Degree project

Impact of a Decision Support System on Obstetricians in the Pregnancy Nutrition Guidance

Author: Xu Chenfan
Date: 2012-July-27th
Subject: Information Systems
Level: Master 2 year
Course code: 5IK00E
Abstract

**Background:** Pregnancy Nutrition (PN) guidance is an issue of great concern worldwide because of its direct relevance to the maternal healthcare and the healthy prenatal development (Li et al., 2004, p. 11). Providing an effective guidance on PN is an onerous and time-consuming task. Extensive experience, knowledge, and continuous and actual calculations are required for the obstetricians. Consequently, the PN guidance is often faced with difficulties and hurdles. It is, however, dramatically changed with the emergence of a Decision Support System (DSS) for PN guidance based on the computer information management technique. This DSS has been applied for the clinic guidance of PN in obstetrics departments or hospitals in China. Its impacts on obstetricians are investigated in this thesis.

**Objectives:** This thesis investigates the consequences and intrinsic correlations of relevant factors during the application of the DSS, so that its effects on obstetricians can be clearly identified and the usefulness of this system for pregnancy nutrition guidance can be effectively established. It also lays a foundation for an effective communication between system developers and the end users of this system. At the meantime, this work proposes the concepts and methods that allow proper utility of such an information management system.

**Methods:** A number of research methods have been applied for data acquisitions and analyses, including direct observations of the obstetrics department in the hospital in study, conversational interviews with the participating obstetricians, and distance communications. These approaches enable us to prepare the resources to construct the model based on these case studies. As a parallel approach, quantitative methods based on questionnaires have been conducted which reach out a large number of obstetricians in different locations. This allows a statistical analysis that permits the impact analysis and correlation of the intrinsic factors, so that the conclusions of this study can be consolidated.

**Results:** Positive impacts will be measured by five factors including convenience, acceptability, generality, concreteness, and effectiveness, while negative impacts by three factors including verbosity, rigidity, and expensiveness.

**Conclusions:** The DSS has successfully enhanced the application of correct PN guidance. Both positive and negative impacts have been generated on obstetricians by the DSS. These impacts are mainly related to the seniority of obstetricians and their familiarity with the PN guidance and the DSS. The development, utilization, and operation management of the DSS in PN guidance has generated impacts and functions. This study might provide resources and foundation of the systematic management of the DSS together with its development. The DSS and the related Chief Information Officers and Specialists will benefit from this study and therefore provide improved support and assistance for the end users to complete information system management successfully.

Key Words: Decision Support System (DSS), Pregnancy Nutrition (PN), impact analysis, working seniority, obstetrician, PN guidance
Executive Summary

A healthy and lovely baby is expected by every pregnant mother and her family. PN as an important issue in prenatal medicine and maternal diets is directly related to the fetal growth environment and the living quality of infants (Yuan and Chen, 2008, pp.530-532). Reasonable, healthy and flexible PN guidance will improve the maternal and fetal health and living quality. Unreasonable and unhealthy PN will lead to detrimental effects on pregnant women and fetal development, and may even trigger adverse outcomes in the end. Some of these adverse effects may remain in the neonatal period, infancy, or even the adulthood.

The obstetricians should consider all the relevant factors, i.e., not only the professional obstetrics knowledge but also the related fields including the areas of gynaecology, genetics, nutrition, sports medicine and so on (Zhao, Yan and Sun, 2006, p.85). Offering the PN guidance might be time consuming because of the onerous and repetitive dietary calculations needed for every individual patient. Not only will it take lots of energy and time of the obstetricians to complete the daily menus needed throughout a patient’s whole pregnancy period, but also the configuration or results might not be sufficiently accurate. This is the burden on obstetricians. The Decision Support System for PN guidance, as a specific kind of DSS, aims to provide the assistance tool for obstetricians during PN guidance. The DSS for PN has reproduced and stored the clinical experience and professional expertise into the knowledge database. The PN guidance has been accomplished through the database management, simulated clinical diagnostics process by artificial intelligence, and the human-machine dialogue interaction. Because the area of PN requires extensive professional knowledge and the information system (IS) specialists do not have this kind of knowledge before, the study of the impacts in the DSS for PN guidance will provide essential information to assist the IS specialists in DSS analysis, design, implementation, maintenance, and the long-term management. At the same time, the understanding from the system users as the obstetricians has been improved in applications.

In this research, there are 18 interviewees for the qualitative data collection and 98 participants for the additional quantitative data collection, including the academic administrators, chief obstetricians, vice chief obstetricians, attending obstetricians, chief resident obstetricians, resident obstetricians, and the interns, who are working in the research obstetrics department in Tianjin First Central Hospital (TFCH) and those in the Tianjin Health Centre for Mothers and Children. The interviewed participants have altogether completed the 1,500 records for 800 patients with the use of the DSS. Research interests about the DSS for PN guidance have been determined. Quite a few interviewed obstetricians have highlighted the idea that the DSS plays quite an important role in the process of PN guidance and it has in fact been widely used in clinical work as well. It is also learned that the computer-aided diagnoses and treatments have improved the possibility of offering every patient, who is pregnant or puerperal, approximately the same level of PN guidance in a satisfactory reduced time and the possibility of reducing the heavy work load and pressure on the obstetricians. Based on the detailed and specific analysis of each participant from qualitative data collection, the additional quantitative data collection with questionnaires has been conducted for all the obstetricians in the Tianjin Health Centre for Women and Children. They filled in the
questionnaires voluntarily. These surveys from the quantitative aspect are not face-to-face interviews with participants but have been analyzed statistically, which has provided further support for the qualitative results of the survey.

The study of the impacts generated from the DSS of PN onto the obstetricians might be able to consolidate the recognitions and understanding of the medical professionals about the use of the DSS. With this thesis, it is expected that they will be able to better understand the DSS for PN guidance, including DSS’s positive and negative factors. Therefore they will be able to enhance the positive impacts and at the same time reduce the negative influences. The obstetricians interviewed also look forward to the improvement or update of the DSS for improved performance, which can then deliver greater impact more positively on obstetricians. It is expected that the studies about the impact of PN DSS could expand the obstetricians’ capability of health care, thus not only benefiting more patients, but also enabling the hospital to improve the working efficiency and to extend the social and economic impact.
Acknowledgements

Where there is a will, there is a way.

All rivers run into sea.

First, I would like to express my gratitude to my supervisor Prof. Päivi Jokela, who offered me invaluable assistance, support and guidance.

I would like to give special thanks to my family for their understanding, encouragement, moral support, and unconditional love throughout my life.

Furthermore, I would like to convey my acknowledgements to obstetricians in the Obstetrics Department in Tianjin First Central Hospital (TFCH) for their support, insight and diligent guidance.

Special thanks to my friends and colleagues for their encouragement and invaluable suggestions. I really appreciate the study opportunity and environment in my dear Linnaeus University and in the beautiful nation of Sweden.
Table of Contents

Chapter 1  Introduction .................................................. 10
  1.1.  Background .......................................................... 10
  1.2.  Research Objectives and Questions .............................. 12
  1.3.  Statement of Significance and Deficiencies ...................... 14
  1.4.  Structure of the Thesis ............................................. 15

Chapter 2  Decision Support Systems – a Literature Review ........ 17
  2.1.  Basics of IS and DSS ................................................. 17
    2.1.1.  Basic Aspects and Definition ................................ 17
    2.1.2.  Classification of Decision Making ............................ 18
    2.1.3.  Development History of DSS .................................. 20
  2.2.  Current DSS Research .............................................. 21
    2.2.1.  Expert Systems ................................................. 21
    2.2.2.  Group Decision Support System (GDSS) and Distributed Decision Support System (DDSS) .............................................. 22
    2.2.3.  Intelligent Decision Support System (IDSS) ................. 22
  2.3.  DSS and Medical Care ............................................. 22
    2.3.1.  DSS Applications in Medical Care Fields ..................... 23
    2.3.2.  In China .......................................................... 24
    2.3.3.  Specialized Systems ............................................. 24
    2.3.4.  For Obstetrics and Gynecology ................................ 24
    2.3.5.  For Perinatal Medicine ........................................ 25
  2.4.  DSS and PN Guidance ............................................. 25
    2.4.1.  Basic Aspects and Definition of PN ........................... 26
    2.4.2.  Importance of PN ............................................. 26
    2.4.3.  Basic Modules of the DSS for PN Guidance .................. 27
  2.5.  Feedback during the DSS Applications ........................... 28

Chapter 3  Research Setting and Methods ................................ 30
  3.1.  Research Setting ................................................... 30
    3.1.1.  Research Venues ............................................. 30
    3.1.2.  Events ......................................................... 36
    3.1.3.  Participants .................................................. 36
    3.1.4.  Process ....................................................... 36
  3.2.  Overview of the Research Methodology ........................... 37
    3.2.1.  Research Inquiry Strategy ..................................... 37
    3.2.2.  Researcher’s Role ............................................ 38
  3.3.  Data Collection Procedure and Methods .......................... 38
    3.3.1.  Observation .................................................. 39
    3.3.2.  Interviews .................................................... 39
    3.3.3.  Questionnaires ............................................... 40
  3.4.  Ethical Issues .................................................... 41
  3.5.  Validity and Reliability .......................................... 42
Chapter 4  Impact Measures

4.1. Example Impact Studies of DSS Applications

4.2. Innovative Theme Model

4.2.1. Convenience
4.2.2. Acceptability
4.2.3. Universality
4.2.4. Concreteness
4.2.5. Effectiveness
4.2.6. Verbosity
4.2.7. Rigidity
4.2.8. Expensiveness

Chapter 5  Data Analysis

5.1. Observations of the Service Flow of PN Guidance

5.2. Features of the Investigated DSS in PN at TFCH

5.3. Basic Information of Interviewees

5.4. Impact Analysis

Focusing on the positive impacts

5.4.1. Theme of Convenience
5.4.2. Theme of Acceptability
5.4.3. Theme of Universality
5.4.4. Theme of Concreteness
5.4.5. Theme of Effectiveness

Focusing on the negative impacts

5.4.6. Theme of Verbosity
5.4.7. Theme of Rigidity
5.4.8. Theme of Expensiveness

Chapter 6  Conclusions and Future Suggestions

Appendix

Table A 1 Basic questionnaires for the interviewed obstetricians in the Obstetrics Department
Table A 2 The Basic information of the survey questionnaires
Table A 3 Consent Form
Table A 4 Basic information of the participating obstetricians
Table A 5 The Impacts of DSS in PN obstetricians
Table A 6 Specific Medical Terminologies

References
Table of Figures

Figure 1: The structure of the thesis................................................................. 16
Figure 2: Literature review on DSS and its applications in PN guidance lays foundation for the investigation in this thesis................................................................. 17
Figure 3: Classification of decision making................................................... 18
Figure 4: Development process of DSS (Song, 2008, p.3014; Yuan, 2010, p.5-7). ................................................................. 21
Figure 5: Four common library system in DSS (Yuan, Li, 2010, p.6). ................................................................. 27
Figure 6: The Basic Structure of IDSS (modified from Li, 2009, p.140). ................................................................. 27
Figure 7: The Structure of DSS (Li, Li, and Dong, 2010, p.58) ................................................................. 28
Figure 8: The outpatient hall of TFCH on the ground floor ................................................................. 31
Figure 9: Map of the Obstetrics Department at TFCH. ................................................................. 32
Figure 10: The entrance of the outpatient service of the Obstetrics Department. ................................................................. 32
Figure 11: The waiting area in the Obstetrics Department ................................................................. 32
Figure 12: A full view of the shelf displaying food models in the DSS for PN at the Obstetrics Department, TFCH. ................................................................. 33
Figure 13: A close-up view of the shelf displaying food models................................................................. 33
Figure 14: The basic nutrition knowledge guide in the diagnostic room................................................................. 33
Figure 15: Offering the PN guidance to a pregnant woman................................................................. 34
Figure 16: Showing the food models to a pregnant woman................................................................. 34
Figure 17: The diagnostic process in the obstetrics clinic room................................................................. 34
Figure 18: The researcher in the PN outpatient service room................................................................. 35
Figure 19: Example studies of impacts of DSS applications (Connor, 2011, pp.12-19; Garg, et al., 2005, pp.1223-1238; Zhang, Zhou and Qu, 2008, pp. 60-62.) ................................................................. 45
Figure 20: The impact study conducted in this thesis................................................................. 45
Figure 21: Outpatient service flow chart in the obstetrics department................................................................. 50
Figure 22: The outpatient service flow chart for PN guidance................................................................. 51
Figure 23: The main user interface of the DSS for PN guidance................................................................. 52
Figure 24: Cover page of a sample PN guidance report................................................................. 53
Figure 25: The structure of main user interface of the DSS................................................................. 54
Figure 26: Working time of PN guidance by DSS of PN and convenience theme................................................................. 59
Figure 27: Working time of PN guidance by DSS of PN and acceptability theme................................................................. 62
Figure 28: Working time of PN guidance by DSS of PN and universality theme................................................................. 64
Figure 29: Working time of PN guidance by DSS of PN and concreteness theme................................................................. 67
Figure 30: Working time of PN guidance by DSS of PN and effectivness theme................................................................. 70
Figure 31: Working time of PN guidance by DSS of PN and verbosity theme................................................................. 74
Figure 32: Working time of PN guidance by DSS of PN and rigidity theme................................................................. 77
Figure 33: Working time of PN guidance by DSS of PN and expensiveness theme................................................................. 78

Table of Tables

Table 1: Summary of impacts and their sources................................................................. 49
Table 2: Information of the interviewed obstetricians................................................................. 54
Table 3: (Continued from Table 3)................................................................................................. 55
Table 4: Main opinions of the participating obstetricians................................................................. 56
Table 5: Results of the questionnaires for the obstetricians about the convenience theme................................................................. 58
Table 6: Results of the questionnaires for the obstetricians about the acceptability theme................................................................. 61
Table 7: Results of the questionnaires for the obstetricians about the universality theme................................................................. 63
Table 8: Results of the questionnaires for the obstetricians about the concreteness theme................................................................. 66
Table 9: Results of the questionnaires for the obstetricians about the effectiveness theme. .......................... 69
Table 10: Food menu related for effectiveness theme. .................................................................................. 70
Table 11: Results of the questionnaires for the obstetricians about the verbosity theme. .............................. 73
Table 12: Results of the questionnaires for the obstetricians about the rigidity theme. ................................. 76
Table 13: Results of the questionnaires for the obstetricians about the expensiveness theme. ...................... 77

**Abbreviations**

Abbreviations in this work are listed in the sequence of their first appearance.

IS - Information Systems (Discipline or Integrations);
DSS- Decision Support System;
CliDSS- Clinical DSS;
PN- Pregnancy Nutrition;
TFCH - Tianjin First Central Hospital;
MIS-Management information system;
ES-Expert system;
IDSS-Intelligent Decision Support System;
SDSS-Synthetic Decision Support System;
DW-Date Warehouse;
OLAP-On-Line Analysis Processing;
DM-Data Mining;
AI-Artificial Intelligence;
BI-Business Intelligence;
CAD-Computer Aided Design;
GDSS-Group Decision Support System;
DDSS-Dispersed Decision Support System;
DDP-Desirable Dietary Pattern;
DSC-Decision Support Centre;
HIS-Hospital Information System;
CIS-Clinical Information System;
EI-Energy Intake;
BMI-Body Mass Index;
IUGR-Intrauterine Growth Retardation;
GDM-Gestational Diabetes Mellitus;
KS-Knowledge System;
Chapter 1  Introduction

The first chapter in the thesis provides the background about the Pregnancy Nutrition (PN) guidance and the Decision Support System (DSS) with the focus on the impact of DSS. The clarification of the impact of DSS in PN on obstetricians during the application procedure is an important issue in the academic investigation of Information Systems (IS). The research objectives and the research questions are presented. The significance, contributions, design, and structure of the thesis are introduced.

1.1. Background

This section will first review the state-of-the-art of the PN guidance, discuss the development of DSS and its use in medical care field, and then address issues that combine the PN guidance and DSS.

The issues about the PN guidance are to monitor the health and nutritional status of the pregnant or puerperal women and at the same time the growth and development status of their fetuses or babies by the obstetricians and then to deliver suggestions on healthy diets and nutritional intervention, which is in need for a new mother during the whole pregnancy and puerperal period, so that the patients are assisted to build up the appropriate and reasonable nutritional diets (Zhang, Zhou and Zhao, 2007). PN as an interesting issue worldwide roots in its relevance with the health of the pregnant mothers and the growing babies, which has aroused particular attention of obstetricians as the focused issue. About the next generation of the pregnant mothers, the PN is related with not only the fetal status but also the newborn babies, infants and childhood health. It is also possible, as supported by experts, that the effects of inaccurate PN guidance will continue to affect their health when they have grown up (Li et al., 2004, pp.11-13). Therefore, it is a crucial work and the responsibility for the obstetricians to effectively diagnose and evaluate the nutritional status of the pregnant women in order to offer reasonable PN guidance. Nonetheless, such significant and vital work related to the health might encounter difficulties.

The PN guidance is a complex and repetitive task. To fulfill the task, it requires the professionals to be competent with not only the obstetrics knowledge and abundant clinical experience but also the related fields of expertise, including the areas of obstetrics & gynecology, genetics, nutrition, sports medicine and so on (Zhao, Yan and Sun, 2006, pp.85-88). According to Zhao, Yan and Sun (2006), to offer the PN guidance the obstetricians have encountered quite a few considerable difficulties including the large amount of calculations, the long working hours in need, and the high frequency in need for patients in different status. In the implementations of the practical PN guidance, for each pregnant woman dozens of calculations and evaluations of the nutrition status are in need, which has led to a large amount of work on obstetricians. The frequency of calculations for patients is high, reaching once per month at least, or once a week, or even every day, which has constructed the difficulties and sometimes becomes impossible for the obstetricians (Zhang, Yan and Sun, 2006). It seems that no one is willing to repeat this kind of iterative work manually; let alone
the obstetricians who are supposed to, and trained to, be working with the medical situations with their intensive professional knowledge. In addition, the accuracy of the PN guidance is also affected by the personal factors of obstetricians (Zhao, Zhou and Qu, 2008, pp.60-62). Therefore, the challenges in complicated and repetitive calculations in PN guidance can be considered as the motivation for the development of this DSS.

DSS is a technology integration system, which focuses on computer technology, information technology, artificial intelligence, management science, decision science, psychology, behavioral science and organization theory and other disciplines of technology. Since it is controlled by one or more decision makers and faces the unstructured part of decision-making environment, DSS is an auxiliary activity system for decision making, with a goal to improve final results (Li, Xu, 2000, p.7). Through empirical study in this research, the current understanding of DSS has been enhanced and supported by the collected facts. Such opinions have been largely agreed and emphasized by the participating researchers.

It has already been widely known that the diagnostics and treatment by the physicians are highly dependent on their experience. It seems quite impossible that a new physician totally without clinical experience is able to handle the disease in a satisfactory way. The medical care provided to the patients has the tendency to depend on practical experience of the clinical physicians with the aids of the required diagnostic index or experimental examination results, since clinical machines mainly help to collect the facts of the patients although some are possible to complete diagnostic task to a certain extent (Wang and Li, 2010, pp.54-59). While a professional physician accumulates adequate diagnostic skills over time, he/she will be inundated with more tasks and workload at the mean time (Li and Zhong, 2010, pp.705-706). Therefore, the DSS is on the right cutting edge. DSS is creating knowledge database of the practical experience and diagnostic knowledge collected from the experienced experts, and designing diagnostic or treatment of DSS with artificial intelligence techniques in the development (Keltch, Lin and Bayrak, 2010, pp.509-516). In this way, DSS helps to provide a basic or suggestive solution as the background or context, extend the medical scope, and improve the quality in all iterations. Medical work can be completed in a more prescriptive and appropriate manner.

Issues related to PN guidance in medical care are now equipped with the DSS that belongs to IS for the purpose of medical performance improvement. Such improvements from IS investigations are considered as the main functionalities and practices of IS for medical care of people’s daily lives. The DSS has been integrated into PN guidance to assist the practical application of the IS achievements. The DSS for PN guidance is designed with the neural network simulation capability and artificial intelligence techniques. It is based on a framework that consists of the knowledge base, model base, method base, predicting capability, and graphic user interface (Maisiak et al., 2000, pp.232-235; Bouaud and Seroussi, pp.66-70; Gao and Huang, 2007, pp.103-105). The DSS for PN guidance can be considered as an exemplary application of IS into the medical care field. It has been widely applied since its appearance since every pregnant woman can achieve approximately the same level of PN guidance through the computer-aided diagnosis and treatment within quite a short period of time (Michel et al., 2008, pp.1-12; Kamal et al., 2010, pp.452-456). However, have all the
issues been studied and clarified in the process of using DSS for PN guidance, as opposed to what has been taken for granted? The obstetricians are also being affected by the DSS in their professional PN guidance. These issues will be dealt with by the impact studies in this thesis.

1.2. Research Objectives and Questions

As discussed in the previous section, the DSS is intensively technology-based and computer-aided with integration of the knowledge in computer science. DSS is associated with many disciplines such as information technology, artificial intelligence, management, decision making and so on (Keltch and Bayrak, 2010, pp.568-572). During the improvement process of DSS, the maintenance and management in the system is a critical part (Kamal et al., 2010, pp.452-456). Although the DSS has been integrated with artificial intelligence, simulated expert thinking, self-modification and self-learning capabilities, it cannot be neglected that its ultimate users are human beings (Ashis, 2010, pp.331-335). Since the humans are opinionated and sometimes prejudiced, the studies about the impact onto the system users could not be neglected. The study of impact onto an issue, a concept or a technology can serve as a convention as the social activities considerations in IS and such convention also exists in other scientific based disciplines such as psychology, behavior science or organization theory (Li and Xu, 2002, pp.6-7). The reason might lie in the considerations of social aspect and human activities within the rapid development of scientific and technological fields.

This thesis will be focused on the DSS rather than on the general IS field. And the issues in question are restricted to the PN guidance process in medical care rather than other parts of medical fields. The study of the impacts has been defined in that of the obstetricians rather than other end users or other practitioners. The general objective of the thesis is to understand the impact of the DSS onto the obstetricians during the PN guidance. Specifically, this study is interested in the following issues:

- First, the thesis put forward the question on what are the impacts generated by the DSS of PN on obstetricians’ work practice? Positive impacts will be measured by five factors including convenience, acceptability, generality, concreteness, and effectiveness, while negative impacts by three factors including verbosity, rigidity, and expensiveness. Therefore a suite of optimized impacts are needed for the application of the DSS of PN by these obstetricians, which in turn provide key inputs on how to improve or update the DSS for PN guidance. To this end, these impacts can be translated into practical measures such as how the DSS of PN improves the obstetrician’s decision making process, working condition, or accuracy of PN calculations, among many others.

- Second, how do the DSSs of PN generate these impacts on the obstetricians during the process of PN guidance? To this end, the conducted data collection is focused on observation, interview, and questionnaires. The correlation of the DSS performance to the working seniority of the obstetricians, the working seniority in PN guidance, and others will be studied in terms of quantitative evaluation of the above identified impacts.
Finally, what is the relationship between the impacts of DSS in PN on the obstetricians and the academic information science field? The works of IS includes the development, utilization and operation management, and the effects on systems users, i.e., the obstetricians. The DSS has shifted its focus from development technology in the beginning to the use of the technology and the application effects. The study of these impacts will help identify key issues on the development and modification of DSS in PN guidance.

The central question is on what these impacts are, how these impacts are evaluated, and what the consequences of this study are on the DSS, on the PN guidance, and also on their relationship. Essentially the impact denotes the influences of the DSS in helping the obstetricians in providing the PN guidance. The kind of impacts this thesis explores are shown by the following examples:

- Whether this system provides the needed functions for this specific medical discipline?
- To what degree the system can expedite the obstetrician’s practice?
- How these impacts are translated to the improvement of the obstetrician’s decision-making during the PN guidance process, or the obstetricians working conditions, or the obstetricians’ calculation?

A multitude of research outcomes can be derived from the above impact study on the DSS for PN guidance. With a conscientious understanding, the obstetricians might be able to expedite the use of these systems, to take full advantages of computer aided decision making process, and to resolve the shortcomings in due courses. The conscientiousness offers the possibility for them to reach their goals. The impact study from the IS point of view is therefore translated into practical outcomes and measurable deliverables as listed in the above bullets.

It is thought that by investigating the outcomes and intrinsic correlations from the system to the related personnel during the application process, the impact on obstetricians can be clearly identified. Theoretically the thesis aims to improve the understanding for the impact of the DSS. The innovation can be the systematic theoretical understanding of the impact on the obstetricians, which might be possible to be considered as a more specific, comprehensive and convincing model of impact. Impacts proposed in the early stage of the study, which is largely based on literature review, have been modified during the course of the study after the data collection procedure with the medical professionals. Practically with the studies of impact, the practitioners might be able to understand the advantages and disadvantages on this issue. About the research setting, the case study data collection is limited to the DSS for PN guidance for pregnant and puerperal women, which is in the experimental period of the obstetrics department in Tianjin First Central Hospital (TFCH), in the city of Tianjin, China. And all the involved participants are in the Tianjin Health Centre for Women and Children. The study of the impact of this specific DSS on the obstetricians can also help to understand the system itself from the aspect of feedback as a secondary value of this study. It is believed that outcomes from such a study can improve both the DSS in PN guidance and the usage of it by obstetricians.
1.3. **Statement of Significance and Deficiencies**

It is known that the DSS is a computer-aided real-time system based on the pre-stored decision-making principles and simulation examples in order to deliver support in acquiring optimal solutions under complex situations (Gao et al., 2002, pp.67-73). Thus it is not surprising that DSS has been designed to offer assistance in the healthcare field (Jain and Brahnam, 2011). Along with the advancement in computer technology, a continuous development of DSS applications has been realized in the 21st century, including quite a few software development and professional applications as the main direction (Ashis, 2010, pp. 331-335). However, the focus on the technology development in the early years has been shifted significantly to the operations and management of the ISs (Gao et al., 2002, pp. 67-73). Along with the advancement of hardware, the focus of the DSS has been shifted from the initial technology development to the use of technology and the impact of application (Cui and Tao, 2011, pp. 93-95). The focus on the management of information systems is to understand the users, the operational problems during the process, and why the problems have been raised so to eventually solve them (Friedlin, 2007, 254-258). In the thesis, the focus is on the impacts on the obstetricians generated by the DSS for PN guidance.

The DSS for PN guidance coherently integrates the IS, the computer-aided technology, and the knowledge of the experts, where medical professional knowledge works with the database, data mining, decision tree and neural network simulations to complete the process. The DSS is then completed with the graphic user interface to reach satisfactory results with human intelligence (Bergman and Fors, 2008, pp.9-10). With the mission of IS (Chen and Qi, 2005, pp.102-103), it can be shown that the development, utilization, operation management as the impact on ultimate system users should all be studied with the DSS to amplify the concept so that the influence of IS onto the user is no doubt a significant component for IS. It can be shown that because of the social activities aspect of IS (Chen and Qi, 2005, pp.102-103), the quality of IS requires the study of its impacts. Moreover, the study of DSS for PN guidance is also expected to provide a platform in understanding the system in order to maximize the applicability and period, which might be the mission of IS integration utilization and clearly included in the fields of the IS academic studies. It can be also understood in this way because of the significance of the PN guidance and the value created by the DSS for the PN process, it is necessary to study the impact of the DSS onto the obstetricians during the PN guidance.

Since it is known that the DSS, as the latest and advanced tool for assistance, has attracted a lot of researches and reports focusing on the discussions about the accuracy of a final decision or any derived results in health care after the application and utilization (Keltch, Lin and Bayrak, 2010, pp.509-516). It can be shown that the performance of DSS have been studied oftentimes and adequately. In addition to the performance studies, expert economists suggest that the funding into the IS field exceeds multi-billion dollars annually, but its yield is only 10% (Basden, 2001, pp.1-21). Thus it is suggested that the economic and beneficial outcomes of the DSS is not that satisfactory, and even some financial investment has been wasted or lost. It is suggested that the gap of communication and consistency between the system users and the system architects can be a major reason (Li et al., 2004, pp.11-12).
About the deficiencies, firstly it can be concluded that a research about the impact of DSS is needed especially on the obstetricians during the process of PN guidance. The current studies about impact of DSS on system users are mainly about the validity, acceptance and risk assessment (Keltch, Lin and Bayrak, 2010, pp. 509-516; Basden, 2001). Secondly and more importantly, the impacts of DSS during the medical care process are needed. Thirdly the specialized process of PN guidance needs to be studied with the impact of DSS onto the obstetricians. Nonetheless, it seems that little research on this specialized area has been conducted. Very few systematic studies about the impact in this particular line have been emphasized. Or it can be expressed in the way that there are very few researches and reports about the impacts of DSS onto the physicians; let alone the specialized studies about DSS in PN process and the impacts onto obstetricians. This focused study is expected to create value for the academics as the understanding of DSS functions which are the model of impact, for the systems architects as the development preparation study. For the latter, they can understand the social issues during PN guidance so that their development might be more suitable for the ultimate systems users, i.e., obstetricians, so that they can be aware of what they might encounter, and for the IS specialists to maximize the value of this new thriving discipline of IS by expressing all values designed by the system architects to the obstetricians and maintaining or configuring the DSS of PN at appropriate components.

1.4. Structure of the Thesis

The research outline follows the process of the topic selection, the initial research, the research direction consolidation, the methodology decision, the literature search with the initial data, the data collection in person to the research setting place, the summarization of the data, the method confirmation, the data analysis with re-collection, the results and discussion, the conclusion, and the extension of the project.

In the second part, the literature review has been conducted. The procedure of data collection will be discussed next. Then in the research framework, we discuss how the impact measures are developed, and what the consequences of the DSS in PN are as determined from the surveys and questionnaire. Concluding remarks will be given in the end. Supporting materials will be placed in the Appendix. The structure of the thesis can be shown in Fig. 1.
Figure 1: The structure of the thesis.
Chapter 2  Decision Support Systems – a Literature Review

Here the most recent and relevant literature is reviewed for the research questions, which are chosen based on the focus of feedback and knowledge management during the application procedure of the DSS. Especially the effects on the professional users are included which highlight studies about the impacts of DSS in PN guidance onto obstetricians. First, most recent information about the DSS is presented. Afterwards the practical application, breadth and depth of application, and application in China of DSS are presented. Then critical literature about the importance and complexity of PN guidance is presented. At last, several possible feedbacks obtained during the application procedure of DSS are proposed. The impacts of DSS in PN are proposed as an important issue for information system management. As schematically illustrated in Fig. 2, the literature review will lay foundation for the evaluation of the DSS in PN in following chapters.

![Diagram](image)

**Figure 2**: Literature review on DSS and its application in PN guidance lays foundation for the investigation in this thesis.

### 2.1. Basics of IS and DSS

The development and utilization of DSS has entered a mature stage. But with respect to information system management, there is obviously some discrepancy in monitoring during the application procedure and in tracking the user’s feedback. The following review of DSS can describe this problem.

#### 2.1.1. Basic Aspects and Definition

A decision support system (DSS) is an intelligent information system supporting decision-making, which is based on management science, operational research, control theory and behavioural science, by means of computer technology, simulation technology and information technology, for semi-structured decision-making (Li, Li and Dong, 2010, p.58). An information system (IS), on the other hand, refers to the application of information technology into management of data and information, as well as the interactions among users, data, and information technology. Since Morton and Keen (both are scholars from the United States) defined DSS firstly in the 1970s (Michael and Morton, 1971, pp.55-70.), scholars from various countries have achieved lots of fruitful work on the theory and applications of DSS.
research (Yuan and Li, 2010, pp.58-64). It is generally accepted that DSS is an advanced development of IS, and it is closely related to, but different in many radical aspects from, the management information system. Both share the routine functions in collecting, processing, and transmitting data, but the management information system lacks flexibility in presenting data analysis to the users. Such a drawback is alleviated by the decision making module in DSS, which clearly requires interdisciplinary efforts and contributions from operational research etc. DSS has therefore incorporated a lot of significant progresses in these related fields. To this end, DSS was considered to be in the latest stage of the development of IS research (Li and Xu, 2000, pp.39-45).

2.1.2. **Classification of Decision Making**

Figure 3 shows the classification of decision making with details given below.

*Figure 3: Classification of decision making.*

**Based on decision nature**

Structured decision making refers to a particular decision-making environment process and rules which can be used to determine the model or language for descriptions in an appropriate algorithm to generate decision-making program and to choose from a variety of programs for optimal decisions (Sun, Pen and Wang, 2010, p.38).

Unstructured decision-making refers to the decision-making process which is complex and impossible to determine the model and the language to describe their decision-making process. But it does not have influence on reaching the optimal decisions (Gao and Huang, 2007, pp.11-13).

Semi-structured decision-making is somewhere between two decisions. Such decisions can create appropriate algorithm to generate decision-making programs to get optimal decision-making solution (Sun, Pen and Wang, 2010, p.11). This type is precisely the basis for the development of DSS.
Based on decision making process

Passive support for non-adaptive decision making: According to the ability to support decision-making process, it can be classified into several types. One of them is the passive support for non-adaptive, i.e., not providing active support without adaptive performance as the adaptive passive support.

Active support for adaptive decision making: Active DSS emphasizes human interaction and the integrated DSS (Mirchandani, Pakath, 1999, pp.31-42), thus intelligent DSS is signed as the initiative decision support (Keltch, Lin and Bayark, 2010, pp.509-516). The development of integrated DSS is based on adaptive DSS and expert DSS, which has taken advantage of the analysis process and logic reasoning of human cognition, learning and knowledge innovation with the system supported decision-making capacity beyond the fact reasoning and learning phase (Ren, Yang and Zhu, 2002, pp.430-432).

Based on source of driver

From the sources of driver, it can be classified into Data-Driven DSS, Model-Driven DSS, Computer-Oriented DSS, Knowledge-Driven DSS, Web-Based DSS, Simulation-Based DSS, GIS-Based DSS, Communication-Driven DSS, and Data Warehouse-Based DSS (Wang, 2008, p.19).

Data Driven DSS: It is the first or the traditional DSS, providing users to query and retrieve documents related to the most basic functions. One recently developed data warehouse (DW) system can provide data manipulation functions (Yang and Liu, 2005, pp.43-45).

Model Driven DSS: Model-driven DSS called for an early version of the calculation of the DSS. Mainly this kind of DSS aims to access and manipulate a model such as statistical models, financial models, optimization models, or simulation models to complete the simple statistics and analysis through recently developed On-line Analytical Processing system (OLAP) model, data retrieval and data summary.

Knowledge Driven DSS: also known as intelligent decision support system (Trick, et al., 2010, pp.51-57). It is through problem-solving expertise of human machine systems that the users are provided with the measures to be taken on the decision-making recommendations to decide the decision support capability (Cao and Zhang, 2006, pp.94-97).

Web-Based DSS: Through a network connection to provide users with decision-making information and decision-making tools is basic working theme for this kind of DSS (Han and Yang, 2003, pp.140-142).

Simulation-Based DSS: It is the simulation of the formation of semi-structured questions to help users simulate real-world analysis to provide information for decision-making and decision-making tools (Wang, 2008, p19).

Geographic Information System (GIS) Based DSS: This kind of DSS provides the auxiliary analysis results or integrated designed decision making tools for the managers or business analysts through the GIS (Han and Yang, 2003, pp. 147-149).
Communication Driven DSS: Supported by the communications assistance for shared decision-making and the boards are the most basic functions (Chen and Lin, 2006, pp.238-241).

Data Warehouse Based DSS: Function of this system is to integrate information from various databases, organize and store the data from the history and development perspective for user’s analysis and decision-making (Han and Yang, 2003, pp.147-149).

2.1.3. Development History of DSS

DSS application development process has gone through several stages, as shown schematically in Fig. 4. Initially, in the early 1970s, DSS mainly assisted managers to achieve the semi-structured decision-making process of which the main symbol is an interactive technology for administrative tasks.

Second, in the late 70s DSS mainly supported management and decision-makers to make judgments, emphasizing the “support process” rather than “decision process” (Dong and Guo, 2007, p.11).

Third, from late 70s to early 80s, DSS mainly focused on improving “effectiveness” rather than “efficiency” in decision-making, where effectiveness has the meaning of useful or correct results derived and efficiency refers to fast and economic consumptions of resource. In a word, being effective means useful and correct working results and being efficient means fast working results (Song, 2008, p.3013).

Final stage in the history before current development as the late 80s and early 90s, practical DSSs emerged. The DSS and the Expert System (ES) began to be combined with each other (Mao, 1998, p.686), forming Artificial Intelligence DSS (IDSS) (Dai, 2004, pp.92-93), especially ideas and methods of knowledge engineering (KE) and expert systems penetrated into the field of DSS. The DSS in the period have not only included the expert system knowledge forms of reasoning to resolve the problem of qualitative analysis of the characteristics, but also been applied the model for the quantitative analysis of the core features of the problem (Li and Xu, 2000, p.6). It made fully quantitative analysis and qualitative analysis of the organic combination, which extended the problem-solving capabilities and scope to a great expansion. The IDSS is a new phase in the development of DSS (Sun, Pen and Wang, 2010, p.11).

In recent years, various technologies have been integrated to produce DSSs at a higher level. They are adapted to different requirements and different levels of decision-making sectors (Song, 2008, p.3014; Yuan, 2010, p.5-7).
Modern lives are in an evolving social environment with complex change. Most decision-making process needs to collect large amounts of information beyond most people’s thinking process information. DSS with recent development has integrated the use of DM, ES, artificial intelligence technology, database, knowledge base, inference generator, and decision tree methods. Development of computer technology and decision-making support system, adapting to human activities, help people to complete the decision-making support (Mollon, et al., 2009, pp.1-7). Initially, nowadays DSS can be applied in nearly all areas including the metallurgy, chemical engineering, transportation, finance, medical and meteorology fields. The economic field as budget control has been discussed in Mosmans, Praet & Dumont (2002). Interestingly, the budgeting control is for a health care system but DSS was designed to assist the economics rather than medical treatment. Additionally, DSS is also applied in the aerospace, geology and military fields (Yin, 2001; Li, et al., 2007, p.527).

With the rapid development of DSS, it is hoped that the decision-making receives computer support at a higher level and in more complex environment. What it faces is not only limited to one person or one institution, but also decision-making to organization which has certain independence (Hao, 2003, pp.17-19). DSS is the process of development from junior to senior, that is, electronic data processing (EDP), Management Information System (MIS) and System Analysis (SA). A new generation of DSS development primarily has the following aspects including Group DSS (GDSS), Distributed DSS (DDSS), Intelligent DSS (IDSS), DSC, and I3DSS etc. (Li, 2007, pp.67-74).

**2.2.1. Expert Systems**

Expert system (ES) is the most extensive, practical, successful branch in the field of artificial intelligence, which is the computer program system in a specific field at the expert level. It includes simulated expert thinking activities, reasoning judgments, and the settlement for specific problems (Ma and Chen, 2007, p.42). With the development and utilization of ES technology in the field of management decisions, computer technology, artificial intelligence tools or methods and human decision-making process are integrated. DSS is developed into the diagnosis, treatment, and preventions, which can reduce the blindness during medical process, extend health care range, and provide the positive diagnosis. In this way the diagnosis and treatment of diseases become more standardized scientifically. Thereby CDSS, with its wide use range, rich knowledge base, and high artificial intelligence level, becomes an active branch of DSS research. It has been widely and deeply studied and has been
accepted by people and recognized by doctors (Mao, 1998, p.686). ES has significant contributions to DSS in PN. DSS can be regarded as experimental data and diagnostic expert knowledge as a knowledge base, with computer artificial intelligence technology.

2.2.2. **Group Decision Support System (GDSS) and Distributed Decision Support System (DDSS)**

Combined use of network technology and communication technology, which has enabled a distributed information resources in different locations, can be categorized by multiple groups of decision makers with the development and the formation of a Group Decision Support System (GDSS) and Distributed Decision Support System (DDSS) (Yuan and Li, 2010, p7). To support group decision-makers together on semi-structured and unstructured decision-making, each network node contains at least more than one decision point (Wang, 2008, p.19) to help group members build up the ability to prevent negative group behaviour with their thinking and decisions. The direction of development in DSS in PN is DDSS and GDSS.

2.2.3. **Intelligent Decision Support System (IDSS)**

Traditional DSS provided appropriate data and models for the choice of the users, and the system only acts as an auxiliary computing tool. Intelligent DSS with the decision-making process can change and improve the results of the users’ working procedures.

Integrated decision support system is the development based on adaptive DSS and ES, which can take advantage of both analysis and reasoning with the innovation advantage so that the system realizes the learning ability rather than merely fact collections (Searl, Borgi and Chemali, 2010, pp.1-7). Decision Support Center (DSC) is based on DSS and makes use of human thinking with decision-making at the core of decision support group, through comprehensive integration of qualitative and quantitative methods, providing the users with high-quality decision support (Keltch, Lin and Bayrak, 2010, pp.507-508). Intelligent Interactive Integrated DSS (I3DSS) is a comprehensive DSS for policy makers and for decision-making process. It combines system analysis, operation research methods, computer technology, knowledge engineering, expert systems together with integrations so that all ideas, all kinds of problems, a variety of methods, and tools have also been integrated. I3DSS solves the problem more comprehensively, specifically and intelligently (Maclean, et al., 2009, pp.1303-1308). These are advanced DSSs.

2.3. **DSS and Medical Care**

*DSS as a contributor in human life*: With the development of DSS, people’s living conditions have been gradually improved with more and more large-scale applications in all fields especially in health care. The application of DSS in medical field (1970s) is among the earliest and widest, which is one of the most active subfields in DSS (Yin, 2001; Li, et al. 2007). At present as everyone observes, DSS has been largely developed and applied in many fields and has simultaneously created significant impacts. The author of this article chooses the field of pregnancy nutrition IS as a research topic due to the strong interests and practical importance in this subject.
2.3.1. DSS Applications in Medical Care Fields

The application of DSS in medical care is applied more widely because medical care diagnostics and prescriptions are depending mainly on the practitioners’ experience, diagnostics methods, and examination results (Li, et al., 2006, p.527). Normally a professional physician seems to need several years to accumulate the professional experience (Ma and Chen, 2007, pp.42-43). In this area, DSS takes the role of gathering practical experiences from the experienced experts so that together with the diagnostics knowledge, the suggestions can be passed on in a convenient way to assist the systems users to conduct the medical treatment, which in turn reduces the uncertainties and enhances the accuracy in order to finally improve the health care level (Perez-Ruiz, et al., 2010, pp.1-10). At the same time, obviously DSS also makes it possible to provide the distance medical diagnostics. The earliest application of DSS in health care was developed in Stanford University in the USA (Mao, 1998, p.686). There are many DSS which were developed successfully in the early stage stated as follows.

In antimicrobial therapy, the clinical DSSs have been most frequently and widely used (Li, et al., 2007, pp.67-74). It could provide results and prescriptions under the circumstances that the figures were not adequate (Trick, et al., 2010, pp.51-56). Since then, the importance and interest of CliDSS has been stimulated and its usage has been encouraged. Later on, an upsurge of CliDSS came and it was gradually applied in practical clinical processes from theoretical and laboratory researches. In the 1970s, the PUFF system has been developed as lung function DSS (Zhao, 2001, p.40), which has been used for quite a long time in the San Francisco Pacific Medical Care Center. During the same period, Lategris University developed a DSS for glaucoma diagnostics and treatment called CASNET (Mao, 1998, pp.686-687). In 1991, Bamett in Harvard Medical School of US developed the DXPLAIN diagnostics CliDSS, which included 2,200 diseases and 5,000 symptoms. The facts are stated in Li et al. (2007).

In the 21st century, it has been shown by Parmar (2010) that a case study has been conducted as intra-operative visualization system for RFA to study the cognitive DSS for clinician in the aspect of workflow driven in 1976. Shortliffe developed MYCIN, which was used for diagnostics and treatment (Gao and Huang, 2007, pp.11-13). These are the development and history of medical care and DSS worldwide. The situations in China are described shortly.

Experience stage, which tends to rely on doctors’ clinical practice experience, the diagnostic indices and laboratory results are basic supports for the expert decision makings (Mao, 1998, p.686). DSS as the experienced senior experts will supply practical experience and diagnosis knowledge as the knowledge base, with the computer and technology development into diagnosis and treatment. It finally derives clinical decision support system, for example, MYCIN with Shortliffe, PUFF system as lung functional DSS, CASNET developed by Lategris University as a DSS for glaucoma diagnosis and treatment (Zhao, 2001). Applications between traditional Chinese medicine and DSS have combined the traditional Chinese medical science and the newly emerging computer science. In medical treatment process, the diagnosis of disease is still in the traditional way.
2.3.2. **In China**

After the application in 1970s in the area of Chinese medicine, Jilin University and Bethune Medical University jointly developed the Chinese Medicine Gynecology DSS. In the late 1970s, a diagnostics process called Guan You Bo Hepatitis Process has been developed by Prof. Guan You Bo and the computer center in Beijing Chinese Medical Hospital (Wang, Bian and Yan, 2004, p11-15). The contribution was the first example that combined the traditional Chinese medical science and the emerging computer science. Later on, Miller in Pittsburgh University of US published the famous Internist-I internal medicine computerized assistance diagnostics system.


2.3.3. **Specialized Systems**

Besides those large medical DSSs, there were some specific diagnostics systems for specific types of disease, e.g., the Skin Cancer assistance diagnostics systems developed by Umbaugh (Fortney, et al., 2010, pp.849-853), and dynamic graphic structure real-time system developed by Provan, which was then constructed into a Chronic Abdominal-ache DSS. Those happened in 1990. In 1996, Birndorf and his colleagues developed the Anaemia Diagnostics Reporting DSS. In the same year, Ling established a typical AIDS DSS in Butler University. Then in 2000, Wells developed a knowledge database system to improve the breast cancer treatment plan (Dye, et al., pp.286-288).

During recent years, it has been gradually understood that not only the diagnostics and treatment are important component for medical care, but also the nutrition is critical to improve the health condition (Kramer, Haas and Kelly, 1998, pp.447-451). The DSS for PN guidance is one of the important DSS (Yin, 2001, pp.201-212; Li, et al., 2007, pp.527-529). The PN guidance has aroused extensive attention of obstetricians. It requires not only the medical treatment knowledge from the obstetricians but also the nutrition knowledge, which might not have been widely studied in the medical education. It is a stimulation to ensure the health of pregnant mothers and the unborn fetus, and has become a focus of the DSS for PN guidance (Zhao, Yan and Sun, 2006, pp.85-87).

2.3.4. **For Obstetrics and Gynecology**

DSSs have been widely used in the field of obstetrics and gynecology. Typical components and examples are obstetric risk score (Ren and He, 1969, pp.972-985), computer recommendation system, computer-aided decision-making in the application of fetal
monitoring (Cen, Meng and Ji, 1971, pp.644-649), gynecological disease diagnosis expert system (Sui and Kang, 1989, pp.17-24), intelligent CTG analysis system developed by Keith et al. in the Department of Obstetrics and Gynecology, Graduate School of Medicine in Plymouth British during 1994 and 1995, the well known Oxford Sonic aid System 8000 system, Beksac in the Department of Obstetrics and Gynecology, computer-assisted cytology systems, the development of trophoblastic disease diagnostic medical expert advisory computer system (Li, et al. 1997, pp.1196-1203), computer-aided diagnosis of pelvic endometriosis (Zhang, 1983, pp.85-88), computer-aided judgment of head position delivery (which is based on head position dystopia, head position delivery score and Bayes theory, testing of human papillomavirus infection with the application of CCT cervical smear), and diagnosis of cervical lesions with application of CCT and colposcopy (He, et al., 1998, pp.265-267).

2.3.5. For Perinatal Medicine

Information Systems Management in the field of Perinatal Medicine: Information systems management as the basis of perinatal care can determine perinatal care issues. For example, Hacettepe University at Turkey designed artificial intelligence to diagnose congenital diseases as determined by maternal serum markers using neural network method for the determination of fetal weight (Shi, et al., 1986, pp.67-71). With the application of information systems, we can evaluate the effects of perinatal care decision-making (Cao, 1999, pp.22-26). Perinatal medicine is extremely important, because it is directly related to intrauterine growth and in turn related to the health of newborns, infants and young children and even to the adult diseases related to the status and quality of life (Stewart, et al., 2006, pp.46-61). As a new concept of the fetus, the new idea is when the origin of life begins, disease happens at the same time. Life and disease are in the process of dynamic change throughout the whole life, while adverse fetal factors are vulnerable and may cause later problems (Parmar, 2010, pp.331-335). The antenatal decision system reported by Anderson, the cardiotoxicogram intelligent computer system developed by Keith, and the intelligent diagnostics system for assessment in gestational age based on ultrasonic fetal head measurement developed by Besac of Hacettepe University in Turkey can be regarded as the milestones or remarkable progress (Beksac MS, et al., 1995, pp.131-136). It can be shown and inferred from the facts that the applications of DSS in PN can be widely and successfully conducted.

2.4. DSS and PN Guidance

The development history of DSS tells us that the focus of computer technology has changed into the technology management, from those in early years, including early development, the involvement of expert systems, the origins of DSS and the current various forms of DSS. The thesis describes the development of computers and information systems and the transformation of DSS from technical level into application level, which is the source of this study. A supplementary line here is that here the IS integration refers to an application, a final result or an integrated system after IS design and implementations, which should be distinguished from the IS concept which also includes the organization, environment and the human activities around as common sense.
2.4.1. Basic Aspects and Definition of PN
Prepared for fetal growth, infant delivery, and milk production, nutritional needs of women are increasing during pregnancy (Li, et al., 2006, pp.42-43). PN is integrated nutrition including protein, glucose, fat, vitamins, trace elements and calories. PN guidance is on the nutrition monitoring and dietary guidance (Li and Zhong, 2010, p.705). Complete knowledge in prenatal medicine of obstetrics including gynaecology, genetics, nutrition, sports medicine, and abundant clinical experience are required. The purpose of PN is to ensure healthy fetal growth and development, to prevent and reduce birth defects and maternal diseases (Pan, et al., 2000, pp.315-317).

2.4.2. Importance of PN
A healthy and lovely baby is expected by every pregnant mother and PN healthcare provider. The pregnancy process is a process of a newborn infant growing from a zygote, which could not be discovered with human eyes (Su, 2011, p.4). For women during pregnancy, in addition to ensure their nutritional needs, it also must be considered to meet the needs of fetal growth and development (Yu and Liu, 2010, pp.1467-1470). Therefore, the need for various nutrients has been increased. Malnutrition on the fetus during pregnancy may lead to low birth weight or overweight, premature, perinatal neonatal death, brain development obstacle, congenital malformations and so on (Zhang, Shan, and Xia, 2009, pp.112-114). PN is an important issue in perinatal medicine. The new mothers’ dietary is directly related to the fetal intrauterine growth environment and the living quality of infants (Cao, 1999, pp.1048-1049). The impact of these adverse outcomes may be extended to the fetus in the neonatal period, infancy and even adulthood (Su, 2011, p.4; Wang, 2010). It has been studied and stated by Zhang and Song (2010, p.210) that PN is related to infant weight, which then influences the insulin resistance in adulthood. At the meantime, the insulin resistance is the syndrome of malfunctions in glucose metabolism and lipid metabolism, which damages cardiovascular and kidney system as evidenced by symptoms such as abdominal obesity, hypertension state, and Type II Diabetes.

Content of PN guidance: A balanced diet during pregnancy, which is the dietary allocation, and the dietary calculation, and dietary characterization and so on, is very important. Types and nutrition should be diversified, including not only the grain group such as millet, maize, cereals, flour, milk, eggs, but also meat such as poultry, fish, together with beans, fresh vegetables, fresh fruit, shrimp, seaweed, kelp, cooking oil and so on (Yuan and Chen, 2008, pp.530-532). There provide caloric needs during pregnancy, such as protein, vitamins, inorganic salts and trace elements. All the above are in need of calculation. Also for a reasonable variety of foods, flavours need to meet the demands (Wang, et al., 2010, pp.1609-1613).

Process of PN guidance: PN guidance during pregnancy is a complex and repetitive work. Firstly obstetricians need to consider all relevant factors. They need not only the professional obstetrics knowledge but also expertise in the related fields, including the areas of obstetrics & gynaecology, genetics, nutrition, sports medicine and so on (Zhao, Yan and Sun, 2006, p.85). Secondly offering the PN guidance requires repetitive dietary calculations (Wang, 2001, p.4). The work may involve different PN for individual mothers, continuous...
requirement to complete the daily, weekly or monthly dietaries, and continuous effort throughout pregnancy (Ming, 2010, pp.903-904).

2.4.3. **Basic Modules of the DSS for PN Guidance**

As people know, the core issue of DSS is correctness or validity of the decision making process (Li, 2009, pp.140-143). For DSS the quality of the knowledge base plays the key role. Whether the clinical development and application of medical decision support system (MDSS) can support the clinical decision correctly and effectively is the issue in need of clarification. During the design of this DSS in PN, the rules have been investigated from different sources (experts system, databases) and different features (Wozniak, 2004, pp.593-601). Firstly, the DSS in PN is the explored professional information systems integration. It is directly and specifically used for PN guidance. It is based on the decision theory and framework of the DSS (Cheng, 2009, pp.49-51), such as the three library system, the four library system in decision support theory as shown in Fig. 5.

![Figure 5: Four common library system in DSS (Yuan, Li, 2010, p.6).](image)

Another recent development has been recognized as artificial intelligence, neural network simulation, and decision tree system structure. Based on the model of medical artificial intelligence system, DSS for PN combined mathematical methods with the expert systems (Cheng, 2009, p.50). It is also the IDSS as shown in Fig. 6.

![Figure 6: The Basic Structure of IDSS (modified from Li, 2009, p.140).](image)
Semi-structured problems have characteristics of both structured and unstructured problems. On one hand it can be programmed for quantitative analysis and calculation, or be solved by the use of relatively well-defined decision-making principles and methods. On the other hand, it also relies on people’s knowledge, experience and intuition for judgment and choice. With respect to the semi-structured problem solving, the human-machine interaction is very important. It often takes many times to go through to solve the problems.

The DSS in PN seems to be suitable to be categorized as the semi-structured decision-making. Because of the DSS of PN, it is impossible to complete the whole medical treatment without human labour force. Usually in the process of PN guidance, obstetricians are controlling the whole process. It seems to be rooted in the high intelligent and responsibility requirement of medical treatment. Any mistake in the medical process will lead to much worse results than some other industry such as machine industry. The obstetricians are holding high responsibility. During the process of the DSS in PN guidance, the DSS takes the work of calculation and basic logic classification. The obstetricians control the complicated and final decisions. Basic data and index of the patients also need the efforts of the obstetricians to type into the interface of DSS. That is why the DSS in PN is a semi-structured DSS.

The structural characteristics of DSS in PN includes the model base and management system, database and management system, method library and management system, knowledge base and management system, interactive computer hardware and software, and user-friendly modeling language (Li and Xu, 2000, p.6). The flexibility and adaptability of decision making, adaptive for the environment and the users outside, will be capable of supporting but not replacing the high-level decision-makers, which are the characteristics of the specific kind of IS (Garg et. al., 2002, pp.1223-1233). DSS of PN developed recently is practical. As what mentioned before, the structure of DSS in PN is usually constructed as in Fig. 7.

**Figure 7: The Structure of DSS (Li, Li, and Dong, 2010, p.58)**

**2.5. Feedback during the DSS Applications**

While the investment in information technology has reached an all-time high, the world has not benefited sufficiently from it. When (copies of) the artifacts are used by many people, the impact is multiplied. Some of these impacts will be positive, and some will be negative. Feedback forms obtained during the application procedure of DSS include Critics of System Application Risk Assessment (Quan, Shao and Qiu, 2005, pp.20-22; Williams, et al. 2003, pp.27-31; Guzek, et al., 2011, pp.930-938; Cooper, et al., 2011, pp.553-556), the Upgrade of
DSS during Application Process (Wang, 2008, p.96), Impacts on the Applications (Chun and Park, 1998, pp. 313-325; Lam, 1997, pp. 193-215), and Value and Results (Hunt, et al., 1999, pp.260-265). When using a technical artifact, its features are inserted into the working situation to help for the tasks. The very use of the artifact helps the users to understand better what the technology might do for them and motivates them to see more clearly what they do and do not want. Users are not aware of what they need until they have experienced what they don’t need but thought they did. There are no systemic indicator and pattern at present, which are thus sometimes ignored (Basden, 2011, pp.1-21). The subject of the thesis is to select the optimum through exploring the software evaluation in various forms of feedbacks and IS management in the application process of DSS. As for the data collection about impact of application process of DSS on the users, it can be treated as a way of information system management, upon which the model in this study is determined on.
Chapter 3  Research Setting and Methods

This chapter discusses the theoretical basis of the research method and demonstrates its role as an integrated part of the entire thesis. The related factors, philosophy worldview of the research method, patterns of manifestation of this research method, practicability of research method have been introduced. Meanwhile, the basic strategy and tactics of the research methods have been described in details with the focus on data analysis. Following this general discussion, the data collection procedure is discussed, including the background and basic status of the participants, the procedures and critical points, the investigated strategy and guideline, and the final results after data collection. Basic and detailed facts about the use of DSS in PN by the obstetricians have been collected which serve as the foundation for the impact studies in the following two chapters.

3.1. Research Setting

The research setting is within the obstetrics department in TFCH and the Tianjin Medical Center for Women and Children, both of which are located in Tianjin, People’s Republic of China. In Health Care academic taxonomies, it mainly contains clinical medicine, which includes Internal Medicine Department, Surgical Department, Gynecology & Obstetrics Department, and Paediatrics Department. The obstetrics contains perinatal care, which contains the PN (studies or guidance). Based on the method discussed in previous section, the case study inquiry strategy and the data collection can be conducted as follows. The research focus includes both the people working there and a newly developed Information System being experimented named as the PN of Prenatal Care Management System for pregnant and puerperal women. From the functionality of IS, it can be considered as a CliDSS.

3.1.1. Research Venues

The city

Tianjin is a municipality city directed under the Chinese central government. It is a metropolitan giant with over ten million people. It builds its fame by a rich spectrum of history, high-technology, and sea port. It is a hub of dynamic economic growth. Its residents have a tendency to accept the new issues and also have the ability both intelligently and financially. The explanation of the city will help to ensure the reliability and increase the acceptance and understanding for the readers.

The hospital

The TFCH is one of the three major medical centers in the city integrated by teaching, disease prevention and scientific research (Memory of The Hospital, Anon., 2009). The situation of the hospital will help to confirm the reliability of the case study. It is important to know that the medical system in China is a three-level system. Level I is mainly about private clinics. These private clinics do not have a high standard and requirement. Professional physicians must be qualified after strict examinations to ensure their abilities in treating patients. Governmental health care units also manage strictly to ensure the results too. The clinicians in
private clinics must take their practice in public hospital first. The obstetricians in this level of health care level are not encountering the demanding professional requirements. Level II mainly includes the community hospitals, where the qualification, studies degree and treatment knowledge of practitioners are not satisfactory. Level III includes public hospitals operated by the government. In China, hospitals in this level usually gather the most advanced technology and knowledge. The most difficult diseases and patients in intensive cares will be suggested to choose the hospitals in this level. And the researches are also more encouraged in this kind of hospital. In this kind of hospitals, the professional practitioners perform generally better and they have quite good medical instruments. Level III can be further categorized into several sublevels. TFCH, being on the top of the Level III sublevels, is well suited for the data collection performed in this thesis. Researches will be encouraged and suitable to take further step. Figure 8 shows the registration office of this hospital on the ground floor.

![Figure 8: The outpatient hall of TFCH on the ground floor.](image)

**The Obstetrics Department**

The Obstetrics Department is a large-scaled clinical department with 62 inpatient beds and 55 medical staff including the temporary employees. Among them, there are 3 Chief obstetricians, 5 Vice Chief obstetricians, 4 Attending obstetricians, 4 Resident obstetricians, 1 Chief Resident obstetrician, 4 Intern obstetricians, and 36 Nursing Staff grouped in 4 responsible teams/groups guided by four competent responsible obstetricians.

The obstetrician working situations in this department are described as follows. The obstetrics department has achieved satisfying clinical contributions to everyday patients and is willing and open to the academic research and new technology. There are five branches in this department, that is, the outpatient service branch, the emergency service branch integrated in the hospital emergency department, the inpatient ward branch, the delivery room branch and the infant room branch. The outpatient service branch includes prenatal clinic, PN guidance clinic, intensive care and serious illness clinic, and the consulting clinic. The hospital ward branch is composed of the delivery room, the baby room, and the prenatal and postnatal rooms. The work in the hospital ward branch includes natural childbirth, cesarean section, treatment of pregnancy coexisted diseases complications, and the newborn care. Except for the emergency service, the other four branches are in the same floor same building. So the obstetricians and patients are convenient to be transferred to either branch. Figures 9-11 illustrate the outpatient service of obstetrics department.
Figure 9: Map of the Obstetrics Department at TFCH.

Figure 10: The entrance of the outpatient service of the Obstetrics Department.

Figure 11: The waiting area in the Obstetrics Department.

In the outpatient service branch, the PN is used to be contained in the diagnostics process. Not long before this research, this treatment is picked up from the ordinary process and treated as an individual project in this department. This will help to encourage the participants. Now normally a patient with special conditions or disease symptoms will be suggested to take the PN guidance during the systematic diagnostics and those wishing to receive the nutrition guidance are certainly welcomed. With their agreement, the PN guidance will not be offered during the diagnostics process. Instead it will be carried out in the PN guidance room especially for the PN guidance. That room is equipped with DSS and necessary assistance tools. The assistant tools are the models simulating the real food.
Figure 12: A full view of the shelf displaying food models in the DSS for PN at the Obstetrics Department, TFCH.

Figure 13: A close-up view of the shelf displaying food models.

Figures 12 and 13 display the food models in the DSS in PN in TFCH. Basic nutrition knowledge for PN, as shown in Fig. 14, includes the notice and instructions from the Ministry of Health in China.

Figure 14: The basic nutrition knowledge guide in the diagnostic room.

In the hospital ward branch, the DSS is also equipped mainly for researches. The main use for medical treatment is held in the outpatient service branch. A model illustrating the nutrition allocation is located to offer visual understanding for the women. And all the food mentioned in the DSS has been modeled. They look exactly like the real food but actually they are model and they cannot be eaten. The obstetrician will then offer the nourishment advices with the DSS and the simulated models in this room. Figures 15 and 16 show the obstetrician is offering the PN guidance for the pregnant woman.
In Fig. 17, the research is the observation of the essential diagnostics process. The person standing is a medical staff. The one sitting here is an obstetrician who is carrying on the conversation for diagnostics and follow-up treatment. The other medical staff is a nurse who takes notes of the follow-up treatment. This is the clinical room for essential treatment in the outpatient service. The PN guidance needs to be held in another PN room especially configured for PN guidance which locates near this room (Fig. 18).
Figure 18: The researcher in the PN outpatient service room.

**The Qualification**

With the consciousness of the former issues, it can be known that the research site is located in quite a qualified, reliable and authoritative hospital. The annual patient number here is 3000-4800, including critically ill patients and pregnancy complication which is taking up 32%. The obstetrics department in TFCH is one of three obstetrical critically ill rescue centers. Perinatal medicine is a developed branch in obstetrics. The topic of PN is quite an important issue in perinatal medicine, and a project funded by the Ministry of Health is being conducted. Therefore, the research cite offers the general reliability to carry out the data collection. The obstetrics department in this hospital has taken 200 research objects for the PN treatment. The hospital is the only cooperation hospital with Health Care Department in the city of Tianjin. Another hospital in Beijing, starting earlier than this hospital, has carried on more than 5000 objects and they have a specific group working on this issue.

The ranks of the physicians range from the resident physicians to the chief physicians. The expressions of responsible physicians are created in clinical management to simplify or enhance the patient management. Since the physicians’ titles are able to show the abilities normally. It is necessary to know that the expressions of the physicians responsible do not mean or show the abilities. However, the responsible work is usually finished by the chief physicians or vice chief physicians because of the requirement in overall medical treatment abilities.

About the frequently used words: In the name of the IS, the phrase management information system does not mean the terminology in the discipline of IS. It is used to mark the functionality of management and it is an acceptable phrase in the social and technical world under the current situations. The current situation is that common people as the system users gradually accept the concept of management IS after accepting the concept software. However, they cannot afford the detailed clarification in the IS discipline. Moreover, even in the academic or specific field of IS, scholars or related people also have not too much globally integrated consent. This happens in China and might also be the case in other countries. Here the focused IS refers to the limited concept version, the set or series of functionalities, instead of the large-scope concept version of IS which includes the organizations, environment and so on. DSS has been provided and introduced in a project encouraged by the Ministry of Health in China. The project has carried on for some time and the preparation of the DSS of PN in this department was completed around the end of last year.
3.1.2. Events
The events focus on a DSS providing PN guidance for pregnant women as part of prenatal period care. It was conducted by interviews and observations jointly. The researcher identified the participants’ ideas through interviews. At the same time, it is also possible for the researcher to testify the system as a participant with the assistant medical knowledge from the obstetrician. The author of the thesis came to the hospital and departments which took part in the diagnosis and therapy process of pregnant women in obstetrical outpatient department. This department can receive pregnant women 50-80 times per day, and complete 15-18 times PN guidance. The researcher attended outpatient clinical for one week. The therapy process of pregnant women, process of PN guidance, and PN guidance process by taking DSS of PN have been observed.

3.1.3. Participants
The participants are the obstetricians working in or related with the obstetrics department and they have been chosen from those who are using the DSS of PN. There are two sessions of the participations. The first and initial 18 ones are those working in the obstetrics department. The participants have been shown in Table A4. The second section is from the Tianjin Medical Center for Women and Children. They have been selected by cluster sampling from classified population in accordance with a certain standard considering each group as a sampling unit. Then draw some units with a random method and investigate them. To ensure the accuracy and credibility of qualitative survey of the paper, the author conducts a questionnaire survey in a large and concentrated range.

Additional Participants
Based on the detailed and specific analysis on qualitative questionnaires for each participant, more data have been collected with the help of the maternal and child health agencies of Tianjin and the research assistant working in the research site mentioned before. A direct and self-service questionnaire of 108 obstetricians in Tianjin has been conducted, of which 98 have filled in the questionnaires directly and voluntarily. The questionnaires are about the impact of DSS of PN on obstetricians. The work seniority, the working seniority of PN with manual calculation, and that with DSS of PN related to the results. The statistical analysis used in the results has supported the analysis further.

3.1.4. Process
The process was conducted by semi-structured questions from the researcher, and open-ended discussions. Thus adequate opinion space has been provided to the participants. Parts of the data have been collected before the visit to the hospital. Brief part has been completed during the visit there. Data collection type contains observations and interviews. Observations have been carried out in the research site by the researcher herself. Regarding the detailed type, the researcher mainly acts as an observer rather than a participant considering vital medical treatment. It is impossible for the researcher to act as an obstetrician to treat the patients by person. However, the research is possible to participate to some degree. Therefore, the researcher is mainly an observer and then sometimes possibly becomes a participant. The other data collection type is the interviews. Email internet interviews have been selected to handle the initial data collection in distance. Face-to-face in person interviews have been
conducted intensively when the research was staying in the research site. The method of email internet interview is following the phrasing pattern of Creswell (2000). For common habits, sometimes it is also substituted by the word of questionnaires because the main issue and purpose for the email internet interview is the questionnaires though not all.

3.2. Overview of the Research Methodology
This section is closely related to the preceding Literature Review chapter and the following Data Analysis chapter. Ideas of theories about how to research, which are the content of Methodology, have been stated in the Literature Review. In the thesis, since the case study and statistics analysis method will be selected and mentioned later, the method part states the selection of case study and the data collection part states the procedure after the method. The former is related to the philosophical worldview and the research inquiry strategy, and the latter is related to the researchers’ roles. The methods carrying out in the thesis are mainly based out the research methods stated in Creswell (2009). The research type here in the thesis is determined to be a qualitative and quantitative design.

The study about DSS in PN concluded in the IS fields is focusing on the social activities, emphasizing the integrated multiple factors analysis and thinking. Therefore there are a few choices in research method theory. Different opinions and solutions on the same issue have been raised. In some cases, different types of research method theories may even lead to different ways or directions in research, which makes it even more difficult to determine the applied research methods without a selection beforehand. Otherwise dilemma or obstacles might be produced as demonstrated from former experiences. This research method theory offers a clear framework in the descriptions and statements of the research approach. The procedure to conduct a research following this kind of research method theory has been discussed. And the detailed recommended procedures and important issues are also given in a clear structure. In this way, the overview of the theory is possible to be understood and then to be carried out. Additionally, this research method theory has provided detailed procedures for a research to follow, which shows the feasibility of the research method theory.

3.2.1. Research Inquiry Strategy
A mixed research type is usually chosen because the “Qualitative Research” oftentimes deals with “social or human problem” from the meanings of “individuals or groups” and qualitative research is “a means for exploring and understanding the meaning” (Creswell, 2009, p.4; Yin, 2009). Since the research question here is about how the information systems influence the human users socially, the qualitative research and quantitative research type has been considered as the possible and suitable approach. Quantitative research can explain better and deeper the influence of pregnancy nutrition decision support system which is used by obstetricians for data analysis. The sequential mixed methods strategies have been applied from the initial qualitative interviews and then the quantitative approvals with the questionnaires. It has been naturally generated and applied through the characteristics of the research setting and purpose for this thesis.

Among several possible strategies mentioned in Creswell (2009), including ethnography, grounded theory, case studies, phenomenological research, and the fifth narrative research, the
case studies and statistics analysis could be a possible one. Since case studies and statistics analysis begins with a specific situation and generates meaning pattern after data collection, it could be a possible way to study how the DSS could influence the medical care in PN for obstetricians. The case and statistics analysis are about the DSS of PN for pregnant and puerperal women in perinatal period, being experimented in the obstetrics department in a hospital. Details of the case have been described in the data collection. Following Hart (2005), the Methodological Traditions & Standpoints here will be the Interpretivism. The methodological approaches and cultures will be the qualitative and quantitative. The methods (techniques) for data collection and analysis will be the case study and statistics analysis. The research type is non-experimental. According to Myers and Avison (2002), case study and statistics analysis research are a good typical research method which has been a preference in the thesis.

3.2.2. Researcher’s Role

Following the three principles for data collection mentioned in Yin (2009), the interviews, observations and questionnaire survey have been used. Databases to show the collection results have been established. The chain of evidence is emerging during the process of data collection, which can be considered as the planned and executed collection strategy. At the same time following Hart (2005), the thesis is determined to be written as a Work-based dissertation type. Researcher’s Role: The researcher handled the investigation for the case study by interviews and observations to collecting data, for the statistics analysis by questionnaire to collecting data. At the same time, the researcher handled analyzing data and the other work. When collecting the data, the researcher is mainly an observer, and the researcher participated in some activities. The researcher prepared adequate IS professional knowledge to correctly or scientifically conduct the research. Mistakes especially in the data analysis part have been avoided as far as possible. The researcher also held the tasks to share IS common sense with the obstetricians and helped them in solving some problems about the computers. In the data analysis part, the constructive theoretical analysis for case study has been focused, which emphasizes the treatments and analyses. They include the attribute and quality identification, the categorization for factor analysis. Following the constructive theoretical analysis, theoretically speaking, the methods of the causal effect, critical, induction and deduction, and the comparative methods can all be candidates in order to find out what qualities or themes have been in the contained in the focused problem situations.

3.3. Data Collection Procedure and Methods

Based on the research setting in previous section, here details on data collection procedure will be narrated. The initial data collection is the Questionnaires carried out in distance while the researcher was in Sweden. This stage acts like a pre-processing before the central and intensive part carried out physically in the research site, the hospital in China. Towards those positively responding to the consent form and email confirmation, initial questionnaires have been sent out. Initial questionnaires were sent out to accelerate the process. After receiving their response and clarification of the misunderstandings in the questions, the initial data have been collected. The author exchanged emails with the participants and then carried out investigation step by step. A resident obstetrician has been found to willingly assist the author.
in research. Email addresses of all participants were achieved by the assistant in China. Then they confirmed with the participants who agreed to join the completed investigation face to face or cooperate with the direct medical observations in China. By the email questionnaires, questions have been proposed and then the misunderstandings have been clarified via emails. The participants proposed their ideas and thinking, established their feelings and exchanged knowledge with the researcher. Later the responses have been available. It has been shown that several obstetricians have held positive critics on the DSS. They agreed on the positive functionalities, vast working efficiency and convenience. They like the results just in a short time, and the PN advices can be provided to the patients. Moreover, some obstetricians express their possible dependency on the software. They prefer not to go back to the former tremendous calculation method by hand and for some others they even have no proficient ability to conduct personal counting by themselves.

First, general discussions have been conducted. Because of the data resource exploration before the research, it has already been done that the employees in this obstetrics department are quite active and willing to contribute to the research, which is obviously the reason for choosing this data collection site. General discussions were mainly conducted before the research to ask for agreement and at the same time provide basic background information and situations of the research. Second, an assistant collaborator was found. The observation to the hospital was intensive, which meant sometimes the research was not in the hospital, for example before and after the intensive data collection. In this situation, a resident obstetrician has been found to willingly assist my research while in distance. She delivered information between the researcher and the participants whenever in need. These situations included administrative information or confirmation not very important. She is a trustful individual working as a resident obstetrician and involved as a participant at the same time. Third, the email addresses of the participants have been collected with the aids of the assisting collaborator. Fourthly and finally, the Consent Form has been sent to the participants.

3.3.1. Observation
The researcher came to TFCH for the first-handed data collection during the period from March 30th, 2011 to April 12th, 2011. Observations have been carried out in the obstetrics department in person by the researcher herself. It has been observed that the process of obstetricians used the DSS of PN to offer the guidance for the pregnant women to balance their nutrition and learnt about the obstetricians’ personal reflections. Figure 17 shows the observation about ordinary medical diagnostics process, and Figure 18 shows that the researcher is being in the outpatient service hall.

3.3.2. Interviews
Interviews will help to understand the situations better and more deeply. A participating obstetrician offers a positive example of the software in the case study. She used to try to offer the nutrition guidance for a pregnant woman with Glucose Diabetes Mellitus (GDM) without the computer aids. In the situation, she had to count for the Expected Date of Childbirth (EDC) and pregnancy week for twice, the pregnant weight for 3 times, the content of three main nutrition components in food for 9 times, Glucose Index (GI) for 15 times, blood glucose examination for 5 times, counting for the meal nutrient content for 25 times. In
all, she needs to count or calculate for nearly 65 times and some contained are repeated work, which was a waste of her labor resource and ability. The result is not very accurate to some extent. After using the DSS of PN, the whole process from the basic information input to the clinical check is finished automatically. There is one input in the meal nutrition investigation, and after receiving the menu, it takes only 20 minutes. Another experienced obstetrician talked about a pregnancy extra fat patient. She used to calculate around 60 times to provide the guidance. After using the software, she needs only 30 minutes. Generally speaking, the reflections of the obstetricians are positive. They think the software offers assistance to them. The contents of the communications with the participants are also explained in detail in the data analysis chapter.

Data recording procedures sometimes are onerous so that people have thought out some ways to handle it. However, the tough point of the data recording is that it is a little bit complicated. After the data collection period, it should be done to ensure all kinds of materials are all in hand. They included the emails, personal notes, and other documents created. Applying these data, including correcting writing mistakes and making everything, is a style personally preferred. Any superficial and simple treatment in need should be done, for example, cutting the pieces of paper in the same size. A typical procedure includes: Read through the materials once and carefully again. Then list the points of each individual or in any unit. Contact the participants whenever something has been neglected. Facing the materials and information collected, the analysis stage is stimulated and should be carried out.

In this research, there are 18 interviewees for the qualitative data collection and 98 participants for the additional quantitative data collection, including the academic administrators, chief obstetricians, vice chief obstetricians, attending obstetricians, chief resident obstetricians, resident obstetricians, and the interns, who are working in the research obstetrics department in Tianjin First Central Hospital (TFCH) and those in the Tianjin Health Centre for Mothers and Children. The interviewed participants have altogether completed the 1,500 records for 800 patients with the use of the DSS.

### 3.3.3. Questionnaires

During the observation processes, the medical treatment cannot be open all the time. It is because the Obstetricians need to explain to the researcher. The patients might feel uncomfortable if the researcher is standing beside. It is too much work to explain the researcher’s observations to every patient. Even understanding the situations, some patients were still feeling uncomfortable or even unhappy when the researcher was standing beside but not offering medical treatment. Furthermore, in some urgent situations, the researcher might also intrude the Obstetricians in medical processes.

In this way, it should be prepared all the time when it was possible for the researcher to enter and the wasted waiting time was enormous. All these factors lead to the situations sometimes the researcher was not well prepared when the opportunity came. For example, sometimes the researcher was trying to handle an interview with an obstetrician or just waiting in the department area. Once it was possible to observe, it is necessary to reach the Outpatient Service Branch as soon as possible. Similar situations also happened in interviews. It is not
easy for the researcher to know or predict when the interviewee would have time. Preparing all the time without emphasis might lead to some failure or missing to some extent.

3.4. Ethical Issues

The author thinks highly of her own privacy, safety and confidentiality in everyday life. Therefore, she also considers the participants’ rights as if her own, and thus thinks from their views and stands in their shoes. Then the ethical issues are protected quite well since the researcher always wants a high protection level. In this way the ethical issues are not being reached with great efforts but just a confirmation.

Due to the relationship with the area of medical care the information of the patients has been protected. The observation during the outpatient service has achieved the permissions from the patients who were seeing the doctors. And the photos of the pregnant women involved in the thesis are also based on their permission. At the same time, the consent from the obstetricians of observing their working process for data collection and of taking pictures of them for thesis publications has been achieved. This is about the privacy protection issues regarding the observations during data collection.

The research has achieved considerable supports from the staff working in the obstetrics department in TFCH. Not only is it the researcher’s great appreciation and good fortune to achievement for her research topic, but also the studied issue is a theme that is being researched and carried on so that the conclusions are expected to share benefits with them. The researcher learned and studied the current and related circumstances of the research sites to ensure that new considerations of ethical issues have been guaranteed, since the detailed ethical codes will increase the pressure on the people. Maybe it can be trusted in a relaxing way. However, even the strict ethical codes cannot prevent invasions for those without adequate ethical common sense. Therefore trying to keep everything in mind is the solution.

Consent Form: “Hello! It’s my great honor and happiness to receive your support in participation towards my research! …Best Regards, Research student: Chen-fan Xu”. The detailed form has been included in the Appendix, where a scanned consent form with the signatures is included.

Researcher’s Role: The research has followed the selected data collection type and without too much modification on how to collect data. The researcher observed the medical process as an observer to see how the obstetricians are working and learnt about the issues and knowledge which were not known before. The researcher is also possible to use the DSS of PN by herself with the help of the obstetricians. In this way, the researcher acted as a participant to some extent but it was not possible to participate in the medical process because it needed too much professional knowledge and needed to hold too much unaffordable risks and responsibilities. The researcher is also the author of the thesis.

The medical professional codes have been respected. The professionals’ guides have been followed whenever necessary. The participants from risks and danger have been protected in the research if there are dangerous or sensitive issues. Obstetrics department is nearly the happiest department at least in this hospital since the patients come here for aids in giving
birth to babies rather than a real unhealthy disease. However, the research should also try to learn more about any possible risks in all kinds to protect the participants.

The following actions have also been confirmed as mentioned before that they are confirmed instead of being reached with great efforts. Ask for permission if in need of nomination of the participants. Consider the time of medical professionals because medical treatment is quite an unusual profession which depends on emergency a lot. Here in this research, as mentioned in potential risks, it is the researcher’s great honor and luck that the obstetricians and other medical professionals are quite willing to help the young scientists or system architects to conduct practical academic research. They are also willing to introduce or help the researcher in looking for patient volunteers as participants and they are quite optimal to an agreed result. This may root in good relationships between the researcher herself and the medical professionals in the obstetrics department. This may have worked here for a long time because her mother and have been getting along well with her colleagues, and the researcher herself has also good relationships with the medical professionals both the experienced and the young. In the research processes, the issues have been followed up and protected.

3.5. **Validity and Reliability**

Since the researcher has been in good personal contacts with the medical staff in the obstetrics department where this research has been conducted, the research has not been influenced by the personal feelings from the obstetricians. None of the obstetricians’ personal opinions have affected the research ideas more than a participant. It means the research is not following anyone’s idea because of the close personal friendship. Thus the biases from personal relations are avoided. The obstetricians themselves have professional knowledge to avoid prejudiced influence on the researcher. Moreover, they have been studying with the Chinese medical culture which has been heavily influenced by the scientific positivist methods so that they usually take objectivity as granted and working conventions to a great extent. Furthermore, the well-educated obstetricians are in a highly ethical level. Biases can be considered to be of remote possibility.

The research has been conducted by the researcher herself to ensure the authenticity. The data have been collected as the facts objectively and preserved to ensure the credibility. After the determination of the direction of research, the author traveled the TFCH of Tianjin, China for the interviews in person. She observed and learned, and kept close contact with obstetric participants, while she was also supported by the obstetric care institutions. As a result, the author could add and enrich information timely during the dissertation process. At least these issues are a preliminary wide and solid base. The following points can be kept as the reminders during the research, with the order from important to unimportant and the procedures of conducting the research. Inform the participants, including department director, senior chief professional Obstetricians, resident Obstetricians, and nurses, about the research to inform them about the research background. Offer a consent form for them to sign. Confirm the permission of any third indirect participant. Although this might be unnecessary, it is good to receive permission from all related parties. As a new progress, the pregnancy product company is happy about the researcher’s studies or evaluation about the software. Although the research will not include deep study as an evaluation process, the company
orally states they will still be happy about any kind of evaluation or use about their software. What they desire in the experimental period is any kind of ideas to improve the use. They are glad to provide any kind of permission or grant to allow for the study. They are asking what kind of document the research is in need. In a word, the research will be able to conduct research without too much worry. After all, the permission from the company may not be mandatory even. For now, the research can eliminate the completed worry about the ethical issues on the research. Develop trust with the participants and protect them if in need.

The data collected has reached the validity and reliability. To ensure validity, the data being analyzed has been collected by the research rather than indirect information. To ensure the reliability, the case for the method of case study strategy has been chosen carefully which can be considered as the reliability to a great extent. The author exchanges emails with respondents then carries out investigation step by step. A resident Obstetrician has been found to willingly assist the author research as discussed previously. The collaborators at Tianjin have expressed the highest confidence on the success of this study.
Based on the literature review in Chapter 2 and the research method in Chapter 3, presented here is a theoretical framework that is used to assess the impacts of DSS on obstetricians in the process of IS-based PN guidance. The developed framework is based on innovative theme model with themes derived from literature and modified in the course of this study. A number of important questions can be addressed in this framework, e.g., what are the impacts generated by the DSS of PN onto obstetricians? How the DSSs of PN have impacts onto the obstetricians during the process of PN guidance? What is the relationship between the impacts of DSS in PN onto the obstetricians and the academic IS field? The factors which are observed as more impacts of DSS on obstetricians during the process of PN guidance, together with the factors derived from theoretical models that constitute the research model, will be discussed in this chapter.

4.1. Example Impact Studies of DSS Applications

DSS has enabled a multitude of advantages in a wide spectrum of application areas. A large number of users apply the latest information technology to complete the correct decision making to improve the quality of everyday lives and businesses (Gao and Huang, 2007, pp.103-105). Problems arising during the application process suggest that these information management personnel should constantly make communication between users and system developers to build a permanent bridge. And such a bridge requires impact analysis of these DSS applications. The topic of impacts of DSS for PN guidance on obstetricians mainly refers to the changes of obstetricians due to this novel way of conducting PN guidance, including physical, physiological, feeling, the spirit, the amount of space, social and economic changes.

Only a few articles have studied the DSS on PN guidance (Zhao, Zhou and Qu, 2008), while there are many general discussions on DSS working for medical or health care. PN may be considered as a branch in perinatal care, which is in series contained in the obstetrics branch in the medical field. A qualitative systematic review has been conducted about the themes or effects of computerized CliDSS on physicians and patients, while the practitioner performance has been improved by the CliDSS (Garg, et al., 2005, pp.1223-1238). At present, it has been largely agreed that research reveals that the DSS for PN guidance has relieved professionals from complex and repetitive labour because it seems to be the phenomenon in common sense. But the studies of DSS performance in PN are still restricted to the viewpoint of information system, but not to this specific domain of practice. Evaluating the procedures specified, only the correct and incorrect considerations about the decision results have been mainly focused on (Hunt, et al., 1999, pp.260-265). In addition, the themes of DSS in obstetrics have not been emphasized or studied to the needed extent (Connor, 2011, pp.12-19). These examples are summarized schematically in Fig. 19.
4.2. Innovative Theme Model

As a theoretical background, it is noted that the construction of assessment and evaluation emphasizes the treatments and analyses that are related to the attribute and quality identification, as well as the categorization for factor analysis (Chen, Shek and Bu, 2011, pp.129-139; Yin, 2009, pp.256-26). These assessment methods can be applied, including the causal effect, critical, induction and deduction, and the comparative methods, in order to find out what qualities or themes have been contained in the research objects and questions (Sánchez and Loredo, 2009, pp.332-349).

Figure 20: The impact study conducted in this thesis.

As the central line of this work, the applications and the themes on obstetricians, especially the issue about inadequate applications of case studies used in this area, have directly or indirectly involved the process of the application which is drawn from the work. For the widespread application of clinical DSSs, it is necessary to conduct rigorous assessment and identification (Sun et al., 2004, pp.701-703). The thesis is based on the point which aims at the themes of DSS in PN on the obstetricians. In the area of DSS research, results in China are only a few; however there are not so many of these focusing on proper communications between developers and users. That is why this study is focusing on themes onto the obstetricians who are the system users. It is expected that the study could contribute to the PN
guidance. The emphasis of innovative research of theme models of DSS is to study the theme and changes on doctors, such as mainly five ones including the convenience, the acceptability, the universality, the concreteness, the effectiveness, the verbosity, the expensiveness, the rigidity and changes, as shown in Figure 20.

The motivation to creating these eight measures is largely derived from literature study in the previous section and modified and adapted during the course of this study. These measures have been developed to ensure intense and efficient analyses, to promote independent thinking, and to provide transformative nature beyond the accepted conventions (which are mainly designed for DSS but not for this particular DSS for PN guidance). A keyword as the impact measure is certainly better than several words or sentences in capturing the essential features. The literature review suggests the impact model consisting of the convenience theme, the acceptability theme, the universality theme, and the effectiveness theme. Facing the opinions collected in the course of this study and borrowing theories developed by Dooyeweerd (Basden and Burke, 2003; Basden, 2011; Dooyeweerd, 1975; Friesen, 2003 and 2005; Plantinga, 2009; Strauss, 2004), new impact measures have been added including concreteness, verbosity, rigidity and expensiveness themes.

4.2.1. Convenience
Most clinical doctors are now more computer literate and accept that computers play an important role in providing and analyzing data, which in turn enables the medical professionals to reach the best decisions (Trafton, et al., 2010, pp.575-585). It would be reasonable to expect that the DSS in PN is capable of enabling the physicians without adequate experience with those valuable experience from the experienced ones (Cooper, et al., 2011, pp.553-557). The clinical application of CDSS has made the complex and repetitive tasks simple and easy, and therefore has brought convenience to the doctor. Application of DSS as proposed in literature review confirmed the above line (Mollon, et al., 2009, pp.1-7; Yin, 2001; Li et al., 2007, p.527; Gerard et al., 2007, pp.776-778). Most people would be frightened if they thought a robot or machine was looking after them. Based on the information by the doctors, nurses, and fetal development monitors, it offers opinions just as physicians do when they consult each other. In this way it can be considered valuable for the obstetrician with high work pressure and load.

4.2.2. Acceptability
The Acceptability theme refers to the available possibility for this newly emerging issue of DSS in PN to be accepted. It has not been irritating or has provided anything unacceptable generally. The usability testing has optimized the CDSS into the validated assessment tools that better address the barriers (Trafton, et al., 2010, pp.575-585). Human-machine interface of the DSS enhances the confidence of the obstetricians. When the CDSS is applied, the physicians work with the system running, including inquiries of medical history, input of a variety of clinical data, identification of diagnosis and treatment guidelines of diseases, which are all from the physicians’ operations. The physicians are not being adverse to the DSS in PN which is an independent system from the hospital information systems. As mentioned above it is acceptable for physicians and patients.
4.2.3. Universality
Studies have shown that physicians are holding the opinions that the DSS can provide customized recommendations based on the risk factors identified (Kastner, et al., 2010, pp.1-12). Universality means the system expands and extends possibilities for each user. The universality theme of DSS in PN refers to the increase of the number of the treated patients, the extension of the treatment scope, the diversity of the targeted groups and the extension of available period, while the universality theme on the physicians refers to the expansion of knowledge scope and clinical thinking, which guide them to be able to understand the patient more comprehensively and to extend the service scope as well as to conduct long-range treatment.

Extended—the Completeness
The completeness theme of the DSS in PN on obstetrician means that the thinking process of the obstetricians has been continuously improved under the guidance of running system. The DSS can help to show the systematic details and information of the patients from the very beginning so that the obstetricians will not miss the special or essential situations of every patient. They can acquire the whole integration of medical information at all time. Because of the DSS all the data of every patient can be stored and integrated by creating at least one large database or even data warehouse. The data are not only just being kept together but also being integrated logically so that the relationship among the data can be discovered. Therefore, it’s possible to display the integrated medical history of a patient which can enable a complete treatment and provide the detailed guidance during the treating processes.

4.2.4. Concreteness
The Concreteness theme means that the application of DSS has made physicians more specific. With the development of computer technology, DSS integrated with artificial intelligence and expert systems has been widely used as an important tool in the medical field. The concreteness theme of DSS in PN on obstetricians refers that it is gradually growing forwards to meet the demands both professional and patients. It has offered details in reports to record the situations with analysis, so that it can consider the detailed issues to ensure the well-informed status.

Extended—the Individuality
The Individuality theme means that the DSS provides the results for a specific person rather than a group of people so that detailed situation of every patient can be analyzed. Doctors and patients all have their individual needs and interests when doctors guide the patients. Under the guidance of the DSS, a lot of personal traits of obstetricians can be standardized by systematic DSS. Due to the personalized and professional development of DSS, it is more applicable for obstetricians to devote their own personal enthusiasm for work. The individuality theme refers to that obstetricians can better meet and fulfill the personal situations of a patient or notify pregnant mother when giving the patient a more targeted diagnosis and guidance so that the obstetricians are able to treat more specifically.
4.2.5. Effectiveness
Trafton et al. have done the original research about the evaluation of the acceptability and usability of a DSS to encourage safety and effectiveness (Trafton, Martins and Michel, 2010, pp.575-578). After experimental periods, the obstetricians and patients have raised trust onto the DSS. This is the evaluation of the DSS applications. The effectiveness theme means the results provided by the DSS are quite helpful in clinical care. The patients’ health has been improved with the results derived from the DSS for PN guidance. The thesis aims towards the recognition of decisions obtained through DSS during the application by obstetricians regarding the validity.

4.2.6. Verbosity
The Verbosity Theme means some steps in the DSS are not needed for the patients. Sometimes they can be omitted by an obstetrician. In this way it is to some extent disliked by obstetricians because of not allowing doctors to find shortcuts. During the observation process, it has been collected that when an obstetrician is using the DSS to conduct PN guidance, every page and step should be filled in one by one. Without completion, the next page or window cannot be displayed. Coincidently there was a patient with simple condition. The obstetrician and the pregnant woman both hoped to go to the next window to achieve the nutrition menu and nutritional assessment report as soon as possible, but they were disappointed with the current format.

4.2.7. Rigidity
The Rigidity Theme means although the DSS has provided possibility to modify menu or index format, sometimes obstetricians do not feel a sufficient level of flexibility under the present frame. Although there is flexibility already, more are in need. The offered possibility in modifying medical processes seems to have come from the systems designers’ understanding although they might not have ever worked with obstetricians before, as raised by a participant. The mandatory procedures might appear to be rigid. In the email collection, there are three young resident obstetricians who reported humorously that if the screen of DSS for PN guidance is keep being the same, they would not like it any more. They expressed that the rigid screen lack of changes might lead to the limited practice. The mandatory and rigid application process of DSS confines people's thinking and results into extra burdens.

4.2.8. Expensiveness
The Expensiveness Theme refers to the cost of the recommended food and nutrients in the database of the DSS. Some items are not affordable to a large portion of the participants. Therefore the PN guidance reported by the DSS may have reduced effectiveness. The system developers have included food materials that are normally considered expensive. They might have focused mainly onto the nutrition rather than the price. An obstetrician has pointed out that sometimes patients might not be wealthy enough to purchase the food mentioned or even have ever heard of that before. In this way, the DSS of PN has lead to the obstetricians to create the menus as results to be relatively expensive and not affordable for all patients (Ke, Tan and Chen, 2010, pp.280-282). It should be pointed out that the development of DSS in recent years has not received suitable income which matches with its investment.
**Table 1: Summary of impacts and theirs sources.**

<table>
<thead>
<tr>
<th>Impacts</th>
<th>Firstly Appeared in</th>
<th>Sources or Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convenience</td>
<td>literature review</td>
<td>(Trafton, et al., 2010; Cooper, et al., 2011; Gerard, et al., 2007; Mollon, et al., 2009)</td>
</tr>
<tr>
<td>Acceptability</td>
<td>literature review</td>
<td>(Trafton, et al., 2010)</td>
</tr>
<tr>
<td>Generality</td>
<td>literature review</td>
<td>(Kastner, et al., 2010)</td>
</tr>
<tr>
<td>Extended - Completeness</td>
<td>research summary</td>
<td>Resident obstetrician</td>
</tr>
<tr>
<td>Concreteness</td>
<td>research summary</td>
<td>Chief obstetrician</td>
</tr>
<tr>
<td>Extended - Individuality</td>
<td>research summary</td>
<td>Attending obstetrician</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>literature review</td>
<td>(Jamie, et al., 2011; Rick Goud, et al., 2010; Toutant, et al., 2011)</td>
</tr>
<tr>
<td>Verbosity</td>
<td>research summary</td>
<td>Intern obstetrician</td>
</tr>
<tr>
<td>Rigidity</td>
<td>research summary</td>
<td>Vice Chief obstetrician; Chief Resident obstetrician</td>
</tr>
<tr>
<td>Expensiveness</td>
<td>literature review</td>
<td>Intern obstetrician</td>
</tr>
</tbody>
</table>
Chapter 5  Data Analysis

In this chapter the data collected from the research place described in the empirical study chapter have been analyzed by constructing into the research model and categories for the impact of DSS in PN. The results have been synthesized to develop the eight themes for the DSS. The involved factors possibly affecting the results, including the structural features of the participants and data resources, have been considered. Finally the eight themes have been discussed and identified.

5.1. Observations of the Service Flow of PN Guidance

The process of the obstetricians who used the DSS of PN to offer the guidance for the pregnant women to balance their nutrition was observed. The observations were conducted between March 30th to April 12th, 2011 as explained in Chapter 3. The process was as follows:

A pregnant woman comes to the hospital.

→ She enters the main outpatient entrance hall from the obvious main entrance.

→ She registers at the entrance.

→ She goes to the obstetrics department on floor 4th and waits at the waiting area.

→ After being noticed, following the notice, she entered into Consulting Room.

→ A nurse takes the blood pressure and body weight notes and basic information for the pregnant woman. Obstetrics outpatient service Flow Chart is shown in Figure 21.

Figure 21: Outpatient service flow chart in the obstetrics department.
She enters the guided room and sees an obstetrician.

The obstetrician carries out the further treatment and takes down notes of the patient’s health situation, for example. And the obstetrician needs to decide if the pregnant woman needs PN guidance. Generally those women in extra weight or unknown how to balance will be suggested the nutrition guide. Those pregnant women in need of guidance might be in the regular situations or have critical ill complications. The DSS included in this research is able to handle not only the general pregnant women but also those with special disease in need of additional attention and care.

The pregnant women in need of nutrition guide needs to go to another room especially for PN guidance outpatient room. This room is about 25 square meters. It is bright and clean and it is a quiet room. There is the food models installed in this room so that the pregnant women can know the food well. At the same time, the women can enjoy a nice atmosphere with the vivid but fake models shown in Figs. 12 and 13.

The responsible obstetrician will then use the DSS of PN software to offer PN guidance to the patient. The PN outpatient service as flow chart is shown in Figure 22.

![Figure 22: The outpatient service flow chart for PN guidance.](image)

The obstetrician follows the general operation instructions to use the software step by step, first setting basic options and then typing in the necessarily required information of the
patients. The information is included mainly in patient’s record book/log carried by the patient with herself to the hospital. The additionally required health index can be done at that time. The next suitable and guided step to use the software is the step of nutrition investigation which can be finished in a newly coming-up page. After the investigation, the DSS of PN will be ready to offer the assistance in PN guidance. The DSS of PN provides opportunities to offer automatically generated advice from its database and intelligence. And it provides another opportunity at the same time that the obstetrician could change the advice from the DSS of PN or create a series of advices completely with the human intelligence. The final advice will be printed out and the items can be selected by the obstetricians. The report will be easily accessible for both the obstetricians and the patients including the basic pregnancy documents of the pregnant women. The final report contains the basic information of the pregnant woman, the result and indexes of her clinical, status of meal with nutrition value, PN guidance, and detailed executive menu for 3 or 7 days in a nice cover page. At the same time, the same meal form can be used for the same nutrition level and the same types of disease; the PN guidance is also conducting without computer aid. It is mainly because of the limited number of the computer when the computer is occupied for another patient. Normally one patient will be offered with only one set of advices from manual calculation or from the computer, and the obstetricians will not compare the results from their own calculation or the computer. In the manual process, the obstetricians ask for the disease history for the patient, make rough calculation, and then provide the nourishment guidance. All 150 cases have been observed, which were finished with the help of the DSS of PN. 3 cases done manually have been observed. So far, the DSS of PN has been used in China. The CliDSS of PN guidance perinatal period for pregnant and puerperal women has been tried. Main interface of DSS of PN shows the interface of the DSS as shown in Figure 23.

![Figure 23: The main user interface of the DSS for PN guidance.](image)

Figure 24 is showing a report of PN guidance shows the cover page of a sample report collected from a case done by the obstetricians. It is a finished sample from a real patient.
5.2. **Features of the Investigated DSS in PN at TFCH**

The general features of the DSS for PN guidance investigated at TFCH are described in Fig. 25. The basic technical structure of the DSS has been analyzed with the observed data. The structure of it has been recognized by the author herself rather than a provided one from the initial system designers.

It seems that according to the common sense the core issue of DSS is the correctness or validity of the decisions have been making. Whether the clinical development and application of CDSS can support correctly and effectively is initially based on the decision theory and framework of the DSS. Following the convention, the focused DSS is also aimed to provide the usability. The recent development of DSS has been recognized from the focused one, which includes the artificial intelligence, the simulated neural network structure, and the current conceived designs including the data mining and the decision tree system architecture.

The medical artificial intelligence schema is always widely used which is also being considered to be included in the design of the focused DSS of PN. It has integrated the mathematical methods and the rule based systems such as AI and ES. The model library has also been applied in the DSS from the observation and interpretation by the researcher that the model library has introduced the meta-generating method to the DSS modeling system. In this way the basic element units can be abstracted and induced from the partial similarity in the decision problem situation in order to simplify the structural complexity of systematic model for DSS. A variety of techniques and algorithms in artificial intelligence have also been applied in the DSS model library including the machine learning, knowledge signifying, artificial neural networks, natural language processing, and the distributed intelligent systems. With the advanced models not only the data mining but also the complex calculations can be achieved. From observation and interpretation the DSS of PN might be possible to be considered as being built with the IDSS standard and the basic model library structure. The main interface of DSS in PN includes the items of obstetricians and those for system maintenance. The former includes the rapid positioning, items list, adding iteration or search.
for saved ones, and the data management. The other system maintenance includes the setup center, system overview, and the operation assistant as already shown in Fig. 25.

![Diagram of system maintenance interfaces]

**Figure 25: The structure of main user interface of the DSS.**

### 5.3. Basic Information of Interviewees

Basic information of the interviewed participants in the obstetrics department of TFCH has been analyzed and presented in Tables 2 and 3, which consists of the employment information and the applying situation, including the working seniority, working seniority of PN guidance, perinatal care tutoring (Systematically Learnt, Not, Self-learnt), consciousness of nutrition by themselves, proficiency in computer literacy, interest of using computer, understanding of IS or even DSS. The option of Systematically Learnt here means if the obstetrician has received the tutoring from by the institute governed by the division of health promotion and education in the Department of maternal and child health care and community health in the Ministry of Health of China and has participated to the domestic and international conferences for PN.

**Table 2: Information of the interviewed obstetricians**

<table>
<thead>
<tr>
<th>Items Participated</th>
<th>Working Seniority (Years)</th>
<th>Working Seniority of PN guidance (Months)</th>
<th>Perinatal Care Tutoring</th>
<th>Consciousness of Nutrition of by themselves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief obstetrician</td>
<td>30</td>
<td>36</td>
<td>Systematically Learnt</td>
<td>Care about</td>
</tr>
<tr>
<td>Chief obstetrician</td>
<td>28</td>
<td>24</td>
<td>Systematically Learnt</td>
<td>Care about</td>
</tr>
<tr>
<td>Vice Chief obstetrician</td>
<td>26</td>
<td>24</td>
<td>Systematically Learnt</td>
<td>Care about</td>
</tr>
<tr>
<td>Vice Chief obstetrician</td>
<td>25</td>
<td>12</td>
<td>Self-learnt</td>
<td>Not</td>
</tr>
<tr>
<td>Vice Chief obstetrician</td>
<td>25</td>
<td>24</td>
<td>Tutoring by the</td>
<td>Care about</td>
</tr>
<tr>
<td>Attending obstetrician</td>
<td>9</td>
<td>12</td>
<td>Tutoring by the</td>
<td>Not</td>
</tr>
</tbody>
</table>

54 / 99
<table>
<thead>
<tr>
<th>Office</th>
<th>Proficiency</th>
<th>Interest</th>
<th>Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attending obstetrician</td>
<td>6</td>
<td>Not</td>
<td>Not</td>
</tr>
<tr>
<td>Attending obstetrician</td>
<td>6</td>
<td>Tutoring by the</td>
<td>Care about</td>
</tr>
<tr>
<td></td>
<td></td>
<td>department</td>
<td></td>
</tr>
<tr>
<td>Chief Resident obstetrician</td>
<td>5</td>
<td>Tutoring by the</td>
<td>Not</td>
</tr>
<tr>
<td></td>
<td></td>
<td>department</td>
<td></td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>4</td>
<td>Tutoring by the</td>
<td>Care about</td>
</tr>
<tr>
<td></td>
<td></td>
<td>department</td>
<td></td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>1</td>
<td>Not</td>
<td>Not</td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>1</td>
<td>Tutoring by the</td>
<td>Not</td>
</tr>
<tr>
<td></td>
<td></td>
<td>department</td>
<td></td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>2</td>
<td>Tutoring by the</td>
<td>Not</td>
</tr>
<tr>
<td></td>
<td></td>
<td>department</td>
<td></td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>1</td>
<td>Not</td>
<td>Care about</td>
</tr>
<tr>
<td>Intern physician</td>
<td>0</td>
<td>Not</td>
<td>Not</td>
</tr>
<tr>
<td>Intern physician</td>
<td>0</td>
<td>Tutoring by the</td>
<td>Care about</td>
</tr>
<tr>
<td></td>
<td></td>
<td>department</td>
<td></td>
</tr>
<tr>
<td>Intern physician</td>
<td>0</td>
<td>Tutoring by the</td>
<td>Care about</td>
</tr>
<tr>
<td></td>
<td></td>
<td>department</td>
<td></td>
</tr>
<tr>
<td>Intern physician</td>
<td>0</td>
<td>Tutoring by the</td>
<td>Not</td>
</tr>
<tr>
<td></td>
<td></td>
<td>department</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: (Continued from Table 3)
<table>
<thead>
<tr>
<th>Participant</th>
<th>Opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attending obstetrician</td>
<td>Proficient Very Interested Understanding</td>
</tr>
<tr>
<td>Attending obstetrician</td>
<td>Proficient Interested Understanding</td>
</tr>
<tr>
<td>Attending obstetrician</td>
<td>Proficient Interested Not</td>
</tr>
<tr>
<td>Chief Resident obstetrician</td>
<td>Very Proficient Interested Understanding</td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>Proficient Interested Understanding</td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>Proficient Interested Not</td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>Proficient Interested Not</td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>Proficient Interested Understanding</td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>Proficient Interested Not</td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>Proficient Interested Understanding</td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>Proficient Interested Not</td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>Proficient Interested Not</td>
</tr>
<tr>
<td>Resident obstetrician</td>
<td>Proficient Interested Understanding</td>
</tr>
<tr>
<td>Intern physician</td>
<td>Very Proficient Interested Not</td>
</tr>
<tr>
<td>Intern physician</td>
<td>Very Proficient Interested Understanding</td>
</tr>
<tr>
<td>Intern physician</td>
<td>Very Proficient Interested Not</td>
</tr>
<tr>
<td>Intern physician</td>
<td>Very Proficient Interested Not</td>
</tr>
</tbody>
</table>

Main opinions of the participating obstetricians are shown in Table 4. These comments provide essential guidance in developing appropriate analysis in the next section.

**Table 4: Main opinions of the participating obstetricians**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief obstetrician</td>
<td>Getting rid of onerous work; better results;</td>
</tr>
<tr>
<td>Chief obstetrician</td>
<td>Getting rid of large quantities of repeated work;</td>
</tr>
<tr>
<td>Vice Chief obstetrician</td>
<td>Focus on Pregnancy Nourishment; delighted models;</td>
</tr>
<tr>
<td>Vice Chief obstetrician</td>
<td>Assistance;</td>
</tr>
<tr>
<td>Vice Chief obstetrician</td>
<td>Peer recommendation;</td>
</tr>
<tr>
<td>Attending obstetrician</td>
<td>Leading place internationally;</td>
</tr>
<tr>
<td>Attending obstetrician</td>
<td>Vast speed;</td>
</tr>
</tbody>
</table>
### 5.4. Impact Analysis

A theoretical framework has been presented in Chapter 4 on how to assess and evaluate the impacts of DSS on obstetricians in the process of IS-based PN guidance. The developed framework is based on innovative theme model with themes derived from literature and modified in the course of this study. A number of important questions can be addressed in this framework, e.g., what are the impacts generated by the DSS of PN onto obstetricians? How the DSSs of PN have impacts onto the obstetricians during the process of PN guidance? What is the relationship between the impacts of DSS in PN onto the obstetricians and the academic IS field? These issues will be elaborated here based on the data analysis.

**Focusing on the positive impacts**

The opinions of the participating obstetricians have been synthesized into 8 themes, including 5 Positive ones and 3 Negative ones. These 8 themes are able to show and represent the characteristics of the opinions. They can be treated as the discovered features of the DSS focused on the empirical study. One issue to be pointed out is that some of them have been largely agreed by the participants and some are not. The themes have their value and significance in revealing and highlight the facts rather than only being accepted or agreed by the majority. Therefore the features have not been influenced by the number of agreed or disagreed people.
For the positive themes, there are mainly five ones including the convenience, the acceptability, the universality, the concreteness and the effectiveness. Furthermore, the completeness is the extended theme of the 3rd universality while the individuality theme is the extended one of 4rd concreteness theme. The analysis will be followed to motivate the consistency or connection. If relating with the data collected, the specific detailed facts will be stated to support the analysis. Considering about the statistical treatment, the meaning of the positive correlation coefficient is that with the increase of the work experience including that for PN and that with the assistance of the DSS, the degree of the probability to accept the system is increasing for obstetricians, which is the positive aspects of the recognition. In other words, the degree correlates with work experience. However, there are difference in the consciousness of nutrition treatment, proficiency in computer literacy, interest of using computer, understanding of IS or DSS among the participants. This correlation is not linear shown in the tables below. While at the same time, the negative correlation coefficient appears for the remained themes.

5.4.1. Theme of Convenience
The convenience theme means the liberation of the end users from manual calculations. The DSS for PN has taken care of the workload of calculation and logical decision, thus paving the way for the obstetricians to accomplish the entire process and simultaneously saving time in diagnostics. Such an obvious time reduction does not require instruments with accurate measurements. Table 5 shows the working process of the obstetricians and the results.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Item</th>
<th>N</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>working seniority</td>
<td>0-5</td>
<td>20</td>
<td>14</td>
<td>70</td>
</tr>
<tr>
<td>(Year)</td>
<td>6-10</td>
<td>41</td>
<td>32</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>11-15</td>
<td>25</td>
<td>22</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>&gt;15</td>
<td>12</td>
<td>11</td>
<td>91.7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>79</td>
<td>80.6</td>
</tr>
<tr>
<td>working seniority of PN guidance</td>
<td>0-4</td>
<td>25</td>
<td>17</td>
<td>68</td>
</tr>
<tr>
<td>(Year)</td>
<td>5-9</td>
<td>37</td>
<td>31</td>
<td>83.8</td>
</tr>
<tr>
<td></td>
<td>10-14</td>
<td>24</td>
<td>21</td>
<td>87.5</td>
</tr>
<tr>
<td></td>
<td>&gt;14</td>
<td>12</td>
<td>11</td>
<td>91.7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>80</td>
<td>81.6</td>
</tr>
<tr>
<td>working time of PN guidance</td>
<td>0-6</td>
<td>9</td>
<td>7</td>
<td>77.8</td>
</tr>
<tr>
<td></td>
<td>7-12</td>
<td>24</td>
<td>19</td>
<td>79.2</td>
</tr>
<tr>
<td></td>
<td>13-18</td>
<td>32</td>
<td>28</td>
<td>87.5</td>
</tr>
</tbody>
</table>

Table 5: Results of the questionnaires for the obstetricians about the convenience theme
Several noteworthy observations can be made from the Table 5. First, there is a strong correlation between the obstetricians’ working seniority and the convenience impact. The longer the working seniority, the more willingness the obstetricians are to accept the use of DSS. Second, a similar correlation between the working seniority of PN guidance and the convenience impact is found. Finally, the relationship between the work time measured in months of PN guidance with DSS and the convenience impact on obstetricians is that with the increase of the work time equipped with the DSS for PN guidance, the acceptance of the convenience impact increases.

**Figure 26: Working time of PN guidance by DSS of PN and convenience theme.**

As shown in Fig. 26, file.1 represents the working seniority, the working seniority in PN guidance, and the work time in PN guidance with the DSS. File.2 stands for the acceptance of the participants about the conveniences of DSS in PN.

According to the definitions of convenience theme, the work-load reduction is included in the meaning and area of convenience theme. ‘It is fantastic’, says a Chief obstetrician, ‘You cannot imagine how much work we had to do before.’ She continued that, ‘It was a little bit torturing before the appearance of the DSS because we had to do everything with patience one by one carefully and accurately.’ Now with the application of DSS, the obstetricians have been relieved from heavy work. They have mentioned that because of this new technology, they have been largely shared in the working pressure and working load.

The reduced work pressure and improved convenience from the DSS is included in the convenience theme. The DSS has fulfilled part of logical decision work while at the same time offering the possibility for the obstetricians to make the final and advanced decisions.
From observations and partial participation of trying the DSS, the assistance provided by the DSS seems to put the metadata of each patient into a correct group and then find the corresponding advices. Both the process of positioning and solutions searching are using the databases included in the DSS and the decision-making principles. A vice chief obstetrician has said that with the assistance of the DSS, she can always remember what she is going to do and the destination can always be kept in her mind rather than being substituted by heavy and onerous calculations. The obstetrician used to work in the times of offering PN guidance without DSS. At that time, she was also being tired of so much calculation and she was trying to use the calculator or advanced statistics program in computer. She was thinking to use the computer to assist her work. However, what she knew at that time was only the individual and specific application for mathematics or calculations. She has also tried to program a little bit. Similarly, she just allocated the calculations tasks to computers. Sometimes, after the mathematical results had been provided by the computer, she forgot where she should put them in the PN guidance process. She said, “Some young doctors did not have experience about manual calculation before so that they do not know how convenient we are experiencing now.” while saying she felt a little bit sorry about it, she then continued, ‘I can concentrate on the medical treatment and diagnosis themselves rather than handling so many threads simultaneously. In the past sometimes it was easily possible to forget something or where I was, drowning in the data sea.’ It can be known that since the DSS has finished the grouping of the patients, detailed calculation and the logical decisions, the obstetricians will be able to concentrate on the complicated and centered core issues.

The reduced time is a feature, an advantage or derived result of the convenience theme. The academic pacesetter helped to provide the information, ‘Since the treatment time for each individual patient has been reduced, a lot of related costs have been reduced, including the waiting time of the patients, the patience and energy of an obstetrician, the occupied time of the clinical rooms and so on. For example, with shorter waiting time, a pregnant woman does not need as many people to be with her as before. The family members and friends of the patients and also the patients themselves do not need to consume as much as the resource of food, fresh drinkable water and their personal time and efforts.’ Moreover, she also said with the shorter treatment time, more patients could be dealt with than before, e.g. in a whole morning in the past a proficient obstetrician was able to fulfill the PN guidance work for 2 pregnant women. Now with the assistance of DSS, an equivalent obstetrician is able to serve 7 to 10 pregnant women. If there were 7 to10 patients before, usually two obstetricians were in need while not only one obstetrician is adequate to meet the demands nowadays. Furthermore, the Academic Pacesetter pointed out that the saved time of the obstetrician could be put into improving the service quality and doing researchers. In summary, according to the Academic Pacesetter, at least the time of the obstetrician for one pregnant woman has been reduced. In this way, more pregnant women could be treated in the same period. At the same time, the related resource cost including everyday consumptions and required people’s efforts has also been reduced and then saved.
5.4.2. Theme of Acceptability

The acceptability theme means how willing the obstetricians are to accept a new emerging technology. If it has not been unacceptable to the general public, even without considering the most open-minded or the most conservative users, there can still be an experimental period for the users to build up their opinions. It seems that a trust has been realized before the end of the experimental period of the DSS for PN guidance. Once the DSS has been accepted, the working procedures or environments of the obstetricians will be updated and influenced by the DSS of PN guidance as a new enabling technique. See Table 6 for the results.

Table 6: Results of the questionnaires for the obstetricians about the acceptability theme

<table>
<thead>
<tr>
<th>Measure</th>
<th>Item</th>
<th>N</th>
<th>Frequency</th>
<th>Percentage ( % )</th>
</tr>
</thead>
<tbody>
<tr>
<td>working seniority</td>
<td>0-5</td>
<td>20</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
<td>41</td>
<td>32</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>11-15</td>
<td>25</td>
<td>23</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>&gt;15</td>
<td>12</td>
<td>11</td>
<td>91.7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>98</td>
<td>81</td>
<td>82.7</td>
</tr>
<tr>
<td>working seniority of PN guidance</td>
<td>0-4</td>
<td>25</td>
<td>19</td>
<td>76</td>
</tr>
<tr>
<td>(Year)</td>
<td>5-9</td>
<td>37</td>
<td>32</td>
<td>86.5</td>
</tr>
<tr>
<td></td>
<td>10-14</td>
<td>24</td>
<td>20</td>
<td>83.3</td>
</tr>
<tr>
<td></td>
<td>&gt;14</td>
<td>12</td>
<td>11</td>
<td>91.7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>98</td>
<td>82</td>
<td>83.7</td>
</tr>
<tr>
<td>working time of PN guidance by DSS of PN</td>
<td>0-6</td>
<td>9</td>
<td>7</td>
<td>77.8</td>
</tr>
<tr>
<td>(Month)</td>
<td>7-12</td>
<td>24</td>
<td>18</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>13-18</td>
<td>32</td>
<td>28</td>
<td>87.5</td>
</tr>
<tr>
<td></td>
<td>19-24</td>
<td>18</td>
<td>16</td>
<td>88.9</td>
</tr>
<tr>
<td></td>
<td>&gt;24</td>
<td>15</td>
<td>14</td>
<td>93.3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>98</td>
<td>83</td>
<td>84.7</td>
</tr>
</tbody>
</table>

Several noteworthy observations can be made from the Table 6. First, there is a strong correlation between the obstetricians’ working seniority and the acceptability impact. The longer the working seniority, the more willingness the obstetricians are to accept the use of DSS. Second, a similar correlation between the working seniority of PN guidance and the acceptability impact is found. Finally, the relationship between the work time measured in
months of PN guidance with DSS and the acceptability impact on obstetricians is that with the increase of the work time equipped with the DSS for PN guidance, the acceptance of the acceptability impact increases.

Figure 27: Working time of PN guidance by DSS of PN and acceptability theme.

As shown in Fig. 27, file.1 represents the working seniority, the working seniority in PN guidance, and the work time in PN guidance by DSS. File.2 stands for the acceptance of the participants about the acceptability of DSS in PN.

According to the definitions of acceptable theme, the convenient feel is the nice mood brought from the acceptance of the obstetricians. An obstetrician stated that the DSS was consistent with the diagnostic processes of her work. She said, ‘I feel quite convenient and have a tendency to use it since it is familiar.’ In this way, she can understand the system with her knowledge. It can be inferred that the system analysts must have conducted the feasibility analysis. It is important for an IS integration if the system users feel familiar with the use in their work. Once the obstetricians have accepted they will feel happy and prefer to use it.

The social interactions are consistent with acceptable theme. Whenever an obstetrician has formed an idea or decision, his or her behaviors are influencing others because the medical care itself is a social activity. It happens for several obstetricians that they are saying, ‘In the past I did not know about the system. But later since my colleague Doctor Li is beginning to use, then I follow her.’ They were expressing that they did not believe in the system in the beginning. They began to try because of their colleagues. This kind of psychological symptoms seems to be common in the consumption expense. It seems quite interesting that it has also influence on the people’s choices at work. It is obvious that they are interested in or did not prefer to try new emerging issues. But they believe in the people around them, for example their colleagues in this situation. Because of social interactions, the obstetricians are discussing the emerging of this DSS of PN. The beginning of the implementation is also be supported by the social activities to some extent.

The nice appearance of the simulated tools is consistent with acceptable theme according to the definitions of Acceptable Theme. If people accept any issue because of nice color or
sound or quality, the interesting and nice status must be the reason. One intern obstetrician has pointed out although the DSS has provided nice and lovely pictures in the report, he thought more nice pictures can be provided and nice background sounds as well. Although some have been fulfilled and some are as expected, these opinions can show his preference on the nice video and audio assistance. He said, ‘If more lovely pictures can be provided, the patients might have higher probability to be attracted by the reports since sometimes the suggestions about cooking are really a little hard to follow.’ It is related with the DSS results. The obstetricians also added that even the obstetricians would prefer to learn about the DSS if it became even lovelier. Furthermore, the DSS, as a branch of IS, has similar definition and research scope that it does not include the electronic computer program only. There are also the simulated models provided at the same time with the DSS as shown in Appendix B\textsubscript{5} and Appendix B\textsubscript{6}. A vice chief obstetrician stated that she knew nearly all patients are quite surprised or excited with the simulated models. Even for the obstetrician herself, she likes them a lot too. It can be inferred that the pregnant mothers must have been in happy mood because they are going to have their babies. From observations, the models have been created with nice appearance. The simulated models as the tools are attracting the patients and the obstetricians at the same time, which increases the degree for its acceptance.

5.4.3. Theme of Universality
The universality theme refers to the treatment number, location, targeted groups, and the available time period for each patient. The DSS for PN guidance enables a short processing time, and thus allows more patients to receive medical care from obstetricians. With respect to the physical location, patients at long distance and outside of hospitals can receive suggestions from obstetricians on information and signals transmitted by the DSS. The numbers of patients in hospital and in remote geographic distance increase with the use of DSS. With respect to the targeted groups, the DSS provide PN guidance for general health issues and also for those with special needs. With respect to the available period, it includes cares for the entire prenatal and antenatal periods, so that pregnant women will receive adequate and complete services. The illness types include most of the ordinary diseases in high frequency. Therefore the DSS is useful for most patients and the obstetricians will be assisted to a great degree. See Table 7 for the results.

Table 7: Results of the questionnaires for the obstetricians about the universality theme

<table>
<thead>
<tr>
<th>Measure</th>
<th>Item</th>
<th>N</th>
<th>Frequency</th>
<th>Percentage(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>working seniority</td>
<td>0-5</td>
<td>20</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td>(Year)</td>
<td>6-10</td>
<td>41</td>
<td>32</td>
<td>78.1</td>
</tr>
<tr>
<td></td>
<td>11-15</td>
<td>25</td>
<td>21</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>&gt;15</td>
<td>12</td>
<td>10</td>
<td>83.3</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>78</td>
<td>79.6</td>
</tr>
<tr>
<td>working</td>
<td>0-4</td>
<td>25</td>
<td>19</td>
<td>76</td>
</tr>
</tbody>
</table>
Several noteworthy observations can be made from the Table 7. First, there is a strong correlation between the obstetricians’ working seniority and the universality impact. The longer the working seniority, the more willingness the obstetricians are to accept the use of DSS. Second, a similar correlation between the working seniority of PN guidance and the universality impact is found. Finally, the relationship between the work time measured in months of PN guidance with DSS and the universality impact on obstetricians is that with the increase of the work time equipped with the DSS for PN guidance, the acceptance of the universality impact increases.

<table>
<thead>
<tr>
<th>seniority of PN guidance (Year)</th>
<th>5-9</th>
<th>10-14</th>
<th>&gt;14</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>37</td>
<td>24</td>
<td>12</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>21</td>
<td>11</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>78.4</td>
<td>77.8</td>
<td>91.7</td>
<td>81.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>working time of PN guidance by DSS of PN (Month)</th>
<th>0-6</th>
<th>7-12</th>
<th>13-18</th>
<th>19-24</th>
<th>&gt;24</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9</td>
<td>24</td>
<td>32</td>
<td>18</td>
<td>15</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>19</td>
<td>28</td>
<td>14</td>
<td>13</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>77.8</td>
<td>79.2</td>
<td>87.5</td>
<td>77.8</td>
<td>86.7</td>
<td>82.7</td>
</tr>
<tr>
<td>Mean Total</td>
<td>98</td>
<td>79</td>
<td>80.6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 28: Working time of PN guidance by DSS of PN and universality theme.

As shown in Fig. 28, file.1 represents the working seniority, the working seniority in PN guidance, and the work time in PN guidance by DSS. File.2 stands for the acceptance of the participants about the universality of DSS in PN.
According to the definitions of universality theme, the large scope of disease type and available period are the definition of universality theme. The chief residence obstetrician has offered the information that a large number of disease types have been pre-stored and prepared in the DSS. The DSS is able to identify quite a lot of disease after the input of a patient’s direct examination index without the obstetricians’ efforts. A vice chief obstetrician who has worked in the PN guidance for quite a long time pointed out that the DSS has already included most frequently happening diseases in perinatal period. At the same time, the DSS is available for patients both before and after giving birth to the kids which has been provided by the chief residence obstetrician. Similarly, if they are in a healthy status, they can be diagnosed after the DSS has collected their physical condition figures. It has also been observed that in the module of providing a patient’s information, it is possible to input the patient in the detailed section of the prenatal period.

The increasing amount of patients and income of hospital have been described and categorized as the universality theme. Because the number of patients receiving medical care has been increased, the obstetricians can contribute to more patients. As mentioned in the convenience theme with Economic Aspect, the academic pacesetter has provided under the condition of manual completion a proficient obstetrician can deal with 2 patients in a whole morning outpatient service compared with 7 to 10 patients with DSS. More people can receive medical care. With the accumulation of several days, weeks, months and years, the amount will be quite considerable. At the same time, the income of the hospital is surely increasing with more patients no matter whether the patients pay the fee by themselves or it is collected from the chief residence obstetrician. These are also measured by figures and numbers.

The distinction, clarification and logics are included in DSS of GN. Large scope of disease type recognizable is described in the universality theme. Recording as many types of disease with nutrition solutions offers the help to the obstetricians. To diagnose a disease and to select the solutions both need analytical processes from the obstetricians or from the IS. A residence obstetrician offered the information that the way to use the DSS is to input the examination index of a patient and some basic physical figure by his try. Then the DSS will ask for further required conditions of the patient. He is mainly typing in the facts but in need of ensuring correct facts with medical knowledge. After this, he can receive the suggested nutrition and food suggestions from the DSS and it is possible to modify the results if he thinks that anything is wrong. From the Obstetrician’s words, it can be known that the DSS has created meal suggestions with the data of the patient’s conditions. The process of distinguishing and clarifying the patient’s data in a suitable group and mapping to the nutrition solutions must be supported by logical decisions. At the same time, the resident obstetrician has also mentioned that after entering the data of a patient, if she has been attacked by any disease, the system is able to recognize it automatically. Similarly, the DSS must have distinguished the patient’s data from others and clarified them into any disease type group with logical requirements.

Completeness theme
The completeness theme means that the DSS offers the possibility of the overview about all the required and related information in PN guidance, both basic and specific details in need, also including the prediction of the future gestational results, the health conditions of the
mother and babies. It can help to show the systematic details and information of the patients from the very beginning so that the obstetricians will not miss any special or essential of every patient. They can acquire the whole information at all time. The obstetricians without too much tutoring in the area of offering PN guidance can also understand the essence and whole picture of PN a lot. This helps the young and new obstetricians a lot. They receive assistance and help at the same time. However, because of the DSS, all the data of every patient have been able to be stored and integrated, creating at least a large database or even a data warehouse. The data are not just kept together but logically integrated so that the relationship among the data can be discovered. For a specific disease, all patients and former treatment records can be known. At least the standard treatment methods could be shown and the suggestions could be delivered to the obstetricians. In this way, it seems that an expert is the obstetrician who uses the system. It is not only helpful to the young and new but also to those experienced. After all, although they are more experienced, they still are not experts or sometimes a patient might have been suffering from rare diseases. Therefore, the completeness theme mainly points out the DSS has realized the possibility about showing the whole medical history of a patient, delivering standard treatment suggestions, and essential supports for the young and new obstetricians.

5.4.4. Theme of Concreteness

The concreteness theme means that the DSS for PN guidance has provided sufficient details in reports so that the detailed situations can be recorded and analyzed, and the obstetricians can be well informed to ensure proper decision making. See Table 8 for the results.

Table 8: Results of the questionnaires for the obstetricians about the concreteness theme

<table>
<thead>
<tr>
<th>Measure</th>
<th>Item</th>
<th>N</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>working seniority (Year)</td>
<td>0-5</td>
<td>20</td>
<td>13</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
<td>41</td>
<td>33</td>
<td>80.5</td>
</tr>
<tr>
<td></td>
<td>11-15</td>
<td>25</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>&gt;15</td>
<td>12</td>
<td>11</td>
<td>91.7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>77</td>
<td>78.6</td>
</tr>
<tr>
<td>working seniority of PN guidance (Year)</td>
<td>0-4</td>
<td>25</td>
<td>19</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>5-9</td>
<td>37</td>
<td>29</td>
<td>78.4</td>
</tr>
<tr>
<td></td>
<td>10-14</td>
<td>24</td>
<td>21</td>
<td>87.5</td>
</tr>
<tr>
<td></td>
<td>&gt;14</td>
<td>12</td>
<td>11</td>
<td>91.7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>80</td>
<td>81.6</td>
</tr>
<tr>
<td></td>
<td>0-6</td>
<td>9</td>
<td>7</td>
<td>77.8</td>
</tr>
</tbody>
</table>
Several noteworthy observations can be made from the Table 8. First, there is a strong correlation between the obstetricians’ working seniority and the concreteness impact. The longer the working seniority, the more willingness the obstetricians are to accept the use of DSS. Second, a similar correlation between the working seniority of PN guidance and the concreteness impact is found. Finally, the relationship between the work time measured in months of PN guidance with DSS and the concreteness impact on obstetricians is that with the increase of the work time equipped with the DSS for PN guidance, the acceptance of the concreteness impact increases.

![Graph](image)

**Figure 29: Working time of PN guidance by DSS of PN and concreteness theme.**

As shown in Fig. 29, file1 represents the working seniority, the working seniority in PN guidance, and the work time in PN guidance by DSS. File2 stands for the acceptance of the participants about the concreteness of DSS in PN.

According to the definitions of concreteness theme, the knowledge system of DSS in PN is included in concreteness theme. Because the details offered in the reports are constructed from technology and medical theories. DSS of PN has provided a basic interface for the obstetricians where they can receive the information in all sections. From the observations, it can be seen that there system configurations, basic information, disease types, nutrition investigation and free definition sections. The available shown databases include knowledge database, food materials database, exchanging calculation database, and nutrition base database. The specific designers have offered the detailed considerations and assistance in the
obstetricians’ work which have been mentioned by several obstetricians. This kind of design provides intensive assistance and resources for the young obstetricians mentioned by an intern obstetrician.

The concreteness and details of social activities are the concreteness theme because details about the report make it easy for the patients to understand and then to follow and also easy for the obstetricians to confirm in the deeper diagnostics. The details offered in the DSS accelerate the communications with the patients. DSS of PN explains the situations and offers a basic background for the patients which shares and accelerates the work of the obstetricians. If an obstetrician forgets mentioning something, the patient is also possible to be reminded by DSS again. The co-operations between the obstetricians and the DSS can double ensured the service for the patients. The communications between the obstetricians and the patients are social activities. DSS accelerates the process.

To respect each pregnant woman and take each of them as an individual such as personal habits, diet preferences and acceptability etc, are the Concreteness Theme. In a report, it is possible not to be so concrete since it is not aimed at the patients and the design of format is free. Offering details must be considered by the designers to offer convenience for the patients or even for the obstetricians. The obstetricians need respect each pregnant woman and take each of them as an individual.

**Individuality theme**

The individuality impact means that the DSS of PN provides the results for a specific person rather than a group of people so that detailed situation of the patient can be analyzed. Thereby the obstetricians are able to offer more accurate PN guidance to the patients. The individuality impact as a positive one is analyzed. Because creating nutrition guidance for every pregnant woman herself makes it possible to identify specific health conditions of a patient. It might be possible that a patient has several special situations, for example, allergies. Under this circumstance, her health can be ensured by DSS of PN with individual care.

It has obtained from the interview with an attending obstetrician as follow. The attending obstetrician expressed that the identification and analysis process of the DSS, which is DSS of GN, for all kinds of index is most popular. She said, ‘when I am sitting in front of the computer, I feel this DSS is so careful, thoughtful and concrete while facing the interface, after inputting the name, age, height, body weight and pregnant weeks of pregnant women, the basic image of the pregnant women has formed in my mind. And then I shall input all necessary laboratory tests of the pregnant women. Afterwards, DSS can help to analyze, think and reason. I input information, make information analysis, draw the conclusion constantly. The analysis process is rigorous, specific and feasible. Each pregnant woman is different from each other’. We can see the relationship between analytical aspect and pertinence from the interview with the attending obstetrician that with analysis and identification of DSS of PN ongoing, the obstetricians can be guided to think and distinguish the during pregnancy illness and nutrition of pregnant women constantly, the accomplishment of the analysis process is based on the pertinence of DSS of PN.
5.4.5. Theme of Effectiveness

The effectiveness theme means that results provided by the DSS are helpful and effective in clinic care. The use of DSS has improved the patients’ health measures. The obstetricians found that they usually have consistent opinions and the output from DSS has created valuable results in reality. After the experimental period, both obstetricians and patients have built up trust in the DSS. See Table 9 for the results.

Table 9: Results of the questionnaires for the obstetricians about the effectiveness theme

<table>
<thead>
<tr>
<th>Measure</th>
<th>Item</th>
<th>N</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>working seniority (Year)</strong></td>
<td>0-5</td>
<td>20</td>
<td>14</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
<td>41</td>
<td>30</td>
<td>73.2</td>
</tr>
<tr>
<td></td>
<td>11-15</td>
<td>25</td>
<td>18</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>&gt;15</td>
<td>12</td>
<td>10</td>
<td>83.3</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>72</td>
<td>73.5</td>
</tr>
<tr>
<td><strong>working seniority of PN guidance (Year)</strong></td>
<td>0-4</td>
<td>25</td>
<td>18</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>5-9</td>
<td>37</td>
<td>28</td>
<td>75.7</td>
</tr>
<tr>
<td></td>
<td>10-14</td>
<td>24</td>
<td>18</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>&gt;14</td>
<td>12</td>
<td>11</td>
<td>91.7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>75</td>
<td>76.5</td>
</tr>
<tr>
<td><strong>working time of PN guidance by DSS of PN (Month)</strong></td>
<td>0-6</td>
<td>9</td>
<td>7</td>
<td>77.8</td>
</tr>
<tr>
<td></td>
<td>7-12</td>
<td>24</td>
<td>18</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>13-18</td>
<td>32</td>
<td>26</td>
<td>81.2</td>
</tr>
<tr>
<td></td>
<td>19-24</td>
<td>18</td>
<td>15</td>
<td>83.3</td>
</tr>
<tr>
<td></td>
<td>&gt;24</td>
<td>15</td>
<td>13</td>
<td>86.7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>79</td>
<td>80.6</td>
</tr>
</tbody>
</table>

Some noteworthy observations can be made from the Table 9. First, there is a strong correlation between the obstetricians’ working seniority and the effectiveness impact. The longer the working seniority, the more willingness the obstetricians are to accept the use of DSS. Second, a similar correlation between the working seniority of PN guidance and the effectiveness impact is found. Finally, the relationship between the work time measured in months of PN guidance with DSS and the effectiveness impact on obstetricians is that with
the increase of the work time equipped with the DSS for PN guidance, the acceptance of the effectiveness impact increases.

![Graph showing working time of PN guidance by DSS of PN and effectiveness theme.](image)

**Figure 30: Working time of PN guidance by DSS of PN and effectiveness theme.**

As shown in Fig. 30, file.1 represents the working seniority, the working seniority in PN guidance, and the work time in PN guidance by DSS. File.2 stands for the acceptance of the participants about the effectiveness of DSS in PN.

According to the definitions of effectiveness theme, the solutions with improved and proper nutrition suggestions for the patients can be considered as the effectiveness theme. Because the DSS of PN has accommodated the nutrition ingestion either for those with disease or for other pre-mothers expecting to be healthier, the provided guidance works effectively on the adjusting of the food dietary every day. The adding and deleting of a kind of food or the increase and reduction of a specific kind of food is all related with PN guidance, the patients are surely to cook and eat following the obstetrician’ advices and the food themselves are physical articles containing energy.

Here the meal survey, the improved meal suggestions, and the suggested meal solutions are related. The meal survey is the current situation and analysis of the patient, what she is eating for every meal. Here the dishes which the patients have eaten have been analyzed into the original raw materials with cooking methods if necessary. Food menu in this report showed Table 10.

**Table 10: Food menu related for effectiveness theme.**

<table>
<thead>
<tr>
<th>Time</th>
<th>Food</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
<td>Baked and fried Chinese bread</td>
<td>100gram</td>
</tr>
<tr>
<td></td>
<td>Soft long bread</td>
<td>50 gram</td>
</tr>
<tr>
<td></td>
<td>Egg</td>
<td>50 gram</td>
</tr>
<tr>
<td></td>
<td>Millet congee</td>
<td>100 gram</td>
</tr>
<tr>
<td>Meal</td>
<td>Food Items</td>
<td>Weight</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
</tbody>
</table>
| **Morning tea** | buckwheat bread  
steamed Cao lake fish  
rice  
fruit | 50 gram  
150 gram  
100 gram  
150 gram |
| **Lunch**    | Pine nut kernel  
Fried corn  
Fried tomatoes  
Fried egg  
Steamed tofu  
Vegetable soup | 50 gram  
100 gram  
30 gram  
50 gram  
50 gram  
100 gram |
| **Afternoon tea** | Apple  
Milk | 100 gram  
200 gram |
| **Dinner**  | Rice  
Steamed Chinese dark green cabbage with vegetable oil  
steamed pork liver with vegetable oil  
tomato and egg drop soup | 100gram  
150gram  
100 gram  
100 gram |
| **Night snack** | Wheat bread  
steamed Chinese dark green cabbage with vegetable oil  
similarly cooked pork with sweet oranges  
milk | 30 gram  
25gram  
25 gram  
100 gram  
25gram |

The improved meal suggestions are lists of food materials with food weight. Here the mentioned bread, fish, rice, tomatoes, egg, apple, cabbage, pork, oranges and oil are physical articles with energy. They can be touched and eaten. The resident obstetrician told the researcher that this report is mainly the guidance for the next week’s meals of the patient. Usually a patient will cook following the guidance so that her nutrition will be controlled properly.

The improved calculation and metering by DSS of PN which has changed the work of the obstetricians is included in the effectiveness theme. The academic pacesetter obstetrician was explaining, ‘Now with the DSS of PN, after typing in basic biographical data of a pregnant woman, a nutrition plan can be produced in half a minute, which is so amazing. You know that, if I do it by hand although the calculations will not take up all the 2 weeks, at least I need
several days.’ Here half a minute the obstetrician mentioned is the work duration of the DSS after collecting all essential data rather than the whole medical treatment duration. The calculation of nutrition ingredients and food weights can be finished by the obstetrician in several days or by the DSS of PN in 30 seconds. It has also been investigated that the whole process of PN guidance also includes other procedures and for each pregnant woman it usually takes 15 minutes to one hour respectively depending on the health status of the pregnant woman, which has also been described in the chapter of empirical studies. These have been provided by the chief resident obstetrician and verified with the researcher’s observations. This can also be the example of the convenience theme.

The academic pacesetter obstetrician offered the information that the high frequency in the manual times is also rooted in the possible biases and mistakes in calculations. Facing such a tough and complicated work, human being has the tendency to make mistakes and there must be biases in logical decisions. Considering the medical knowledge, clinical conventions, her judgment and the pregnant woman’s health condition, she finally carried out the PN guidance per week. She commented that if a person can ensure the correctness of every calculation step and every logical decision, the PN guidance did not need to be carried out so frequently. This can also be a positive impact of DSS of PN onto the obstetricians that since the DSS has fulfilled the calculations automatically and electronically and established the logical decision algorithms, the correctness and effect results have been ensured and improved a lot than before. She also added that the DSS of PN has also increased the flexibility of the PN guidance. Once the situation or any index has been changed, the diet suggestions can be redone. But without the DSS of PN, in some cases the nutrition suggestions would not be run again because of the impossibilities. It was not related with the faith or responsibilities of the obstetricians, the rules or conventions also have to admit it just because of the impossibilities. And there is no correct or best PN guidance, while only a more suitable or even most suitable ones.

After the nutritional guidance has been decided, the obstetricians need to articulate them to the patients. Furthermore, to understand the Case History and situations of the patients, the obstetricians also need to talk with the pregnant women. The useful results derived from the DSS have offered supports to the obstetricians. PN guidance is a human communication process, it is necessary to put forward that the communication between obstetricians and pregnant women is particular, requiring a good communication ability and communication skill, among which language is very important. It even asks the doctor to not only master a door language, but one or several foreign languages. These are the conditions of effectiveness theme of DSS of PN on obstetricians, which are closely related with the language.

**Focusing on the negative impacts**

The 3 negative themes are those of verbosity, rigidity and expensiveness. In the following three sub-sections of the analyses about the three themes, the specific detailed facts collected from the empirical study have been stated to support the analysis.
5.4.6. Theme of Verbosity

The verbosity theme is mostly related to some steps or procedures in the DSS which are otherwise not needed for the patients. Some obstetricians suggest the omission of some portions of reports by the DSS. They are also the main impacts and synthesis of opinions that have not been mentioned by many participants. This impact has been divided into positive and negative ones. To simplify the analysis, it is easier to only consider the contrast of positive and negative attitudes while the scattering of each can be neglected. See Table 11 for the results.

Table 11: Results of the questionnaires for the obstetricians about the verbosity theme

<table>
<thead>
<tr>
<th>Measure</th>
<th>Item</th>
<th>N</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>working seniority</td>
<td>0-5</td>
<td>20</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
<td>41</td>
<td>8</td>
<td>19.5</td>
</tr>
<tr>
<td></td>
<td>11-15</td>
<td>25</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>&gt;15</td>
<td>12</td>
<td>1</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>24</td>
<td>24.5</td>
</tr>
<tr>
<td>working seniority of PN guidance</td>
<td>0-4</td>
<td>25</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>(Year)</td>
<td>5-9</td>
<td>32</td>
<td>5</td>
<td>15.6</td>
</tr>
<tr>
<td></td>
<td>10-14</td>
<td>24</td>
<td>9</td>
<td>37.5</td>
</tr>
<tr>
<td></td>
<td>&gt;14</td>
<td>12</td>
<td>1</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>21</td>
<td>21.4</td>
</tr>
<tr>
<td>working time of PN guidance by</td>
<td>0-6</td>
<td>9</td>
<td>4</td>
<td>44.4</td>
</tr>
<tr>
<td>DSS of PN (Month)</td>
<td>7-12</td>
<td>24</td>
<td>8</td>
<td>33.3</td>
</tr>
<tr>
<td></td>
<td>13-18</td>
<td>32</td>
<td>10</td>
<td>31.2</td>
</tr>
<tr>
<td></td>
<td>19-24</td>
<td>18</td>
<td>7</td>
<td>38.9</td>
</tr>
<tr>
<td></td>
<td>&gt;24</td>
<td>15</td>
<td>4</td>
<td>26.7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>33</td>
<td>33.7</td>
</tr>
<tr>
<td>Mean</td>
<td>Total</td>
<td>98</td>
<td>26</td>
<td>26.5</td>
</tr>
</tbody>
</table>

Several noteworthy observations can be made from the Table 11. Regarding the relationship between the obstetricians’ working seniority and the verbosity impact, it is found that with the increase of the working seniority, the participating obstetricians may not totally agree with the verbosity impact of the DSS. And some participants reserve their negative attitude towards
the use of DSS for PN guidance in terms of the verbosity. With the increase of the working seniority in PN guidance, the participants may consider the verbosity impact as a negative factor. For the relationship between the work time measured in months of PN guidance with DSS and the verbosity impact, it is found that again with the increase of the work time in PN guidance, some obstetricians have a negative attitude towards the verbosity.

Figure 31: Working time of PN guidance by DSS of PN and verbosity theme.

As shown in Fig. 31, file.1 represents the working seniority, the working seniority in PN guidance, and the work time in PN guidance by DSS, while file.2 is in regards of evaluation of participants about whether the DSS in PN is of verbosity.

According to the definitions of verbosity theme, the issue about those steps unable to be jumped and the expected reduced time is included in verbosity theme. The step-by-step working procedures guided by the DSS of PN might take a little more time in processing than enough. It has been mentioned by a Resident obstetrician that for some steps in the DSS of PN she believes they can be omitted but the DSS of PN does not offer the portal and possibility. She stated that although the DSS of PN is already much faster than manual completion she thinks if some steps can be controlled by her as a system user the reduced time for a unit diagnosis can be more. She said, ‘I think the results could have been derived even faster than current if some steps could be skipped.’ The obstetrician has directly mentioned that because she cannot control the steps, and sometimes more time is needed. It might be a thinking habit or routine that if something has been fast, the result might not be good. Thereby after her opinion, the resident obstetrician added that if her opinion can be understood and followed, the medical result will not be affected from a negative direction. And how a person knows more time has been spent is calculated by the numbers which is an amount of time.

The determined framework and issue of the unchangeable serial steps is included in the verbosity theme. The verbosity is rooted in the structured design or a certain framework. It seems that the system designers have not prepared portal in the structure to realize jumping the steps as the obstetrician describes and the design methods they have chosen do not support. Current structure seems uneasy to meet her demands in a short iterative design circles. She has described her demands like this, ‘I think some steps are totally unnecessary. But there is
no portal to jump a step so I have to follow the procedures step by step. These steps increase my impatience. Moreover, she has also expressed her opinion to the systems designers who are working in the provider corporation. The response is that the demands might be fulfilled in a better version but it is impossible for the current one for technological reasons.

This is a common problem about the communication between feasibility analysis and implementation periods. There seems to be always a gap what the customers want and what the designers are able to do or what they have caught the customers’ demands. Except unawareness of the demands, there might be difficulties in the system logic to jump step or in the interface design to add another portal. For the problem and gap, there are always discussions and solutions.

However the opinion advocated by the resident obstetrician has not been supported by others. To discover the reason, the basic information of the obstetrician has been focused shown in Appendix A. It has been found that the unlike from her or the difficulty she has met might result from her personality with the tendency of doing everything as fast as possible. It has been supposed in the analysis that DSS of PN should be improved with the flexibility to some extent in some way. Here it has been recognized that the seemingly verbose steps might still be in the tolerant scope. It is the residence obstetrician’s preference to expect faster than the others’ expectations. Furthermore, it has been known that the resident obstetrician is quite young who has been born with high technology products with quite high speed. However, the medical DSS seems to have to take significantly crucial responsibility in medical treatment so that it might not be able to react as fast as everyday electronic facilities which are not taking such high responsibility. Maybe she has already got used to the fast speed in a way that she has expected too much. Finally, the detailed exploration helped to discover that the Resident obstetrician seems to have been trapped by one step and she might feel far difficult after solving the inconvenience or she might have not been able to understand the latter steps completely. Nonetheless unless an obstetrician’s opinion can be totally ignored, even her demands have been temporarily set at a low priority, the problem still exists. Therefore the studies about the problem are still necessary and meaningful.

5.4.7. Theme of Rigidity

The rigidity theme refers to the flexibility provided by the DSS with which the obstetricians can modify menu or diagnostic index format. Although the current system has a certain degree of flexibility, more are needed as voiced by some obstetricians. As quoted from a participant, “the offered possibility to modify medical processes (in DSS) seems to be derived from the designer’s understanding while the designers may not have worked within the obstetrics environment before.” In another example, when using the DSS to conduct the PN guidance, the participant and the pregnant women both hoped to move on to the next interface in order to reach the nutrition menu and to generate the nutrition assessment report in a timely manner. But they were disappointed. A resident obstetrician reported in an email investigation that “if the screen of DSS remains unchanged, we won’t like is any longer.” It is apparent that additional flexibility and adaptability are needed not only for system interfaces but also for better coordination with obstetricians. See Table 12 for the results.
Table 12: Results of the questionnaires for the obstetricians about the rigidity theme

<table>
<thead>
<tr>
<th>Measure</th>
<th>Item</th>
<th>N</th>
<th>Frequency</th>
<th>Percentage ( % )</th>
</tr>
</thead>
<tbody>
<tr>
<td>working seniority (Year)</td>
<td>0-5</td>
<td>20</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
<td>41</td>
<td>8</td>
<td>19.5</td>
</tr>
<tr>
<td></td>
<td>11-15</td>
<td>25</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>&gt;15</td>
<td>12</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>28</td>
<td>28.6</td>
</tr>
<tr>
<td>working seniority of PN guidance (Year)</td>
<td>0-4</td>
<td>25</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>5-9</td>
<td>37</td>
<td>9</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>10-14</td>
<td>24</td>
<td>9</td>
<td>37.5</td>
</tr>
<tr>
<td></td>
<td>&gt;14</td>
<td>12</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>29</td>
<td>29.6</td>
</tr>
<tr>
<td>working time of PN guidance by DSS of PN (Month)</td>
<td>0-6</td>
<td>9</td>
<td>5</td>
<td>55.5</td>
</tr>
<tr>
<td></td>
<td>7-12</td>
<td>24</td>
<td>6</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>13-18</td>
<td>32</td>
<td>8</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>19-24</td>
<td>18</td>
<td>6</td>
<td>33.3</td>
</tr>
<tr>
<td></td>
<td>&gt;24</td>
<td>15</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
<td>28</td>
<td>28.6</td>
</tr>
<tr>
<td>Mean</td>
<td>Total</td>
<td>98</td>
<td>28</td>
<td>28.6</td>
</tr>
</tbody>
</table>

With the increase of working seniority in obstetrics, the participating obstetricians may not agree totally with the rigidity impact of the DSS. Some participants even have negative attitude towards the DSS on its rigidity. With the increase of working seniority in PN guidance, the participants may have a negative view on the rigidity impact. With the increase of the work time measured in months of PN guidance by the DSS, the participants again may consider the rigidity impact as negative.
Figure 32: Working time of PN guidance by DSS of PN and rigidity theme.

As shown in Fig. 32, file.1 represents the working seniority, the working seniority in PN guidance, and the work time in PN guidance by DSS, while file.2 is in regards of evaluation of participants about whether the DSS in PN is rigid.

According to the definitions of the rigidity theme, the requirement of an obstetrician for the flexibility and freedom in format can be considered as the rigidity. Once an obstetrician feels being restricted or limited, he or she might feel depressed. A resident obstetrician has shared her experience that sometimes she thought an index configuration is not being done correctly. The examining index should have more or less attributes rather than what the DSS was requiring. She felt quite frustrated that the DSS was not in a correct track of medical care to some extent but she was unable to change it. The structure model of a decision support is the result of system implementation while the implementation process itself is associated with the formation because of determined structure of the DSS in PN. Although the theory and model structure of DSS have been developed to the level of artificial intelligence and simulated expert thinking process, the DSS is after all the technology without human intelligence as a physical human obstetrician. The system has been designed with the common need for most circumstances to fulfill the customer requirements. However, it cannot always be suitable. A flexible possible is desired by obstetricians to some extent.

5.4.8. Theme of Expensiveness

The expensiveness theme refers to the cost of the recommended food and nutrients in the database of the DSS. Some items are not affordable to a large portion of the participating pregnant women. Therefore the PN guidance reported by the DSS may have reduced effectiveness. See Table 13 for the results.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Item</th>
<th>N</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>20</td>
<td>11</td>
<td></td>
<td>55</td>
</tr>
</tbody>
</table>
With the increase of the working seniority in obstetrics, the participating obstetricians may not totally agree with the expensiveness impact of the DSS. Some participants have a negative view on the DSS. With the increase of the working seniority in PN guidance or with the increase of the work time measured in months of PN guidance by the use of the DSS, a similar trend has been found, i.e., many participants may consider the expensiveness impact as negative.

Figure 33: Working time of PN guidance by DSS of PN and expensiveness theme.
As shown in Fig. 33, file 1 represents the working seniority, the working seniority in PN guidance, and the work time in PN guidance by DSS, while the named file 2 is in regards of evaluation of participants about whether the DSS in PN is expensive.

According to the definitions of expensiveness theme, the purchasing and relatively expensive food is included in the expensiveness theme. Purchasing and cooking are the social activities. Different accepted ability relies on different wealth conditions. A resident obstetrician has pointed out that the food materials contained in the database as the possible options provided in the final reports for the patients might be a little expensive. In her opinion, different people have different ideas about being expensive or cheap. She thought that the obstetricians who were using the DSS or the people working in the computer corporations must have their relatively high salary. She believed that not all people can afford the food materials. This is a unique idea that pregnant women seldom mention. It might be the tradition that pregnant women does not need to consider the price of the food since her family members will handle all issues. However, this opinion might also show that the financial factor might have to be considered to some extent. People having different income and holding different opinions about how to treat the pregnant women hold different opinions. It might be rooted in the personal values.

The good use of money is included in the expensiveness theme. The expensiveness is connected with how to spend money correctly which is the good planning. To decide or think a purchasing is affordable or non-affordable, worthy or non-worthy is related with the expensiveness especially when the purchasing costs not a small amount of financial deficit. It is the economical person who is able to purchase worthy goods with relatively less money. The high price is included in the expensiveness theme. If something is too much expensive, it is not equal for those who are able to handle to some extent. It might be a thinking route that if something is too much expensive, the rights of purchasing by those without the ability have been reduced. In another way to attract more consumers, it is also the sellers’ benefits to decide a lower price. However, this is not related in this issue because the DSS is not cooperating with the sellers. To serve all the people, the DSS designers have the responsibility to the offer food materials which are everyday food.
Chapter 6 Conclusions and Future Suggestions

The DSS has emerged in the process and context of rapid computer technology and knowledge engineering. The stimulated reason is the desire of expertise and knowledge from the professional experts in a knowledge-intensive area. To discover the reasons, the social activities need to be considered. They are carrying on every day with its unique regulations. However, in the practical application processes, the regulations or laws sometimes have been hidden by complicated symptoms and appearance. This is the originally expected value of DSS. And it has also been supported by the research of the thesis. Since the revealing and allegations of the regulations highly depend on the experience, knowledge and personnel qualities of experts in the focused fields, the decision-making system attempts to provide a route or road to largely apply the experts’ knowledge and experience, to simulate the experts’ thinking routes and to infer or judge, aiming at discovering and studying basic regulations of social activities in all areas, and resolving problems in a professional area.

Pregnancy Nutrition (PN) is an interesting issue worldwide because of its relevance with the health of the pregnant mothers and the healthy growth of the babies (Li, et al., 2004, p.11). Offering the PN guidance is a complex and repetitive task. Therefore the PN guidance is obstructed. However, the situations have been changed when the DSS in PN was applied to the clinical work in the obstetrics department of hospitals in China. The impacts on the obstetricians should be studied. The initially found impact model with 4 themes has been expanded to 8 themes.

First, the thesis has put forward the question on what are the impacts generated by the DSS of PN onto obstetricians? And finally the answers have been delivered as the positive impacts, which contain the convenience, acceptability, universality together with the extended completeness, concreteness together with the extended individuality, and the effectiveness impacts. The negative impacts include the verbosity, rigidity and the expensiveness impacts.

Second, how do the DSSs of PN generate these impacts onto the obstetricians during the process of PN guidance? The answer in the thesis has been shown as that the work is mainly related to the working seniority of the obstetricians, the working seniority in PN guidance, and the work time of the obstetricians in PN guidance with the assistance of the DSS. In addition, it is related to the experienced period, the character, the habits, the extent of computer literacy, and the interest of the obstetricians in nutrition.

Finally, what is the relationship between the impacts of DSS in PN onto the obstetricians and the academic information science field? The answer in the thesis is that the DSSs are the advanced scientific systems in the IS management field. Additionally, the Clinical DSS is the most advanced branch in the development. The works of IS includes the development, utilization and operation management, and the effects on systems users, i.e., the obstetricians. With the development of the computer technology, it shifts focus from development technology in the beginning to the use of the technology and the application effects. Because a lot of expert economists have put forward that the funds for information system are multi-
billion dollars annually, but its yield is only 10% (Basden. 2001, pp.1-21). The cause may be
that the communications between the users and developers are disjointed, especially when the
influence on users is on the important work of IS at present. Besides, the impact of DSS onto
the obstetricians in PN guidance also includes the improvements on the systematization,
extensiveness, acceptability, reproducibility, and the clinical results. Finally, the further
improvement of the DSS is a key point, such as the increased voice prompt, graphic interface
and the final reports which are the contributions of the thesis. The thesis has answered that the
series of development, utilization, operation management and the impacts onto the
obstetricians belong to the task of IS.

Some extensions of this work are discussed below. First, the thesis is the master degree thesis
of the author in the Two Year Master Program of Information Systems (120 Higher Education
Credits) in Linnaeus University, Växjö, Sweden. The thesis has been guided by the
Informatics Department in the School of Computer Science, Physics and Mathematics. The
structure of the thesis follows the instruction of paper in the department. Some ideas of the
essential concepts and components about the quantitative versus qualitative method,
quantitative hypothesis, and literature view for every thesis have been accepted and assumed
because the thesis has already followed the guideline. The further study from here is to do
more in-depth investigation where it can be extended to the fetus palace diagnosis, pregnancy
diagnosis and so on, upgrading DSS of PN based on the obstetricians’ needs, servicing for
clinical work, obstetricians and pregnant women.

Second, the impact study in this thesis provides a foundation for future studies using
Dooyeweerd’s aspect theory for aspect-oriented software development. Dooyeweerd
characterizes things and matters via quantitative, spatial, kinematic, physical, analytical,
formative, lingual, social, economic, aesthetic and other aspects. The state-of-the-art software
development is aspect oriented (Missikoff, 2002, p.51), which is able to improve the focus-
separating method, to reduce the code entanglements and scattering, so as to finally improve
the software quality and performance. The applications of the Dooyeweerd’s theory for DSS
development are emerging (Hong and Mao 2007, pp.94-120), but a careful study is lack on
how these aspects are reflected and how the aspect theory is connected to the information
system research area. The scope of this thesis is limited to what are the impacts of DSS of PN
on obstetrician’s practice and how these impacts are generated, primarily via the data
collection, impact analysis, etc. While the impact study was aided by the Dooyeweerd’s
theory, no specific studies have been done on the systematic and extensive analysis of the
influence of the design of DSS on these aspects and impacts. Results from this thesis will help
to investigate the development and modification of DSS using Dooyeweerd’s theory, and thus
to optimize the identified impacts that have been studied in this thesis.
### Appendix
The appendix here provides original documents and materials to assist and supplement the main thesis.

### A 1 Basic questionnaires for the interviewed obstetricians in the Obstetrics Department

<table>
<thead>
<tr>
<th>number</th>
<th>question 问题</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>What do you think about the nutrition suggestions from this software? Any noticeable discrepancies? (在你看来，这个软件给出的营养建议是不是比较正确的，有没有明显的误差)?</td>
</tr>
<tr>
<td>2</td>
<td>Does the software help you in offering prescriptions and advices to the pregnant mothers? (所以，这个软件有助于你的治疗，或者给孕妇提供建议么)?</td>
</tr>
<tr>
<td>3</td>
<td>Are you able to handle the new decision support system? Does this software require you to provide technical information in nutrition science that is out of your expertise? (这个软件有没有要求提供一些你不懂的过度偏向营养学的信息)?</td>
</tr>
<tr>
<td>4</td>
<td>Number 4 out of 7, 4-7) Do you find it helpful and why? ([7 项当中的第 4 项] 你觉得这个软件有用吗，怎么个有用法)?</td>
</tr>
<tr>
<td>5</td>
<td>Do you find it understandable? (你觉得这个软件容易理解吗，会不会给你的理解和分析造成障碍)?</td>
</tr>
<tr>
<td>6</td>
<td>Do you have any expectation about it and has it been realized? (你对其是否曾经有过什么预期，如果有的话，那些功能都实现了吗)?</td>
</tr>
<tr>
<td>7</td>
<td>(Last) Ignoring all of my questions which might be subjective, how do you think about the DSS and any comments? Do you like any other characteristics or do you think anything can be changed which have not been mentioned before? (最后一个]忽略和忘记我之前所有的问题 [因为有可能他们带有倾向性]，你对于这个 DSS 有什么看法评论之类的吗？或者有之前没有涉及到的特点是你喜欢的，或者是可以改进的)?</td>
</tr>
</tbody>
</table>

remark
A 2 The Basic information of the survey questionnaires
A general sample for an attending obstetrician

1. Name:
   My name is Ming Zhang.
2. Sex:
   Male.
3. Do you mind telling your age?
   37.
4. How long have you been working in the hospital?
   13 years.
5. Are you a doctor or a nurse?
   Doctor.
6. Are you an intern?
   No.
7. Are you obstetrician?
   Yes.
8. Professional post:
   Attending physician.
9. Education and degrees:
   Graduate, Dr.
10. How long have you been working in maternal nutrition guidance?
    5 years.
11. How many women have you treated in maternal nutrition guidance?
    More than 800 pregnant women.
12. How many babies are delivered in your department every year?
    More than 4,000 babies.
13. Your Hometown:
Rongxian, Sichuan province.

14. Is personal nutrition interested with you?
Yes.

15. Do you think maternal nutrition guidance is meaningful?
Yes.

16. Do you like application of computer?
Yes.

17. How long do you work at the computer every day?
6 hours.

18. How long have your used the maternal nutritional decision support system?
1 year.

A general sample for a resident obstetrician
1. Name:
My name is Xiaolin Li.

2. Sex:
Female.

3. Do you mind telling your age?
28.

4. How long have you been working in the hospital?
5 years.

5. Are you a doctor or a nurse?
Doctor.

6. Are you an intern?
No.

7. Are you obstetrician?
Yes.

8. Professional post:
Resident.

9. Education and degrees:
Graduate, Master.

10. How long have you been working in maternal nutrition guidance?
2 years.

11. How many women have you treated in maternal nutrition guidance?
More than 200 pregnant women.

12. How many babies are delivered in your department every year?
More than 4,000 babies.

13. Your Hometown:
Nanchang, Jiangxi province.

14. Is personal nutrition interested with you?
Yes.

15. Do you think maternal nutrition guidance is meaningful?
Yes.

16. Do you like application of computer?
Yes.

17. How long do you work at the computer every day?
8 hours.

18. How long have your used the maternal nutritional decision support system?
1 year.

A general sample for a chief obstetrician
1. Name:
My name is Hong Li.

2. Sex:
Female.

3. Do you mind telling your age?
48.
4. How long have you been working in the hospital?
23 years.

5. Are you a doctor or a nurse?
Doctor.

6. Are you intern?
No.

7. Are you obstetrician?
Yes.

8. Professional post:
Chief Doctor.

9. Education and degrees:
College, Bachelor.

10. How long have you been working in maternal nutrition guidance?
10 years.

11. How many women have you treated in maternal nutrition guidance?
More than 2500 pregnant women.

12. How many babies are delivered in your department every year?
More than 4,000 babies.

13. Your Hometown:
Tianjin.

14. Is personal nutrition interested with you?
Yes.

15. Do you think maternal nutrition guidance is meaningful?
Yes.

16. Do you like application of computer?
Yes.

17. How long do you work at the computer every day?
4 hours.
18. How long have you used the maternal nutritional decision support system?

1 year.

**A 3 Consent Form**

Hello! It’s my great honor to receive your support in participation towards my research thesis! Before launching the research, maybe you would like an introduction about me. My name is Chen-fan Xu. I am studying in a master program of Information Systems in Linnaeus University, Växjö, Sweden. I am writing my master thesis in this semester. It is about the impact of Information Systems (IS) on Medicine. The software about pregnancy nutrition you are using in experimental period carried out in your department can be understood as a representative of IS. I am hoping to collect the data here in your working department about that software. 你好! 非常感谢你对于我研究学习的帮助和支持! 在开始之前, 估计你希望更多的了解我. 我叫胥晨帆, 正在林奈大学的信息系统专业学习, 一所坐落于名叫韦克舍这个地方的瑞典大学. 我正在写我的硕士论文, 大体上是关于信息系统对于临床诊断的影响. 而目前在你的科室试运行的有关孕期营养的系统\软件, 就是我所研究的信息系统的一个体现\实例. 而我准备在这里你所在的这个科室收集一点经验研究资料.

About the research, I’m planning to collect the data here mainly on your opinions about the experimental system. I will conduct it by emails or printed questionnaire for you. I will offer open questions to articulate my research focus. I will ensure that you can not only understand my research, but also be offered adequate room to express your opinions. And if you would like to talk with me, I can handle an online group video meeting or face-to-face discussions. 我准备做的事情主要是在这里收集你对于我关注的这种信息系统的想法, 就是你正在使用或者试用的围产营养软件. 我决定采用的形式就是问题形式. 这些问题将会通过电子邮件发送给你, 如果有不方便的话, 也是可以直接提供纸质版本的. 我会提供一些开放式的问题来清我关心的问题, 然后你可以自由发表你的看法. 我会保证你不仅可以既理解我的问题, 更是可以有足够的空间来表达自己的想法. 如果你觉得还是聊一聊比较好, 那么这也是可能的. 我们可以在线视频联系, 或者直接面谈.

The data collected here will be used only for academic purpose, actually just in this master thesis. Without your agreement, your detailed information will not appear in my thesis. I will try all means to protect any information collected here, especially the participants’ personal information and that of the software itself. You are completely welcome to read about my final thesis. Meanwhile, it is important to know that your participation in my research is voluntary, that is to say, you can choose participate or not as you wish. And what I would like to express is my completely emotional appreciations for your assistance and support towards a young scientist! Thank you very much! Best Regards, Research student: Chen-fan Xu

Consent Form 同意书（简单说明）:
Hello! It's my great honor and happiness to receive your support in participation towards my research! Before launching the research, maybe you would like an introduction about me. My name is Chen-fan Xu. I am studying in a master program of Information Systems in Linnæus University, Växjö, Sweden. I am writing my master thesis during this semester. It is about the impact of Information Systems (IS) on Medicine. The software about pregnancy nutrition you are using in experimental period carried out in your department can be understood as a representative of IS. I am hoping to collect the empirical data here in your working department about that software. 你好! 非常感谢你对于我研究学习的帮助和支持！

在开始之前，估计你希望更多的了解我。我叫肖晨帆，正在林奈大学的信息系统专业学习，一所坐落于名叫韦克舍这个地方的瑞典大学，我正在写我的硕士论文，大体上是关于信息系统对于临床诊断的影响。而目前在你的科室运行的有关孕期营养的系统软件，就是我研究的信息系统的一个体现实例。而我准备在这里为你所在的这个科室收集一点经验研究资料。

About the research, I’m planning to collect the data here, mainly your opinions about the experimental system. I will conduct it by emailed or printed questionnaire for you. I will offer open questions to articulate my research focus to receive your ideas. I will ensure that you can not only understand my research, but also be offered adequate space to express your opinions. And if you would like to talk with me, I can handle an online group video meeting or face-to-face discussions. 我准备做的事情主要是在这里收集你对于我关注的这种信息系统的想法，就是你正在使用或者试用的这个营养软件。我将采用的反馈形式就是问题形式。这些问题将会通过电子邮件发送给你。如果有不方便的话，也是可以直接提供纸质版本的。我会提供一些开放性的问题来完成我关心的问题。然后你可以自由发表你的看法。我会保证你不仅能够理解我的问题，更可以有足够的时间来表达你自己的想法。如果你觉得还是聊一聊比较好，那么这也是可能的。我们可以在线视频联系，或者直接面谈。

The data collected here will be used only for academic purpose, actually just in this master thesis. Without your agreement, your detailed information will not appear in my thesis. I will try all means to protect any information collected here, especially the participants’ personal information and that of the software itself. You are completely welcome to read about my final thesis. Meanwhile, it is important to keep that your participation in my research is voluntary, that is to say, you can choose participate or not as you wish. And what I would like to express is my completely emotional appreciations for your assistance and support towards a young scientist! 谢谢你非常多地！我在这里收集到的各种信息都将仅仅用于学术研究，实际上应该仅仅是我的这些论文。未经允许的情况下，我的论文中不会出现具体信息，参与者信息和软件信息安全我都会保护和保密，如果你想知道我怎么样利用这些收集的想法进行分析，我完成论文之后给你一份。同时还有一个很重要的是，你的参与是自愿的。也就是说你可以根据自己的意思选择参加或者不参加。在这里我还要非常感谢你对于我的帮助和支持！非常感谢！

Best Regards, Research student: Chen-fan Xu

敬礼，学生肖晨帆

2011 年 3 月 18 日

Signed consent form
A 4 Basic information of the participating obstetricians

<table>
<thead>
<tr>
<th>Item Participated</th>
<th>Gender (M-Male, Female)</th>
<th>Age</th>
<th>Accurate Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief Obstetrician</td>
<td>Female</td>
<td>56</td>
<td>Obstetrics</td>
</tr>
<tr>
<td>Chief Obstetrician</td>
<td>Female</td>
<td>49</td>
<td>Obstetrics</td>
</tr>
<tr>
<td>Vice Chief Obstetrician</td>
<td>Female</td>
<td>44</td>
<td>Obstetrics</td>
</tr>
<tr>
<td>Vice Chief Obstetrician</td>
<td>Female</td>
<td>41</td>
<td>Obstetrics</td>
</tr>
<tr>
<td>Vice Chief Obstetrician</td>
<td>Female</td>
<td>40</td>
<td>Obstetrics</td>
</tr>
<tr>
<td>Attending Obstetrician</td>
<td>Male</td>
<td>36</td>
<td>Gynecology and Obstetrics</td>
</tr>
<tr>
<td>Attending Obstetrician</td>
<td>Male</td>
<td>32</td>
<td>Gynecology and Obstetrics</td>
</tr>
<tr>
<td>Attending Obstetrician</td>
<td>Female</td>
<td>33</td>
<td>Gynecology and Obstetrics</td>
</tr>
<tr>
<td>Chief Resident Obstetrician</td>
<td>Female</td>
<td>29</td>
<td>Gynecology and Obstetrics</td>
</tr>
<tr>
<td>Resident Obstetrician</td>
<td>Female</td>
<td>29</td>
<td>Gynecology and Obstetrics</td>
</tr>
<tr>
<td>Resident Obstetrician</td>
<td>Female</td>
<td>30</td>
<td>Gynecology and Obstetrics</td>
</tr>
<tr>
<td>Resident Obstetrician</td>
<td>Female</td>
<td>27</td>
<td>Gynecology and Obstetrics</td>
</tr>
<tr>
<td>Resident Obstetrician</td>
<td>Male</td>
<td>28</td>
<td>Gynecology and Obstetrics</td>
</tr>
<tr>
<td>Resident Obstetrician</td>
<td>Male</td>
<td>28</td>
<td>Gynecology and Obstetrics</td>
</tr>
<tr>
<td>Intern Obstetrician</td>
<td>Male</td>
<td>26</td>
<td>Intern</td>
</tr>
<tr>
<td>Intern Obstetricist</td>
<td>Female</td>
<td>26</td>
<td>Intern</td>
</tr>
<tr>
<td>Intern Obstetricist</td>
<td>Female</td>
<td>26</td>
<td>Intern</td>
</tr>
<tr>
<td>Intern Obstetricist</td>
<td>Male</td>
<td>27</td>
<td>Intern</td>
</tr>
</tbody>
</table>

A 5 The Impacts of DSS in PN obstetricians

<table>
<thead>
<tr>
<th>Name</th>
<th>Gender</th>
<th>Age</th>
<th>Title</th>
</tr>
</thead>
</table>

89 / 99
<table>
<thead>
<tr>
<th>Working seniority (Year)</th>
<th>Working seniority of pregnancy guidance (Year)</th>
<th>Working seniority of pregnancy guidance by DSS of GN (Month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Convenience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acceptability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concreteness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effectiveness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigidity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbosity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expensiveness</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**A 6 Specific Medical Terminologies**
About the career and knowledge:

**PN of Prenatal Care Management System (for Pregnant and Puerperal Women):** PN of Prenatal Care Management System (for Pregnant and Puerperal Women) refers to a series of monitoring standards of obstetrics such as pre-pregnancy examination, antenatal
examination, pregnancy guidance, delivery, postpartum rehabilitation, newborn maternity care, etc.

**Clinical Medicine:** Clinical medicine is a generic term in medical science, which does research on the diagnosis, treatment, and prevention of diseases. It studies the etiology, mechanisms and pathological process of diseases from the whole, according to the patient's clinical manifestations.

**Perinatal Period (Perinatology):** Refers to a week, an important time, from pregnancy to postpartum. The aim of perinatal care is to reduce the baby and mother morbidity and mortality.

**Perinatal Care:** Perinatal care refers to a series of health care work made for maternal and infant health care during prenatal, intrapartum and postpartum time.

**Health care=Medical care:** Health care refers to the comprehensive measures taken by medical institutions to protect and promote human health, prevention and treatment of diseases.

**Hospital/Inpatient) ward:** The hospital room of inpatients for treatment.

**Outpatient (service):** A department of the hospital receiving patients of continuous treatment without Hospitalization.

**Nursing station/center:** the nurse work center

**Registration office:** A department of the hospital for outpatients’ appointment with the doctor about time and place.

**Case History:** The text record of the patient’s medical treatment.

**E.N.T. (Ear Nose Throat) Department, Otolaryngological Department:** A department of the hospital for special treatment for ear, nose and throat.

**Diagnostics index, examination results:** Diagnostics index, examination results are reference standard data used by doctors to make clinical judgement, by taking out specimens from the body for chemical, physical, biological and other laboratory test.

**Fetus:** unborn babies, the infants: newly born, and the babies: after born:

**MYCIN:** Antimicrobial therapy is a special tool, which is based on the expert systems obtaining successful applications, by removing the specific knowledge and retaining knowledge representation and reasoning institutions, enhancing the knowledge acquisition subsystem features. MYCIN system, as a diagnostic expert system for blood infections, when you take away the knowledge of blood infections, by enhancing the man-machine conversation function during knowledge acquisition, it has finally formed a development tool, called EMYCIN. These special tools are easy to use and the efficiency of resulting expert system is high. But application scope of such tools is narrow.
PUFF(1977-1979) : PUFF is the first use of the EMYCIN system. By means of putting EMYCIN into lung function, it finally formed expert system for diagnosis of lung function, called PUFF.

CASNET: causal-associational network (CASNET) model for describing disease processes, and its application in an expert-level consultation program in glaucoma (CASNET/Glaucoma), that incorporates the knowledge of a national network of clinical experts in the disease.

DXPLAIN: ( Using decision support to help explain clinical manifestations of disease DXplain ), a decision support system developed at the Laboratory of Computer Science at the Massachusetts General Hospital, has the characteristics of both an electronic medical textbook and a medical reference system. In its reference or case analysis mode, DXplain accepts a set of clinical findings (signs, symptoms, laboratory data) to produce a ranked list of diagnoses which might explain (or be associated with) the clinical manifestations.

RFA: Radio Frequency Ablation (medical)

About the people:

Academic Pacesetter [Administrative Director]:

Academic Pacesetter refers to experts who can lead and guide and organize the relevant persons to carry out the academic categories of academic research, and obtain the research achievements with an extremely high academic level on some academic category in the university. The name of Academic Pacesetter is a kind of respect, not a title or position, and there is no unified standard.

Chief Physician:

Chief Obstetrician is a title of physicians, currently it is the highest level of the titles, belonging to positive-high level, and they assume certain clinical teaching and scientific research task, Chief Obstetrician refers to the professional experts in obstetrics

Attending Physician:

The attending physician is the name of the title of the hospital, one title of physicians, the level of which is higher than resident and lower than vice of vice-chief physician of low level, belonging to the intermediate title.

Chief Resident Physician:

Chief Resident Obstetrician Chief Resident Physician; Chief Resident Obstetrician is one kind of the physician post, not the title; generally its title is resident. This kind of post will be set up, its purpose is to make them assume more work to gain exercise under high strength working pressure before promotion for attending physician in large hospitals.
Resident/House Physician: Resident/House Obstetrician is one title of physicians, under the attending physician, belong to primary title. His main duty is to perform basic medical work, including receiving patients, recording courses of diseases, working out the physicians’s advice under the guidance of the superior physician, doing certain clinical operation and so on.
References


Jenkins, M.L., Hewitt, C., and Bakken, S., 2006. Women’s Health Nursing in the Context of the National
Health Information Infrastructure. JOGNN, 35(1), pp.141-150.
Luitjes, S.H.E., et al., 2010. An innovative strategy including a computerised decision support system compared to a common strategy of professional audit and feedback, a randomized controlled trial. Implementation Science, 68(5), pp.1-7.
Maclean, C.D., 2004. The Vermont Diabetes Information System (VDIS): Study Design and Subject Recruitment for a Cluster Randomized Trial of a Decision Support System in a Regional Sample of


