

CRIS Obstetrics Ultrasound Module Calculations

Standard Forms (North West)

Training Department

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1. Introduction

Purpose

This document summarises the key equations and calculation logic for the Obstetrics module in CRIS as at version 1.06, 2.07, 2.09, 2.10, 2.11 and 2.12

Audience

This document is aimed at Sonographers, Obstetricians and RIS / PACS Managers who will be involved with the deployment and use of the CRIS Obstetrics Ultrasound Module using standard forms which were derived from development in conjunction with the North West Clinical Reference Group.

2. Glossary

Acronym	Description
AC	Abdominal Circumference
AFI	Amniotic Fluid Index
CRL	Crown Rump Length
EDF	End Diastolic Flow
FL	Femur Length
EDD	Estimated Delivery Date
EFW	Estimated Fetal Weight
HC	Head Circumference

3. Associated Documentation

CRIS_CRIB_IM_354_Obstetric_Reporting_V2.1.pdf – Comprehensive overview of the CRIS Obstetric Ultrasound module using Standard forms.

CRIS_CRIB_IM_354_Obstetric_Ultrasound_Configuration_v2.0.pdf – Details of all XR Settings which enable the Trust to customise the module as applicable.

4. Obstetric Ultrasound Configuration

Please refer to **CRIS_CRIB_IM_354_Obstetric_Ultrasound_Configuration_v2.0.pdf** for full details of all configuration settings which enable the Trust to customise the module as applicable.

5. Calculations used for Estimated Delivery Date (EDD)

The order in which metrics are used for calculating the EDD for each scan type is as follows:

Early scan

Value captured at previous scan, if this is not present then EDD calculated on CRL using Robinson key equation.

Dating Scan

Value captured at previous scan, if this is not present then EDD calculated on CRL, if this is not present then EDD is calculated on HC based on Robinson and Chitty key equations / calculations respectively.

Anatomy / Detailed scan

Value captured at previous scan, if this is not present then EDD calculated on HC, if this is not present then EDD calculated on FL using Chitty key equations.

Growth scan

Value captured at previous scan, if this is not present then EDD calculated on HC, if this is not present then EDD calculated on FL.

Please note: The EDD is only filled in with the default value AFTER the user has moved to the maturity week's field. This is so that the user has entered all the measurements for this scan before it tries to calculate the EDD. Once the EDD and maturity has been filled in CRIS will not normally automatically change them again unless the user blanks these fields manually.

If the **XR Setting REPORT.ObsEDDCutoffDays** has been defined, then an EDD calculated from a Gestational Age less than the number of days defined in the setting will be ignored on the subsequent Scan.

If the **XR Setting REPORT.ObsUseLMPForEDD** has been set to **YES** then if the LMP is filled in on this pregnancy it will be used in preference to the measurements for calculating the EDD when the EDD has not been set on a previous scan.

The **XR Setting REPORT.ObsLMPEDDMargin** defined the maximum number of day's difference between the EDD calculated by LMP and Measurements before the EDD by LMP is ignored.

6. Relevant Equations & Growth Charts

ROBINSON EQUATIONS are used for **CRL** in Early Pregnancy and Dating scans:

- **CRL** growth charts British Journal of Obstetrics and Gynaecology 82(9):702-10 1975 Sep.

$$GA_{(Days)} = [8.052 (CRL * 1.037)^{\frac{1}{2}} + 23.73] / 7_{(Weeks)}$$

The **CHITTY GROWTH** charts used for **HC, AC and FL** in Dating, Anatomy, Detailed, Anomaly and Growth scans. Where GA is the gestational age in weeks and SD is the standard deviation. Where m = measurement entered.

The centiles obtained as measurement +/- z(SD) where z = -1.88, -1.28, 0, 1.28, 1.88 for the 3rd, 10th, 50th, 90th and 97th centiles respectively.

- **HC** Derived equation parameters from British Journal of Obstetrics and Gynaecology Volume 101 Jan 94 No1 - Chitty94

$$HC = -109.7 + 15.16(GA) - 0.002388(GA)^3$$

$$SD = 3.913 + 0.2329(GA)$$

HC Derived equation parameters from Ultrasound - Volume 17 – No3 - August 2009 – Chitty97

$$Age_{(days)} = 7.0 * \exp((0.0000000435 * m * m * m) + (-0.0000303210 * m * m) + (0.0106110000 * m) + 1.8480000000)$$

$$SD_{(log\ weeks)} = (0.0000142040 * m * m) + (-0.0005263500 * m) + 0.0802400000$$

- **AC** Derived equation parameters from British Journal of Obstetrics and Gynaecology Volume 101 Jan 94 No1 P131 – Chitty 94

$$AC = -85.84 + 11.92(GA) - 0.0007902(GA)^3$$

$$SD = -3.08 + 0.6018(GA)$$

- **FL** equation parameters from British Journal of Obstetrics and Gynaecology Volume 101 Jan 94 No 1 P131 – Chitty 94

$$FL = -32.43 + 3.416GA - 0.0004791(GA)^3$$

$$SD = 1.06 + 0.05833(GA)$$

FL Derived equation parameters from Ultrasound - Volume 17 – No3 - August 2009 – Chitty97

$$Age_{(days)} = 7.0 * \exp((0.0343750000 * m) + (-0.0037254000 * m * \log(m)) + 2.3060000000)$$

$$SD_{(log\ weeks)} = (0.0002521500 * m) + 0.0316500000$$

Please note: BPD was removed in 2011 due to BPD no longer being measured. This was effective from 2.09.10h onwards.

7. Equations used for Estimated Fetal Weight (EFW)

CRIS can use the following equations as published in the American Journal of Obstetrics and Gynaecology Volume 151 No 3 Feb 1 1985: to calculate the EFW.

Hadlock 1 Using AC and FL (H1 Equation)

$$EFW = 10 ^ {(0.005281 * AC + 0.01938 * FL - 0.00004 * FL * AC + 1.304)}$$

Hadlock 2 Using AC, HC and FL (H2 Equation)

$$EFW = 10 ^ {(0.00107 * HC + 0.00438 * AC + 0.0158 * FL + 0.0000326 * FL * AC + 1.326)}$$

Shephard Using AC (S Equation)

$$EFW = 10 ^ {(0.0166 * BPD + 0.0046 * AC + 0.00002646 * BPD * AC + 1.2508)}$$

Campbell Using AC Only (C Equation)

$$EFW = 1000 * (2.7182818 ^ {(0.0282 * AC - 0.0000331 * AC * AC - 4.5648)}).$$

The default configuration of CRIS is to calculate the EFW using the equation priority as follows:

If HC, AC and FL are all entered Hadlock 2 formula is used.

If the AC and FL are entered, then CRIS uses the Hadlock 1 formula.

If AC and BPD are entered, then CRIS uses the Shephard equation*

Otherwise if AC is entered then CRIS uses the Campbell equation*

* It should be noted that CRIS is typically configured so that any AC only equations are ignored via the [XR Setting REPORT.ObsAllowEFWbyACOnly](#).

CRIS can be also configured using the [XR Setting REPORT.ObsEFWPriority](#) to change the order of equation priority from the default above. Changing the default priority order will also allow the users to choose a specific equation for calculating the EFW on this report. The typical configuration is recommended as H2,H1,S.

8. Centile Display on Graphs

The lower and upper centiles as displayed on the graphs, as a default, show 3rd and 97th centiles.

Should a user wish to change the displayed values, this is managed by the **XR setting Report.obsSDvalue**.

For 3rd and 97th this would be blank (default) or 1.88

For 5th and 95th this should be set to 1.5

For 10th and 90th this should be set to 1.28

The values shown on the charts are the 5th, 50th and 95thpercentiles, displayed as the lower (red), middle (black) and upper (red) lines respectively. It is therefore possible to select one of the three common centile ranges and the selected range will be displayed on both the UI and printed graphs.

If this value is left blank the system will default to 3rd and 97th Centile, but will only be displayed if the below setting **REPORT.ObsShowSDCentiles** is set to Yes.

Document Control

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Issue	Date	Author / Editor	Details of Change
D1.0	17/06/2020	Emma Savage-Mady	Rebranding – Amendment to correct document typo’s including CRL equation which should be a square root not squared. (Days) and (Weeks) has also been added for clarity on why the equation is divided by 7. Hadlock 1 equation has been amended due to a typo mentioning +0.00004 rather than the correct – 0.00004 and EFW wording changed to clarify EFW priority and configuration regarding AC for Shepherd and Campbell. All verified the correct calculations are being fully utilised within the CRIS client and all error were simple typo’s in the documentation.
V1.0	19/06/2020	Emma Savage-Mady	First Issue
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