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# Normal Pregnancy Diagnosis Using Software of Ultrasonography Decision Support System

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Additional information is available at the end of the chapter

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## Abstract

Decision support system will help physicians in analyzing more accurate diagnosis, which can be made faster and easier with this time-saving system, and reduce tardiness in making referrals. Benefits with this system are as follows: (1) services can be provided across all places, regardless the distance and (2) it is ready to be used anytime; day and night, 24 h, 7 days a week, and throughout the year. The research design is the quasi-experimental post-test only without control; in stage I: Analysis and Design System, in stage II: Prototype, and in stage III: Application. The Verifying is needed by a specialist in Obstetrics for the Analysis and System Design as a way to perform conformity assessment with specific benchmarks as a diversification process. Routine examination, which involves: (1) input data, in general, which includes patient data such as symptoms and signs, (2) physiological and pathological description, (3) differential diagnosis or problems, (4) up to the problem itself as well as further suggestions. Decision support system is made to be used by physicians, and it contains the pattern of input-process-outcome and its display, so it can be used for the manufacturing of the software. This will be helpful for primary care physicians to avoid late referrals.

**Keywords:** normal pregnancy, diagnosis, ultrasonography, decision support system, software

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## 1. Introduction

### 1.1. Reason

Reason of specific, relevant and accurate use of the Decision Support System is needed, will help physicians in analyzing more accurate diagnosis can be made faster and easier with this time saving system and reduce tardiness in making referrals. Ultrasonography (USG) is

part of the routine ante natal care (ANC) at health facilities that provide resources and allow access. These checks are generally conducted in the second trimester of pregnancy; however, ultrasound increasingly offered since the first trimester, especially in health facilities that have adequate resources. Current technological developments, including a high-frequency transvaginal examination, produce a resolution of ultrasound imaging in one trimester at a level where early fetal development can be assessed and monitored in detail.

### 1.2. Objectives

Objectives of ultrasound obstetrics related to gestation age are as follows:

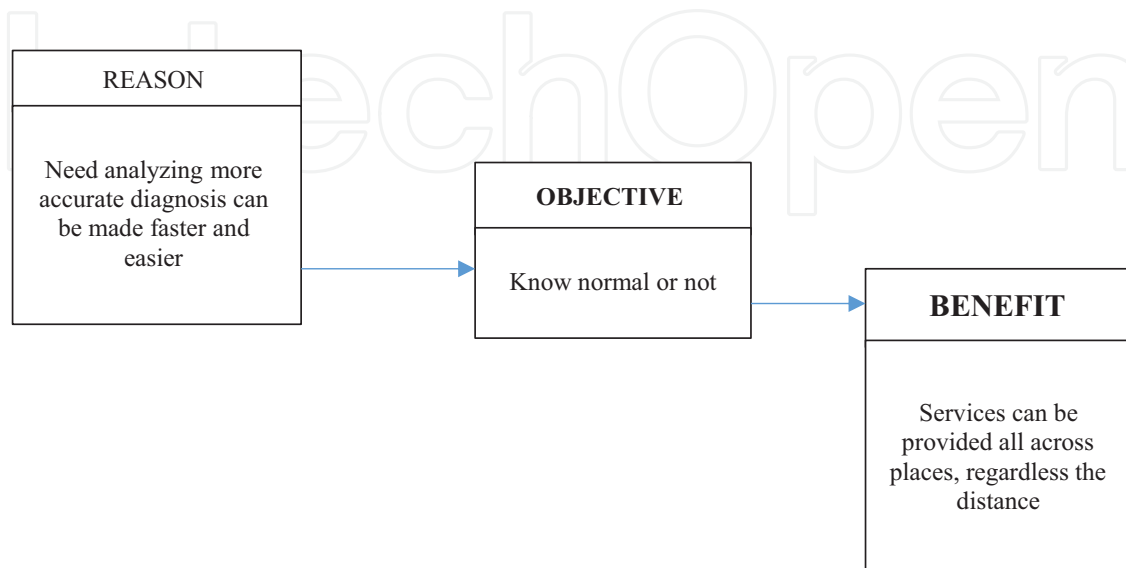
- (1) To know gestation age;
- (2) To see specific development in first trimester;
- (3) To see specific development in second and third trimester;
- (4) To know whether there is emergency.

Objectives above tell that Doctor know situation of normal or not and can be prepared the cases for next examination, monitoring and follow up.

### 1.3. Benefits with this system

- (1) Services can be provided across all places, regardless the distance;
- (2) It is ready to be used anytime, i.e., day and night, 24 h, 7 days a week, and throughout the year;
- (3) The problem of the scarcity of experts can be solved as long as it is still within the limits of the doctors' capacity or expertise and authority from doctors.

By benefits above is important for Student to study more detail in really patient and for Primary Care Doctors has beside assistant for their practice.



## **2. Ultrasound for basic obstetric examination**

### **2.1. Classification of fetal ultrasound**

#### **A. First trimester**

Standard first-trimester obstetric sonogram includes their evaluation:

- size,
- location,
- the number of gestational sac.

Gestational sac observed by the yolk sac and the embryo/fetus. If the embryo/fetus is detected, cardiac activity should be measured and recorded using a video clip or two-dimensional imaging Models Spectral M. Using Doppler imaging is not recommended. The uterus, cervix, adnexal, and local cul-de-sac should be observed.

#### **B. Trimester second/third standard**

Standard obstetric sonogram on the second and third trimester includes:

- evaluation of fetal presentation,
- amniotic fluid volume,
- cardiac activity,
- placental position,
- fetal biometry,
- number of fetuses,
- anatomic survey.

Cervical and adnexal can be observed clinically appropriate if technically possible.

#### **C. Inspection limited**

Limited examination performed when special inspection is needed. For example, in almost all cases is not routinely emergency, limited examination can be performed to confirm the fetal heart activity in patients with bleeding or to verify the fetal presentation in patients who would do the labor. Appropriate sonographic examination is limited if complete examination is stored previously.

#### **D. Special investigation**

Detailed anatomical examinations carried out when there is suspicion anomaly based on medical history, biochemical abnormalities, or the results of standard tests or limited. Special examination includes fetal Doppler ultrasound, biophysical profile, fetal ECG, and additional biometric checks.

Gestational Age	Examination
6 – 7 weeks	Their fetuses
12 weeks	Fetal anomalies
22 weeks	Pregnancy Rate
32 weeks	Fetal growth and well-being
38 weeks	The condition of the fetus before birth

Figure 1. Gestational age.

### E. Summary purpose obstetric ultrasound

Here is the purpose of obstetric ultrasound-related inspection with gestational age (**Figure 1**).

### 2.2. First trimester USG examination

There is no reason to recommend that routine ultrasound only to confirm their current pregnancy in the absence of consideration of clinical, pathological symptoms, or specific indications. It is advisable to offer an ultrasound examination for the first time when the gestational age between 11 and 13 weeks 6 days, so that the objective examination ultrasound first trimester is actually achieved, such as confirm the presence of the fetus, estimated gestational age accurately, determine the number of fetuses real, if necessary determine a rough anatomy and risk of fetal aneuploidy [1–3]. Before starting the examination, health care providers should counsel women or couples about the benefits and limitations of first trimester ultrasound.

#### A. Indications of Examination

Indications of ultrasound examination in trimester as following but not limited to:

1. Confirmation of intrauterine pregnancy [4–6];
2. Evaluation of suspected ectopic pregnancy [7, 8];
3. Determining the cause of vaginal bleeding;
4. Evaluation of pelvic pain;
5. Determine the gestational age;
6. Diagnosis or evaluation of multiple pregnancy;
7. Confirm cardiac activity;
8. Imaging as aid chorionic villus sampling, embryo transfer, and localization and expenditure IUD;
9. Send some fetal anomalies such as anencephaly, high-risk patients;
10. Evaluation of the future pelvis and/or uterine abnormalities;

11. Thickness measurement of the neck (Nuchal Translucency) when used as part of a fetal aneuploidy screening programs; and
12. Evaluation of suspected hydatid form mole.

Limited examination may be required to evaluate the growth interval, estimate amniotic fluid volume, cervical evaluation, and assess the presence of cardiac activity.

## **B. Basic parameters USG imaging**

USG examination in pregnancy first trimester can be done through transabdominal, transvaginal, or both. When the transabdominal examination failed to get a good picture, transvaginal ultrasound examination should be done and vice versa.

### **1. Evaluation of the uterus and adnexal to determine their pregnancy**

The uterus and adnexa should be evaluated for the presence of gestational sac. If it seems the gestation sac, location has to be determined. If possible, once the gestational sac should be evaluated for their yolk sac (YS) or embryo, and the length of CRL (Crown Rump Length) should be recorded.

A definitive diagnosis can be confirmed as pregnancy when intrauterine gestational sac containing yolk sac or embryo/fetus with fetal activity. Set slightly eccentric intrauterine liquid with echogenic boundary can be seen before the yolk sac and the embryo is detected at a very early intrauterine pregnancy. In the absence of sonographic depiction of an ectopic pregnancy, a collection of fluid is very likely to represent the intrauterine gestational sac. In this situation, it may be useful intra-desi dual mark [9]. Advanced Sonography and/or serial test of  $\beta$ -HCG hormone levels to find location of pregnancies that cannot be determined to avoid inappropriate interventions in early pregnancy.

CRL is a more accurate indicator of gestational age than the mean gestational sac diameter. However, the mean gestational sac diameter can be recorded when the embryo is not identified. Diagnosis allegation must be upheld with caution in the gestational sac is not visible embryo or yolk sac. Without intervention, pool of liquid in intrauterine gestational sac may show false associated with ectopic pregnancy.

### **2. Cardiac activities**

The presence or absence of cardiac activity should be kept to a video clip or two-dimensional imaging mode-M. With transvaginal examination, when the movement of heart is observed, when measuring 2 mm or more embryos, if the embryo with a size less than 7 mm seen without cardiac activity, so advanced inspection in next week's is recommended to ensure that the pregnancy is existed [10–12].

### **3. The number of fetuses**

The existence of multiple pregnancy should be determined based on the discovery of fetal echo illustration and not by the number of gestational sac. Sometimes early pregnancy more than one structure resembles a gestational sac. It can appear before the incorporation of the

amnion and chorion or chorion membrane as a result of the lifting of intrauterine hemorrhagic (bleeding subchorionic). Amnionity and chorionity should be recorded for false multiple pregnancy if possible.

#### **4. Assessment of the anatomy of an embryo or fetus**

#### **5. Imaging the neck (nuchal), and cystic abnormalities fibroma must be recorded (especially at high risk)**

#### **6. Uterus including cervical, adnexal structures, and cul-de-sac**

Abnormalities of these structures should be displayed and recorded. The presence of adnexal masses along with the location, the view, and the size should be recorded. The existence and amount leiomyomata, as well as the largest leiomyomata measurement or clinically manifest, must be saved. Cul-des-sac should be evaluated in the presence or absence of liquid. Uterine abnormalities should also be noted.

### **C. Signs of early pregnancy failure possibilities**

1. No activity fetal heart rate (FHR)
2. Abnormalities yolk sac: gestational sac on transvaginal examination  $\geq 8$  mm without yolk sac, or yolk sac calcification, abnormal shape, floating, or the distance from the embryo, no growth yolk sac). Yolk sac normal round shape with the center over anechoic (looks like a ring) in diameter 4–6 mm (according to gestational age).
3. Abnormalities gestational sac: the transvaginal ultrasound examination mean gestational sac diameter  $\geq 8$  mm without a yolk sac or  $>20$  mm without an embryo picture indicates pregnancy failure. Other signs that indicate pregnancy abnormalities such as: distortion of the gestational sac, decidual reaction thickness  $<2$  mm, no evidence of a double decidual, decidual reaction showed erogeneity weak, and the location of the gestational sac is low (near the internal cervical ostium). Therefore, each case with a threatened abortion needs to do an ultrasound to determine whether the pregnancy is normal or pathological.
4. Abnormalities of amniotic bag: signs of pregnancy when the amniotic sac of failure to deflate (collapse), irregular walls, and do not seem echo fetus (embryo). The size of the amniotic cavity or yolk sac diameter exceeds 2 SD of normal size ( $\geq 8$  mm), associated with poor outcomes.
5. Bradycardia: the frequency of fetal heart rate (FHR), 85 times per minute at 5–8 weeks of pregnancy showed a poor prognosis.
6. Oligohydramnios: their oligohydramnios in the embryonic period (less than 8 weeks) showed a poor prognosis.  $\beta$ -HCG levels were lower with the size of KG incompatible pregnancies indicate abnormalities predictive value of about 65%.



## **2.3. UGS examination trimester second/third**

### **A. Indications examination**

Indications second trimester ultrasound examination/third included the following but not limited to:

1. Screening for fetal anomalies; [13–15]
2. Evaluation of fetal anatomy;
3. Determination of gestational age;
4. Evaluation of fetal growth;
5. Evaluation of bleeding paravaginal;
6. Evaluation of abdominal or pelvic pain;
7. Evaluation of cervical insufficiency;
8. Determination of fetal presentation;
9. Evaluation of multiple gestations is already known;
10. Help for amniocentesis or other procedure;
11. Evaluate the real difference as between the size of the uterus and clinical date;
12. Evaluation of pelvic masses;
13. Evaluation of the hydatid form mole;
14. Help for the placement of the cervical sickles;
15. Suspicion of ectopic pregnancy;
16. Suspicion of fetal death;
17. Suspicion of uterine abnormalities;
18. Evaluation of fetal well-being;
19. Suspicion of amniotic fluid abnormalities;
20. Suspicion placental abruption;
21. Support for external cephalic version;
22. Evaluation of premature rupture of membranes or preterm delivery estimates.
23. Evaluation of abnormal biochemical markers;
24. Follow-up evaluation of fetal abnormalities;



25. Follow-up evaluation of placental location for suspicion of placenta previa;
26. History of previous congenital abnormalities;
27. Evaluate the condition of the fetus in the late ANC examination; and
28. Assessment of findings that may increase the risk of aneuploidy.

## **B. Indications of basic ultrasound**

### **1. Evaluation of signs of life, number, presentation, and fetal activity**

Any rhythm disorders or abnormal FHR frequency should be reported. Fetal heart abnormalities should be continued with the cause, and if possible provide therapy to the fetus through the mother (e.g., in cardiac arrhythmias). If found multiple pregnancy, include a description of the number of yolk sac (YS), number of fetuses, placental number, whether there is a bulkhead amnion-chorion, gender (if visible), the weight ratio of the fetus, and amniotic fluid volume ratio of each fetus.

### **2. Evaluation of the estimated volume of amniotic fluid**

Determining the volume of amniotic can wear a subjective assessment, according to the amniotic fluid index phalanx or measuring the diameter of the largest in the amniotic sac (single pocket).

### **3. Evaluation of placental location, description of the placenta (the degree of maturation), and placental relationship with the internal ostium uteri (IOU) as well as the examination of the state of the umbilical cord**

The location of the placenta in early pregnancy may be different from the third trimester of pregnancy, and it is associated with the migration of the placenta due to uterine enlargement and the formation of the lower uterine segment (LUS). Mother's bladder is too full or the contraction of the lower uterine segment can make a wrong diagnosis of placenta previa or myoma uteri. Transabdominal ultrasound examination, trans-perineal or transvaginal can visualize a better relationship with the placenta.

### **4. Determination of gestational age based on initial examination trimester fetal biometry-1**

Biometric of the third trimester is not accurate in determining gestational age; therefore, any determination of the gestational age based on the biometric fetus must refer to an ultrasound in the first trimester (early pregnancy), the Crown Rump Length (CRL), bi-parietal diameter (BPD), head circumference (HC), or the length of the femur (LF), in this way would be more accurate.

### **5. The calculation of estimated fetal weight**

TBJ measurements must be made at the end of the second and third trimester belly by comparison circle (CC) with DBP. LP measured in transverse section of the abdomen as high as the meeting area right and left portal vein. LP measurement is important in the diagnosis of growth retardation (IUGR) and macrosomia. Evaluation of fetal growth by measuring biometric is needed spare time with screening earlier. That is, if you have already done biometry

measurements of the fetus, the forecast rate of growth of the fetus should be determined. Distance time needed for the evaluation of fetal growth rate, at least 2 weeks.

#### **6. Evaluate the state of the uterus (including cervix) and adnexal structures**

This examination is useful to obtain additional findings that have important clinical significance, such as the mass of the uterus that can interfere with the birth.

#### **7. Evaluation of fetal anatomy**

Ultrasound examination includes the assessment of fetal anatomy, such as ventricle cerebral, posterior fossa, four chamber heart, spine, stomach, kidney, bladder, insertion umbilicus, and the integrity of the front wall of the abdomen.

### **2.4. Clinical decision support system**

Clinical decision support system is an application that analyzes data to help health professionals make clinical decisions. Clinical decision support system is an adaptation of a decision aid system that is used generally to support business management. Doctors use a clinical decision support system to prepare the diagnosis and assess the diagnosis as a way to improve outcomes. Data mining may be designed to observe the patient's medical history in conjunction with related clinical research. Some analysts predict a wide range of potential events, ranging from drug interactions to the symptoms of the disease.

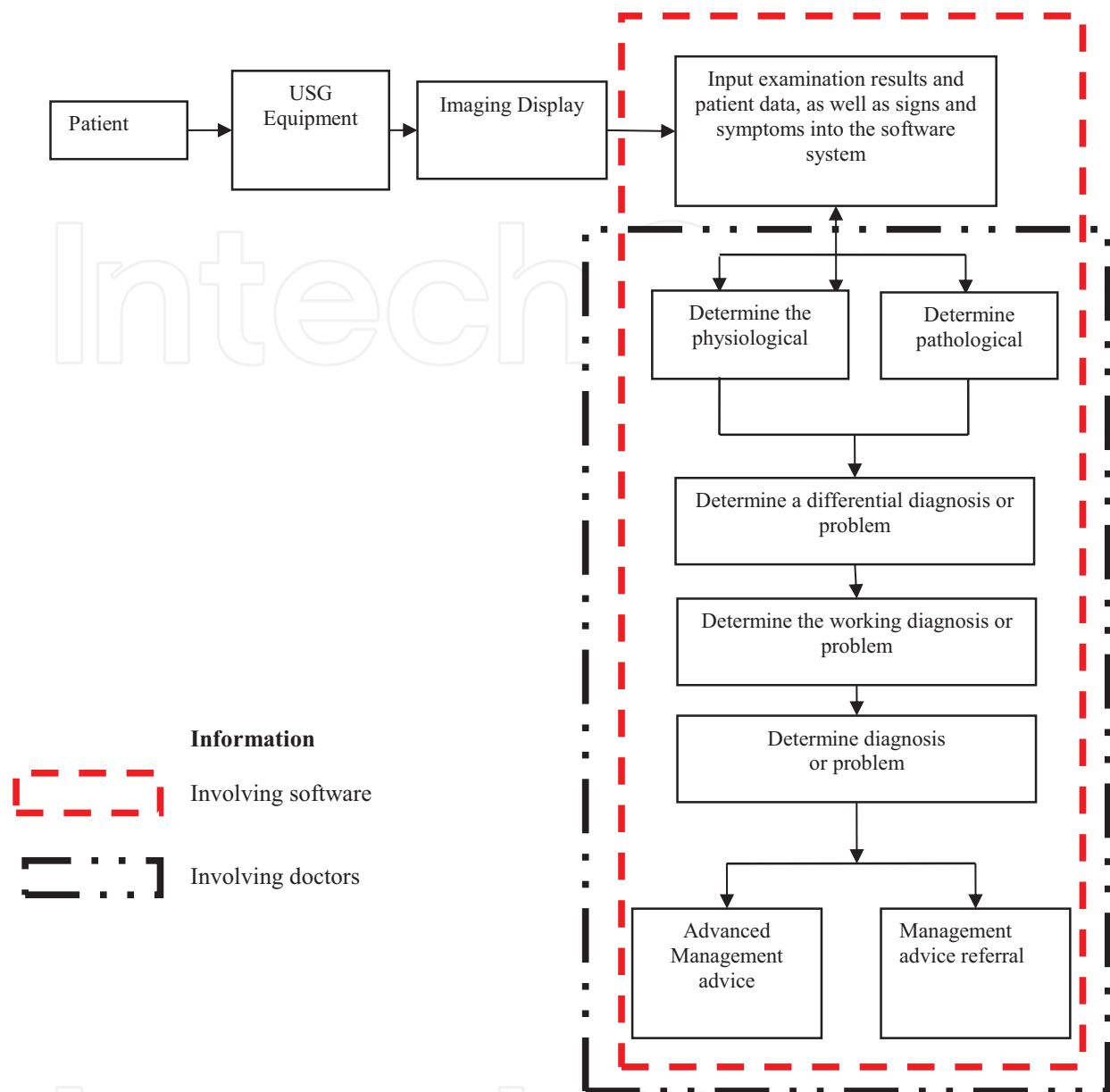
There are two types of clinical decision support system. The first type uses a base of knowledge, to apply the rules on patient data by using an inference engine and displays the result on the end user. The second type, without the knowledge base, relies on machine learning to analyze clinical data.

### **2.5. Clinical decision support system basic obstetric ultrasound**

Clinical decision support system is designed to help health workers in primary care in order to produce clinical decisions related to the examination of pregnant women who perform routine ANC examination or pregnant women who come into service with the primary complaint with either symptoms or signs. The result or outcome of clinical decision support system is form of advice the management of treatment or examination also suggestions to do references of treatment or examination. Schematic process can be seen below.

The above schematics described outcomes such as: theory from the literature, Analysis and Design Systems, and verification from obstetricians and seminars to finalize its shape. Routine examination, which involves:

- (1) input data, in general, which includes patient data such as symptoms and signs,
- (2) physiological and pathological description,
- (3) differential diagnosis or problem,
- (4) up to the problem itself as well as further suggestions.

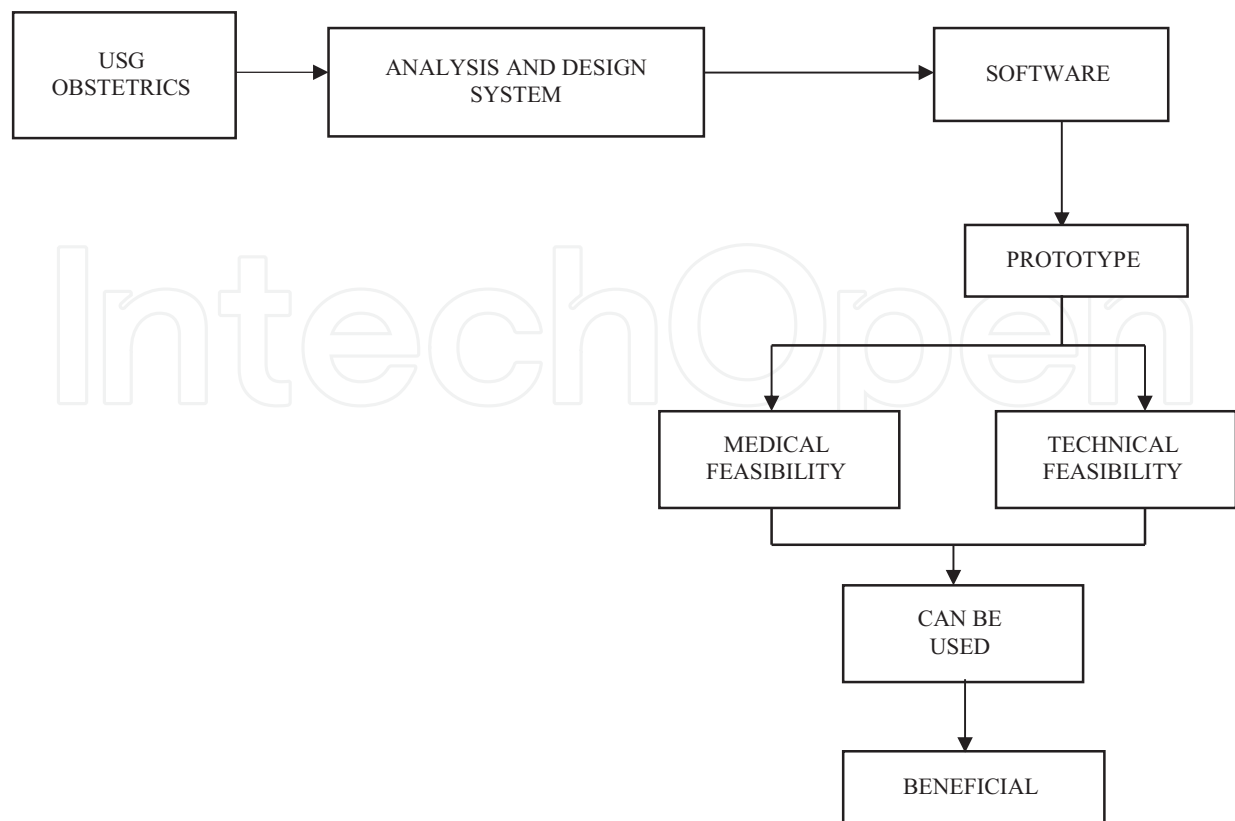


### 3. Method of development

The research design is the quasi-experimental post-test only without control, in stage:

- I. Analysis and Design System,
- II. Prototype,
- III. Application.

Flowchart can be seen as below.



Decision support system (DSS) as a tool:

- gives an overview of differential diagnosis,
- helps enforce diagnosis,
- provides landing therapy,
- provides direction need for a referral or a consul.

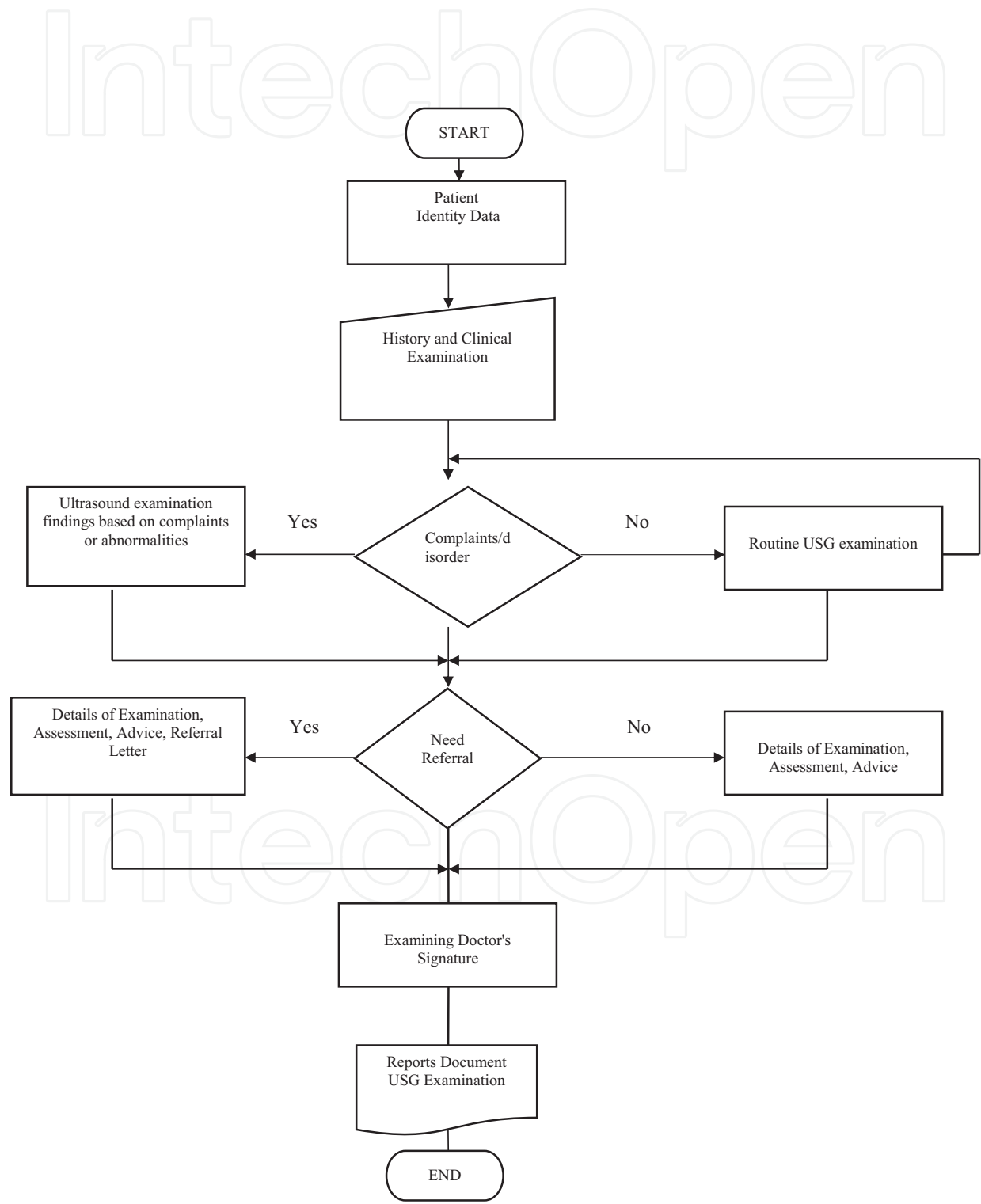
Use of DSS will benefit from three sectors:

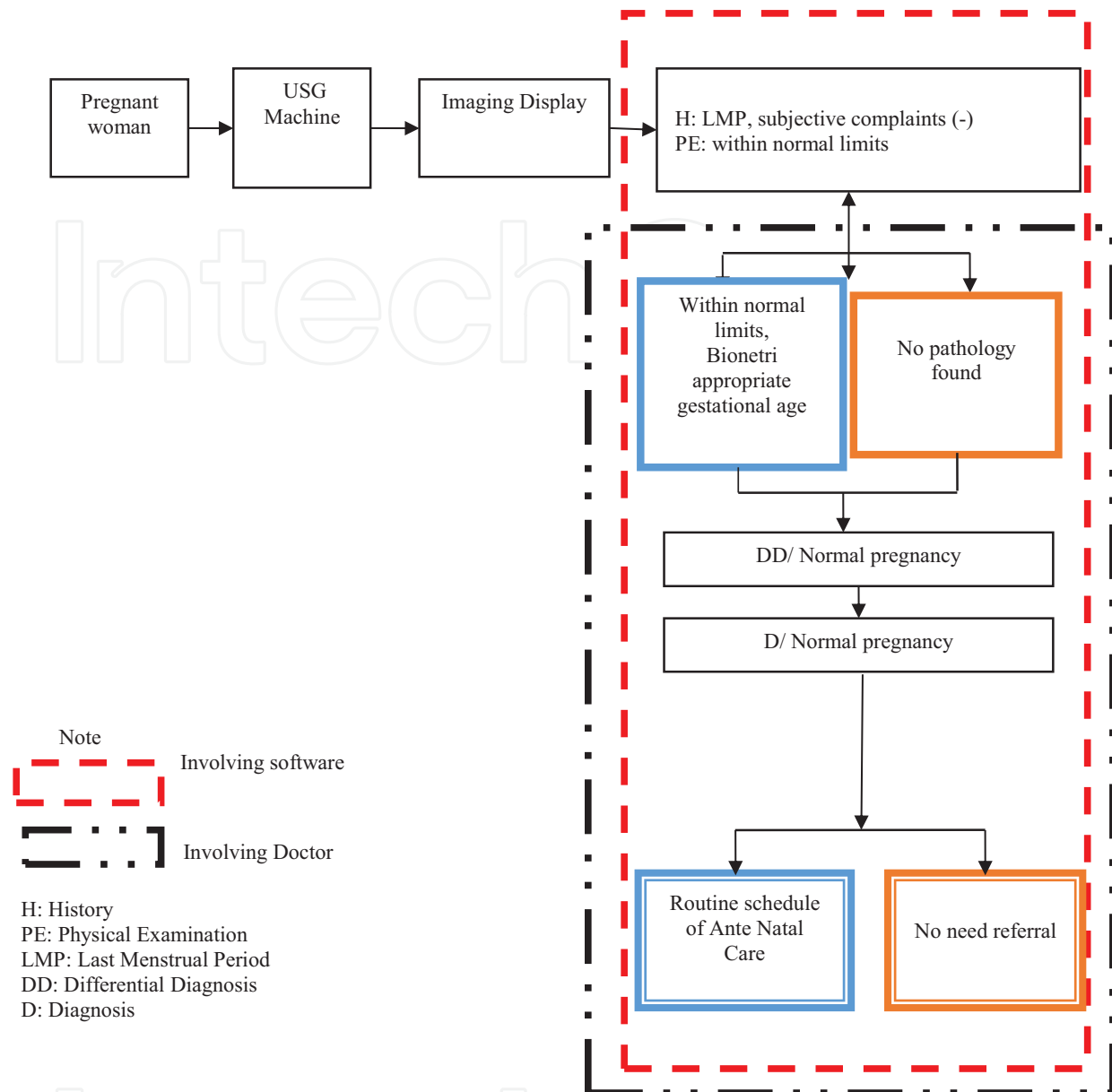
1. Range far and wide will be very helpful because being close in around us;
2. An unlimited time, day and night, 24 h, 7 days a week, throughout the year; make it easier for ready for use anytime;
3. Difficult and rare expertise that can be met, but remain in the capacity of thought or competence, so that appropriate action can be immediately implemented.

4. Clinical decision support system in pregnancy: a general examination

General examination flow chart

Chief complaint or disorder: normal pregnancy





**Important features** at this stage are:

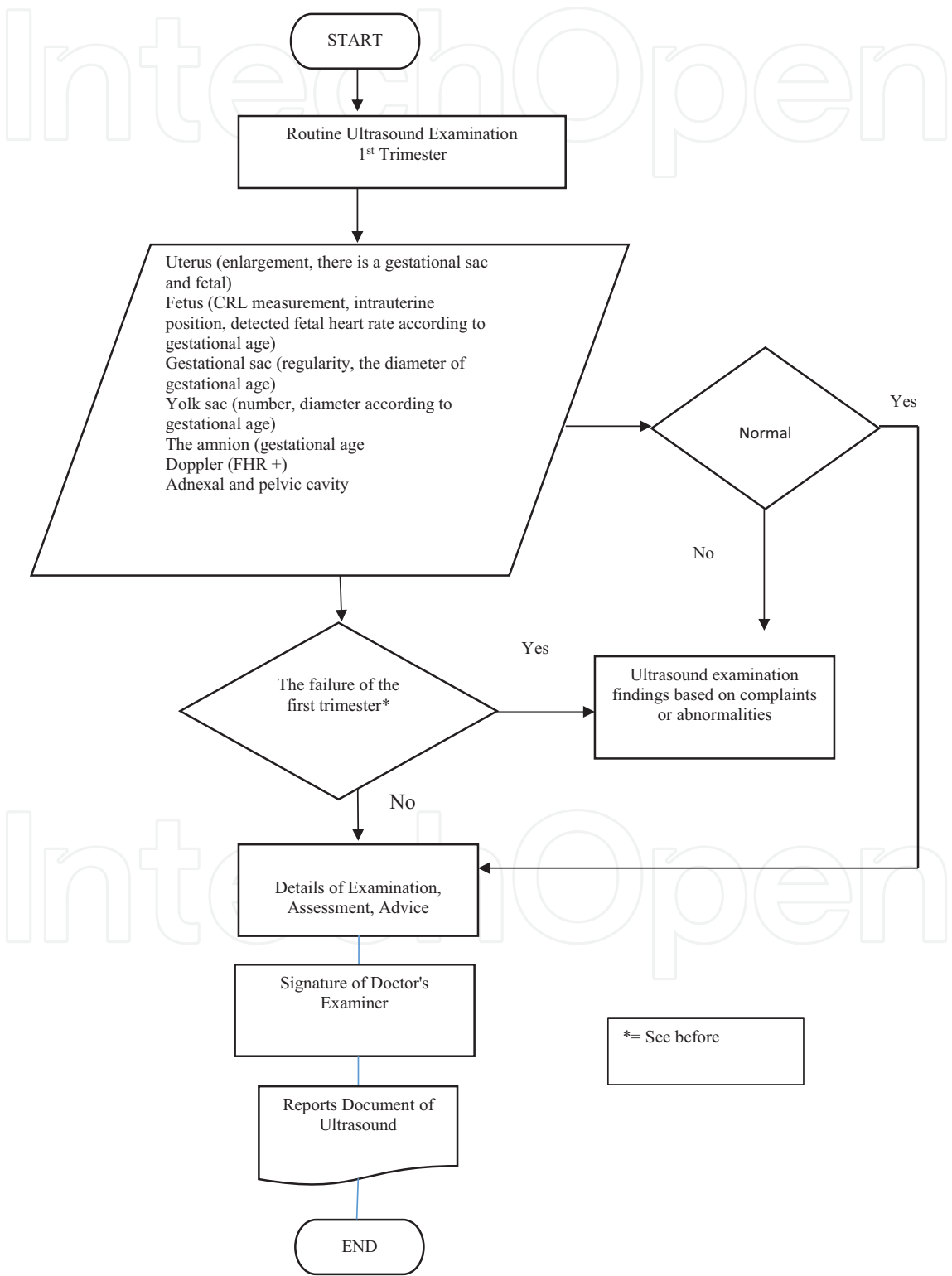
- (1) compliance of the last menstrual calculation;
- (2) no complaints;
- (3) examination within normal limits;

with state of the USG:

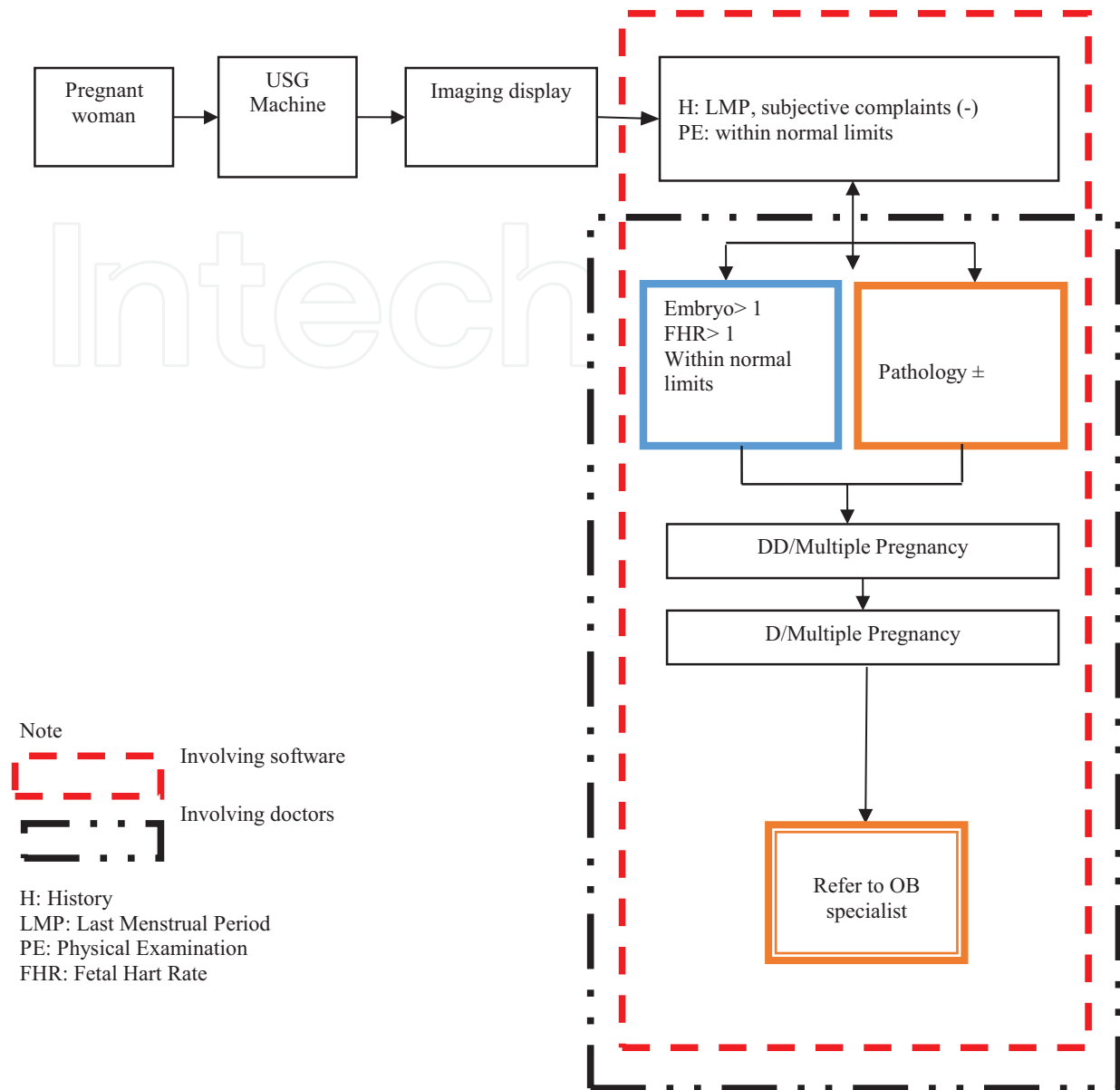
- fetal biometry according to gestational age;
- there is no pathological sign

5. Clinical decision support systems in pregnancy first trimester

Chief complaint or disorder: multiple pregnancy







**Important features** at this stage are:

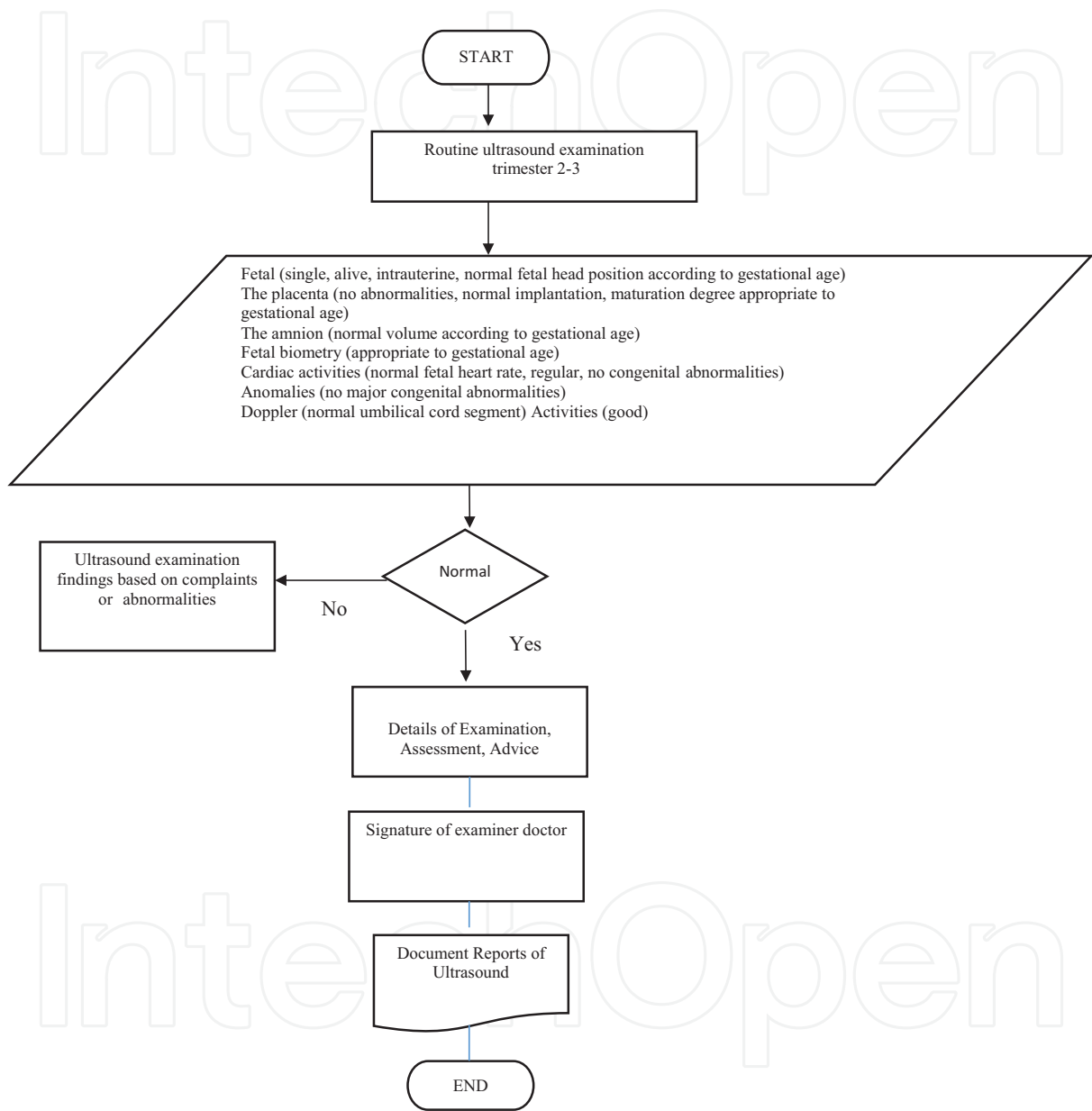
1. compliance of the last menstrual calculation;
2. no complaints;
3. examination within normal limits;

with state of the sonogram:

- there is one or more embryos and FHR there is one or more;
- fetal biometry according to gestational age;
- there is no pathological sign.

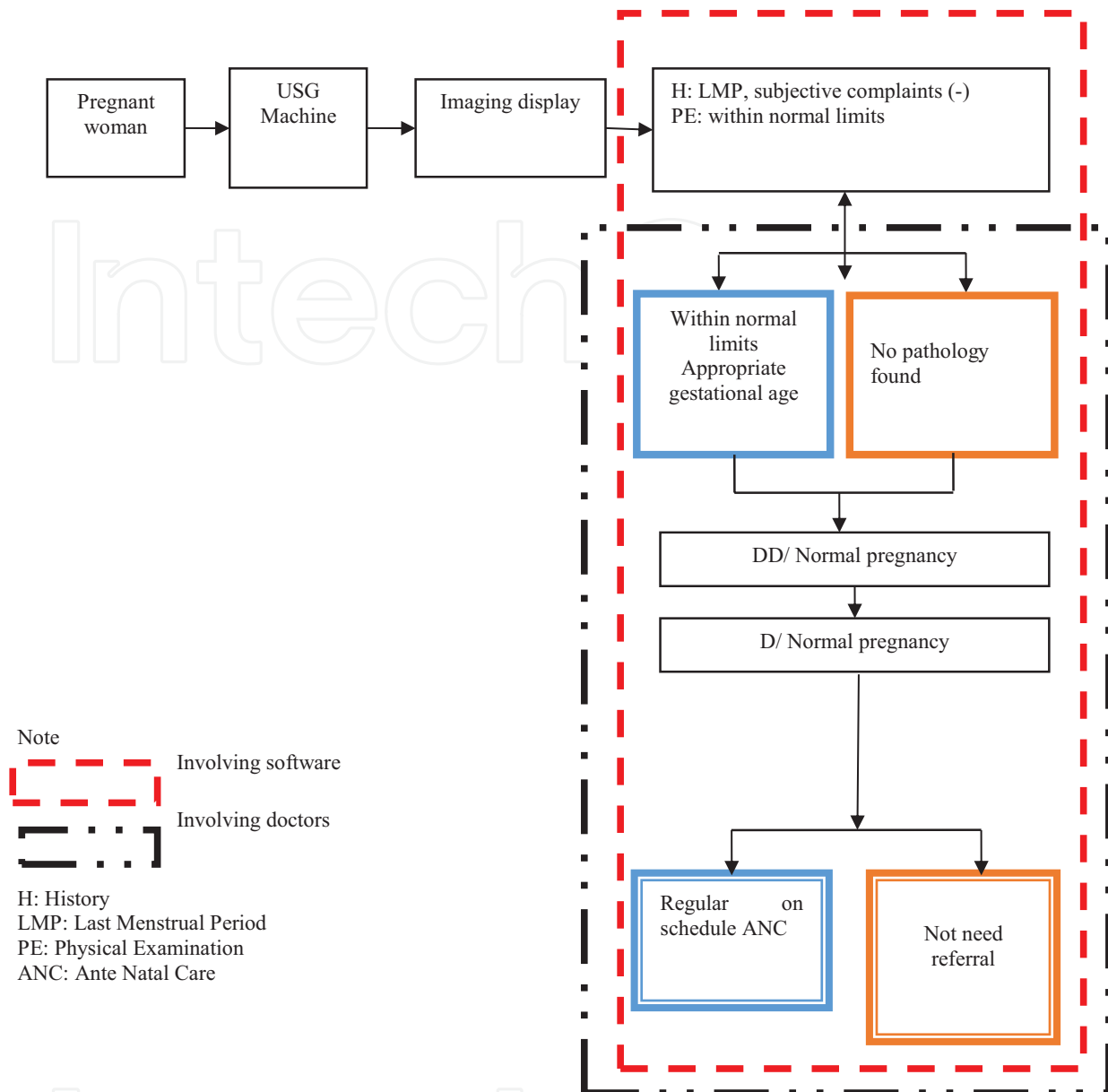
6. Clinical decision support system in pregnancy: second and third trimester examination

Chief complaint or disorder: normal pregnancy 2nd–3rd trimesters



Important features at this stage are:

1. compliance of the last menstrual calculation;
2. no complaints;
3. examination within normal limits;



with state of the sonogram:

- Fetal biometry according to gestational age;
- there is no pathological sign.

## Author Note

Part of the book “Sistem Bantu Keputusan pada EKG Dan USG – Kebidanan untuk Dokter Pelayanan Primer Serta EEG untuk Resident Penyakit Syarat” (Decision Support

System on ECG and Ultrasound – Obstetric for Primary Care Physicians and EEG for Neurological Disease Resident), Copy Right Registration of Indonesian Government No. C00201502598, 2015.

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