

Fertility Awareness: An appraisal

Unless you had a reason to reflect on it, you might think that we understood the basics of human reproduction since the beginning of time. Certainly there had to be some type of general understanding of the process that brings life into the world. Otherwise, none of us would be here at all. Likely the evolution of the knowledge of the sexual act came from observing domesticated animals behavior.

Maybe it would be interesting to know, then that up until the second half of the seventeenth century, Thought relating to the natural world was completely dominated by the idea of the Ancient Greeks. In the case of reproduction, there was no consensus, but two conflicting views, each harkening back to the heights of Greek and Roman culture.¹

Hippocrates, the patron of medicine, noted that pregnancy took place between the joint action of two kinds of semen – one provided by the man, and a second provided by the women in the form of her menstrual blood. His proof was based in the observable phenomena of the ejaculate, and the fact that menstruation stops during pregnancy.

Aristotle, a century after Hippocrates theory, suggested that all mammals were created when the male's semen combined with the female menstrual blood to form a new individual, with the heart, as the central organ, created immediately after intercourse. Thus the female provided the matter to create the pregnancy, while the male provided the form, just as a sculptor might address a block of marble.

There was not much of a development in thought regarding reproduction until the 14th century. Indeed Leonardo D'Avinci believed that semen came from the man's brain. And Saint Thomas Aquinas newly championed the writings of Aristotle, and postulated that the soul entered the human pregnancy around 40 days in the boy and about 3 months in a girl (because they grew slower). This belief continued into the Nineteenth century. In actuality, there are remnants of this theory present even today, during the arguments about when life truly begins.

There are no further developments until the 17th Century. William Harvey, renowned for his work on the circulatory system, published *Exercitationes de Generatione animalium*² in 1651. His observations led to the idea that every creature was generated from an egg (*Ex ovo omnia*). This egg can be most likened to the chicken eggs which are scrambled at breakfast. Later in the century, Regneir de Graaf recognized the ovary as the producer of eggs. However, these scientists believed that the structure known as the ovarian follicle was indeed the egg itself.

It took another two hundred years to discover the oocyte within the ovarian follicle³ and it was not until the twentieth century that the human oocyte was discovered and the first descriptions of ovarian follicular development were made⁴

Hormonal methods to evaluate the state of the ovary and ovulation were slow to develop^{5 6}. Initially, the methods were insensitive and in addition to the low concentrations of these substances in blood and urine made relatively large quantities of urine or plasma were necessary for accurate measurement^{7 8 9}.

You could imagine the laborious task of obtaining multiple specimens from people to detect the subtle changes in this dynamic system. However, over the course of the 1960's more sensitive and practical methods for measuring the hormones involved in ovarian function that allowed evaluation of the components of the system, known as the hypothyseal (brain)-ovarian axis, were developed.^{10 11 12} When these more sensitive tests were used to study normal menstrual cycles, it was shown that there is a moderate variation of values surrounding the time now known as the LH midcycle "peak" that is associated with ovulation.¹³ In fact, it is the normal variability of these hormones that lead to the variation in the length of menstrual cycles in general.

While studies such as these developed some basic conceptual models for understanding ovarian function, it was not until the late 1970's that the growth and regression of ovarian follicles could be viewed by trans abdominal ultrasonography.^{14 15} High resolution transvaginal ultrasonography, which was first used in the late 1980's have dramatically improved the visualization of ovarian structures and with continual improvement, provide clear growth information of individually identified follicles.^{16 17}

It is important to realize that the development of ovulation monitoring and even natural family planning has developed as an offshoot of the continuing understanding of ovarian function. We will follow the natural evolution of the understanding of ovarian function as we continue this review.

The Menstrual Cycle

Many superstitious beliefs have surrounded menstruation throughout recorded history. From hair washing during the menses has been said to not hold a curl, to making meat rot, to fear that menstruating women would scare off the game in a hunting party, menses has been regarded with misgivings and outright fear by people over the ages.

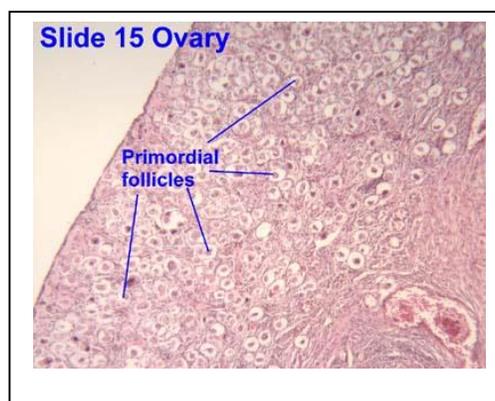
Much of the suspicion was related to misunderstandings about the nature of the process. Since bleeding has been related to misadventure or potential disaster, the process was seen as back luck or even impending doom. Little wonder, that, just as the ovary and ovulation remained largely unknown until the 18 or 19th century, so, too it took until 1842 until the relationship between menstruation and ovulation was described.¹⁸

In order to understand the basis for Natural Family Planning methods and ovulation, it is helpful to have an awareness of the mechanisms involved in the regulation of the normal menstrual cycle. It is most helpful in this regard To divide the cycle into three phases: the follicular phase, ovulation and the luteal phase.

The Follicular Phase

During the follicular phase, an orderly sequence of events occurs that ensure the proper number of oocyte containing follicles are ready for ovulation. In humans, the end result of this process is usually one mature follicle, and typically occurs over a span of 10-14 days. Hormones from the pituitary gland (located at the base of the brain) and the ovaries are largely responsible for follicular growth and development. A normal menstrual cycle lasts about 28 days. The first day of menstruation is considered to be day one of both the menstrual cycle and the follicular phase.

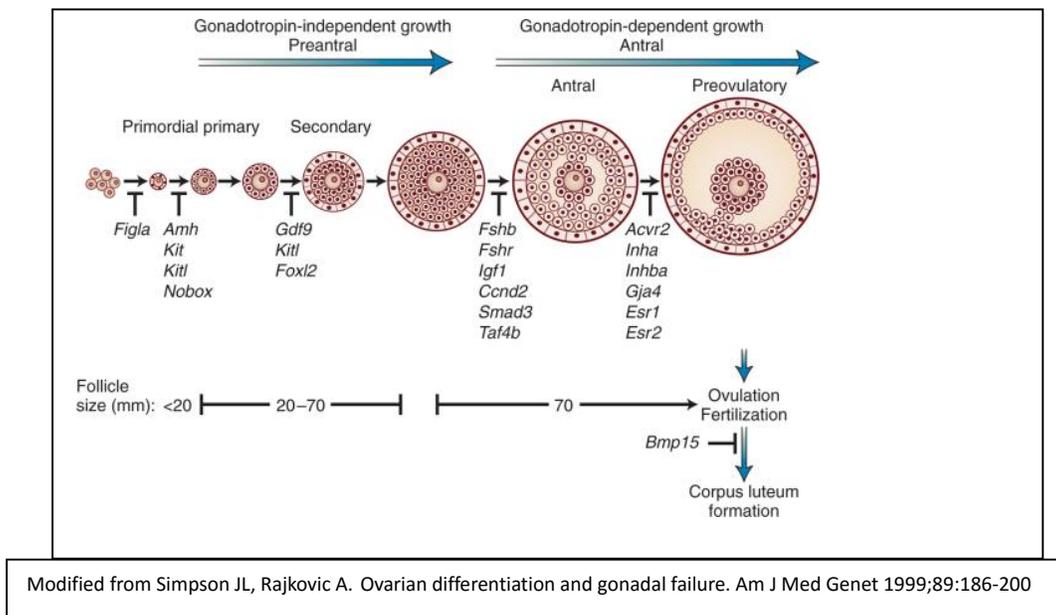
Prior to birth, the human ovary contains about 6 million oocytes surrounded by a single layer of cuboidal cells, called primordial follicles.¹⁹ Until their number are exhausted, primordial follicles grow and undergo atresia continuously. Growth and atresia are not interrupted by pregnancy, ovulation or periods of anovulation. This dynamic process occurs at all ages, including infancy and around the menopause. From the peak number at about 16-20 weeks of gestation, the number of oocytes will irretrievably decrease. The rate of decrease is proportional to the total number present: thus, the most rapid decrease occurs before birth, resulting in a decline from 6-7 million to 1-2 million at the time of birth and to 300,000 to 500,000 at puberty. From this reservoir, about 400-500 follicles will ovulate during a women's reproductive life.



The mechanism for determining which follicles and how many will start growing on any day is unknown. The number of follicles in each growing group appears to be dependent on the size of the residual pool of inactive primordial follicles.^{20 21} These follicles are resistant to stimulation by pituitary hormones known as gonadotropins. It is possible that the follicle that is singled out to eventually ovulate in any cycle is the beneficiary of a timely match of follicle “readiness” and the appropriate hormonal stimulation.

The follicle that is destined to ovulate is typically recruited in the first few days of the cycle.²² The early development of follicles occurs over a time span of several cycles, but the ovulatory follicle is one of a group recruited during the late luteal phase of the previous cycle.²³ The total time to reach preovulatory status is about 85 days. As previously noted, the majority of this time, until the latest stages, involves responses that are independent of hormonal regulation.²⁴ Eventually, this cohort of follicles reaches a stage where, unless recruited by the pituitary gonadotropin Follicle Stimulating Hormone (FSH), the next step is atresia. As a result, follicles are continually available for a response to FSH.

The first visible signs of follicular development are an increase in the size of the oocyte. As follicular maturation progresses, the number of layers of supporting cells increases. Initially, the oocyte is surrounded by a poorly defined layer of granulosa cells and a smaller layer of theca cells. These cells will produce hormones that will aid in the further development of the oocyte. When the oocyte is surrounded by two to eight layers of granulosa cells, it is known as a Preantral follicle. Continued growth and development of the granulosa and theca layers is gonadotropin dependent. At the antral stage, fluid containing follicles are approximately 3 mm in diameter.



Each follicle is developed individually rather than in groups. The follicle that is selected to mature fully up to ovulation is slightly more advanced and slightly larger than other follicles that are not selected to mature. The follicle that proceeds through ovulation is thought to contain a larger number of granulosa cells.

Follicular development is regulated by pituitary gonadotropins and ovarian hormones that are produced in the granulosa or theca cells. These hormones may be involved in selection and maintenance in the lead or dominant follicle. Under the influence of the rising FSH levels and resultant estrogen levels of the early follicular phase, there is an increase in the fluid that develops within the granulosa cells, which combine to form a cavity as the follicle makes its gradual transition to the antral stage. This fluid serves to nurture the oocyte in a specific hormonal environment. At this stage, estrogen becomes the major substance in the follicular fluid, produced by the granulosa cells. This estrogen also stimulates LH receptors on the other major cell in the follicle, the theca cell. These cells produce precursors to testosterone, which are transformed into estrogen by enzymes in the granulosa cells. The successful conversion to an estrogen dominant follicle marks the “selection” of a follicle destined to ovulate. With rare exception, in natural cycles, only a single follicle succeeds²⁵

Ovulation

As the now dominant follicle secretes more estrogen, the pituitary gland is “stimulated” by the estrogen in a process known as positive feedback to secrete LH. The timing of the LH surge and then of ovulation varies considerably from cycle to cycle, even in the same woman. A reasonable and accurate estimate places ovulation approximately 10-12 hours after the LH peak and 24-36 hours after peak estrogen levels are attained.^{26 27} The onset of the LH surge is the most reliable indicator of impending ovulation, occurring 34-36 hours prior to follicular rupture.²⁸ A threshold of LH concentration must be maintained for at least 14-27 hours in order for full maturation of the oocyte to occur.²⁹ Usually, the LH surge lasts 48-50 hours.³⁰

The LH surge stimulates a large collection of events that ultimately lead to ovulation, the physical release of the oocyte and its cumulus mass of granulosa cells.³¹ This is not an explosive event; therefore a complex series of changes must occur which cause the final maturation of the oocyte and the decomposition of the follicular wall. These changes include a number of factors including

1. An increase in intrafollicular pressure
2. Proteolytic enzyme activity on the follicular wall
3. Morphologic changes in the stigma that favor follicular rupture
4. Perifollicular ovarian smooth muscle contractions
5. Changes in the ovarian intercellular collagen bundles, such as increased distensibility and plasticity
6. Vascular alterations in the perifollicular vessels

The mechanism that shuts off the LH surge is unknown. Within hours after the rise in LH, there is a precipitous drop in estrogen. The decrease in LH can be due to a loss of the positive stimulating action of the estrogen or to the increasing suppression caused by the production of progesterone by the granulosa cells, started with the onset of the LH surge.

It should be noted that an adequate LH surge does not ensure ovulation. The follicle must be at the appropriate stage of maturity in order for it to respond to the ovulating stimulus. In the normal cycle,

gonadotropin release and morphological maturity are usually coordinated and coupled in time. IN the majority of cycles, the requisite feedback relationships in the system allow only one follicle to reach the point of maturity.

The Luteal phase

The luteal phase of the menstrual cycle is characterized by a change in secretion of sex hormones from estrogen prominence to progesterone dominance. As FSH rises early in the cycle, stimulating division of the granulosa cells and production of estrogen, additional receptors for LH are created in both the granulosa and theca cells. With the LH Surge at the time of ovulation, these receptors bind the LH and convert the enzyme machinery in the theca cells to facilitate production of progesterone.

At the same time, the granulosa cells begin to increase in size and assume an appearance associated with the accumulation of a yellow pigment called lutein. Hence the resultant structure is known as a corpus luteum. What is remarkable about this process is that the transformation occurs over a few hours.³²

The production of progesterone begins approximately 24 hours before ovulation and rises rapidly thereafter. A maximal production of progesterone occurs 3-4 days after ovulation and is maintained for approximately 11 days following ovulation. If fertilization and implantation do not occur, progesterone production diminishes rapidly, initiating events leading to the beginning of a new cycle.

Progesterone levels rise sharply after ovulation, reaching a peak approximately 8 days after the LH surge. The secretion of progesterone during the luteal phase is episodic, and changes correlate with LH pulses.³³ Because of this mode of secretion, there can be relatively low midluteal progesterone levels, which may falsely diagnose luteal phase defects in otherwise normal luteal phases.

In the normal cycle the time period from the LH midcycle surge to menses is consistently close to 14 days. Typically luteal phases lasting between 11 and 17 days can be considered normal.³⁴ The incidence of short luteal phases is 5-6%. It is well known that significant variability in cycle length among women is due to the varying number of days required for follicular growth and maturation in the follicular phase.³⁵

The corpus luteum rapidly deteriorates 9-11 days after ovulation, and the mechanism of the degenerative process remains unknown. The survival of the corpus luteum can be prolonged by a new stimulus of rapidly rising levels of hCG. This first appears about 9-13 days after ovulation, just in time to prevent corpus luteum regression.³⁶ hCG maintains the production of progesterone by the corpus luteum until about the ninth or tenth week of the pregnancy, by which time placental functioning is well established.

The Normal Menstrual cycle

As previously noted, menstrual cycle length is determined by the rate and quality of follicle growth and it is normal for the cycle to vary in individual women.³⁷ Cycle lengths are the shortest, and least variable in the late 30's, when there are small but real increases in FSH.^{38 39} This can be demonstrated by accelerated follicular growth. At the same time, fewer follicles grow per cycle as a woman ages.⁴⁰ Approximately 2-8 years prior to menopause, the cycles lengthen again, in general. In the last 10-15 years before menopause, there is an acceleration of follicular loss.⁴¹ This accelerated loss starts when the total number of follicles reaches approximately 25,000, a number reached in normal women at age 37-38.⁴² Eventually, menopause occurs because the supply of follicles is depleted.⁴³

Variations in cycle length reflect differences in the length of the follicular phase of the menstrual cycle. In general, women who have a 25 day cycle will ovulate on or about cycle day 10-12, and those with a 35 day cycle ovulate about 10 days later. Within a few years after the beginning of cycles (called menarche), the luteal phase becomes very consistent (13-15 days) and remains so until about the time of menopause.⁴⁴ At age 25, over 40% of the cycles are between 25 and 28 days in length; from age 25 to 35, over 60% are. Although it is the most commonly reported timing, only about 15% of cycles in women of reproductive age are actually 28 days in length. Less than 1% of women have a regular cycle lasting less than 21 days or more than 35 days.⁴⁵ Most women have cycles that last from 24 to 35 days, but at least 20 % of women experience irregular cycles.⁴⁶

With this basis in history and biology, we can now evaluate the various methods that have developed over time to predict the ovulatory window in order to improve or diminish the ability for a married couple to conceive.

Natural Family Planning

Throughout human history, a natural form of child spacing has been available through long term breast feeding. However, with the introduction of bottlefeeding in 1851⁴⁷, most Western women eventually were deprived of this natural means of avoiding pregnancy.

Many Couples today wish to regulate conception beyond the possibilities offered by breastfeeding alone, and some are interested in natural methods. The first real assistance for those interested in Natural Family planning became available in the 1930's through the independent work of Kyusaku Ogino in Japan and Hermann Knaus in Austria. They developed a system known as "calendar rhythm". However, this system did not cover all women, especially those with menstrual irregularity, and other options were needed.

The efficiency of Natural Family planning was tremendously assisted by the discovery that the hormone progesterone, produced by the ovary after ovulation, causes an easily measured elevation of the waking body temperature which persists until menstruation. Observations of other signs led to the development of what is known as "sympto-thermal" methods of natural family planning. These signs include changes in the quantity and quality of cervical mucus, physical changes at the level of the cervix, and ovulation pain, known as Mittelschmerz.

The development of the ability to measure the ovulation signal, LH, in the urine in the 1980's allowed for newer models of natural family planning that did not require daily measures of temperature or other physical signs.

But what is the best model for preventing and maximizing pregnancy naturally. It is likely that no one model will fit every woman at every stage of reproductive life. But let us examine each current model for it's benefits and shortcomings.

I. Calendar Based methods

Among the earliest of attempts at controlling childbearing was through understanding the benefits of periodic abstinence. However, it bears repeating that, As late as the 1920's researchers could not agree upon the precise function of the corpus luteum or the function of estrogen or progesterone. Indeed, these hormones were so new that they were not included in the medical textbooks of the time.⁴⁸

However, some researchers did attempt to apply the new science into their practices. In the mid 19th century, a French zoologist Felix Pouchet maintained that "women can always conceive on the eighth or tenth day after menstruation, and more rarely on the tenth to twelfth day."⁴⁹ He advised that from day 10 or 12 to the next menstrual flow, women were in their infertile phase. In cases where the women were not comfortable with counting their days of fertility, Pouchet said that "it was sometimes possible to identify the moments after which conception became physiologically impossible."

Knowing about Pouchet's work, Another Frenchman, Adam Raciborski advanced a more stringent strategy for periodic abstinence in 1844. He advised married couples to abstain from sexual intercourse 'for two to three days before menstruation and for eighteen days following the end of the menstrual flow.'⁵⁰ This formula would coincide with the post ovulatory phase of the menstrual cycle in most women with average cycle length (28-30 days). These findings encouraged more study into how to increase the efficiency of periodic abstinence. What is most amazing is that as this was embraced by more medical professionals, it was more accepted by the general population. By the end of the 19th century, this method of family planning was almost universally accepted and practiced.

What is most amazing about this fact is that it occurred while there were still a wide range of rules outlining the boundaries of the fertile period.⁵¹ Guidelines differed regarding the number of days counting as potentially fertile, or even when to begin counting. This persists to this time, as there is some confusion still among some women regarding the first date of menses. The typical advice recommended was that a woman abstain eight to twelve days after menstruation. The variations persisted into the early twentieth century. It was not long before both couples and physicians lost interest.

However, periodic abstinence is thought to have played a major role in the well documented decline in fertility from the 1850's through 1920. As the understanding behind the science of human reproduction improved, more precise protocols emerged in the 1920s with a different approach based in the fledgling science of endocrinology.

It took the independent research of two men, Kyusaku Ogino of Japan and Hermann Knaus of Austria to provide a modern scientific basis for periodic abstinence. Dr Ogino had a keen interest in the ovary, specifically the corpus luteum, on which he published several articles in Japan in the 1920s. Using his scientific methods, including observations of the ovary and uterus, he determined the "period of ovulation." Ogino published data in English in 1928⁵² and described the period of ovulation as comprising "five days from the 16th to the 21st days preceding the expected menstruation. Calculating three more days before this span and two days afterward, Ogino proposed a fertile window of about ten days. He added "this period [was] not influenced by differences in length of the menstrual cycle and... applied to cases of irregular menstrual periods." Ultimately, according to the Ogino's formula, a woman would estimate the beginning of her fertile period by subtracting 18 days from the shortest of her previous 6-12 cycles; she then estimates the end of the fertile period by subtracting 11 days from the longest cycle.

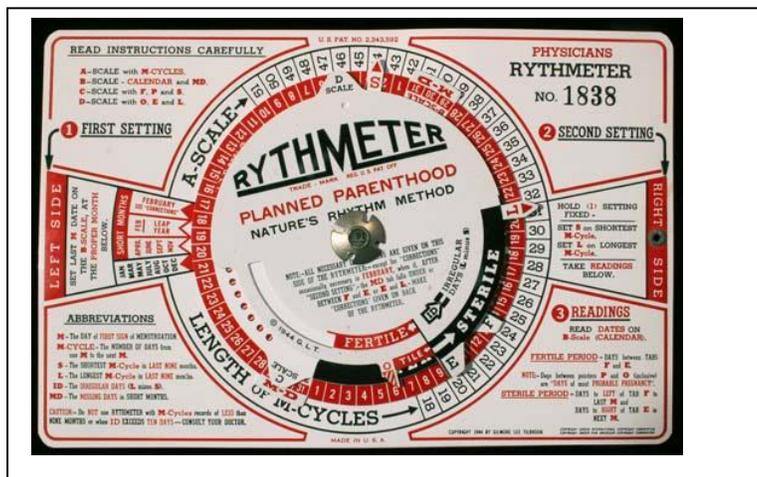
Meanwhile in the mid-1920's, Hermann Knaus would arrive at similar conclusions as Ogino but through an alternate route. His interest laid in the hormonal relationship between the pituitary gland, corpus luteum and uterus. Knaus' endocrinological observations revealed that sperm live inside the woman's reproductive tract for three days, but ova only live for 24 hours. It also challenged the long held belief that coitus stimulated ovulation.⁵³ His conclusions regarding the "time of ovulation" was shorter than Ogino's; Knaus identified it as 14 days after menstruation, but, as did Ogino, he was convinced that women had a fixed time of ovulation.⁵⁴ While the discovery of Ogino's research corroborated with

Knaus, both had only reported their work to the scientific community, and had not released it to the general public

Joannes Nicolaus Josephus Smulders, from Holland, saw the practical implications of the research of Ogino and Knaus and produced a formula to help women identify their time of ovulation. In 1930, Smulders wrote an article on what he termed the “Method Ogino-Knaus”.⁵⁵ The articles was well received and he published a book on the subject in the same year.⁵⁶ In the United States, a Chicago Physician Leo J Latz published a book in 1932. The Rhythm of Sterility and Fertility in Women gave birth to the term “the Rhythm Method.” Latz advised avoiding intercourse for eight days: for women with a regular 28 day cycle, this began five days before ovulation, with an extra three days added for safety.

While many people shared faith in the science behind the Ogino-Knaus method, the truth is that the process may not be so straight forward. Calculating the time of ovulation can be tricky. It varies from woman to woman and cycle to cycle. Stress, illness or interruptions in normal routine can also alter a woman’s cycle. A number of different products were developed to assist in the documentation of cycles.

But perhaps the most intriguing was the Rythmeter

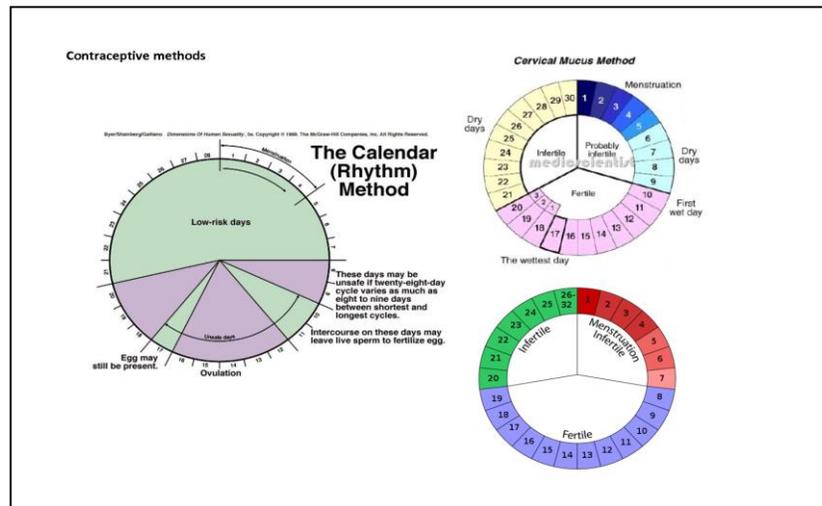


This device was developed by an engineer, Gilmore Tilbrook, in 1930, and, while ingenious, women were cautioned not to use it without having recorded at least 9 previous cycles.

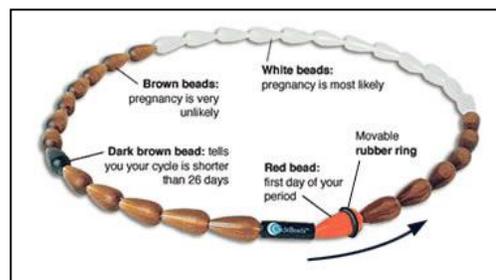
What was true during the earliest days of the development of the calendar method, and the reason for the multiplicity of products and long term documentation is that the female menstrual cycle is naturally variable. In the most recent study of the variability of menstrual cycles⁵⁷ Cole and associates estimate that 95% of normal menstrual periods will occur between 23-32 days. In addition, the follicular phase concludes with a the presumed ovulatory window within 10-20 days after the start of the last menstrual period, and the luteal phase last 9-17 days after the presumed ovulatory window. The net result of this data is that a woman fitting this description would abstain for 16 days, from the fifth to the twentieth day of her cycle. Women with great variation in cycle length would need to abstain longer.

In early studies of the Calendar method, pregnancy rates were high. In three studies, pregnancy rates ranged from a low of 14.4 pregnancies per 100 woman years to a high of 47.^{58 59 60} As newer forms of natural family planning were developed, Calendar methods began again to fall away in popularity, or became incorporated into other forms of monitoring.

There was new attention brought to the Calendar methods by Georgetown University's Institute for Reproductive Health. In 2001, they developed a system known as the Standard Days Method. Unlike the rhythm method, it has been tested in several efficacy trials, and has yielded a typical use effectiveness rate of 88%. It is appropriate for women whose menstrual cycles range from 26-32 days. Standard Days method used avoid unprotected sex (or better yet, practice periodic abstinence) on days 8-19⁶¹ To help couples monitor cycle length and identify fertile days, The Institute has developed a mnemonic device (CycleBeads[®]) consisting of a strand of color-coded beads that correspond to fertile and safe days. This method has been introduced in 30 countries and is included in the family planning norms in 16 countries. The World Health Organization recognizes it as an effective and modern method.⁶²



www.docstoc.com



While the Calendar method appears relatively easy, even in the closed adherents, there is not 100% protection from pregnancy. While this might improve the chances of conception, it is unlikely that it would do much more than chance at improving the opportunities to conceive. It does allow for both members of the couple to take an active role in the process, as the method allows for clear

At rest, the BBT usually fluctuates between 97.0° and 98.0°F during the follicular phase of the menstrual cycle. Progesterone levels greater than 5 ng/ml raise the central hypothalamic setpoint for basal temperature by approximately 0.6°F. Progesterone agents can also cause this rise in temperature. In most ovulatory women a sustained rise in BBT is indicative of ovulation. This can occur anywhere between 1-5 days after the midcycle surge in luteinizing hormone (LH) and up to 4 full days after ovulation has already occurred.

For greatest accuracy, the BBT needs to be a measurement of the basal temperature at rest before rising from bed in the morning.⁶⁹ Traditionally, a rectal thermometer is recommended, but with the advent of digital technology, an oral thermometer with the scale able to differentiate temperature to tenths of a degree will suffice. BBT is measured on awakening at approximately the same time each morning, before getting out of bed or doing any other activity. At least six hours of uninterrupted sleep the preceding night is necessary for accurate measurement. BBT remains high throughout the luteal phase secondary to higher progesterone levels. Ovulation is assumed after three consecutive days of temperature elevation. Pregnancy is avoided by abstaining from the beginning of menstruation until 3-4 days after the rise in BBT. All subsequent days until the beginning of her next menses are considered infertile.⁷⁰

Because sperm survive for 5 days,⁷¹ BBT does not predict ovulation far enough in advance to identify all the potentially fertile days; it predicts only peak fertility, so thus the need to have abstinence from the beginning of menstruation. Many other factors also limit the use of the BBT.⁷² Since women ovulate without a clear rise in BBT. Alcohol consumption, late nights or oversleeping, disrupted sleep, travel, time zone differences, holidays, shift work, stress, illness, gynecologic disorders and medications can all lead to inaccurate basal temperature measurement.

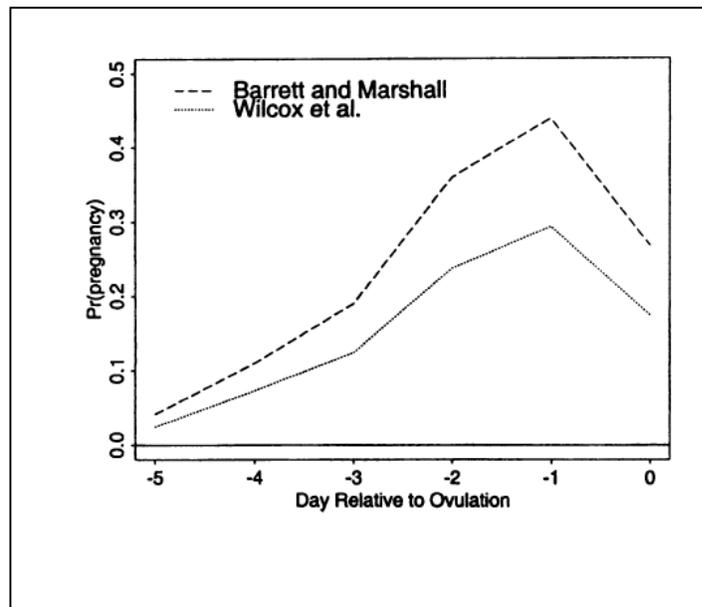
Classic Studies on ovulation prediction and use of the BBT revealed that only 95% of biphasic cycles are actually ovulatory and only 80% of monophasic cycles are anovulatory.⁷³ This indicates a 5% false positive rate and a 20 % false negative rate.

The advantages of the BBT chart are that it is inexpensive and allow couples to become directly involved with their own care. Previous month's data can be extrapolated in an effort to appropriately time coitus, which can be charted on the same chart for comparison.

The disadvantage of BBTs is that they can be difficult to accurately interpret and cannot be used to predict the exact day of ovulation. However, as a natural monitoring system, It is a viable choice for people to space pregnancies. The basal body temperature chart remains a good method for many couples to understand their individual reproductive cycles.

In more recent times, the fastidious detail of Dr Marshall's study has been matched with computerized models.⁷⁴ The result has led to more precision in detecting the window of ovulation, specifically to improve the chances of conception. The protocols that have been developed utilize information regarding the day specific likelihood of pregnancy when conjugal activity occurs in the first part , or follicular phase of the menstrual cycle. Dr Marshall's data was reanalyzed by Schwartz et al in 1980⁷⁵ and

additionally by Royton in 1982.⁷⁶ However, this was essentially retrospective data. Wilcox performed a prospective study in 1995 to test the Marshall theory. While not using basal body temperature as a means to test the ovulatory period, he nonetheless was able to confirm that there was a chance of pregnancy when conjugal activity occurred within 5 days of ovulation.⁷⁷ This data compares favorably with the estimates of Barrett and Marshall in 1969.



As a result, internet sites that catalogue the temperature entries from women attempting pregnancy have been developed⁷⁸ which utilize a coverline method predicts the likely ovulatory day or window. This is based on the suggestion, again by Marshall, that the end of the ovulatory period comes after the third elevated temperature day.

Again, utilizing the same data, a British company, Cambridge Temperature Concepts, developed a Monitor in 2009 that continuously monitors temperatures, which then can be uploaded to a web site. This monitor, known as Duofertility, theorizes that the additional data moves the pregnancy success that approaches IVF.⁷⁹ The future may bring additional means to improve the efficacy of temperature as a fertility monitoring plan.

III. Cervix/Cervical Mucus

IT might seem amazing to some, but until the mid-twentieth century there were only two methods of natural family planning: The rhythm (calendar) method and the basal body temperature method (which could be combined with the calendar method). In 1953, John Billings, a young neurologist, was spending time as a medical consultant for the marriage consultant for the Archdiocese of Melbourne, Australia. He was impressed by the number of couples who were using the calendar and temperature methods who were having unintended pregnancies, and dedicated himself to finding another option. Finding an

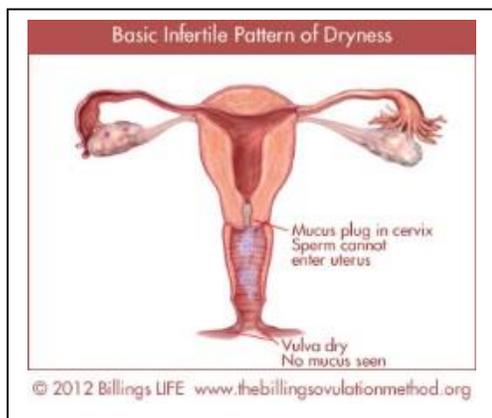
excellent and comprehensive review by TW Smith written in 1855 titled “The Pathology and Treatment of Leucorrhœa”⁸⁰ led Billings to begin to ask women about the sensation of a discharge during their cycle. He knew about the research of Ogino and Knaus that demonstrated that ovulation occurred about two weeks before the next menstrual period, and was able to guide the women towards the best time to expect the sensation of mucus and to “steer clear of the mucus”

In 1962, JB Brown accepted an appointment as First Assistant in the Department of Obstetrics and Gynecology at the University of Melbourne. This was despite being recruited heavily in the United States, particularly by Gregory Pincus, the developer of the oral contraceptive pill. Dr Brown had become so in demand because he had developed a chemical method for measuring estrogen in the urine. The method was developed over a decade and validated in 1955⁸¹ This method was considered the gold standard for measuring reproductive hormones for over 20 years, until the advent of modern radioimmunoassay on the blood.

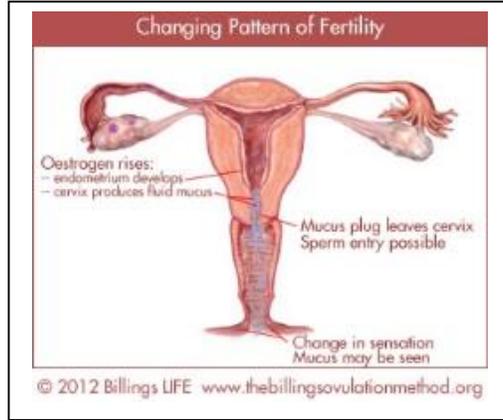
Dr Brown and Dr Billings developed a close friendship and Brown’s assays were tasked to validate the clinical observations of mucus appearance that Billings had been documenting. This led, in 1964, to the first edition of “The Ovulation Method”⁸². This was done to emphasize that a new idea was being devised with reference to the time of ovulation and the resulting ability to identify the fertile time. Billings had observed that the characteristics of sensation of the mucus on the vulva and any other observations that might be made, is a variable pattern. Brown was able to correlate the observations with hormonal patterns, beginning with the progressive rise of estrogens up to a peak about a day before what was described as the Peak day, which was the day on which was the best chance of a woman becoming pregnant. The changes of the mucus characteristics after this day were reflected in the rise of progesterone just prior to ovulation.

The precise timing of ovulation could now be determined by measuring the estrogen and progesterone metabolites in the urine, and these were well related to the symptoms that Billings had gleaned from his interviews. Thus ovulation was shown to occur on the Peak day or on the following day or, in rare cases, the second day after the Peak. Likewise, other patterns of mucus sensation could be correlated to patients experiencing infertility or pre- menopausal symptoms.

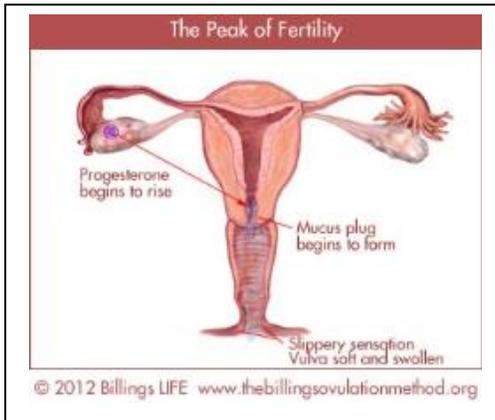
Billings taught that, following menstruation, the first few days are marked by no discharge. Estrogen levels are typically low at this time, and the resultant mucus is thick and forms a plug, which blocks the progress of sperm. Alternatively, the woman might feel a constant, unchanging discharge. This is from the mucus plug, and estrogen remains low.



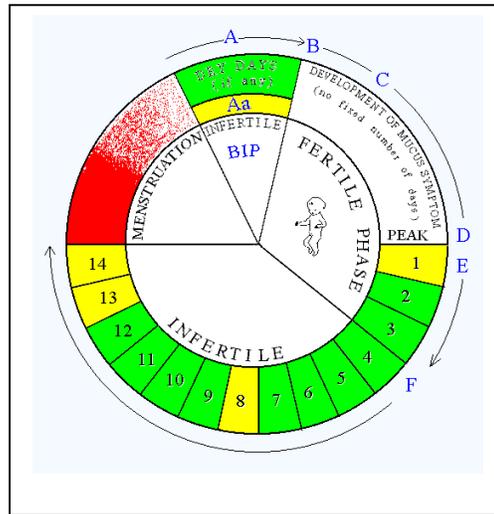
Next, there is a change in sensation that occurs over one to six days. The mucus sensation becomes thinner and clearer and there is a sensation of wetness that becomes slippery. There may also be a fullness or softness of the vulva. This is a result of the slow and steady rise of estrogen in the follicular phase of the menstrual cycle



The last day of this wet, slippery sensation is noted to be the Peak of fertility. This might last a day or two after the Peak mucus sensation.



Following the peak of mucus, menstruation should occur within 11-16 days, if the cycle is fertile, the mucus thickens in response to progesterone, there should be no discharge. The slippery, wet sensation will not return until the next ovulatory period.



Further Understanding of the characteristics of the cervical mucus were provided by Eric Odeblad. In 1959, he showed through microscopic samples that cervical mucus was composed of several sub-types which were produced in cervical crypts within different parts of the cervix.⁸³

In 1966, Odeblad was able to show the existence of Crypts (glands) which responded to the same hormonal stimulation.⁸⁴ Two distinctly different types of single crypt mucus were characterized,⁸⁵ “G”, from crypts that react to gestagenic stimulation and “E” from crypts reacting to estrogenic stimulation. The “E” type was further divided into “L” and “S” types. Microscopic studies also found a variation of the mucus on Peak days that were names P mucus.⁸⁶

“G” mucus is present in the cervical canal in all phases of the menstrual cycle except during the fertile phase and menstruation. It is produced as a result of progesterone stimulation and acts as a natural barrier to sperm. Its high viscosity makes it a mechanical plug, closing the cervical canal, which is narrowed during the infertile phases by the muscular action of the cervix.

The “L” mucus has an intermediate viscosity, and is secreted during the whole of the fertile phase. During the course of the fertile phase, the “L” mucus becomes beaded, and acts as a support for the “S” mucus, which appears 1-3 days after the “L” mucus. The cooperation that develops between the “L” and the “S” mucus creates a positive environment for sperm transport. Subtypes of P type mucus can be present as far as 8 days prior to ovulation.

After menstruation, “G” mucus dominates and gives rise to the Basic Infertility Pattern. After 4-6 days, it becomes gradually replaced by the “L” mucus, and the fertile phase begins with the sensation of a wet tacky mucus, some days later the “S” mucus appears with a transition to wet, slippery mucus culminating on the Peak day with an extremely wet, lubricating vulva sensation. This sensation disappears quickly and within 1-2 days, the “G” mucus dominates through the entire secondary infertile period.

Sister M Cosmas Weissman first published outcome data using the Ovulation method in 1972.⁸⁷ She instructed 395 women, 331 of whom opted to use the method. Two hundred and eighty two couples practiced the method for a total of 2,503 days with only one method related pregnancy reported.

While the work of Dr Odeblad explained many of the reasons for the sensations that women were feeling during the menstrual cycle, it does not provide a practical means of evaluation. Most of the findings were made using nuclear magnetic resonance. There was need to create or find a method that could evaluate the mucus clinically. Vaclav Insler presented a semiquantitative method for monitoring the menstrual cycle using a Cervical scoring system.⁸⁸ A four point score (0,1,2,3) was adopted for estimation of the quantity, spinnbarkeit (stretchiness), and ferning of the mucus. During the initial 5-7 days of the cycle, the score was negative (up to 3 points), correlating with low urinary estrogen excretion. Over the next 3 days, a gradual rise in the score was observed, and some 3 days before ovulation, the score reached a plateau lasting up to the day of ovulation. A significant decrease in score occurred after the ovulatory day with a return to negative numbers (less than 4 points). These scores correlated well with urinary estrogen and progesterone levels.

Since the advent of the Billings method, almost all Natural family methods utilize some measurement of cervical mucus as a part of the data. It does not require a daily temperature, and is an improvement on previous methods that required a woman to actually check the cervix and cervical mucus internally.⁸⁹ While there are charts and stamps that can be utilized, the system does not require any special equipment. However, not every woman will experience noticeable changes in the vulvar sensations. This is particularly true as women become more mature, in their 30's and 40's that can see a decrease in fertile cervical mucus. In addition, while the changes are in line with estrogen and progesterone levels to a point, there is no guarantee that ovulation will occur, as even small changes in progesterone will cause changes in the cervical mucus.

The Ovulation method is very effective for couples who utilize the method perfectly. However, the first year pregnancy rate of those who utilize the ovulation method with less than perfect precision is about 20%^{90 91} To use the Ovulation method effectively, women need to be able to differentiate the feel, color texture and general appearance of the mucus, and to correctly interpret and chart the findings⁹²

In 1999, Irit Sinai and her colleagues from the Institute for Reproductive Health at Georgetown University proposed a simpler means for identifying the fertile period of the cycle. Called the Two Day Method,⁹³ The TwoDay method only requires that the women monitor for the presence of an cervical secretions. It does not differentiate between the physical characteristics of the mucus. The woman essentially just asks herself "did I note secretions today" and "did I note any secretions yesterday. She is likely fertile during the days when either of the questions are answered "yes" and not fertile when both questions are answered "no".

In 2004, the same group published a study evaluating the efficacy of the new system.⁹⁴ They followed 450 women using the method. The first year pregnancy rate was 3.5% with correct use of the method. When All cycles and pregnancies were included in the findings, the pregnancy rate was 13.7. This outcome compared very well with the efficacy of other fertility based methods of family planning.⁹⁵ A

World Health Organization study of the ovulation method showed a pregnancy rate of 19.6 when all cycles (correct and incorrect use) were included in the analysis.⁹⁶ The TwoDay method is could very well be a viable alternative to women seeking an easier method that does not require charting for utilizing the cervical mucus.

IV. Sympto-Thermal Methods

“Sympto-Thermal” methods involve combining two or more charting symptoms of the fertile time, such as the basal body temperature, and the cervical mucus. Each symptom is independently charted. The first report of this was made by Josef Roetzer in 1951 and by Edward Keefe in 1953. Roetzer, A Public Health Physician in Germany, Published a handbook in 1965 which was updated in 1979⁹⁷ and is currently the basis for Natural family planning classes in Germany. Edward Keefe was a New York Obstetrician who found that a number of women could not recognize the mucus signs at the vulva. He found that as ovulation approached, that, while gathering a sample of mucus pressed from the cervical os each day, that the cervix softened and the os gaped.⁹⁸ However, while reporting that the cervix also moves towards the head (cephalad) as ovulation approaches, he noted that his finding represented a “sign” and not a method and that it should not be used independently of other methods.⁹⁹

Roetzer published his findings in 1968. Using basal body temperature Charts and the ovulation method together in 180 women, he found an unintended pregnancy rate of all users of 0.68 per 100 women per year. Dr Marshall took interest in Roetzer’s data and completed a study which was published in 1976.¹⁰⁰ Following 84 women, he found a total pregnancy rate of 22 per 100 women per year, which was consistent with a previous study of the Ovulation Method alone, which reflected an unplanned pregnancy rate of 25 per 100 women per year.¹⁰¹

In the United States, the Sympto-Thermal Method is the major subject of most NFP classes. John and Sheila Kipply, in association with Konald Prem, an Obstetrician/Gynecologist at the University of Minnesota, developed a program which included the basal body temperature, mucus method and Keefe’s method of cervical position. In 1971, they founded the Couple to Couple League, which has grown to become the largest provider of NFP services in America. The classes included detailed instructions about the proper means of collecting and charting basal body temperature data. They advise checking the cervical mucus utilizing the method previous detailed by Insler. And finally, they review the physiological changes of the cervix obtainable by internal palpation originally described by Dr Keefe. The Couple to couple league refers to a study in 2007,¹⁰² which prospectively evaluates the method of Roetzer, and reflects a pregnancy rate of 1.8 per 100 women per year.

Perhaps the reason why there is such discordance in the paucity of studies using the Sympto-thermal method is that there are several methods from which to choose, and that increases that possibility of error, as much as effectiveness. The methods are also very people intensive, with different types of charting, and, in an effort to be efficient, usually multiple measures are present on the same chart.

V. The Creighton Method

Dr Thomas Hilgers was initially exposed to the Ovulation Method as a Resident in Obstetrics and Gynecology in 1972. In that year, he went to a conference at which John Billings was speaking. In 1975, he travelled to Australia, and spent time with John and Evelyn Billings and “learned everything we could about this system and brought it back to the United States.”¹⁰³ In 1976, as a member of the faculty at St Louis University, he started his first studies intended to standardize the Ovulation Method. This developed into what is now called the Creighton Model Fertilitycare system.

The fundamental principle of the Creighton model is the way in which the cervical mucus is monitored as ovulation approaches. The system is based on the original work of Cohen¹⁰⁴ who identified that, as ovulation approached, the stretchability and clarity of the mucus increased and its content of leukocytes and viscosity decreases. The survival of sperm is directly related to the presence of an ovulatory or periovulatory type of mucus produced by the cervix. These observations are also the basis for a fertility test known as the post coital test. This evaluation was performed at the midcycle of a woman’s cycle. A sample of mucus is aspirated from the cervical os, and the spinnbarkeit testing was done along with a microscopic view to identify motile sperm. In the Reproductive world, this test has largely been abandoned in favor of artificial insemination, though.

The cervical mucus is evaluated by means of testing after wiping the vulva, and then estimating the color, consistency and stretchiness of the mucus present on the tissue. This testing is done multiple times a day and before bed.

Use of the system is correlated to a 0.5 chance of unintended pregnancy, according to a metanalysis of five sites and over 1800 couples.¹⁰⁵

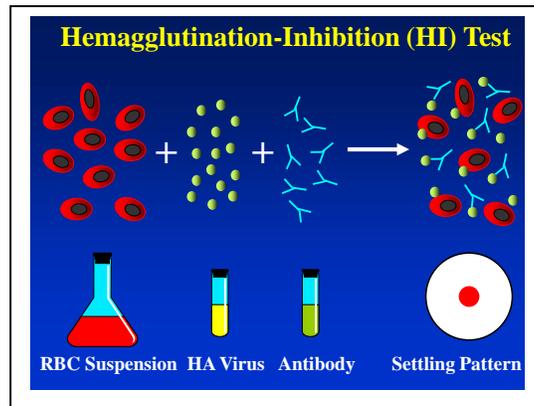
A complete compendium of protocols utilized in NaProtechnology go beyond the scope of this review. However, in cases of infertility, there is a full medical evaluation, and hormonal support offered to assist in the successful conception of children.

The Creighton Method, is currently the dominant method for Catholic minded couples. It has largely existed without independent evaluations, and has marked relations with the Ovulation Method of Dr Billings. However, it is a good option for couples seeking Natural Family Planning.

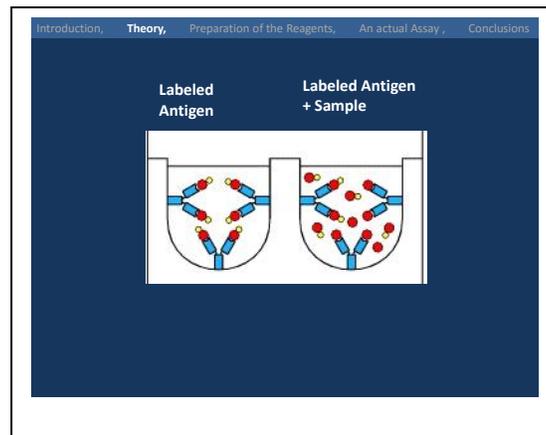
VI. Ovulation predictors: The Marquette Method

Of all of the predictive models for ovulation, the documentation of the LH surge has always been held as the gold standard.^{106 107} The precise timing of periovulatory events is made difficult by the episodic release of LH from the pituitary gland. Pituitary LH is pulsatile and varies in frequency and amplitude throughout the menstrual cycle.¹⁰⁸ Therefore, creation of a reliable test to detect LH initially proved difficult. The first report of testing for LH appeared in 1961.¹⁰⁹ This test utilized a hemagglutination inhibition reaction.

Hemagglutination Inhibition utilizes a solution of red blood cells mixed with a known antibody. In the LH test, if LH was present in the serum, then the sticking together, or agglutination of the red blood cells and antibody would be inhibited. The test is now done mostly for viral testing.



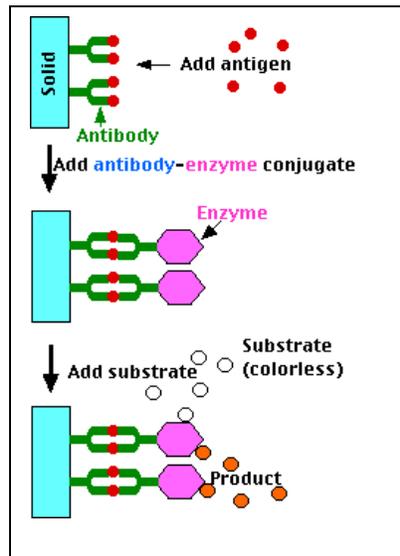
As a bioassay, the agglutination inhibition did not allow for practical quantification. The first report of a radioimmunoassay for LH was reported in 1966.¹¹⁰ Radioimmunoassay can quantify the amount of LH that is present in a serum sample by mixing it with a radioactively labeled antigen (which is similar to the LH). These compete for each other in a vessel that is lined with antibodies to LH, and then the vessel is placed in a gamma counter to measure the amount of LH is present in the sample.



Radioimmunoassay techniques, which dominated endocrine testing in the 1960's, are very precise means to detect plasma, and even urinary LH.^{111 112} However, the need for frequent office visits, repetitive blood samples, and the effort and cost to perform RIA has led to the development of more rapid, simple, and inexpensive methods for detection of the LH surge. The techniques have proved to be more convenient for both patients and laboratory personnel than daily blood LH determinations using RIA techniques.¹¹³

All currently available home ovulation prediction kits use the principle of enzyme linked immunoabsorbent assay (ELISA), otherwise known as a "sandwich technique." ELISA is similar to RIA, but there is no radioactivity. Instead monoclonal and polyclonal antibodies against LH are utilized to quantify the amount of the hormone in a sample. The vessel is coated with an antibody specific to LH,

then, after the sample is added, the amount of LH is quantified by an additional marker that is used to “sandwich” the LH and show a reaction that can be read by one of several methods.



Ovulation Predictor kits have one antibody that is attached to a stick or test pad and one that is bound to an enzyme. When LH is present in the urine, a “sandwich” is formed. The enzyme, once bound, can convert a noncolored substance found in the kit into a colored product. The intensity of the color is proportional to the amount of LH in the sample.

Ovulation prediction kits are specifically designed for home use. The results of studies using these kits have consistently shown correlation with laboratory generated testing.¹¹⁴ Most untrained people can easily perform and interpret the tests.¹¹⁵

The ClearPlan Easy™ Fertility Monitor was introduced 2001. The monitor is a hand held electronic instrument that measures both LH and estrone-3-glucuronide via ELISA. The difference is that, while most ovulation predictor tests give a colorimetric change that is qualitative in nature, the data provided by the electronic monitor provides a more quantitative output. The Addition of the Estrone-3 glucuronide is designed to indirectly follow the estrogen levels. These levels increase just prior to the LH surge. In the initial study using the monitor showed good concordance between the expressed data, and vaginal ultrasounds which showed the development of a follicle and it’s disappearance on the appropriate day.¹¹⁶

A brief study from a private practice in North Carolina,¹¹⁷ 54 couples were recruited and, over 6 months 21 conceived. The cumulative life table pregnancy rate was 16.7 after the first cycle, 31.5 after two cycles. 35.5 after three cycles, and 39.5 after four cycles, which suggested that the monitor was demonstrably effective.

The college of nursing at Marquette University has been using this monitor as the basis of their NFP methodology since 1999. Their first study, published in 2004 revealed the opening of the fertile window was , on average, day 11.8 using the monitor and day 9.9 using the cervical mucus.¹¹⁸

They followed up this study in 1997. Following 195 women seeking to avoid pregnancy for 1 year, using a method of self observation of cervical mucus and an electronic monitor (Clearplan easy), they found a correct use pregnancy rate of 2.1%. The imperfect rate was 14.2%¹¹⁹

This method utilizes the ovulation predictor to follow the LH surge, and cervical mucus testing similarly to the Creighton model. It, like the Ovulation Method, asks the woman to learn the sensation of the mucus at the level of the vulva, and then asks the woman to blot the area with tissue, observe and then measure the spinnbarkeit.

In 2009, the Marquette Institute for Natural family planning launched a web based study to compare the use of the monitor and cervical mucus. As of their first report in 2011, there was a 2% unintended pregnancy rate among those using the method correctly and a 7% unintended pregnancy rate in those with imperfect use¹²⁰

Overall, the Marquette Method appears to move NFP into the 21st century with the use of a more modern home based method, mixing the old (cervical mucus) with the new (LH kit).

VII Other Monitors

A. Cue/OvuCue

A different type of device that has been studied since the 1980's.¹²¹ The OvaCue ovulation predictor consists of a handheld digital monitor with vaginal and oral sensors. The sensors detect and record the electrical resistance of the saliva and vaginal secretions. The electrical resistance and electrolyte concentrations correlate to the estrogen levels in the serum. The electrical resistance of the saliva tends to stay low and begins to increase just before the LH surge. Vagina resistance declines to a low which coincides with the beginning of the LH Peak, and then sharply increases marking the purported day of ovulation.¹²²

Multiple studies have been performed to determine the usefulness of this Ovulation Predictor. Moreno et al¹²³ conducted the first study to test the CUE ovulation predictor for its potential use in NFP. They studied 29 menstrual cycle from 11 women and found peak salivary resistance 5-11 days prior to the estimated day of ovulation in all of the cycles. The Vaginal electrical resistance reached a nadir within 2 days of the estimated day of ovulation in 93% of the cycles. The vaginal electrical resistance had a strong correlation with the estimated day of ovulation.

Roumen and Dieben¹²⁴ found no strong correlation between the CUE salivary peak and the day of the LH surge in 27 cycles measured among 18 female volunteers. Fernando and Betz¹²⁵ disputed the results of the Roumen and Dieben study, claiming that the CUE ovulation predictor had not been used correctly.

Jacobs and his collaborators¹²⁶, using a different electrical resistance monitor, found that the salivary electrical resistance occurred 4 to 9 days prior to the LH surge and that the Salivary electrical resistance was moderately positively correlated with the LH surge.

Moreno revisited his work in 1997. Analyzing data from an additional 10 women representing 42 cycles, he found that the salivary peak predicted ovulation on an average of 8 days in advance of its occurrence, and an increase in vaginal resistance within 1 day of follicle collapse in all of the cycles.¹²⁷

While the Ovucue monitor holds some promise, it does include an invasive vaginal probe, which is necessary to maximize the predictive ability of the monitor to document ovulation.

B. Ov-Watch

Research on the effect of menstrual cycle hormones on women's rate of sweating and the kinds of electrolyte salts began in the 1960's. Lieberman investigated the fluctuations in sweat electrolytes in women over the course of the menstrual cycle in 1966.¹²⁸ He examined 57 women in observed an apparent surge in chloride ion levels in women around the presumptive time of ovulation. He also noted a peak in sweat chloride just prior to the onset of menses.

Taylor et al analyzed the variation in sweat gland function in 20 women.¹²⁹ He found that when there was an alteration in eccrine ductal activity, it occurred in association with ovulation, as well as at the time of menstruation, corroborating Dr Lieberman's work.

In the development of a non-invasive monitor based on the work done in this period of time, the makers of a product known as the Ov Watch devised a sensor which could quantitatively measure the chloride ion concentration of the sweat in the skin. They found a rise in chloride ion secretion 5-7 days prior to the urinary LH surge, a drop around 2 days before the LH surge and a rise again just after the time of the LH surge. This data is consistent with the salivary impedance previously discussed under the Cue Monitor studies.

TG Hannam performed the first clinical study of this product, then known as Fertilite-OV.¹³⁰ In this study of 21 women, the monitor confirmed ovulation within 2 days of actual ovulation (confirmed by blood testing) in 16 of the 21 cycles (76.2%). This compared favorably with the Clear plan monitor used as a control (75% within 2 days).

The usefulness of the OV-Watch was assessed in a clinical trial conducted by researched at Duke University and the Women's institute in Philadelphia. The effectiveness of the product for predicting ovulation within approximately three days of ovulation was compared with that of two other products, the Clear Plan urine LH test strips and basal body temperature charts. The study, which included 105 women, concluded that the Ov-Watch was equivalent to the other two ovulation prediction products in correctly identifying ovulation within two to three days of the event. Additionally, it was shown that eh OV-Watch could identify more days of the fertile window than could LH detecting urine kits. 72% of women using the Ov-Watch compared to 13% of those using the LH kits were able to detect four or more

of their fertile days. Furthermore, 56% of women using the OV-Watch detected 5-6 fertile days, compared with none of the women using LH kits.

What is interesting about this data is that it is not published, but the data is held by the company that produces the monitor. Personal correspondence with the primary investigator of the trial said that, in his opinion that the monitor did not work as described. As of today, there are no clinical trials that are ongoing, but with the possibilities that this device could have in NFP, it deserves a long look.

VII. Summary/Recommendations

Based on the most recent National Health Statistics reports from February 14, 2013¹³¹ that since 1982, between 2.3 and 4.1 % of sexually experienced women between the years of 15 and 44 utilize natural family planning as a means of spacing their families. From 2006-2010, 22% of sexually experienced Catholic women have used any periodic abstinence method. We also know from recent surveys and studies that NFP methods have been judged somewhat ineffective in helping couples avoid pregnancy.¹³²
¹³³ Most importantly, we know that women prefer to have a family planning method that is effective, easy to use, and convenient.¹³⁴

When reporting the efficacy of methods of family planning to avoid pregnancy, two numbers consistently appear: the correct use efficacy and the total use efficacy. The correct or perfect use pregnancy rate refers to the pregnancies that occur when the method is used consistently and according to instructions. The total pregnancy rate includes all unintended pregnancies, whether the method was used correctly or not. Typical use rates refer to the average rate in the use of the method outside of a controlled efficiency study.

The following table includes the perfect and typical use rates of some of the studies that have been published on some of the studies of various NFP methods:

Rates per 100 women over 12 months of use

Study	Indicators	Correct	Typical
WHO (Billings)	Mucus	3.0	22.0
Howard (Creighton) ¹³⁵	Mucus	0.1	17.0
Arevalo (SDM)	Fixed Calendar	5.0	12.0
Arevalo (Two Day)	Mucus	4.0	14.0
Frank Herrmann et al (STM)	Mucus/Temp	0.6	1.8
Fehring (Marquette)	Mucus/Clear plan	2.0	13.0

As is clear, there is a significant difference between correct and Typical use of most NFP methods. One must also understand that most of the methods are designed and studied to avoid pregnancy. There is little data supporting any of these methods to promote pregnancy, and very little comparative literature on this subject as well.

For a method to be considered for lifetime use, it must be effective, safe, and simple to learn and use. The efforts to simplify NFP methods by the Georgetown University Institute for Reproductive health seem to be moving in the correct direction. If there is to be a mucus monitoring method instituted into the method taught be PCR, it would be most useful to use the Two day method that has been described. It is easy to learn, does not require any standardized charting, and, with the right support, can easily achieve family planning rates in the perfect use range and beyond. Since it is a naturally occurring sign, it can be taught at a young age, and help young women learn more about their cycle.

Temperature appears to also have made a comeback. Between the web based options that exist currently, and some of the newer devices that exist, matched with the two day method can give a great deal of information for home use.

When a Married couple is attempting pregnancy, and these signs are not enough, the use of the Ov-Watch with the two day method may be the most natural and cost-effective method. While the Marquette method appears well designed, the monitor is expensive, and requires steps. The Ov-Watch, however, needs more study to show it's full applicability in these environments.

We cannot rest with these methods, Though. There need to be continued searches for more signs that can be brought together to create easier methods for family planning. There need to be more good randomized clinical trials comparing the current methods so that we can tell couples which methods are most effective with confidence. We need to incorporate all of the information technology that is at our disposal to teach and provide NFP monitoring assistance, and watch for the future.

There is an opportunity at PDR to create an environment that was first envisioned by Pope Pius XII in 1951. He asked scientists to "bend their backs" to help with developing secure natural methods. Pope Paul V was well known for encouraging studies in NFP and intensifying research.

What final recommendation will be based on a comprehensive review of this and other summaries, but I do believe that there is a clear basis for success in teaching methods that can be used for the entire reproductive life.

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