives an e-prescription through the doctor's workstation system, which is connected to the billing and pharmacy management systems. The doctor can check Mrs. Yang’s previous medication from the doctor’s workstation system. A printed prescription is given to Mrs. Yang. The doctor writes medication information also on Mrs. Yang’s Patient Card.

- **Information tools**: paper-based Patient Card, PC, printer to write a prescription

- **Information**: personal data, information about the previous prescriptions to check if the medicines are matched or duplicate.

- **Information systems**: Doctor’s workstation system, connected with the pharmacy management system and billing system.

- **Development points**: duplicate work

**The doctor’s office: The doctor orders an e-test**

During the visit the doctor sees the clinical data and ongoing pregnancy information on the Maternity and Patient Cards. On the basis of the previous pregnancy history and physical examinations, the doctor decides whether laboratory tests are needed. The doctor orders a test through the doctor’s workstation system to the LIS, where the blood-collecting nurse and the laboratory technician can see it. A printed test order is given to Mrs. Yang. The doctor can view the test results on the doctor’s workstation system. Information concerning the test is written also on the Patient Card, Maternity Card and Examination form of pregnant women

- **Information tools**: PC to write a test order on the doctor’s workstation system, printed test order, Patient Card, Maternity Card and Examination form of pregnant women

- **Information**: personal data, clinical data and ongoing pregnancy information, test order

- **Information systems**: doctor’s workstation system to handle the test order, connected with the LIS

**Laboratory (sample collecting) window: Taking a test**

Mrs. Yang goes to the sample collecting window. The blood-collecting nurse uses a card reader and an e-hospital card to identify Mrs. Yang, and sees the test order from the LIS. The nurse takes the tests and marks the samples using the card reader. A barcode is used for identifying test samples at East Hospital.

- **Information tools**: e-card, card reader and barcode, printed test order

- **Information**: personal data, test order
• **Information systems**: LIS

**Laboratory: examination of the test, results in LIS**

A laboratory technician examines the samples and records the results in the LIS. Then the results are sent to the test report window and the doctor’s workstation system. The doctor can see the results on the PC and writes them on Mrs. Yang’s paper-based documents.

- **Information tools**: electronic test order, barcode reader, barcode (the sample is identified by barcode), PC, Patient Card and Maternity Card
- **Information**: test order, results, identification
- **Information systems**: LIS (the results are sent to the test report window by the LIS)

If a special test that cannot be done in East Hospital is needed, the samples are collected and sent to another special hospital by the mailing service staff at East Hospital within 2 or 3 days, and the test results are sent back by mail or phone call.

3.2.3. **After delivery: Weifang CHC, East Hospital and Maternity and Child Health Centre**

The care process after delivery takes place in the Weifang CHC, Mrs. Yang’s home and East Hospital. After delivery, Mrs. Yang goes home. The maternity health provider (GP) makes a home visit appointment by phone and visits Mrs. Yang’s home twice 3-7 days after the delivery. If Mrs. Yang has a high risk of hypertension or diabetes, 3 home visits are made. The maternity health centre, MHC, send the two last pages of Mrs. Yang’s Maternity Card to the Weifang CHC, where it is archived. When the maternity case is closed, the maternity health provider creates a digital maternity health file for Mrs. Yang and writes a summary of the case according to the paper-based records.

Immunization of the baby is taken care of, and the baby is registered in the children’s healthcare IS in the Weifang CHC. Thirty days after delivery, Mrs. Yang brings the baby to East Hospital (or the Maternity & child centre) for examination. Forty-two days after delivery, Mrs. Yang goes to the delivery hospital for a physical check. The nurses call her if she does not turn up at the scheduled time.

After all scheduled visits have been done, Mrs. Yang collects all her receipts for maternity health care payments, and sends them to the insurance office. The insurance company returns some money to Mrs. Yang. The amount depends on the size of Mrs. Yang's salary and the hospital fees.

A paper-based Patient Card for the baby is created when the newborn visits the hospital for the first time. The baby has the hospital's own e-card for payments because there is no official insurance card for the baby yet. It is possible to buy insurance for the baby (60RMB insurance fee, 50-80% refund for hospital payments).

The whole process is shown in Figure 13. Work flows for agreeing follow-ups, home visit and closing case are depicted in more detail in subsection 3.2.3.1 and Figures 14-16.

**Paper-based maternity information:**

- Patient Card is used to record clinical information such as test results, and it is kept by mother
- Maternity Card is created in the CHC, and kept by the mother
- Paper-based maternity health record, kept in the Weifang CHC
- Home visit notes
- Last pages of Maternity Card are archived after delivery in the CHC
- Notification letter for the mother
Digital information systems:
- Maternity health management system

Development points in information sharing:
- The last pages of the Maternity Card often arrive in Weifang too late to be used in planning home visits.
- A centralized database is not used in all facilities at this moment; and only input is possible.
- There is no transfer of clinical or delivery date information between East Hospital and the Weifang CHC.
- The maternity management system is not integrated with other systems.
- There is no clear information sharing with the GP taking care of Mrs. Yang in the early pregnancy phase and the maternity health provider taking care of Mrs. Yang after delivery. The maternity health provider spends some morning hours with the GP in the clinic room. Joint meetings are necessary for cooperation, and a digital information system supporting communication between them is needed.
Figure 13. Process for the follow-ups after delivery
### 3.2.3.1 Work flows for arranging follow-ups, Home visit and Closing case

**Weifang CHC, Maternity department: arranging follow-ups**

- The maternity public health provider makes an appointment for the mother for home visits. Information about delivery is often delayed. Finding out the right day for home visit is sometimes problematic, because the CHC health provider does not always receive information about the delivery time from the hospital as soon as needed. As a result, the health provider must keep phoning the mother’s home, until he finds her at home and they can arrange the home visit appointment. For this reason, the public health provider tries to contact pregnant women by phone usually already 7 days before the estimated time of delivery.

  **Information tools:** phone, maternity health record

- **Information:** personal data, Mrs. Yang's and her family’s contact info, expected time of delivery

- **Information systems:** paper-based maternity health record

- **Development points:** The information and data written on the Maternity Card at the hospital is not available to GPs and health providers at the CHC, unless the mother brings it to the CHC right away after discharge from the delivery hospital. In East Hospital, the delivery information about the mother and baby is typed into the public health system (centralized database) for reporting to the CDC, but the GP and health providers are not able to access this system in the Weifang CHC.
In Weifang CHC, 
Agreeing home visit appointment

Figure 14. Arranging home visit
Mrs. Yang's home: home visit

The maternity public health provider (GP) of the Weifang CHC visits the home after the delivery. During the visit the GP checks that Mrs. Yang and the baby are well, gives advice about breast feeding and nutrition, makes basic measurements such as blood pressure, blood glucose (if there is diabetes), and the weight of the mother and baby. The results are recorded on the Maternity Card (summary information) and also in the paper-based Maternity Health Record in the CHC office. Some time ago there was a PDA device for the whole CHC, used in home visits to take notes. The notes were further recorded manually into the paper-based maternity health record in the CHC office.

- **Information tools**: Maternity Card, home visiting form, home visit notes, discharge summary from East Hospital
- **Information**: the information on the Maternity Card, results of measurements and observations, summary information about delivery
- **Information systems**: paper-based maternity health record
- **Development points**: Information is paper based, all home measurements are manually done and recorded by the CHC health provider.
Home visit:
Maternity health provider visits Mrs. Yang’s home.
Checks if everything is OK, makes measurements, gives advices etc.

Figure 15. Home visiting
Weifang CHC, Maternity department: closing the case

The maternity health provider writes a summary of the pregnancy, delivery and follow-ups in the Maternity and child Health System and also in the paper-based Maternity Health Record, which is archived for 30 years. Also the last two pages of Mrs. Yang’s Maternity Card containing information about delivery and the new-born (filled in in East Hospital) are archived in the Weifang CHC. A summary of the case is recorded in the digital Maternity Management system for digital archiving.

- **Information tools**: paper-based Maternity Health Record, home visit notes, last pages of Mrs. Yang’s Maternity Card (sent from East Hospital by post, or brought by Mrs Yang herself)
- **Information**: summary information about early pregnancy, delivery and follow-ups
- **Information systems**: paper-based Maternity Health Record, Maternity Management System
- **Development points**: Duplicate work in summarizing the case in both the paper-based and digital records. Summary of late pregnancy visit stays in East Hospital.
In Weifang CHC, Summary of the pregnancy and child birth is recorded to maternity and child health system after ‘case is closed’

3.3. Information entities in the maternity pathway

The activities in the pathway where information (regarding an ongoing pregnancy) is produced are: confirmation, registration, creating the Maternity Card and other documents, regular visits {making appointments, examination, laboratory test, prescription, education, ultrasonic inspection}, delivery {admission, delivery, inpatient treatment, discharge}, home visit, baby check,
body check, and closing case. These activities happen in different facilities and Mrs Yang is present in all except in ‘closing case’.

The information entities which are needed in clinical care can be categorized as follows: Basic personal data, Family data, Cumulative pregnancy data, Medication data, Laboratory test data, Delivery data, Baby data, and Follow-up data. Personal and family data are ‘stable’ data, containing information about the mother and her family (names, contact info etc.) and their history (hereditary and other diseases, previous pregnancies etc.). Cumulative pregnancy data include observations and results from regular examinations. These information entities are shown in the maternity pathway in figure 17. However, it should be noted that in the current situation data are distributed in different organizations. For example, Cumulative pregnancy data in the Weifang CHC contains data collected from the early pregnancy phase and Cumulative pregnancy data in East Hospital contain data collected in the late pregnancy phase.

Other information entities could be identified, such as payment data, insurance data, reports, and appointment data. These data are supportive to maternity care in each organization.

The mother’s own paper-based Patient Card and Maternity Card are the most important tools for information sharing, because the mother brings them with her to all maternity care activities in different healthcare facilities. Most of the maternity-related information is paper based, e.g. the different maternity health and visiting records which are kept in each hospital.

The digital information systems in use are designed mostly for supportive activities and management.

3.4. Digital information systems used in Weifang and East Hospital

In this section we summarize the overview of the information systems in Weifang and East Hospital. Functional architecture diagrams describe the existing applications and the information connections between the applications used in the maternity pathway. In addition, the outpatient and inpatient workflow in East Hospital is described from the information systems’ viewpoint. The descriptions are based on the interviews and workshops conducted during the eHP team visits in Shanghai in November 2007 and January 2008. It must also be noted that the current
infrastructure and information systems are constantly under construction due to the efforts of different development projects, for example the Pudong area pilot project.

The descriptions can be used as a baseline for developing and presenting different integration and development concepts. The diagrams describe the existing infrastructure (November 2007 status), where the possible solutions (products, standards, integration concepts and guidelines) of eHP partners in Finland and China can be proposed. They are also used as a basis for general solutions/guidelines of the eHP research team. Some additional information about the organizations, systems and their vendors is provided in the diagrams.
3.4.1. Information systems in Weifang CHC

The information systems used along the maternity pathway are shown in figure 18. The main information systems used in Weifang are eHR, HIS, DWS (Doctor Workstation) and NWS (Nurse Workstation). The functionalities of these systems are represented in the diagram inside the system frames. The connections and remotely used (Web-application etc.) systems owned by other organizations are also included in the diagram (in the section “Other organizations”).

The main vendor of the systems in Weifang CHC is Kingstar Winning Technology Co., which is also the main system supplier of the Pudong pilot environment. Kingstar Winning is the biggest healthcare systems provider in China. The company has expressed interest in co-operation with several Finnish eHP companies and is also wants to participate in the eHP-research work. They have implementation experience of HL7, web services and interest in IHE-co-operation (IHE-Asia).

Figure 18. Information systems currently used in the maternity pathway in Weifang CHC
3.4.2. Information systems in East Hospital

The main information systems used along the maternity pathway in East Hospital are: HIS (appointment system, outpatient registration and payment (invoice), admission and discharging management, pharmacy management, hospital manager inquiry system); EPR system; Doctor Workstation (DWS) and Nurse Workstation (NWS); LIS; RIS and PACS. Each out-patient doctor has a computer in her room during the treatment.

The information system environment consists of 60 subsystems provided by 11 different vendors (situation in November 2007). The main vendor in East Hospital is B Soft Ltd. An overview of all the information systems used in East Hospital is presented in Appendix 2.

Outpatient and inpatient workflows are described from the information systems’ viewpoint in subsections 3.3.2.1 and 3.3.2.2. A combination of workflows of inpatient/outpatient treatment (systems/functions) is shown in figure 19.

![Combined overview of Inpatient/Outpatient workflows in East Hospital](image)

Figure 19. Combined overview of Inpatient/Outpatient workflows in East Hospital

3.4.2.1 Outpatient workflow in East Hospital

Patients can make hospital appointments in three ways:

1. Calling by phone: the phone call is recorded and an appointment is made in the appointment system which has the doctors' schedules. The call is free of charge for patients.
2. When a patient is visiting a doctor, the doctor can arrange the next appointment on the appointment system.

3. Patients can use the website appointment service. (quite few patients use the web appointment service) Staff collect data daily in the appointment system.

In all these cases, the patient gets an appointment number. Patients can also come to the hospital without an appointment, in which case (s)he gets a sequence waiting number.

1. When a patient comes to East Hospital, she first goes to the service centre, where a nurse guides her to the right department. No electronic IS used here but the patient gets a note where different colours indicate the right department.

2. The patient goes next to the registration and payment window. A card reader is used here. East Hospital has a multiple use hospital card for patients, and the patient information is typed into the system in the first visit. The patient may also have an insurance card, from which information is read by a card reader. Here a nurse gives her a waiting number. If the patient has made an appointment beforehand, the waiting number is the same as the appointment number. The patient information goes into the calling system and the screen on the wall (Patient name, doctor name), and into the doctor’s workstation (Patient basic information & what problem, which clinic/doctor).

3. Each special department has a waiting hall and a big screen on the wall. The screen is connected to the DWS and outpatient registration system, and a nurse operates the screen. When the doctor is ready to see the patient, she calls the patient’s name, which can also be seen on the screen in the waiting hall.

4. The doctor can see the patient’s basic information from the DWS. It is connected to the LIS, RIS, MiniPACS, the outpatient registration and payment system, and the pharmacy management system. The doctor uses the DWS when giving e-test orders or e-prescriptions. The test order with barcode is printed for the patient. The test results come to the DWS. A printed prescription is also given to the patient.

5. The doctor gets information about the medical treatment of the patient from the DWS, to check if medications are matching or duplicates. The clinical information is recorded in a paper-based system. The patient has her own paper-based Patient Card with her, as well as the Maternity Card.

6. When necessary, the doctor orders a test or makes an e-prescription in the DWS. The information goes to the registration and payment window, where a nurse collects and checks them. The patient goes to the registration and payment window to pay for the tests and drugs.

7. The nurse collects the payments then copy-pastes the test order to the LIS and the e-prescription with a ‘paid’ label to the drug management system. The nurse gives a paper receipt for the prescription payment to the patient.

8. The patient goes to the sample collecting window. The blood collecting nurse takes the tests and marks the samples using the card reader (health insurance card, or the hospital’s own card), using a barcode. A laboratory technician examines the test, and the results are recorded to the LIS, which is connected to the DWS and the test report window.

9. If there is a need to send a sample to other specialist, it is sent by post from East Hospital, and the results come back by mail or phone call.

10. The nurse in the pharmacy sees the e-prescription on the computer and prepares the ordered medicine. The patient goes to the pharmacy window and shows her paper receipt for the drugs. The nurse gives her the drugs.

3.4.2.2 Inpatient workflow in East Hospital

1. A doctor at the outpatient clinic sends a referral to the inpatient clinic through the DWS.
2. The referral goes to the hospital admission-discharge office, in the discharge system. The patient goes to the registration desk and the insurance card is used to identify the patient and to check the referral. An in-patient number is created for those who do not have an insurance card.

3. The patient information is sent to the NWS. A nurse arranges a bed for the patient. Basic information of the patient goes also to the DWS.

4. In the DWS, a doctor can order tests, surgery, or e-prescriptions and makes notes of treatment in the EHR. Test orders are transferred from the DWS to the NWS, which send orders to other places. A nurse checks, collects and confirms orders and sends e-versions to a laboratory, LIS, RIS, PACS. The nurse work station and LIS are connected by a data sheet.

5. Orders are also sent to ‘care’ department employees, who help and transfer patients who cannot walk. They print orders and take patients to the right places, e.g. a laboratory.

6. Test results are sent to the DWS electronically.

7. The doctor makes decisions for any surgery when needed. The order goes to the operation system in the Surgery and anaesthesia department. The plan for surgery comes to the DWS.

8. A nurse sends meal orders through the NWS.

9. The information about drugs goes through the NWS. A nurse can go to the drug store in an emergency situation to pick up drugs.

10. Basic information about the charging for the patient’s hospital inpatient time goes to the Admission and discharge system and can be seen through the NWS.

11. The patient pays for her treatment at the Admission and discharge window.
4. Development points and information sharing needs within the maternity pathway

In the current situation, not all information is transferred from one facility to another where it might be needed, but rather stays in the facility where it is produced. Development in information sharing between different health providers and information systems is needed at two levels: 1. between different health facilities, and 2. inside each facility. In this chapter we present development points and information sharing needs from the healthcare chain viewpoint, and some generic needs.

4.1. Development points and information sharing needs from the healthcare chain viewpoint

Although the majority of maternity information is paper based, it is important for health providers’ to integrate the DWS and EHR with other systems. The systems are easy to use and it is easy to copy the data from one system (e.g. LIS) to the other (e.g. DWS), but copy-pasting takes up the time of the health providers, and two windows need to be open when working. It is important to have integrated data of the patient’s health status, e.g. patient history information, basic information, test results, drugs usage, treatment, diagnosis and discharge summary; and to have effective communication system between health providers. Patient registration at one health organization should be available at any other health organization, and the appointment information should be found at any place.

The information department of each health facility arranges a training program in the use of the new system for each department in turn, also for newcomers. Healthcare professionals are happy to use the workstation system and EPR system, which save them time in their work, and also help them reduce errors. However, sometimes some errors happen when they are using the templates. Also, there are not enough computers for every department.

In the next subsections some main development points are discussed in more detail to clarify how information sharing problems appear in the daily work in healthcare and maternity care.

4.1.1. Paper-based information sharing and overlapping information

The paper-based Patient Card and Maternity Card, kept by the mother, are the main means of collecting a cumulative individual record of the mother’s health and pregnancy information. They are the most important means of sharing clinical information between the different health facilities: They contain information that is produced in one organization and used in another. Other shared information is also mostly in paper-based form: a pregnancy confirmation note, a pregnancy registration note, a referral to a higher-level hospital, a test-order and results when a test is made at a higher-level hospital, and a summary of delivery. Some information in the paper-based information entities may be overlapping. Clearly, paper-based information plays a large part in maternity care (see Figure 20).
4.1.2. Lack of information transfer causes fragmented and isolated information

Maternity data are fragmented in two levels: within the maternity care chain in different organizations and inside each hospital in different systems, both paper-based and digital information systems. For example, in the Weifang CHC data along the maternity pathway are recorded in the paper-based maternity health record; LIS, Pharmacy management system, Outpatient registration and payment (invoice) system, Admission and discharging management system, EHR system, Doctor and Nurse work stations, and in maternity management System. In the same way, information is also isolated in two levels: information is not always shared between organizations, and the systems are not all integrated with each other. Fragmentation and isolation of information leads to other problems, such as duplicate or increased work, and overlapping or inconsistent information. Information sharing and seamless patient care between healthcare organizations should be based on the EPR or EHR system. Interface standards for data exchange at pilot hospitals should be identified and based on HL7.

4.1.3. Delay in or lack of information transfer causes many phone calls

Healthcare professionals call mothers to arrange visiting times. During late pregnancy, maternity nurses from East Hospital call mothers if they do not turn up for the regular examinations which have been arranged in the paper-based visiting schedule. After delivery, Public health providers call mothers to arrange times for home visits. In addition, the maternity health provider from the CHC checks by phone where the mother will stay after delivery. If the mother will stay in another community (e.g. in her grandmother’s home) the maternity health provider calls the other CHC maternity health provider to inform them about the mother. They also send the referral letter to the Maternity and Child Healthcare centre, which collects all such letters and posts them to the appropriate CHC all at once.

Some of the results of test carried out in higher level hospitals are obtained by phone. Any health organization should be able to print out test reports and to send test results by SMS.

Making phone calls was considered to be a time and resource consuming task.

4.1.4. Duplicate work

Inside hospitals, all the applications are not integrated with each other. For example, in East Hospital nurses collect test orders from the EPR and transfer them to the LIS by copy-pasting.
Some information is not in printable form in the electronic IS. For example, in Weifang the GP has to write paper-based prescriptions for the mother, besides the e-prescription which goes to the pharmacist.

Some information is first recorded in paper-based form, and then again in electronic form. For example, in the Weifang CHC a paper-based maternity health record is kept during pregnancy (for pregnancy care), and afterwards typed in the Maternity IS for e-archiving.

Reports of maternity issues, as well as patient numbers and disease numbers, are collected by the healthcare actors (see section 2.2). Most often these reports are manually collected from different systems which might contain both paper-based and digital parts. They are then sent either by post (paper-based collection) or by e-mail. A regional Web portal has been established, but it is not used in every health facility.

4.1.5. Information transfer is important for developing healthcare actors’ professional skills

If a mother has a special problem, a lower-level hospital gives her a paper-based open referral to some higher-level hospital. The referral contains a summary of the case, but sometimes it would be useful to have more complete information. The mother is free to choose any hospital, and the sending hospital does not receive any information about which hospital she chooses. After treatment, the higher level hospital does not send any feedback to the hospital where the patient came from. If the mother comes back to the sending hospital, then the higher-level hospital’s entries can be seen on the Maternity and Patient Cards. Feedback from the higher level hospital is important not only for seamless treatment in the care chain, but also for educational reasons.

In the current situation, when consultancy is needed, a doctor calls a specialist doctor. Another way is for a specialist doctor to visit a lower-level hospital. Tele-consultation between health organizations is needed for communication, training and academic workshops.

4.2. Generic needs

There are also some generic issues in the larger context, the healthcare service system, which have to be solved before digital information sharing can effectively take place. Governmental decisions in China at the national level are needed in healthcare services organization, unambiguous identification of citizens, and development of healthcare information systems.

Healthcare is organized in independent healthcare facilities financed mostly by patient fees (doctor’s appointment, examinations etc.). This does not encourage facilities to share test results with each other. Citizens are free to select any healthcare facility and there is no referral system in Shanghai yet. The Shanghai local government encourages citizens to visit the community health centre first. The standard workflow and information flow for a two-way referral system and effective feedback system is needed between health organizations.

There might also be a issue of healthcare quality when citizens decide where to go, because the training for GPs who work in health centres is shorter than it is for doctors who work in level two or three hospitals.

In China, there is a standardized personal ID number with 18 characters (Standard GB11643-1999 revised from GB11643-1989), but it might not be used nation-wide yet. [http://www.cisr-irb.gc.ca/fr/recherche/rdi/?action=record.viewrec&goto=416308]. Hospitals give their patients an ID number valid only in that specific hospital, but if a citizen goes to another hospital, (s)he gets another patient number. Thus it is not easy to integrate citizens’ patient data from different sources.

The development of a Health IS has been started with an HIS having basic invoicing and patient management functionalities and a supportive IS, such as a laboratory IS and public health management systems. Health information systems are developed in many different software companies and hospital IT departments, often locally. This has resulted in numerous different HISs. Because of the lack of a unified standard policy, different HISs do not communicate with
Integration is problematic both inside hospitals and between different hospitals. There is overlapping information in public health systems (which are used to collect summary reports for health management purposes) and clinical information systems (which are used to support healthcare clinical work).

From the government’s viewpoint the most important tasks are to have a unified identification number for patients, to integrate the public health system with the EHR system, and to set up a regional platform for information sharing among hospitals.

From the citizens’ viewpoint it is important to be able to check their own health status online and have effective communication between the patient and health providers for homecare.

5. Summary, discussion and further work

In this report the current state of maternity care in the Weifang CHC and East Hospital is presented from the viewpoint of the maternity healthcare chain, emphasizing healthcare professionals’ information needs in their work.

Chapter 2 provides some basic information about the healthcare organizations and the current information flows and the standards used in China and Shanghai area. In chapter 3, the basic maternity pathway is described and the main activities and actors are identified in both the case organizations, the Weifang CHC and East Hospital. Information currently needed and used in the pathway is identified. This information is related to a) the location in which the information is used; b) the information systems in which information is saved; c) the information tools which are used to read and record information; d) the actors who use the information; and e) the time/events when information was produced and used in the pathway.

In chapter 4 development points of information sharing are discussed. Most of the maternity-related information is paper-based. In the Weifang CHC and East Hospital the basic HIS includes appointment management and invoicing systems; also LIS, PACS, EPR and HER are used through the doctor’s workstation. Some of the different systems are integrated with each other inside hospitals, but not all. Integration between different hospitals as well as integration between hospital and CDC is also needed. Lack of integration causes often duplicate work or information inconsistency. Also the question of unified personal ID needs to be solved.

This report is used as a basis for the evaluation report and integration guidelines, which are the two other main products of this project.
APPENDIX 1. MAP OF FIGURES 3-16
APPENDIX 2. INFORMATION SYSTEMS IN EAST HOSPITAL

- Healthcare services for citizens
  - Medical treatment platform
  - Medical technology
  - Prescription
  - Surgery and anesthesia
  - Nutrition
  - ICU
- Care relationship management system
  - e-Medical
  - Hospital accounts
  - Medical technology
  - e-Medical history
- Health protection platform
  - Physical check-up system
  - Community health service system
  - Public health system
  - Health insurance system
  - Bank system
- Internal business platform
  - Drug warehouse
  - Patient records
  - Medical history
  - Goods and materials
  - Financial software
  - Hospital infection system
  - Tele-conferencing
  - Department management queries
  - Hospital management queries
  - Work time recording
  - Business counting
- External business platform
  - Health protection system
  - External business platform
  - Health protection system
  - SMS system
  - Hospital website
  - Phone
  - Mobile
  - Internet
- Other systems
  - Outpatient ward
  - Intra vascular notes
  - Intra vascular nutrition
  - Patient guidelines
  - Patient management and service platform
  - Outpatient doctor workstation (DWS)
  - Appointment center
  - Hospital nurse
- Internet
  - Digital hospital service
  - Online evaluation
  - Quality control management
- Mobile
  - SMS system

- Drug warehouse
- Patient records
- Medical history
- Goods and materials
- Financial software
- Hospital infection system
- Tele-conferencing
- Department management queries
- Hospital management queries
- Work time recording
- Business counting
- Outcome evaluation

- Internal business platform
- Supply room
- Nursing management
- Staff wages