The medical paradigm in which physicians practice is constantly thoroughly tested and offer value to patients and their physicians. Not long ago many of the tests available for over-the-counter use were only possible through a hospital or physician’s office. At present, there are myriads of tests commercially available to consumers that claim to be accurate without the need for invasive blood testing. This billion-dollar-a-year industry continues to grow as a result of improved technology, an increased patient demand for autonomy and privacy, and the increasing cost of office-based services (1).

The purpose of this review is to provide physicians with an up-to-date survey of over-the-counter devices available to their patients. This review focuses specifically on tests designed to aid couples in matters related to human reproduction and infertility. The goals of the review will be to identify available tests and evaluate their advantages and disadvantages as defined by reliability, effectiveness, accessibility, cost, usefulness, and other available indicators. Although the review concentrates primarily on testing for infertile couples, it does not necessarily encompass all the modalities that have been promoted at this time.

Some of the products available over the counter have been thoroughly tested and offer value to patients and their physicians. Other products, however, at the present time, seem to lack enough practical application, relevance, or sound science to be broadly recommended to patients as a valuable adjunct to medical management. Based on the interpretation of the data reviewed by the investigators, suggestions of testing modalities that may be of maximal and minimal benefit are outlined in Tables 1–3.

The methodology used to compose this article involved several approaches. A detailed Medline search was first performed to identify available literature in the English language discussing over-the-counter testing. We then searched the online inventory of several major retailers to obtain pricing data and also alert us as to new devices commercially available. Online search engines, including www.google.com, were also used to identify testing modalities and their prices that were not found through mainstream retailers. In several cases, the manufacturers were contacted directly to provide further information regarding their products.

**OVULATION**

The ovum only survives 12–24 hours after ovulation without fertilization, whereas sperm may survive in cervical mucus for up to 5 days (2). Therefore, defining the time at which ovulation occurs is vital to determine the fertile period. The ability of women to predict the day of ovulation without formalized measures of specific physical changes has been documented to be imprecise (3). One study found that the ability of women to predict ovulation without formally monitoring cervical mucus or basal body temperature (BBT) was only 28% in highly motivated, regularly cycling women (3).

**Basal Body Temperature**

Ovulation is accompanied by physiologic changes that can be monitored by the patient. A biphasic pattern in the BBT is an increase,
ranging from 0.5°C–1.0°C (0.278°C–0.555°C) as measured with a thermometer, which corresponds with the production of P after ovulation (4). It is useful to establish a pattern of ovulation rather than to predict ovulation (4, 5).

Advantages of BBT are its low cost and ease of application at home (5). The test's accuracy, however, is questionable. Studies place the ability of BBT to precisely predict the LH surge to the day at 18.3%–30% and to within 1 day at 56.7%–70% (6). However, not all women display a clear shift in BBT after ovulation and conditions including illness, changes in sleep patterns, alcohol consumption, and certain medications may alter the BBT (4, 7).

The method also requires women to check and record their BBT daily. This is significantly burdensome for many women (8). Commercially available thermometers are able to track BBT electronically and then predict, based on past patterns, the most fertile points in a cycle. Natural Methods (Natural Methods, Inc., Orangeville, Ontario, Canada) is a company that provides such electronic devices that range in price from USD $279–$685 (9). The Natural Methods website provides the text for a study abstract presented at the International Meeting on Infertility and Assisted Reproductive Technology in 1997 which showed the device to confirm ovulation in 80% of women (10). However, the study (10) did not comment on the ability of the product to predict the ovulatory day and included only 10 women in the study. A Medline search by the authors could not find this work in the published literature.

Summary of BBT Records
Advantages (4, 5, 9):

- Cost
  - Low cost of traditional thermometer

- Accessibility
  - Highly accessible to consumers
  - Traditional thermometer available over the counter in a variety of retail stores

Disadvantages (4, 6–9):

- Accuracy
  - Able to predict the LH surge to the day at 18.3%–30%
  - and to within 1 day at 56.7%–70%
  - Requires patient interpretation of results

- Cost
  - Significant up-front cost for electronic monitors

- Accessibility
  - Electronic monitors not easily accessible to consumers
  - Electronic monitors available at few retailers
    - Products are available online

- Ease of use
  - Requires high level of patient compliance
  - Often requires instruction by physician’s office to train patient

Brand Evidence and Cost (9–11):

- Over-the-counter oral thermometers
  - Brand data
    - Specific brand data not found by literature review conducted by investigators
  - Cost
    - At USD $5.99–$19.99

- Natural Methods electronic monitors:
  - Brand data
    - One study of 10 women indicated that the device could accurately confirm 80% of ovulatory cycles retrospectively
  - Cost
    - Natural Methods produces
      - Baby-Comp at USD $685
      - Bioself at USD $279

Cervical Mucus
Another physiologic change that may be monitored by the patient is the characteristic of the cervical mucus that accompanies ovulation. The volume and viscoelasticity of the cervicovaginal fluid (CVF) increase in the late follicular phase and immediately after ovulation (12, 13). There have been attempts to quantify the volume of CVF. A plastic volumetric aspirator called the Rovumeter was developed in the mid-1990s that allowed women to aspirate CVF from the cervical os (13). The results of this device, however, were disappointing, causing the Rovumeter to fall out of favor and it is currently no longer in production (13).

Other investigators have evaluated the ability of women to detect qualitative changes in CVF at the level of the vulva to predict ovulation (14). Studies evaluating the accuracy of this method in

### TABLE 1

<table>
<thead>
<tr>
<th>Type of testing</th>
<th>Examples</th>
<th>Advantages</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovulation prediction</td>
<td>BBT (thermometers)</td>
<td>Low cost</td>
<td>Poor predictive value</td>
</tr>
<tr>
<td></td>
<td>Cervical mucus</td>
<td>Low cost</td>
<td>Conflicting data</td>
</tr>
<tr>
<td></td>
<td>Salivary ferning</td>
<td>Low cost</td>
<td>Conflicting data</td>
</tr>
<tr>
<td>Ovarian reserve</td>
<td>FSH testing kits</td>
<td>Low cost</td>
<td>Difficult to interpret an isolated result</td>
</tr>
</tbody>
</table>

Note: Adjuncts to clinical practice that may be helpful in some patients due to financial barriers. BBT = basal body temperature.


### TABLE 2

<table>
<thead>
<tr>
<th>Type of testing</th>
<th>Examples</th>
<th>Advantages</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovulation prediction</td>
<td>BBT (thermometers)</td>
<td>Low cost</td>
<td>Poor predictive value</td>
</tr>
<tr>
<td></td>
<td>Cervical mucus</td>
<td>Low cost</td>
<td>Conflicting data</td>
</tr>
<tr>
<td></td>
<td>Salivary ferning</td>
<td>Low cost</td>
<td>Conflicting data</td>
</tr>
<tr>
<td>Ovarian reserve</td>
<td>FSH testing kits</td>
<td>Low cost</td>
<td>Difficult to interpret an isolated result</td>
</tr>
</tbody>
</table>

Note: Adjuncts to clinical practice that may be helpful in some patients due to financial barriers. BBT = basal body temperature.

predicting ovulation are varied (15, 16). The advantages of using CVF to predict ovulation include low cost to the patient and lack of invasive testing (14). However, some view the inherent subjectivity of CVF interpretation by patients as a challenge (15). Furthermore, significant professional resources, specifically time, are needed to train women to evaluate CVF competently at home (14, 15).

Summary of Cervical Mucus Evaluation

Advantages:
- **Cost**
  - Low or no cost for patient
- **Accessibility**
  - Highly accessible to consumers
  - No purchase required

Disadvantages (14–16):
- **Accuracy**
  - Cervical mucus evaluation is able to predict ovulation within 1 day at a rate of 48%–76%
  - Requires patient interpretation of results
- **Ease of use**
  - Requires high level of patient compliance
  - Often requires instruction at physician’s office to train patient

Brand Evidence and Cost (13):
- **Subjective evaluations**
  - Brand data: not applicable
  - Cost
    - Does not require consumer to purchase a product
- **Rovumenter**
  - Brand data
    - Poor accuracy
  - Internet search by investigators did not reveal a company selling this product

Salivary Ferning Kits

Another approach to determine the fertile window has been the development of salivary ferning kits (SFK). An increase in the salivary NaCl concentration surrounding the ovulatory period results in crystallization, or ferning, on slide preparations (14, 17–19). Data indicate that women can accurately interpret salivary ferning in the home (18, 20). Not all data surrounding SFKs are supportive. Many have called into question the usefulness of salivary ferning as a tool to predict ovulation (19). Several studies have shown poor accuracy of the test to predict the ovulatory day and significant issues with women interpreting the test results (17, 20).

Variations in the estrogen (E) concentration within the saliva may cause a high degree of pattern variation when evaluating salivary ferning (20). Furthermore, air bubbles or excess saliva may invalidate or alter results (1). It has even been documented that salivary ferning patterns may also be noted in the saliva of male patients and postmenopausal women (19, 21).

One advantage of SFKs is their relatively low cost (19). An Internet search was able to identify kits for sale from $33.50 (22–24). This cost is only required once by the patient, in contrast to LH tests that require a fresh stick for each test. Furthermore, SFKs are sold over the counter at numerous pharmacies across the United States (23).

Summary of SFKs

Advantages (19, 22–24):
- **Cost**
  - Low cost of kits
  - One time up-front cost
  - Potentially beneficial for women with irregular cycles
- **Accessibility**
  - Highly accessible to consumers
  - Over the counter at numerous pharmacies

Disadvantages (1, 18–21):
- **Accuracy**
  - SFKs are able to predict ovulation within 3 days at a rate of 46%–76%
  - Requires patient interpretation of results

---

**TABLE 3**

<table>
<thead>
<tr>
<th>Type of testing</th>
<th>Examples</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovulation prediction</td>
<td>BBT electronic monitors</td>
<td>Conflicting data</td>
</tr>
<tr>
<td></td>
<td>Salivary and vaginal secretion</td>
<td>High cost</td>
</tr>
<tr>
<td></td>
<td>resistance monitors</td>
<td>Conflicting data</td>
</tr>
<tr>
<td>Gender prediction</td>
<td>Urine gender testing kits</td>
<td>Supportive data lacking</td>
</tr>
<tr>
<td>Remote genetic testing</td>
<td>“Send out” genetic testing kits</td>
<td>External data lacking for many of diagnosis claims</td>
</tr>
<tr>
<td>Remote hormonal testing</td>
<td>“Send out” salivary testing kits</td>
<td>High cost</td>
</tr>
<tr>
<td>Home semen testing</td>
<td>Electronic home semen tests</td>
<td>Results may cause patient confusion and anxiety</td>
</tr>
<tr>
<td></td>
<td>Home semen microscope</td>
<td>Conflicting/lacking data</td>
</tr>
<tr>
<td></td>
<td>evaluation kits</td>
<td>Fail to evaluate all semen analysis parameters</td>
</tr>
</tbody>
</table>

**Note:** Significant limitations render the use of these technologies questionable at this time. BBT = basal body temperature.

Electronic Resistance Evaluation of Salivary and Vaginal Secretions

Changes in NaCl and other electrolytes within the ovulatory period are thought to cause differences in electrical resistance, which may be measured (14, 25, 26). The OvaCue Monitor (Zetek Inc., Aurora, CO) monitor is a device that measures and records resistance in salivary secretions, with or without vaginal secretions, to predict the fertile window (1, 14, 25). According to the OvaCue Web site (www.zetek.net) the Cue probes, detects, and records this resistance in salivary secretions through the use of a “spoon-sized sensor on your tongue for five seconds each morning” (27).

Computerized software stores the data and predicts the fertile window with the use of the oral probe (14, 27). The vaginal sensor is required to document the “entire fertile window” including ovulation (14, 27). The Zetek Web site claims that the device is 98% accurate (27). However, there are conflicting data concerning the accuracy of these devices (1, 25, 26, 28, 29).

Another drawback to the OvaCue monitors, which range in price from $198–$249, is their cost (27). Other accessories, such as a vaginal secretion sensor and home personal computer software, are also available for additional costs (27). An advantage of the monitors is that they are reusable and do not require repeated purchases for testing strips (1, 27).

Salivary and Vaginal Secretion Resistance Monitors

Advantages (1, 26–28, 30):

- Ease of use
  - Requires high level of patient compliance
  - Often requires instruction by physician’s office personnel to train patient

Brand Evidence and Cost (22–24):

- Fertility Scope (Miracle Light Labs, Inc.; Natural Partners, Inc., Scottsdale, AZ)
  - Brand data
    - Specific brand data not found by literature review conducted by investigators
    - Company’s Web site cites studies that support the general concept of SFK
  - Cost
    - At USD $29.99

- Fertile Focus (Fairhaven Health, LLC, Bellingham, WA)
  - Brand data
    - Specific brand data not found by literature review conducted by investigators
    - Company’s Web site cites studies that support the general concept of SFK
  - Cost
    - At USD $34.95

- Saliva Biotester QTest (Q Test, Inc., Linden, NJ)
  - Brand data
    - Specific brand data not found by literature review conducted by investigators
  - Cost
    - At USD $33.50

LH Testing

Ovulation follows 12–48 hours after urinary detection of the surge peak (1, 14, 31). Home LH kits contain antibodies that bind to LH to form complexes that result in a color change, which the patient can easily see and compare to a control bar (1). Most home LH kits detect urinary LH levels at more than 20–40 mIU/mL (1).

The LH test kits require women to collect their urine beginning on day 6 of the cycle and continue daily tests for 5–9 days or until a positive result is obtained (1). A positive LH result is highly correlated with ovulation. Trials correlating serum and ultrasound office testing confirm home LH kit accuracy in predicting ovulation from 90%–100% depending on the study (5, 16, 31, 32). However, even with daily testing the LH surge may be missed, especially in women with irregular cycles (1).

Multiple over-the-counter LH detection kits are available. A review by Eichner and Timpe (31) recently compiled data from several studies as well as from Consumer Reports and found that most tests were noted to have a high level of LH sensitivity. The highest performing product tested was the ClearPlan Easy Ovulation Test Pack (Unipath Diagnostics) (Unipath LTD; Bedford, Bedfordshire, U.K.), which detected an LH concentration of 22 mIU/mL (31). The poorest performing tests were the Answer Quick (Carter-Wallace) and Simple One Step Ovulation (Carter-Wallace) (Carter-Wallace, Inc., New York, NY) (31). Clear Blue Easy One Month Ovulation Test (Unipath LTD; Bedford, Bedfordshire, U.K.) is stated by the manufacturer to be 99% accurate and is available in a version that displays results in a liquid crystal display format (33). These strips are sold for approximately $2.50 to $4.00 per testing strip (34, 35).

LH Test Kits

Advantages (5, 14, 16, 31, 32, 34, 35):

- Accuracy
  - Conflicting data on the accuracy in the ability to determine fertile period

- Cost
  - Significant initial investment for equipment
  - Additional expense required for vaginal secretion sensor and other equipment

- Accessibility
  - Not easily accessible to consumers
  - Electronic monitors available at few retailers
    - Products available online

- Ease of use
  - Requires high level of patient compliance
  - Invasive nature of vaginal probe required for optimal performance

Brand Evidence and Cost (27, 29, 30):

- OvaCue line of monitors (Zetek Inc.)
  - Brand data
    - Product Web site claims excellent accuracy. Some studies showed the product to be extremely sensitive to determine fertile window, whereas other studies have shown conflicting results
  - Cost
    - OvaCue Fertility Monitor at USD $249
    - OvaCue Classic Monitor at USD $219
    - CueII Monitor at USD $198

Disadvantages (1, 25, 27, 29)

- Accuracy
  - Conflicting data on the accuracy in the ability to determine fertile period

- Cost
  - Significant initial investment for equipment
  - Additional expense required for vaginal secretion sensor and other equipment

- Accessibility
  - Not easily accessible to consumers
  - Electronic monitors available at few retailers
    - Products available online

- Ease of use
  - Requires high level of patient compliance
  - Invasive nature of vaginal probe required for optimal performance
Cost
- Low cost of testing strips

Accessibility
- Highly accessible to consumers
- May be purchased over the counter in a variety of retail stores

Ease of use
- Noninvasive, easy to perform and interpret

Disadvantages (1, 14):
- Accuracy
  - In some patients it is still possible to miss the LH surge using daily testing
  - May miss key fertile days before the LH surge if couples use LH surge alone to time intercourse
- Cost
  - Purchasing many strips over an extended period of time financially burdensome

Brand Evidence and Cost (31):
- ClearPlan Easy Ovulation Test Pack (Unipath Diagnostics)
  - Brand data
    - Highest LH sensitivity
    - Detects LH concentrations of 22 mIU/mL
    - Results rated “Easiest to Read”
    - Reaction time: 3 minutes
- First Response (Church & Dwight Co., Inc)
  - Brand data
    - Good LH sensitivity
    - Reaction time: 5 minutes
- Answer Quick (Carter-Wallace)
  - Brand data
    - Average LH sensitivity
    - Reaction time: 5 minutes
- Simple One Step Ovulation (Carter-Wallace)
  - Average LH sensitivity
  - Reaction time: 5 minutes
- Cost
  - Cost of all strips are $2.50 to $4.00 per testing strip depending on where they are bought and the quantity of strips bought as sold by a major US retailer (34, 35)

E2 and LH Testing
The Clear Blue Easy Fertility Monitor (formerly ClearPlan Easy Fertility Monitor; Unipath Diagnostics) (Unipath LTD, Bedford, Bedfordshire, UK) is an electronic device that measures urinary LH and estrone-3-glucuronide, an E2 metabolite (1, 36). Increasing E levels correlate with physiologic changes leading up to ovulation (37, 38). Therefore, by evaluating both estrone-3-glucuronide and LH, the Clear Blue Easy Fertility Monitor predicts both ovulation by the determination of the LH surge as well as the most fertile days preceding ovulation by determination of estrone-3-glucuronide levels. Internal data on file with the manufacturer note that the monitor identified an average of 6 days of high fertility or peak fertility per cycle (39).

The Clear Blue Easy Fertility Monitor predicts periods of “Low Fertility,” “High Fertility,” or “Peak Fertility” according to the enclosed brochure (39). One study of 53 women showed ultrasound confirmation of ovulation in 90% of subjects, which correlated with the day that the device predicted ovulation (32). Another study (40) noted that the device could predict the days of peak fertility in more than 75% of women. Another prospective and randomized study (38) showed significantly higher pregnancy rates (PR) with women using the Clear Blue Easy Fertility Monitor when compared with a control group who had access to other over-the-counter ovulation predictor kits.

Advantages of the device include the ability to identify the entire fertile period and display these results in a simple and easy to ready format (38). The device is marketed to be helpful for women with irregular cycles (33). Data specifically supporting this claim were not found in this review. Disadvantages include cost. A major US retailer currently sells the Clear Blue Easy Fertility Monitor for $199.99 and a pack of 30 test strips to fit the monitor at $49.99 (41). Furthermore, patients must be adequately motivated to comply with daily urinary testing to optimize the performance of the device.

Urinary LH and Estrone-3-Glucuronide Monitors
Advantages (32, 38, 40, 41):
- Accuracy
  - Able to predict day of ovulation at 75%–90%
  - Identifies days of peak fertility before LH surge
  - May help women with irregular cycles identify key fertile days before the LH surge
- Accessibility
  - Highly accessible to consumers
  - May be purchased over the counter in retail stores
- Ease of use
  - Noninvasive and easy to perform
  - Data clearly displayed in an easy to read format

Disadvantages (1, 41):
- Cost
  - Significant initial cost
  - Higher price for irregularly cycling women due to increased number of testing days, and therefore strips

Brand Evidence and Cost (32, 40, 41):
- Clear Blue Easy Fertility Monitor (Unipath Diagnostics)
  - Brand data
    - 75%–90% accurate in predicting day of ovulation
  - Cost
    - Monitor sold at USD $199.99
    - Price per testing strip about USD $1.60

Home Semen Tests
The evaluation of a semen sample has been an integral component of the infertility evaluation (42). The conventional semen analysis includes the detailed laboratory evaluation of multiple variables, which were first established by MacLeod and Gold in 1951 (43, 44, 45). Morphology, motility, and sperm concentration are considered to be particularly important in determining fertility (42, 46, 47). A disadvantage of a laboratory-based semen analysis is the time intensive nature of the process and the inherent subjectivity that comes from different observers describing parameters (42, 46, 48).

A device called the Fertell home sperm test, manufactured by (Genosis, Inc., Needham, MA) is a home test claiming to evaluate both sperm concentration and quality (49).

After a semen sample is placed into the device, the sperm must swim through a hyaluronic acid barrier, thought to be associated with sperm quality, to reach a sensor that triggers a red light to appear when sperm concentrations are more than 10 \times 10^6/mL
The device has been shown to produce results that correlate well with computer-assisted sperm analysis (CASA) and hyaluronate migration test (49). Studies comparing the Fertell device, available for $99, to standard sperm analysis were not found by the investigators (50).

Other devices are available for use in the home that evaluate only sperm concentration. The FertilMARQ (Wisconsin Pharmacal, WI) (Wisconsin Pharmacal, Jackson, WI), also marketed as the Baby Start Male Infertility Test, is a "stick" test that works by staining the cells in the sperm sample to produce a color change when the sperm concentration is less or more than 20 × 10^6/mL (51). The company’s Web site claims that the accuracy of this test is 78% based on internal data (51).

Over-the-counter microscopes that are directly marketed to the consumer are also available to perform home semen analysis. Kokopelli Technologies (Kokopelli Technologies, LLC., Sante Fe, NM) produces and sells kits that include a microscope, slides, and other accessories (52). These kits range in price from $184.99–$524.99 (52). Kokopelli also produces a more modest microscope evaluator test called the Micra sperm test available for $99.99 (53). A Medline literature review did not reveal studies that have evaluated the performance of these kits compared with semen analysis performed by a laboratory.

Tests to Evaluate Semen

Advantages (42, 49):

- **Accuracy**
  - Home samples shown to be of higher quality than those collected in a laboratory environment
  - Some trials show reproducibility of results compared with CASA

- **Ease of use**
  - Home collection avoids anxiety associated with a formal semen analysis for the male partner

Disadvantages (49, 51, 52):

- **Accuracy**
  - Fails to test all parameters evaluated in formal semen analysis parameters
  - FertilMARQ tests only sperm concentration
  - No home method evaluates all parameters addressed in formal semen analysis
  - Data comparing results of home tests with formal semen analysis could not be found by the investigators

- **Cost**
  - May require significant initial cost

- **Ease of use**
  - Requires patient interpretation of results

Brand Evidence and Cost (49–54):

- **Kokopelli manually operated home microscopes**
  - **Brand data**
    - Specific brand data not found by literature review conducted by investigators
  - **Cost**
    - Kokopelli brand microscopes for USD $184.99–$524.99
    - Micra sperm test available for USD $99

- **FertilMARQ** (formerly FertilMARQ Male Fertility Screening test also sold as Baby Start Male Infertility Test)
  - **Brand data**
    - Claims that the accuracy of this test is 78% based on internal data
    - Specific brand data not found by literature review conducted by investigators
  - **Cost**
    - At USD $39.00

- **Fertell home sperm test by Genosis Ltd.**
  - **Brand data**
    - Claims to evaluate quality, motility, and quantity (more or less than 10 × 10^6/mL sperm concentration)
    - Concurrence in 95% of samples with automated laboratory (not a traditional semen analysis) evaluation of semen
  - **Cost**
    - At USD $99

PREGNANCY Urinary β-hCG

The home pregnancy test (HPT), since its introduction in 1960, has revolutionized the way in which early pregnancy is diagnosed (1, 55, 56). The HPT contain antibodies that bind to the β-hCG molecule to form complexes that result in a color change, which the patient can easily see and compare to a control bar (1, 55). A clear correlation exists between blood and first morning urine levels of intact β-hCG (57).

As of April 2007, there were 33 pregnancy test products registered with the US Food and Drug Administration (FDA) intended for home use (1). The FDA as well as the US Department of Health and Human Services has issued detailed quality guidelines, including sensitivity ranges, that must be followed by manufacturers of home urinary β-hCG tests (56, 58, 59). Tests routinely claim to have an accuracy of 99% to detect certain β-hCG concentrations, typically quoted at 25–100 mIU/mL (1, 31, 55).

It was estimated by Cole et al. (55) that a β-hCG sensitivity of 12.5 mIU/mL is necessary to detect 95% of pregnancies at the time of missed menses. Of 18 HPT brands tested in a 2003 trial, only one brand, the FIRST RESPONSE Early Results Pregnancy Test (Church & Dwight Co., Princeton, NJ), was able to detect a β-hCG level in this range (55). Another study found the FIRST RESPONSE Early Result Pregnancy Test (Church & Dwight Co.) could detect β-hCG concentrations of 6.3 mIU/mL (60). The sensitivity of the Clearblue Easy Earliest Results (Unipath Diagnostics Inc., Princeton, NJ) was 25 mIU/mL (60). The sensitivity of the EPT, CVS One Step (Inverness Medical Innovations Inc., Waltham, MA) and Eckerd One Step (Inverness Medical Innovations Inc.) were 100 mIU/mL (60). The sensitivity of the Accu-Clear (Inverness Medical Innovations Inc.) and Fact Plus Select (Ross Products, Columbus, OH) was more than 100 mIU/mL (60).

In 2003, **Consumer Reports** chose FIRST RESPONSE Early Results Pregnancy Test (Church & Dwight Co.) and Clear Choice (Pharmatech, Fairfield, NJ) as the most accurate home pregnancy tests (1). A 2009 study found the lowest β-hCG detection limits in the First Response (Siemens HealthCare, East Walpole, MA) brand device (61).

A limitation of the test is that a "faint" positive result that may be missed by the consumer (60, 62). For this reason, there are currently HPT tests available that display the words “pregnant” or “not pregnant” on a digital liquid crystal display (62). One study found that such a digital test was read correctly by 100% of patients compared with traditional tests that were read as “certain” by only 40%–87% of patients, depending on the brand (62).
Home Pregnancy Tests

Advantages (1, 42, 55, 63, 64):

- Accuracy
  - Able to predict the presence of urinary \( \beta \)-hCG at an extremely high rate when sufficient \( \beta \)-hCG concentration is present
  - Broadly accepted as a first detection step of an early pregnancy
- Cost
  - Low cost of testing strips
- Accessibility
  - Highly accessible to consumers
  - May be purchased over the counter in a variety of retail stores
  - As of April 2007, there were 33 pregnancy test products registered with the FDA intended for home use
- Ease of use
  - Noninvasive, easy to perform and interpret

Disadvantages (1, 55):

- Accuracy
  - A \( \beta \)-hCG test sensitivity of 12.5 mIU/mL is necessary to detect 95% of pregnancies at the time of the missed menses
  - Few tests meet this threshold
  - No quantitative \( \beta \)-hCG
  - Only positive or negative results
  - Early testing may lead to a false-negative result

Brand Evidence and Cost (1, 55, 60–64):

- FIRST RESPONSE Early Results (Church & Dwight Co., Inc)
  - Brand data
    - Highest \( \beta \)-hCG sensitivity (detects \( \beta \)-hCG < 6.3–12.5 mIU/mL)

- Clear Choice (Pharmatech)
  - Brand data
    - Highest \( \beta \)-hCG sensitivity (detects \( \beta \)-hCG 12.5 mIU/mL)

- Clearblue Digital Pregnancy Test (Pharmatech)
  - Brand data
    - Highest \( \beta \)-hCG sensitivity (detects \( \beta \)-hCG < 6.30–25 mIU/mL)

  - Brand data
    - Good \( \beta \)-hCG sensitivity (detects \( \beta \)-hCG 25–50 mIU/mL)

- CVS One Step (Inverness Medical Innovations Inc.)
  - Brand data
    - Good \( \beta \)-hCG sensitivity (detects \( \beta \)-hCG 50–100 mIU/mL)

- Eckerd One Step (Inverness Medical Innovations Inc.)
  - Brand data
    - Good \( \beta \)-hCG sensitivity (detects \( \beta \)-hCG 50–100 mIU/mL)

- Accu-Clear (Inverness Medical Innovations Inc.)
  - Brand data
    - Average \( \beta \)-hCG sensitivity (detects \( \beta \)-hCG 25 to >100 mIU/mL)

- Fact Plus Select (Ross Products)
  - Brand data
    - Average \( \beta \)-hCG sensitivity (detects \( \beta \)-hCG 25 to >100 mIU/mL)

- Cost of all strips is roughly $3.25–$6.50 per testing strip depending on where they are bought and the quantity of strips bought as sold by a major US retailer

FSH TESTING

Follicle stimulating hormone levels are thought to reflect ovarian oocyte quantity (65). On cycle day 3 FSH levels of more than 10 mIU/mL in the blood have been associated with low oocyte yield, poor conception rates, and the menopausal transition period (65). Urinary FSH values are highly correlated to serum FSH values (66, 67). Day 3 urinary FSH has been suggested as a marker for determining ovarian reserve for IVF (66).

Multiple over-the-counter “Stick” devices are available currently that measure urinary FSH levels using FSH antibody complexes (1, 68). All FDA-approved devices can detect urinary FSH concentrations at more than 25 mIU/mL (1). Tests currently marketed in the United States include the First Response Fertility Test for Women by Church & Dwight Co., Inc. (claim 99% accurate and approximately $24.99), the Estroven Menopause Monitor manufactured by Amerifit Nutrition (Amerifit Nutrition Inc., Bloomfield, CT) (claim 99% accurate and approximately $20), the Menocheck manufactured by Synovia (Synovia Healthcare Group, Inc., Media, PA) (claim 95% accurate and approximately $18), and the RU 25 Plus Menopause Monitor manufactured by Applied Biotech, Inc (Applied Biotech, Inc., San Diego, CA) (claim 99% accurate and approximately $20) (1, 68, 69). An Internet search showed that non-name brand sticks that detect “nonfertile levels” FSH elevation can be purchased for as little as $1.99 per test strip (70).

The success rate in achieving pregnancy decreases as levels of serum FSH are more than 10 mIU/mL (65). Therefore, although FSH levels of more than 25 mIU/mL are likely associated with decreased ovarian reserve, women with “normal” results of less than 25 mIU/mL do not necessarily have reassurance of an adequate ovarian reserve. When asked by the investigators to provide the level of FSH that is measured in their test, the manufacturers of First Response Fertility Test for Women by Church & Dwight Co., Inc, stated that, “The FSH levels used to gauge ovarian reserve are considered proprietary” (McCauley K, personal communication, 2010). A Medline search did not reveal studies regarding specific testing of different brands of urine FSH detection kits.

Home Testing for Menopause

Advantages (1, 68–70):

- Cost
  - Low cost of testing strips
- Accessibility
  - Highly accessible
  - May be purchased over the counter in a variety of retail stores
- Ease of use
  - Noninvasive, easy to perform and interpret

Disadvantages (1, McCauley K, personal communication, 2010):

- Accuracy
  - The threshold concentration of FSH that results in a positive opposed to a negative result for these tests is considered “proprietary” and is not published
  - All FDA-approved devices can detect urinary FSH concentrations of more than 25 mIU/mL
  - Women with “normal” FSH stick test results of less than 25 mIU/mL do not necessarily have reassurance of an adequate ovarian reserve
  - Tests evaluate FSH in isolation
  - Results may be misleading to the consumer without having the context of the larger clinical picture
Brand Evidence and Cost (1, 67–69, McCauley K, personal communication, 2010):

- First Response Fertility Test for Women (Church & Dwight Co.)
  - Brand data
    - Claim 99% accurate
    - Specific brand data not found by literature review conducted by the investigators
    - Actual levels of FSH measured considered “proprietary” and have not been disclosed
  - Cost
    - At USD $24.99 (major US retailer)
  - Actual levels of FSH measured considered “proprietary” and have not been disclosed

- Menocheck (Synovia)
  - Brand data
    - Claim 95% accurate
    - Specific brand data not found by literature review conducted by the investigators
  - Cost
    - At USD $18 (major US retailer)

- RU 25 Plus Menopause Monitor (Hormone Check)
  - Brand data
    - Claim 99% accurate
    - Specific brand data not found by literature review conducted by the investigators
  - Cost
    - At USD $20 (major US retailer)

- Estroven Menopause Monitor (Amerifit Nutrition)
  - Brand data
    - Claim 99% accurate
    - Specific brand data not found by literature review conducted by the investigators
  - Cost
    - At USD $20 (major US retailer)

- Other FDA-approved generic sticks
  - Brand data
    - Specific brand data not found by literature review conducted by the investigators
  - Cost
    - As little as USD $1.99

**BABY GENDER TESTING**

There are also tests available over the counter that claim to be able to tell expectant mothers the gender of their unborn children with a home urine test. Two tests, which are available currently, are the Intelligender Prediction Test (Intelligender, Plano, TX) and the Best Baby Gender Test (Hello Baby LLC; Whitesboro, TX) (71, 72). News organizations, such as CNN and CBS News, have featured these tests in their broadcasts (71).

According to the Intelligender Web site, the test uses first morning urine of a pregnant woman after 10 weeks gestation and provides results within 10 minutes (71). The manufacturer claims on their Web site that “laboratory results show 90% accuracy and real world studies indicate 82% accuracy” (71). The Web site of Best Baby Gender Test (Hello Baby LLC) claims that its product is “100% accurate” based on internal data but concedes that “at home” accuracy could differ from their internal studies (72).

The investigators were unable to find literature regarding the mechanism of how these tests function or their accuracy. When questioned as to whether more details were available regarding the function and accuracy of their products, the manufacturers of both tests responded that such details were not published and were unavailable to the public at this time (Griffin R, personal communication, 2010; Representative at Best Baby, personal communication, 2010). The companies caution that the test is not a surrogate for an ultrasound examinations or formal obstetric care and “does not recommend test users to make any financial, emotional, or family planning decisions based on the test results” (71). These products are available over the counter at numerous retailers and sell for about USD $35.00 (71–73).

**Home Testing for Baby Gender**

Advantages (71–73):

- Cost
  - Low cost to consumers
- Accessibility
  - Highly accessible to consumers
  - May be purchased over the counter in a variety of retail stores
- Ease of use
  - Noninvasive, easy to perform and interpret

Disadvantages

- Accuracy
  - Specific brand data not found by literature review conducted by the investigators
- Questionable utility
  - In current practice environment many patients obtain obstetric sonography during their pregnancy at which time gender is discovered

Brand Evidence and Cost (71–73):

- Intelligender Prediction Test (Intelligender)
  - Brand data
    - Manufacturer’s Web site claims 82%–90% accuracy
    - Specific brand data not found by literature review conducted by the investigators
  - Cost
    - At USD $34.99

- Best Baby Gender Test (Hello Baby LLC)
  - Brand data
    - Manufacturer’s Web site claims 100% accuracy in laboratory testing
    - Specific brand data not found by literature review conducted by the investigators
  - Cost
    - At USD $34.99

**REMOTE TESTING**

There is a growing trend in which patients may send, by mail, samples of bodily fluids, such as saliva and blood, for evaluation at a remote laboratory. These laboratories then contact the consumer directly and offer interpretation of results. Some states do not permit such testing without an order from a health care provider (74, 75).

**Salivary Send Outs**

The concept that systemic hormones may be measured through salivary samples is certainly increasing in popularity (76). Salivary cortisol (F) measurements, for example, are currently recommended by the Endocrine Society as a screening test for Cushing syndrome (77). Salivary levels of F, however, may be influenced by a variety of factors such as obesity, diabetes, depression, stress, and tobacco...
(77). Serum and salivary levels of T and P, however, have not been shown to consistently correlate (76, 78–80).

The ZRT Laboratories (ZRT Laboratories, OR; ZRT Laboratory; Beaverton Oregon) is one such company that offers salivary test kits than measure a wide variety of hormones including E2, P, T, DHEA, and F (74, 75). Consumers, after submitting the sample, are provided with results and interpretations as to what the values mean with regard to their health (74, 75). Depending on which panels are desired, these saliva kits are sold online for $69.95–$255.95 (74, 75).

ZRT Laboratories, upon request, provided the investigators with internal data that support the accuracy of the laboratory in determining salivary hormone levels and indicated that they were poised to publish much of this literature within the next several years (Zava D, personal communication, 2010). One study of 12 women using ZRT Laboratories confirmed the ability of the laboratory to detect salivary E2 and P when the hormones were applied as a vaginal cream (81). However, the peak values for the hormones were detected at 6 hours in the saliva compared with 24 hours in the serum (81).

Salivary Send-Out Testing

Advantages (73, 74, Zava D, personal communication, 2010):

- Accuracy
  - Internal data reported to indicate highly reproducible results
  - Emerging technology that may be increasingly useful
- Ease of use
  - Noninvasive and easy to perform

Disadvantages (74, 75, 80):

- Accuracy
  - Hormone levels in the saliva do not necessarily correlate with blood levels
- Cost
  - Assays require significant investment

Brand Evidence and Cost (73, 74, Zava D, personal communication, 2010):

- ZRT Laboratory kits (ZRT Laboratories)
  - Brand evidence
    - Internal data provided that confirm reproducibility of test results
  - Cost
    - Sold online from $69.95–$255.95

Direct-to-Consumer Genetic Testing

Currently there is a growing industry that performs genetic testing directly for consumers (82). Companies offering these tests claim to detect disease states with an established genetic fingerprint, such as cystic fibrosis (CF), and conditions with less established genetic markers such as asthma (83). There are more than 1,300 such genetic tests available that require only a saliva sample or a blood-spot collection (84, 85). These tests, which range in price from $295–$1,200, require only a saliva sample or a blood-spot collection (83, 84, 86).

In recent years, this technology has been looked upon with concern by the medical and public policy community. Specifically, the ability of the consumer to interpret the test results is questionable, especially in cases where the scientific foundation for the tested mutation, such as those associated with common conditions like depression, is lacking (82). Such results could lead to potentially damaging and inaccurate information (82, 86).

Currently, laboratories performing these services must be certified by the Centers for Medicare and Medicaid Services and comply with the Clinical Laboratory Improvement Amendments of 1988 (87). However, there is no uniform system to evaluate the analytic or clinical validity of tests offered to patients (87). Multiple consumer alerts have been issued warning consumers to be skeptical of claims made by companies providing direct-to-consumer genetic tests (82, 84, 86, 88, 89).

23 and Me (Mountain View, CA) is an example of a company that provides direct-to-consumer genetic testing (83). The kit marketed by the company was chosen in 2008 by Time magazine as the retail invention of the year (90). According the Web site of 23 and Me, the company provides genetic evaluations of 136 genetic traits and conditions with 99% accuracy for $499.00 with a saliva sample (91). However, the Web site states that the information yielded by their test cannot be used for diagnostic purposes in isolation and that clinical correlation with a health care provider is necessary (91). A Medline search did not reveal any literature regarding the accuracy of this company’s product.

Direct-to-Consumer Genetic Testing

Advantages (84, 85, 91):

- Accuracy
  - Internal data reported to indicate highly reproducible results
  - Emerging technology that may be increasingly useful
  - Ability to evaluate numerous genetic conditions
    - >1,300 genetic tests available with more currently being researched
- Ease of use
  - Minimally invasive to patient
  - Tests available with more currently being researched

Disadvantages (82, 86, 87):

- Accuracy
  - Lack of uniform system to evaluate the analytic or clinical validity of tests offered
  - Questionable ability of test to detect many of the conditions for which it claims to screen
    - Many conditions, such as depression, are multifactorial in nature
    - Could lead to misdiagnosis
    - Could introduce unwarranted concern to individuals receiving test results
- Evidence
  - Independently conducted large scale studies are lacking
  - Internal data from manufacturers now used to support claims of accuracy
- Cost
  - Assays require significant investment

Brand Evidence and Cost (83, 86, 91):

- 23 and Me
  - Manufacturer claims to provide genetic evaluations of 136 genetic traits and conditions with 99% accurate results based on internal data
  - Specific brand data not found by literature review conducted by investigators
CONCLUSION

Home testing fulfills a need. Many of these needs stem from consumer demand. Patient privacy is maximally protected through at-home testing. At home testing also may offer patients a sense of autonomy not present when dealing directly with a physician. Furthermore, patients may find cost savings in buying over-the-counter testing when compared with office-based testing.

Explosive growth in the scope and availability of over-the-counter testing devices has been evident in recent years (1). Some of these devices, such as the urinary hCG test, have been subjected to the scrutiny of scientific investigation and have publicly mandated quality control measures aimed at ensuring their accuracy (58, 59). Such devices have gained the trust of the patient and the physician and are well-accepted adjuncts to the practice of medicine, surely this same trend will, with proper evaluation, be applied to the numerous testing devices available at present in the market.

REFERENCES


