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## Interpretation of Serum Human Chorionic Gonadotropin (hCG) Results in Pregnancy

The analysis of serum hCG has been used to confirm a pregnancy, to help diagnose an ectopic pregnancy, to help diagnose and monitor a pregnancy that may be failing, and/or to monitor a woman after a miscarriage. The following information helps to interpret serum hCG results in pregnancy evaluation.

Serum hCG Reference Intervals and Expected Values	
<b>Non-pregnant persons</b>	<b>Reference Interval (IU/L) (2.5-97.5<sup>th</sup> percentile)</b>
<b>Male</b>	< 3
<b>Female</b>	
Non-pregnant pre-menopausal:	< 5
Equivocal (may indicate early pregnancy):	5 - 9
Post-menopausal:	< 8
<b>Pregnant females</b>	<b>Expected Values (IU/L) (5-95<sup>th</sup> percentile)<sup>2</sup></b>
<b>Weeks of gestation<sup>1</sup>:</b>	
3	5.8 - 71.2
4	9.5 - 750
5	217 - 7,138
6	158 - 31,795
7	3,697 - 163,563
8	32,065 - 149,571
9	63,803 - 151,410
10	46,509 - 186,977
12	27,832 - 210,612
14	13,950 - 62,530
15	12,039 - 70,971
16	9,040 - 56,451
17	8,175 - 55,868
18	8,099 - 58,176
<sup>1</sup> Weeks of gestation is defined as completed weeks of pregnancy beginning with the start of the last menstruation phase. <sup>2</sup> These expected values are specific for hCG tested by the Roche Cobas <sup>®</sup> analyzer, the method used by Dynacare [1]. These values should not be used to interpret results from other methods.	

## Serum Human Chorionic Gonadotropin (hCG) Concentration Doubling Time

In the first three weeks of a normal pregnancy, the serum hCG approximately doubles every two days. The doubling time of hCG is considered a more reliable method of evaluating an early pregnancy than a single serum hCG result [2].

Serum hCG Concentration Doubling Time	
Days of gestation <sup>1</sup> :	Expected Doubling Time (Days)
9-21	≤ 2.2
21-28	≤ 2.6
28-36	≤ 4.4
Doubling Time (Days) = $[(\log 2) \times (\text{time interval in days})] / \log (\text{hCG}_2 / \text{hCG}_1)$	
<p><b>Example:</b>            If the serum hCG from a patient with 24 days of gestation is 400 IU/L and 2 days later is 700, the doubling time is then:  <math display="block">[(\log 2) \times (2)] / \log (700 / 400) = 0.60 / \log 1.75 = 0.60 / 0.24 = 2.5 \text{ days}</math>           A doubling time of 2.5 days is normal as it is less than the limit of 2.6 days.</p>	
<sup>1</sup> Days of gestation is defined as completed days of pregnancy beginning with the start of the last menstruation phase.	

It is expected that the hCG level for a successful intrauterine pregnancy should increase by at least 35% in two days. A slower rate of increase suggests a possible miscarriage or ectopic pregnancy. For women who are having a miscarriage, it is expected that the hCG level should fall 36 - 47% over two days. A fall that is slower than this is suggestive of an ectopic pregnancy [3].

However, serial hCG values should not be used alone to determine whether or not a pregnancy is likely to be a successful intrauterine pregnancy, a miscarriage, or an ectopic pregnancy. About 21% of ectopic pregnancies (pregnancies implanted outside of the uterus) have a rise in hCG similar to an intrauterine pregnancy and 8% of ectopic pregnancies have a fall in hCG similar to a miscarriage. Serial hCG values should be used in combination with clinical judgment, evaluation of symptoms and repeat ultrasound (as needed).

### References:

1. Roche MODULAR ANALYTICS E170 package insert for reagent of intact human chorionic gonadotropin + the  $\beta$ -subunit. 2017-03, V 17.0
2. Pittaway, DE and Wentz AC. Evaluation of early pregnancy by serial chorionic gonadotropin determinations: a comparison of methods by receiver operating characteristic curve analysis. *Fertil Steril* 1985 Apr;43(4):529-33.
3. Morse CB, Sammel MD, Shaunik A, et al. Performance of human chorionic gonadotropin curves in women at risk for ectopic pregnancy: exceptions to the rules. *Fertil Steril* 2012 Jan; 97(1): 101-106.e2.