



Helping Patients to Predict and Confirm Ovulation with the Use of Combined Urinary Hormonal and Smartphone Technology: A Proof-of-Concept Retrospective Descriptive Case Series

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Abstract

Smartphone-based fertility awareness methods with home-based urinary hormonal testing are gaining popularity for fertility tracking. In our university-affiliated family practice, we integrated a previously developed ovulation tracking application into a protocol for monitoring urinary sex hormones and cervical secretions. Serum progesterone was used to confirm the luteal phase, with levels ≥ 15.9 nmol/L ensuring confirmation. Data from 110 women seen for infertility treatment ($n = 95$) or family planning advice ($n = 15$) and using our ovulation prediction protocol showed that most opted for a combination of cervical mucus and luteinizing hormone testing ($n = 86$). Among those using it for family planning, the median usage among women spanned 56 cycles, and 13 cycles per woman required progesterone testing for confirmation. Thirteen patients are still using the method without unintended pregnancies. No unintended pregnancies occurred. Confidence in tests based on serum progesterone was high (93%). For infertility, the method helped in the identification of anovulation, evaluating treatment response, and in diagnosing subfertility causes. This proof-of-concept retrospective descriptive case series suggests the potential for smartphone-based monitoring in fertility management, urging further studies for application enhancements and prospective validation.

Keywords

- ▶ fertility awareness methods
- ▶ progesterone
- ▶ ovulation detection
- ▶ mobile application
- ▶ urinary luteinizing hormone

Mobile applications have become extremely popular in the field of fertility monitoring particularly for either achieving conception or avoiding pregnancy with over 100 already in the market.^{1,2} These applications make use of parameters such as urinary hormone levels, cervical mucus quality, menstrual cycle length, and basal body temperature (BBT), to predict the fertile window and confirm ovulation.³ The use

of these application apps can be helpful to predict ovulation and increase the chances of conception.^{1,4–6} Additionally, recent use of some of these is being incorporated to provide an alternative to hormonal and barrier contraceptive methods.^{7,8} However, there have been concerns that some of the current applications may not be sufficient to prevent pregnancy.² One approach that was developed for couples using

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natural family planning who want to avoid pregnancy with certainty is to incorporate a definite marker to confirm ovulation.⁹ This approach proposes that couples abstain from sexual intercourse until after ovulation. This postovulatory infertile (late luteal) phase of the menstrual cycle has been confirmed by luteal progesterone above a certain level.^{10,11} A serum progesterone level of 15.9 nmol/L (5 ng/mL) or greater confirms that ovulation has occurred. Therefore, any woman who has a level of 15.9 nmol/L or above can confidently know that she has arrived at her infertile luteal phase.

We have developed a protocol (►Appendix 1) to either record the menstrual cycle with the use of a previously developed ovulation tracking application that tracks their urinary luteinizing hormone (LH; ►Figs. 1 and 2) or record their cervical secretions, or a combination of both¹² followed by an optional cycle phase timed serum progesterone testing to confirm ovulation.¹⁰ This combined method allows women to both predict and confirm ovulation as well as monitor their fertility for the assessment of potential disorders such as luteal phase defect, irregular cycles, and anovulation.

As a description, the ovulation tracker application provides an intuitive quantitative ovulation test reading feature in the application. With the in-application scanning feature, the application automatically calculates the ovulation test results and identifies the LH peak which is visually presented in an autogenerated LH chart. The application can also provide an easy way to log and record cervical mucus observations, BBT, serum hormone results, symptoms, moods, intercourse timing, and medications. All recorded parameters are presented in the calendar for users to visually track their cycle and know their fertile window. Once users find their LH peak, serum progesterone can be taken to confirm ovulation. We present a

descriptive retrospective case series of this process which we believe is the first documented series of use of virtual monitoring of menstrual cycles.

Materials and Methods

Patients

We conducted a chart review of 110 female patients who attended our university-affiliated family practice. Women were of reproductive age (13–50) who presented to the primary care clinic for infertility assessment/treatment, gynecologic conditions, or family planning and used the ovulation tracking approach described in this article.

Ovulation Tracking Assessment

Patients were instructed to record their daily observations starting on the first day of menses in each cycle. Recording was done via a smartphone application for LH tracking and/or via cervical mucus charting (Billings Method or Creighton Model Fertility Care System).^{12,13} Serum progesterone levels were obtained from a local laboratory. Patients were told that to increase the chance that the progesterone level will be 15.9 nmol/L or above, the test should be taken: anytime right after peak day for those using mucus-based fertility awareness methods (FAMs) or after the LH peak identified by using LH smartphone application or a combination of the two. A level greater than 15.9 nmol/L was used to confirm the luteal phase. Both the clinic and the patient had access to the progesterone results via an online portal.

Measured Outcomes

Patient feedback regarding the use of the method was gathered using a questionnaire (►Table 1). Data collected

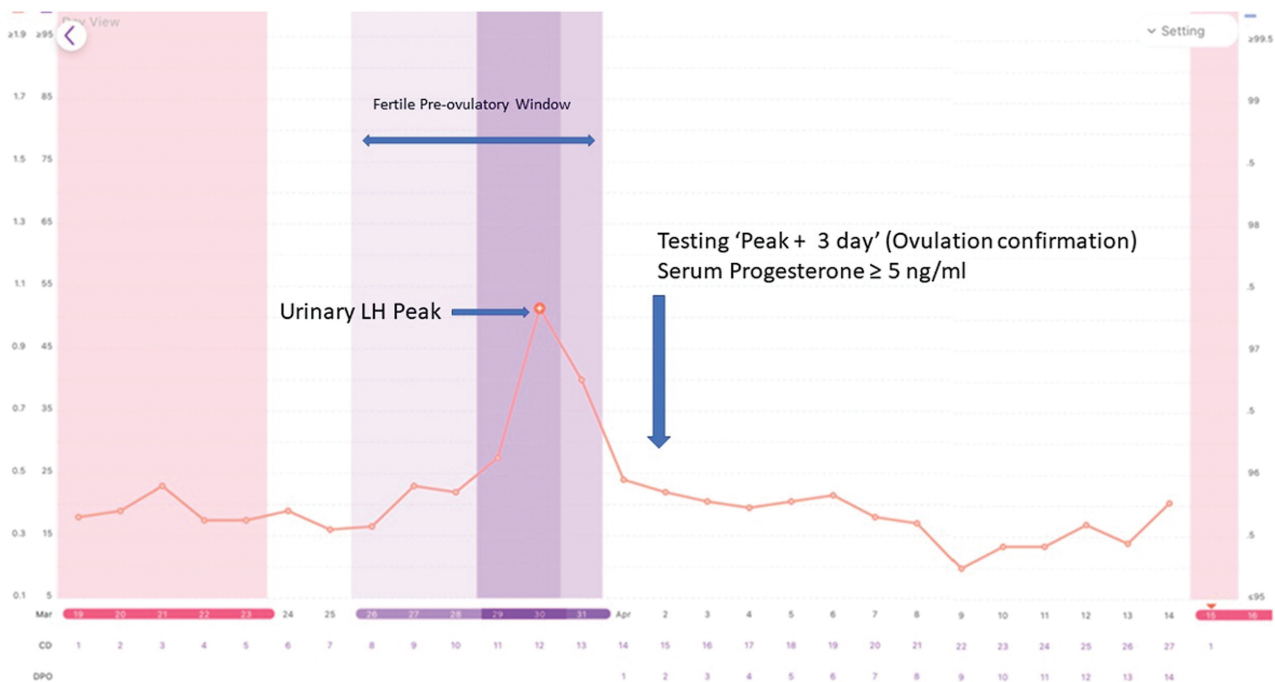


Fig. 1 Example of a luteinizing hormone (LH) graph pattern generated by app based on daily urinary LH tests.

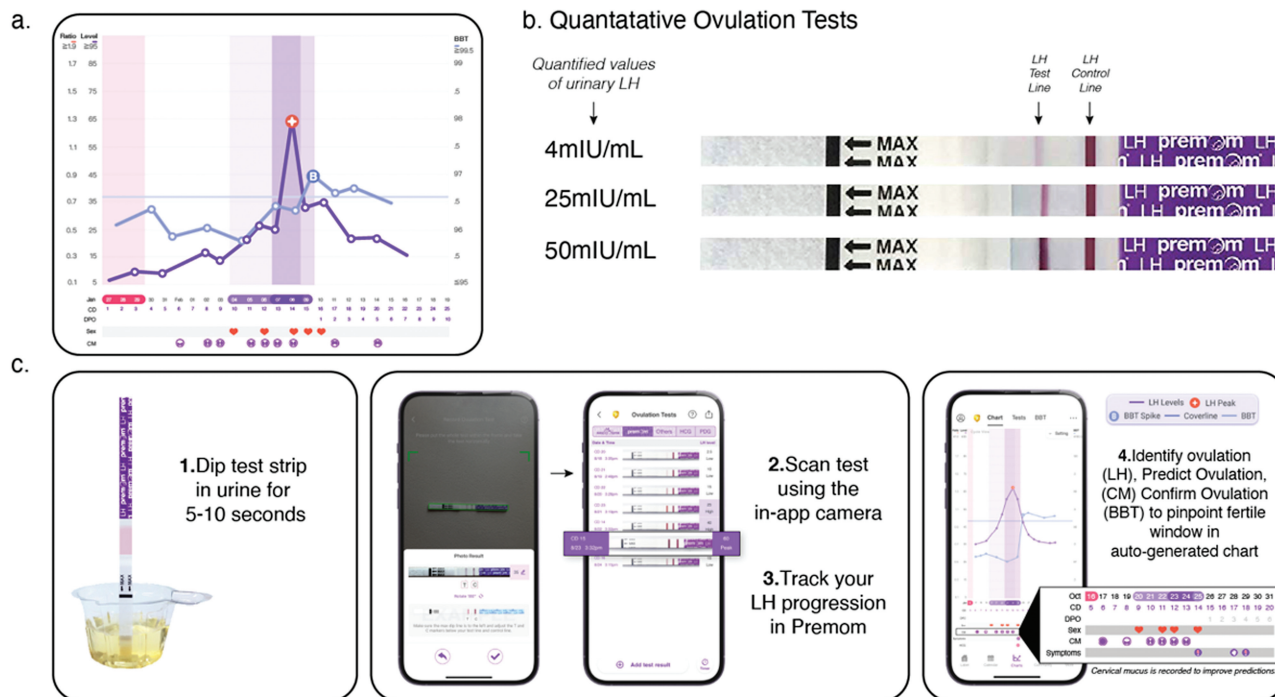


Fig. 2 Visual description of commercial ovulation tracker.

included age, parity, length of use of the method, the number of tests performed, the FAM utilized by the patient to identify impending ovulation (mucus only, LH only, or both), and whether they continued using the method. Intention of pregnancy was also recorded for those who used the method for family planning and had a pregnancy.

Ethics Approval

The Bruyère Research Ethics Board provided an exemption for formal review, as this project was deemed a clinical practice quality assessment study.

Results

The women trying to avoid pregnancy ($n=15$) predicted their ovulation by cervical mucus alone ($n=5$, 33%), with LH only ($n=4$, 26%), or a combination of both ($n=6$, 40%; ►Table 2). Patients have been using this approach for a median number of 56 months. Confirmation of the luteal phase per cycle was done solely with serum progesterone. The majority of patients felt comfortable with using this approach (►Table 1). The median number of menstrual cycles per woman requiring progesterone testing was 13 (range: 4–54). Thirteen out of 15 patients are still using the methods to avoid pregnancy. Three women had pregnancies intentionally while using the methods. No unintentional pregnancies occurred (►Table 2).

For those trying to conceive ($n=95$), the main reasons for use were ovulation identification, supervised normalization of irregular menstruations in polycystic ovary syndrome, and, in adolescents, for the diagnosis of fertile window or anovulation and treatment response in subfertility

(►Table 3). There was a significant overlap among the reasons with most of the patients having three to four or more reasons. In this category, all cycles were confirmed via the use of progesterone.

Discussion

Despite being an observational design and reliance on patient self-reporting and chart reviews which may introduce biases and limitations, we think our case series describes a practical protocol using e-technology for monitoring the menstrual cycle virtually and dynamically for timely input in the diagnosis and treatment of fertility issues. We incorporated a dual approach (smartphone approach to measure daily urinary LH to identify the presumptive ovulation in combination with cervical mucus monitoring). Previously, we found that using the two markers (mucus and LH testing) may provide a more precise identification of the impending ovulation.¹⁴ In addition, using an application for charting the pattern of surging urinary LH rather than visually reading a qualitative yes/no urine test presents a much easier interpretation for patients. This becomes very useful since it is known that timing intercourse to ovulation might play an important role in helping couples get pregnant.¹⁵

This dual approach allowed for flexibility and accommodated patient preferences, potentially increasing adherence and accuracy in identifying the luteal phase. The integration of serum progesterone measurements to give confirmation of ovulation, with easy access to the online portal, provided a reliable confirmation of the luteal phase, reinforcing the initial trust in the tracking methods. The questionnaire

Table 1 Feedback obtained on the use of the method

Statement	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)	Prefer not to answer (%)
There is a laboratory location that is easily accessible to me	42	50	0	8	0	0
Wait times for blood testing are acceptable	33	50	0	17	0	0
It is easy for me to adjust my day to accommodate blood testing	42	8	0	33	17	0
I don't mind having blood tests taken	17	33	25	25	0	0
It is easy for me to understand the result of my blood test when I see it online	50	42	0	8	0	0
I have confidence in serum progesterone testing to identify when I have ovulated	67	25	0	0	8	0
I plan to continue using this type of testing in the future	42	42	0	8	8	0
I would recommend someone I know to speak to her health care professional about this type of testing to avoid/become pregnant	33	50	17	0	0	0
I would use a urine test to confirm ovulation instead of serum progesterone testing even if it was less accurate than serum progesterone testing	25	25	8	42	0	0
The design of the patient information sheet, such as the font size, diagram, and graphics, is adequate	17	83	0	0	0	0
The written language of the patient information sheet is clear and easy to understand	42	50	0	8	0	0
The patient formation sheet provides me with sufficient information about serum progesterone testing	25	75	0	0	0	0
I feel more informed after reading the patient information sheet	17	75	8	0	0	0
I feel that the patient information sheet will help me to remember facts about this type of testing	17	67	8	8	0	0

feedback highlighted a general comfort with the methods, suggesting a positive reception among our patients. The median duration of method use was 56 months, which could indicate sustained engagement and satisfaction. The rate of continued use (13 out of 15 patients) among those trying to avoid pregnancy might underscore the method's acceptability and perceived effectiveness.

Our study population represented various targets for ovulation tracking, such as infertility assessment, gynecologic conditions, and family planning which overall may be a good representation of the potential methods' applicability. Confirmation of ovulation is one of the cornerstones for infertility workup.¹⁶ The combination monitoring with a follow-up timed serum progesterone¹⁰ proved to be very acceptable for our patients. Among the 15 patients using FAM for pregnancy avoidance, the methods proved effective, with no unintentional pregnancies reported. The intentional pregnancies observed encourage us that the methods may have utility in family planning, and further studies might be warranted. All patients used the protocol for

ovulation prediction and confirmation. Furthermore, all of them used it for more than one reason. Self-observed cervical mucus and LH levels with smartphone applications enable women and their clinicians to time hormonally sensitive clinical tests and treatments in relation to phases of the menstrual cycle.^{16,17} Additionally, calendar tracking provides an objective record of conditions such as oligomenorrhea and amenorrhea seen in polycystic ovarian syndrome and perimenopause. Cervical monitoring is also important to assess infertility and it has been associated with increased fecundability independent of intercourse frequency or use of urinary LH monitoring.^{18,19} All of the above were commonly used to address our patients' conditions.

As a novelty, with the use of the application, the option to incorporate BBT monitoring might become practical. It has been previously published that given the clear correlation between progesterone and BBT rise after ovulation, BBT can be used to confirm ovulation retrospectively in selected patients. In a great majority of cases, the correlation between

Table 2 Descriptors for 15 cases using a combination of urinary and blood hormonal with smartphone technology for FAMs to avoid pregnancy

ID	Age	Parity	First date used	Number of menstrual cycles when serum progesterone test was performed	FAM method used	Continuation
1	45	3	2017–02	4	Mucus	Yes
2	36	6	2015–03	9	Both	Yes
3	40	2	2017–02	12	Both	Yes
4	40	3	2018–07	32	Both	Yes
5	33	4	2018–04	4	Both	Yes
6	34	3	2014–08	28	Both	Yes
7	32	2	2019–07	6	Mucus	Yes
8	38	3	2017–06	12	LH	Yes
9	32	3	2019–06	15	LH	Yes
10	38	1	2019–06	4	LH	No (not sexually active)
11	38	4	2017–03	36	Mucus	Yes
12	36	3	2016–05	54	Mucus	Yes
13	29	0	2019–08	15	Both	No (now trying to get pregnant)
14	39	2	2019–10	13	Mucus	Yes
15	38	6	2017–10	30	LH	Yes
Median	38	3		13		

Abbreviations: FAMs, fertility awareness methods; LH, luteinizing hormone.

progesterone and BBT suggests that BBT rise might be a good surrogate for progesterone level in indicating that ovulation has occurred; a BBT rise was present in 95% of the cycles analyzed in this study.²⁰ The baseline BBT or “baseline average” of each cycle was calculated as the average of the six lowest consecutive BBTs during the follicular phase. This hyperthermic shift, or rise, was defined by three consecutive days of BBT at least 0.3 °C above the baseline average. ► **Fig. 3**

shows an example of this shift seen among one of our patients. Interestingly, a hypothalamic shift, or drop, from this “elevated” temperature at the end of the luteal phase could herald the start of menses. Alternatively, it can be hypothesized that ongoing elevated temperatures could indicate pregnancy. The use of smartphone-integrated artificial intelligence can be used to dynamically assess this BBT. We hold this could be tested in a future study.

Table 3 Common reasons for use of the protocol (not in any order)

Reason	Examples of use
Ovulation identification	To predict and help confirm ovulation for infertility/fertility assessment and family planning
Identification of the luteal phase	To time hormonally sensitive clinical laboratory tests (i.e., day 7 post-ovulation measurement of progesterone and estradiol levels) and treatments in relation to phases of the menstrual cycle (i.e., progesterone luteal support)
Calendar tracking	Menstrual monitoring of days for medical conditions such as PCOS and perimenopause after interventions. For PCOS, interventions such as weight loss, medications (Metformin, Letrozole, Clomiphene), and/or cyclic luteal progesterone use to induce menses. For perimenopause, monitoring LH surges (or lack of), cycle lengthening, and amenorrhea.
Monitoring of cervical mucus	Impact on infertility and other health conditions such as infection identification (e.g., yeast), spotting (perimenopause, luteal phase defect) ¹⁹

Abbreviations: LH, luteinizing hormone; PCOS, polycystic ovary syndrome.

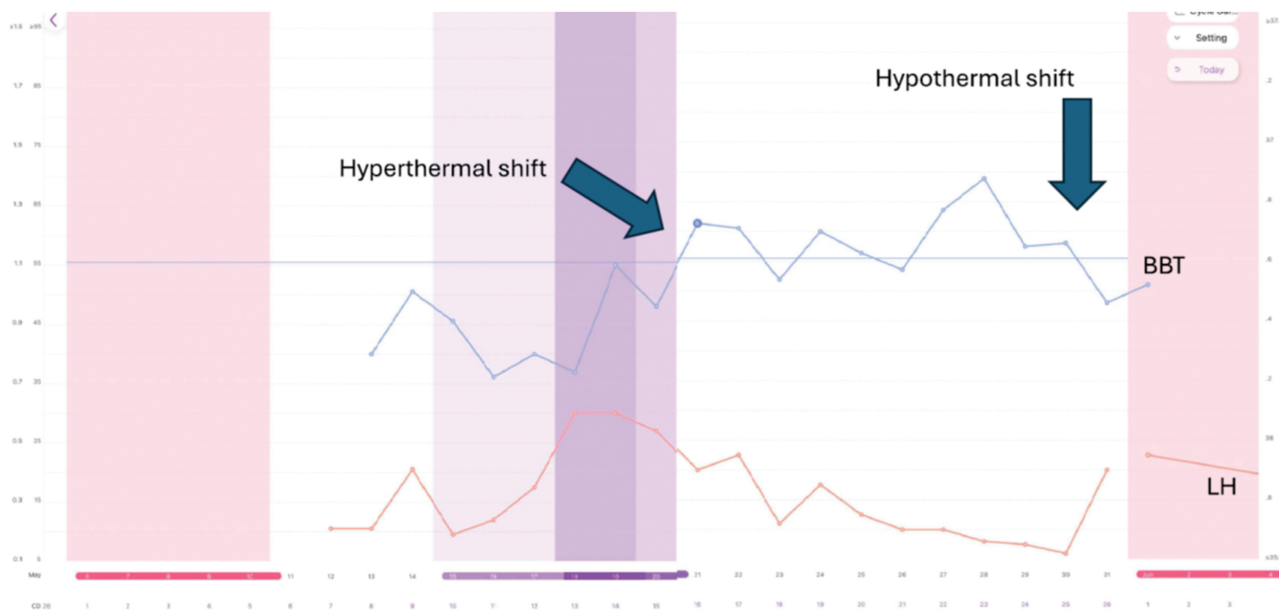


Fig. 3 Example of the use of basal body temperature (BBT) in combination with luteinizing hormone (LH) monitoring.

Conclusion

The use of a combination of urinary and blood hormonal monitoring with smartphone technology for the monitoring of fertility for both achievement and avoidance of pregnancy is a feasible option. It can help women in improving their reproductive health. This small case series indicates that further prospective studies incorporating improvements to smartphone applications integrated with hormonal urine tests are warranted.

Funding

None.

Conflict of Interest

We do not report any conflicts of interest and we are responsible for the writing of this article. This article is being submitted as a special issue invitation by the journal and the cost for open publication was provided by Pre-Mom, but they had no role in any data gathering, analysis, and writing of this article.

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References

- Stanford JB, Willis SK, Hatch EE, Rothman KJ, Wise LA. Fecundability in relation to use of mobile computing apps to track the menstrual cycle. *Hum Reprod* 2020;35(10):2245–2252
- Duane M, Contreras A, Jensen ET, White A. The performance of fertility awareness-based method apps marketed to avoid pregnancy. *J Am Board Fam Med* 2016;29(04):508–511
- Johnson S, Marriott L, Zinaman M, Gleib D. Smartphone apps for fertility tracking: How do they measure up? *Journal of Contraception and Reproductive Health Care* 2018;23(04):265–270
- Freis A, Freundl-Schütt T, Wallwiener LM, et al. Plausibility of menstrual cycle apps claiming to support conception. *Front Public Health* 2018;6:98
- Blair DL, Morgan HM, McLernon DJ. Women's perspectives on smartphone apps for fertility tracking and predicting conception: a mixed methods study. *Eur J Contracept Reprod Health Care* 2021;26(02):119–127
- van de Roemer N, Haile L, Koch MC. The performance of a fertility tracking device. *Eur J Contracept Reprod Health Care* 2021;26(02):111–118
- Berglund Scherwitzl E, Gemzell Danielsson K, Sellberg JA, Scherwitzl R. Fertility awareness-based mobile application for contraception. *Eur J Contracept Reprod Health Care* 2016;21(03):234–241
- Pearson JT, Chelstowska M, Rowland SP, et al. Natural cycles app: contraceptive outcomes and demographic analysis of UK users. *Eur J Contracept Reprod Health Care* 2021;26(02):105–110
- Hilgers TW. The identification of postovulation infertility with the measurement of early luteal phase (peak day +3) progesterone production. *Linacre Q* 2020;87(01):78–84
- Leiva R, Bouchard T, Boehringer H, Abulla S, Ecochard R. Random serum progesterone threshold to confirm ovulation. *Steroids* 2015;101:125–129
- Leiva R, DiRienzo L. Combination of home-based hormonal and mobile technology for virtual monitoring of menstrual cycles. *Ann Fam Med* 2021;19(02):180
- A prospective multicentre trial of the ovulation method of natural family planning. I. The teaching phase. *Fertil Steril* 1981;36(02):152–158
- Stanford JB, Smith KR, Dunson DB. Vulvar mucus observations and the probability of pregnancy. *Obstet Gynecol* 2003;101(06):1285–1293
- Leiva R, Burhan U, Kyrillos E, et al. Use of ovulation predictor kits as adjuncts when using fertility awareness methods (FAMs): a pilot study. *J Am Board Fam Med* 2014;27(03):427–429

- 15 Gibbons T, Reavey J, Georgiou EX, Becker CM. Timed intercourse for couples trying to conceive. *Cochrane Database Syst Rev* 2023;9(09):CD011345
- 16 Practice Committee of the American Society for Reproductive Medicine. Electronic address: asrm@asrm.org Practice Committee of the American Society for Reproductive Medicine. Fertility evaluation of infertile women: a committee opinion. *Fertil Steril* 2021;116(05):1255–1265
- 17 Practice Committees of the American Society for Reproductive Medicine and the Society for Reproductive Endocrinology and Infertility. Diagnosis and treatment of luteal phase deficiency: a committee opinion. *Fertil Steril* 2021;115(06):1416–1423
- 18 Evans-Hoeker E, Pritchard DA, Long DL, Herring AH, Stanford JB, Steiner AZ. Cervical mucus monitoring prevalence and associated fecundability in women trying to conceive. *Fertil Steril* 2013;100(04):1033–1038.e1
- 19 Martyn F, McAuliffe FM, Wingfield M. The role of the cervix in fertility: is it time for a reappraisal? *Hum Reprod* 2014;29(10):2092–2098
- 20 Écochard R, Leiva R, Bouchard T, Boehringer H, Iwaz J, Plotton I. Descriptive analysis of the relationship between progesterone and basal body temperature across the menstrual cycle. *Steroids* 2022;178:108964

Use of Serum Progesterone + Smartphone LH Application to Confirm the Luteal Phase

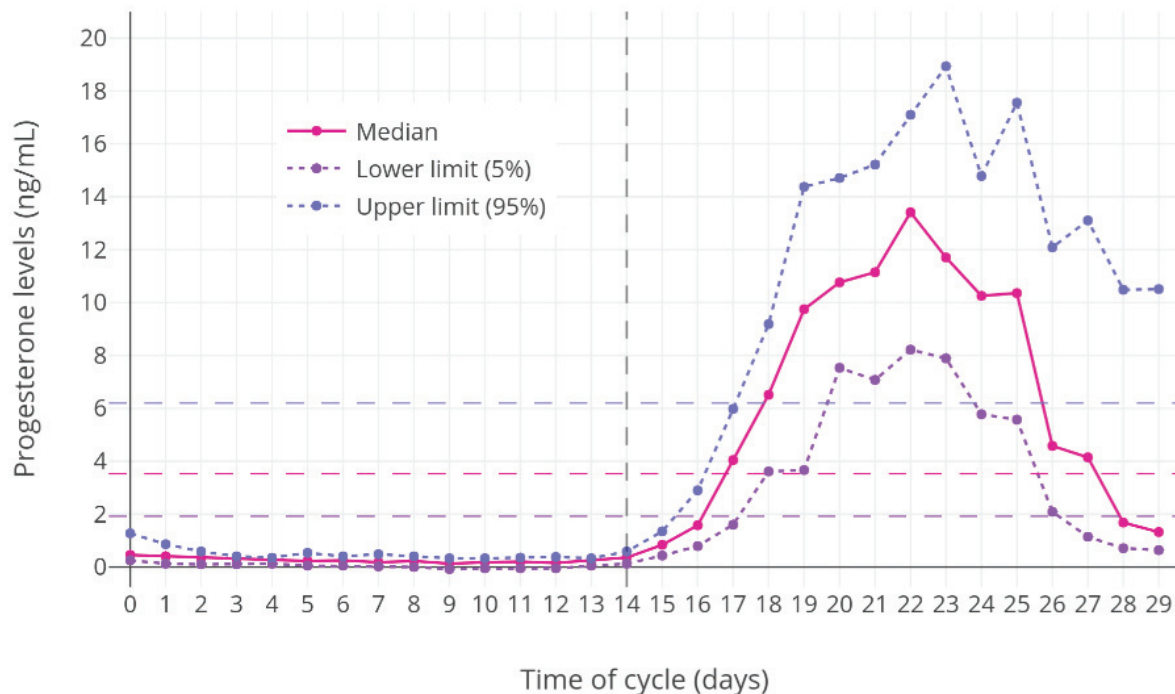
It is important that you first talk to a doctor to discuss the information provided in this sheet. It is not intended to substitute for consultations with a doctor, nor medical advice specific to your health condition.

What does Luteal-Phase mean?

The luteal phase is the second part of your menstrual cycle that begins after you ovulate and ends when you begin your next period. This is considered to be the infertile phase of your menstrual cycle.

What is Luteal-Phase Confirmation Progesterone?

This is a blood test that checks for a hormone called progesterone. The hormone is released mostly by the ovaries in high concentration only after ovulation. Thus, it may confirm that ovulation has occurred. The original idea to check progesterone for this purpose was proposed by a doctor named Dr. Thomas Hilgers.¹



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Why use this test?

Any woman may want to know whether she might have ovulated or not. It can also be used for patients having difficulty with Fertility Awareness Methods (FAM) monitoring or patients with infertility problems.

Dr. René Leiva

How does this test work?

A progesterone level of 5 nanograms per milliliter (15.9 nanomoles per liter or 15.9 nmol/L) or greater in your blood implies that ovulation has occurred.² Research shows that this level of progesterone can confirm ovulation with very good certainty (98%).³ Therefore, any woman who has a level of 16 nmol/L or above can confidently know that she has arrived at her infertile luteal phase.

To avoid pregnancy, you will need to abstain from any genital contact starting the first day of your period until the day after the progesterone test confirms that you are in the luteal phase. You can then be intimate with your spouse anytime during the luteal phase until the first day of your next period.

When should this test be done?

The test can be done anytime during the menstrual cycle. However, to increase your chance that the level will be 16 nmol/L or above, it should be taken:

- anytime right after Peak day for those using mucus-based FAM⁴ or
- after a positive LH test (also called an ovulation predictor test-stat testing on first day of menses)⁵ or
- after the LH Peak identified by a using LH smartphone apps such as <https://premom.com/> (start on testing on first day of menses- see below) or
- combination of the above⁶

Does this test confirm ovulation with 100% certainty?

No. The gold standard for confirming ovulation is follicular tracking with ultrasound.⁷ Also, in about 12% of cycles among regularly menstruating women, the ovarian follicles fail to ovulate and keep growing. This event is known as Luteinized unruptured follicle (LUF). When this happens, the test does not confirm ovulation, but that luteinization has occurred. Luteinization is when the follicle cells change to luteal cells and progesterone is released. Once luteinization has occurred, the cycle is infertile.⁸

References

1. Hilgers, T. The Creighton Model Fertility Care System: A Standardized Case Management Approach to Teaching. Book II: Advanced Teaching Skills. 1st Ed. 2003. Pope Paul VI Institute Press.
2. Lindsay TJ, Vitrikas KR. Evaluation and treatment of infertility. *Am Fam Physician*. 2015;91(5):308-314. Erratum in: *Am Fam Physician*. 2015;92 (6):437. Available at: <https://www.aafp.org/afp/2015/0301/p308.html>. Accessed on October 1, 2024.
3. Leiva R, Bouchard T, Boehringer H, Abulla S, Ecochard R. Random serum progesterone threshold to confirm ovulation. *Steroids*. 2015;101:125-129. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/26111590>. Accessed on October 1, 2024.
4. Ecochard R, Duterque O, Leiva R, Bouchard T, Vigil P. Self-identification of the clinical fertile window and the ovulation period. *Fertil Steril*. 2015;103(5):1319 - 1325. e 3. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/25724738>
5. Leiva RA, Bouchard TP, Abdullah SH, Ecochard R. Urinary luteinizing hormone tests: which concentration threshold best predicts ovulation? *Front Public Health*. 2017; 5:320. Available at: <https://www.frontiersin.org/articles/10.3389/fpubh.2017.00320/full>. Accessed on October 1, 2024.
6. Leiva R, Burhan U, Kyrillos E, Fehring R, McLaren R, Dalzell C, Tanguay E. Use of ovulation predictor kits as adjuncts when using fertility awareness methods (FAMs): a pilot study. *J Am Board Fam Med*. 2014;27(3)427-429. Available at: <https://www.jabfm.org/content/27/3/427.long>. Accessed on October 1, 2024.
7. Bashir ST, Baerwald AR, Gastal MO, Pierson RA, Gastal EL. Follicle growth and endocrine dynamics in women with spontaneous luteinized unruptured follicles versus ovulation. *Hum Reprod*. 2018;33(6):1130-1140. Available at: <https://academic.oup.com/humrep/article-lookup/doi/10.1093/humrep/dey082>. Accessed on October 1, 2024.
8. Qublan H, Amarin Z, Nawasreh M, Diab F, Malkawi S, Al-Ahmad N, Balawneh M. Luteinized unruptured follicle syndrome: incidence and recurrence rate in infertile women with unexplained infertility undergoing intrauterine insemination. *Hum Reprod*. 2006;21(8):2110-2113. Available at: <https://academic.oup.com/humrep/article/21/8/2110/2938623>. Accessed on October 1, 2024.

Links to FAM (or Natural Family Planning) methods:

- Billings Method (mucus-based) <https://billings.life/en/>
- Creighton Method (mucus-based) <https://www.creightonmodel.com/>
- Marquette Model of NFP (mucus- and urinary hormone-based) <https://www.marquette.edu/nursing/natural-family-planning-model.php>