Andrology Center and Reproductive Tissue Bank

Who We Are

The Andrology Center and Reproductive Tissue Bank - a section of the Glickman Urological & Kidney Institute at Cleveland Clinic - provides specialized tests and services to evaluate male infertility. Our laboratory offers referring physicians and patient’s quantifiable results using the latest state-of-the art technology. We are located in the Building X, which is part of the Downtown Main campus.

As part of the American Center for Reproductive Medicine, the Andrology Center and Reproductive Tissue Bank is staffed with highly qualified and experienced laboratory technologists who are well trained in fertility testing and certified by the American Society of Clinical Pathologists (ASCP). Our laboratory is certified by the Clinical Laboratory Improvement Amendments (CLIA) and the Department of Health and Human Services. Since 1994, the lab has been accredited by the College of American Pathologists (CAP). Our reproductive tissue bank is registered and inspected by the JCAHO and FDA.

“Patients First” is the guiding principle of the Cleveland Clinic. To emulate this standard, our staff at the Andrology Center and Reproductive Tissue Bank continually strives to provide compassionate care and outstanding service every step of the way.

What We Offer

The Andrology Center and Reproductive Tissue Bank’s specialized laboratory offers a wide variety of comprehensive tests and the latest technology to meet patient needs. The Andrology Center offers both clinical and research services. Our laboratory uses the latest World Health Organization (WHO, Fifth Edition, 2010) guidelines and reference ranges in the evaluation of semen samples. Additionally, our laboratory’s Therapeutic Sperm Banking program provides a complete fertility preservation service including a reliable system for the long-term preservation of human semen, epididymal aspirate and testicular tissue.

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August 8, 2019
Semen Profile
A semen profile assesses semen quality using the most comprehensive and advanced testing available. It is considered the cornerstone of infertility investigation because it provides the physician with a clear understanding of the functional capacity of the sperm. A typical profile assesses routine semen parameters and levels of reactive oxygen species (ROS), oxidation reduction potential (ORP), total antioxidant capacity (TAC) and sperm DNA fragmentation (TUNEL).

Semen Analysis
Semen analysis assesses a man’s fertility potential, sperm production, accessory gland function and ejaculatory capability. It specifically examines semen volume, pH, color, viscosity, sperm concentration, total sperm count and percent motility. A computer assisted semen analyzer enhances this analysis by measuring sperm motion characteristics not detected by the human eye such as velocity, linearity, progressive motility and amplitude of lateral sperm head movement. It is also capable of determining sperm morphology. Our CASA system is among the most technologically advanced systems and yields far more accurate and quantifiable results than manual methods of semen analysis.

Computer Assisted Semen Analysis (CASA)
Our laboratory is equipped with a Computer Assisted Semen Analyzer and Integrated Visual Optical System (IVOS) software version 14 (Hamilton Thorne Research), which operates as a cell motion analyzer and computer. Computer assisted semen analysis has two advantages: it is precise and can quantitatively assess sperm kinematics. It is a semi-automated technique that provides data on sperm concentration, motility and special sperm motion parameters. These include: average path velocity, linearity, curvilinear velocity, amplitude of lateral head displacement, flagellar beat frequency and hyperactivation. The percent progressive motility has been shown to relate with pregnancy rates. The CASA results for motility and concentration are also verified manually.

Clinical Utility of the Semen Analysis
The results of both manual semen analysis and CASA guide the clinician in assessing semen quality and creating an individualized treatment plan. Some of the motion parameters are used to grade of sperm motility while others are used to assess the functional quality of the sperm such as the fertilization potential.

Turn-Around-Time: 1-3 days

Leukocytospermia Quantification/Endtz Test
The presence of high numbers of white blood cells (WBCs) in semen, especially the presence of granulocytes, is often associated with an underlying infection and male infertility. Leukocytes are powerful generators of free radicals called reactive oxygen species or ROS. The myeloperoxidase or Endtz test differentiates WBCs from other immature germ cells in the semen.

Figure 1: Microscopic view of the fixed cell counting chamber.

Figure 2: CASA screen shot showing measurement of various sperm motion parameters

Turn-Around-Time: 1-3 days

Clinical Utility of the Test
Clinicians need to be aware that an Endtz value of ≥0.4 X 10^6 WBC/mL is indicative of a possible infection of the male accessory glands. The patient should undergo further investigation to identify the possible cause of infection. Antibiotics may be prescribed. Treating men with antibiotics may help reduce any infection by decreasing seminal leukocytes and ROS production. This often results in a subsequent improvement in sperm motility and natural conception. The patient may be asked to repeat the Endtz test to confirm that the infection has cleared.
Retrograde sperm count and preparation
In some men, semen passes into the bladder instead of coming out through the urethra; this condition is known as retrograde ejaculation. Urine sample is centrifuged and the pellet re-suspended in culture media and examined for sperm count and motility. Processing of retrograde sample for IUI can be done using density gradient method.

**TAT: 3-5 Days**
**Clinical Utility of test:** Negative result indicates absence of retrograde ejaculation.

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Post-vasectomy screen
Post vasectomy screen is ordered in patients who had a vasectomy performed. The test involves examination of a semen sample for presence of sperm. If <100,000 sperm/ml are seen then results pass the AUA criteria.

**TAT: 1-3 days**
**Clinical utility of the test:**

<table>
<thead>
<tr>
<th>Results</th>
<th>AUA criteria</th>
</tr>
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<tr>
<td>No sperm seen on unspun wet prep</td>
<td>Pass</td>
</tr>
<tr>
<td>Sperm count between 0 to 100,000/mL</td>
<td>Pass</td>
</tr>
<tr>
<td>Sperm count ≥ 100,000/mL</td>
<td>Fail</td>
</tr>
<tr>
<td>Sperm motility ≥ 0%</td>
<td>Fail</td>
</tr>
</tbody>
</table>
Sperm Morphology
Sperm count and motility alone are not adequate predictors of fertility. These tests must be run in conjunction with sperm morphology for the evaluation of the infertile male. The Cleveland Clinic Andrology Center uses the WHO 2010 (5th edition) criteria for assessing sperm morphology. Smears are stained using the Diff-Quik method. Abnormal sperm forms are associated with lower fertilizing potential and increased DNA damage.

Reference Value: ≥4% normal sperm forms

Turn-Around-Time: 1-3 days

Clinical Utility of the Test
Normal sperm morphology is a significant predictor of pregnancy in in-vivo and in-vitro fertilization.

Eosin-Nigrosin Test
It is important to determine whether immotile sperm are alive or dead. This is accomplished using the Eosin-Nigrosin or vitality test. Spermatozoa that are alive have an intact sperm plasma membrane that does not allow the Eosin stain to penetrate. These sperm appear white when stained and viewed under a microscope. Dead spermatozoa have a compromised sperm membrane that absorbs some of the stain, which turns them pink.

Vitality Staining: It is performed when the sperm motility is <25%. Viability test should be conducted within 30 but no more than 60 minutes after semen collection.

Turn-Around-Time: 1-3 days

Clinical Utility of the Test
Normal cutoff for viability is >58%. The presence of a high percentage of immotile and non-viable sperm is characteristic of epididymal pathology.
Special Staining for Azoospermic Patients

Azoospermia is the absence of spermatozoa in the ejaculate. Special staining is performed when no sperm are seen during a semen analysis. Semen specimens are concentrated in a small area on the slide using a special centrifuge called cytospin. The sample in the concentrated area is examined to confirm the presence of spermatozoa. After analysis of the semen specimen, a special stain called the nuclear fast red picroindigocarmine, or NFPIC stain, is used. Sperm heads stain bright pink and tails green. This test confirms the complete absence of spermatozoa or the presence of rare spermatozoa in the ejaculate.

Turn-Around-Time: 1-3 days

Clinical Utility of the Test

This test may help the clinician determine whether to perform a testicular biopsy or microscopic testicular sperm extraction (MicroTESE).

Key Publication On Identification Of Sperm In An ‘Azoospermic’ Semen Sample By Andrology Staff

Urology 1998; 51: 816-819

ADULT UROLOGY

IDENTIFICATION OF SPERMATOZOA AND ROUND SPERMATIDS IN THE EJACULATES OF MEN WITH SPERMATOGENIC FAILURE

BENJAMIN N. HENDIN, BRIJESH PATEL, HOWARD S. LEVIN, ANTHONY J. THOMAS, Jr, AND ASHOK AGARWAL
**Intrauterine Insemination**

Intrauterine insemination (IUI) is an effective method of assisted reproduction that helps couples with male idiopathic infertility. The procedure works by increasing the number of healthy motile sperm available for fertilization during a given menstrual cycle.

**Sperm Processing**

Tests marked with an asterisk (*) require an appointment. All others do not.

Intrauterine insemination (IUI) is regarded as an effective method for a specific subset of infertile patients such as those with idiopathic infertility, or cervical factor with unexplained or mild to moderate male-factor infertility. The rationale of this procedure is to increase the number of healthy spermatozoa available for fertilization during a given cycle. Total motile sperm needed for insemination is >1.0 million. Data from our laboratory reports pregnancy rates per cycle of 15.5% and per patient success rate of 33.3%. The average number of cycles which the patients undergo is between 3 to 6 cycles.

**Clinical Utility of the Procedure**

The highest cumulative pregnancy rates with IUI are seen within 3 to 4 cycles. The average live birth rate per cycle is approximately 10-15%. Pregnancy rates depend on the underlying causes of male infertility. In most reports, cumulative pregnancy rates plateau after 3 to 6 cycles.

Sperm preparation, or sperm wash, may be done using the swim-up or a double-density gradient method.

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**Key Publication On Intrauterine Insemination By Andrology Staff**

*Journal of Assisted Reproduction and Genetics, Vol. 17, No. 5, 2000*

The Effect of Patient and Semen Characteristics on Live Birth Rates Following Intrauterine Insemination: A Retrospective Study

Benjamin N. Hendin, Tommaso Falcone, Jorge Hallak, David R. Nelson, Sreenivas Vemullapalli, Jeffrey Goldberg, Anthony J. Thomas, Jr., and Ashok Agarwal
Sperm Processing Techniques*

Swim-up Sperm Wash
The swim-up technique is based on active self-migration of motile spermatozoa into the wash medium. This technique can be used only for ejaculate with a high degree of progressively motile spermatozoa. Recovery rates are low if the initial semen specimen has poor progressive motility.

The swim-up method results in sperm fractions with improved motility and numbers that are adequate for conception. It also yields spermatozoa with good normal morphology that are free from seminal debris such as round cells and dead cells.

Figure 9: Steps in the swim-up sperm preparation method.

Turn-Around-Time: 1-3 days

Advantage of Swim-up:
High percentage of motile sperm can be recovered.

Disadvantage of Swim-up:
The recovery rate of total number of motile sperm is low, especially if the initial progressive motility is low.

Density-Gradient Sperm Wash*

The density-gradient separation method concentrates highly motile, viable and morphologically normal sperm with low levels of DNA damage in a small volume of sperm wash medium. A double-density gradient is prepared by layering a high density layer (80%; lower gradient) on the bottom of the tube and an equal volume of a low density gradient (40%; upper layer) on the top. Liquefied semen is layered above the two gradients. Highly motile, morphologically normal spermatozoa are separated as a result of sperm density as well as by centrifugation. Seminal plasma, leukocytes and other debris are retained on the top of the gradient and the highly motile sperm are collected in a pellet at the bottom of the tube.

Figure 10: Separation of highly motile, morphologically normal sperm with high DNA integrity prepared by a double-density gradient method.

Turn-Around-Time: 1-3 days

Advantages of Density Gradient Preparation:
The density-gradient method is an efficient technique for samples with very low sperm concentration and motility. It results in a higher recovery rate of motile sperm than the swim-up technique. It is the method of choice for sperm preparation in the majority of ART and andrology laboratories.

Disadvantages of Density Gradient Preparation:
Poor total motile sperm recovery may be seen in semen samples that are highly viscous, show sperm agglutination and have very poor sperm concentration and motility.

Recovery Rates: >30-60% are seen by our laboratory

Other Tests
Sperm Antibody Test*
The presence of sperm antibodies reacting with antigens on the surface of the spermatozoa is considered typical of male immunological infertility. Autoimmune male infertility is defined as an inappropriate immune response against sperm antigens. Antibodies bind to sperm and cause sperm dysfunction that renders the male infertile. If a significant amount of agglutination of motile spermatozoa (clumping) is seen on wet preparation, this may be indicative of an underlying immunological problem. Men with high levels of sperm antibodies have significantly reduced fertility.

When to Order the Antibody Test:
1. Sperm agglutination
2. Poor sperm motility
3. Unexplained infertility
4. Failed in vitro fertilization (IVF)

Direct Mixed Antiglobulin Reaction (MAR) Test*
A patient’s semen sample can be tested for the presence of antisperm antibodies (IgG and IgA) by using a mixed antiglobulin reaction (MAR) test. Latex beads coated with the antibodies are added to a semen sample. This causes any sperm containing the antibodies to bind together with the beads. The percentage of live, motile sperm bound with beads is related to the severity of the immunological reaction.

Reference Value: <40% sperm binding to beads

Turn-Around-Time: 1 week

Clinical Utility of the Test:
The clinician needs to be aware that anti-sperm antibodies (ASA) may interfere with sperm-oocyte membrane interactions. Pregnancy rates may be reduced by ASA. Simple sperm wash may help reduce sperm clumping or agglutination prior to swim-up or density gradient. Steroids may be given to lower ASA levels in semen titers before intrauterine insemination (IUI), but are unnecessary if intracytoplasmic sperm injection (ICSI) is performed. Using IVF in patients with high ASA titer has been shown to result in lower pregnancy and higher miscarriage rates.
Semen Biochemistry
Fructose Test
Fructose is normally present in all semen specimens. The absence of fructose could indicate congenital bilateral absence of the vas deferens or bilateral ejaculatory duct obstruction. Qualitative measurement of fructose can be performed on patients suspected of having obstructive azoospermia. Obstructive azoospermia is the absence of sperm in the ejaculate due to a blockage of the ejaculatory duct.

Result: Positive test is indicated by a color change from dark pink to orange.

Turn-Around-Time: 1-3 days

Clinical Utility of the Test:
A negative result is indicative of a congenital bilateral absence of the vas deferens.

Did You Know?
The American Center for Reproductive Medicine at the Cleveland Clinic has an international reputation for excellence in innovative research in human fertility and is dedicated to the dissemination of its results. Research papers from the Center’s staff are regularly selected for publication in distinguished specialty medical journals.

Our Center is recognized as having the largest number of peer-reviewed publications in male infertility and andrology anywhere in the world.
Sperm Function Tests
Hypo-Osmotic Swelling (HOS) Test

The ability of the human sperm tail to swell in the presence of a hypo-osmotic solution is a sign of a normal sperm membrane. HOS is correlated with the in vitro fertilizing ability of the spermatozoa. This test measures the functional integrity of the sperm plasma membrane.

**Reference Range:** > 58% tail swelling (normal)

**Clinical Utility of the Test:**
HOS helps identify which spermatozoa are alive in specimen with poor motility or those retrieved from the testicular tissue for use with Intracytoplasmic Sperm Injection (ICSI).

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**Semen Oxidative Stress Profile**

This analysis consists of three advanced tests conducted after an initial semen analysis. Reactive oxygen species, total antioxidant capacity and DNA fragmentation are measured in a semen sample.

**Male oxidative stress in infertility (MOSIT™) test:** The MIOXSYS System measures oxidation reduction potential (ORP) in millivolts which is the integrated measure of the existing balance between total oxidants and reductants in a biological system. MOSIT™ test provides a comprehensive measure of oxidative stress by analyzing all known and unknown oxidants and antioxidants with a high sensitivity and specificity.

**When to order the test:**
1. Male subfertility
2. Idiopathic infertility
3. Infertile men with normal semen parameters

**Turn around time:** 1-3 days

**Reference Range:** > 1.36 milliVolt/ 10^6 sperm/mL

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**Figure 15:** Spermatozoa with intact sperm membrane show different types of tail swelling while those with damaged membrane integrity do not.

**Figure 16:** ORP instrument set up

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Our Center remains a global leader for excellence in the personalized diagnosis and treatment of male infertility through the development of several non-surgical, innovative techniques:

- Quantification of seminal oxidative stress by MOSIT™ test in semen, allowing personalized intervention and antioxidant regimens
- Non-surgical optimization of semen quality by antioxidant therapy and management of oxidative damage
- Selection of best quality spermatozoa for assisted reproductive techniques
- Diagnosis of sperm functional abnormalities by advanced cytological and biochemical tests

Reactive oxygen species are highly reactive oxidizing agents belonging to the class of free radicals. The presence of ROS in the male reproductive tract has become a real concern because of potential toxic effects on sperm quality and function when levels are too high. Normally, antioxidants in seminal fluid neutralize any increased production of ROS. However, in cases of infection or other clinical conditions such as varicocele, significant amounts of ROS may be generated. About 40% to 80% of infertile men have sperm damaged by oxidative stress.

ROS levels can be measured using a chemical probe called luminol that reacts with free radicals and produces a luminescence. This is converted into an electronic signal that can be detected by an instrument called a luminometer.

**Did You Know?**

**When to Order the Test:**
1. Leukocytospermia (high levels of WBCs in semen)
2. Idiopathic infertility
3. Infertile men with normozoospermic semen sample
4. Clinical varicocele
5. Advanced paternal age

**Turn-Around-Time:** 1-2 days

**Reference Range:** Normal Values: <102 RLU/sec/million sperm

**Clinical Utility of the Test:**
High ROS levels are seen in men with idiopathic infertility and men with other underlying etiologies such as leukocytospermia, prostatitis, genital tract infections and varicocele.
Male infertility testing: reactive oxygen species and antioxidant capacity

Edmund Y. Ko, M.D.,a Edmund S. Sabanegh Jr., M.D.,b and Ashok Agarwal, Ph.D.c

aDepartment of Urology, Loma Linda University, School of Medicine, Loma Linda, California; and bDepartment of Urology and cCenter for Reproductive Medicine, Glickman Urological and Kidney Institute, Cleveland Clinic Foundation, Cleveland, Ohio

Fertility and Sterility 2006, 86: 878-885

Reactive oxygen species as an independent marker of male factor infertility

Ashok Agarwal, Ph.D.,a Rakesh K. Sharma, Ph.D.,a Kiran P. Nallella, M.D.,a
Anthony J. Thomas, Jr., M.D.,a Juan G. Alvarez, M.D.,b,c and Suresh C. Sikka, Ph.D.d

aCenter for Advanced Research in Human Reproduction, Infertility and Sexual Function, Glickman Urological Institute and Department of Obstetrics-Gynaecology, Cleveland Clinic Foundation, Cleveland, Ohio; bCentro de Infertilidad Masculina ANDROGEN, La Coruña, Spain; cHarvard Medical School, Boston, Massachusetts; and dDepartment of Urology, Tulane University Health Sciences Center, New Orleans, Louisiana
Total Antioxidant Capacity (TAC) Test
A balance between ROS and available antioxidants is important. A shift in the balance results in a decrease in the available antioxidants or an increase in free radicals. This shift is unfavorable, with the imbalance resulting in oxidative stress. Data suggests that antioxidant concentrations are significantly lower in patients who have increased levels of ROS.

This test utilizes clear seminal fluid that has been stored at -50 to -80°C. A colorimetric test called the total antioxidant assay is used to measure levels of total antioxidants (enzymatic, non-enzymatic and macromolecules) in the seminal plasma. The intensity of the color is inversely proportional to the amount of antioxidants in the sample. Results are expressed as micromoles of Trolox (standard).

Figure 18: Antioxidant levels measured as micromoles of Trolox in infertile patients and healthy donors.

**Turn-Around-Time:** 2-3 weeks

**Reference Range:**
Normal Values: >1950 MicroMoles of Trolox

**Clinical Utility of the Test:**
Low TAC values indicate poor antioxidant reserve and lack of antioxidants to combat oxidative stress.

**Key Publication On Total Antioxidant Capacity By Andrology Staff**

*Diagnostic application of total antioxidant capacity in seminal plasma to assess oxidative stress in male factor infertility*

Shubhadeep Roychoudhury, Rakesh Sharma, Suresh Sikka, Ashok Agarwal
Sperm DNA Damage Test*
Intact sperm DNA is important for successful fertilization and pregnancy.

DNA damage can be assessed using the terminal deoxynucleotidyltransferase dUTP nick end labeling (TUNEL) assay. The assay labels sperm DNA strand breaks with a fluorescent stain that can be visualized with a flow cytometer. This test is sensitive, requires 2.5 X10^6 sperm. Semen samples are often frozen and batched for DNA testing.

Indications for ordering DNA test:
1. Couples with unexplained infertility of more than 6 months to a year
2. Couples with a history of repeated miscarriage and abortion
3. Couples considering IUI, IVF, ICSI
4. Advanced paternal age (>40 Years)
5. Men who are smokers
6. Men who were treated for cancer
7. Men exposed to toxic agents
8. Men who have had urogenital infections
9. Men considering varicocele repair

Figure 19: Single or double-stranded DNA breaks are labeled by the TdT enzyme and measured by flow cytometry.
Reference Lab Services

The Andrology Center offers DNA testing services to physicians who are not part of the Cleveland Clinic Health System. After initial semen analysis is conducted, the remainder of sample can be aliquoted, frozen at -70°C and batched. The samples can then be shipped overnight on dry ice.

**Turn-Around-Time:** 2-3 weeks

**Reference Range:** Normal Value <17%

**Clinical Utility of the Test:**
High DNA damage in infertile men can lead to poor ART (assisted reproductive techniques) outcomes and increased miscarriage rates. Based on the extent of DNA damage, specific ART or therapeutic intervention should be undertaken.

To Schedule sperm DNA test please call:
Reference Lab at
Tel. 216.444.5755

Figure 20: A: Receiver operator characteristic (ROC) curve showing TUNEL cutoff and the area under the curve. Values within the parentheses represent the 95% confidence interval. B: Distribution of TUNEL values between controls and infertile men.

Urology 2010, 76:1380-1386.

Infertility

TUNEL as a Test for Sperm DNA Damage in the Evaluation of Male Infertility

Rakesh K. Sharma, Edmund Sabanegh, Reda Mahfouz, Sajal Gupta, Aparna Thiagarajan, and Ashok Agarwal

Technologist processing a semen specimen for sperm DNA damage.
Cryopreservation of human spermatozoa is an important area in assisted reproductive technology and oncology. Men undergoing cancer treatment, including certain types of chemotherapy, radiation therapy or surgery, face the possibility of temporary or permanent damage to their fertility. Physicians know which treatments are likely to cause a problem but often cannot predict how severely a man's fertility may be affected by his cancer treatment.

One option to preserve a man's ability to father his own children is to freeze, or cryopreserve, semen samples before cancer treatment begins. This process is called therapeutic sperm banking. Therapeutic sperm banking is also available to men before a vasectomy. Occasionally, therapeutic sperm banking is recommended in other situations where a man's fertility could be damaged by surgery, gonadotoxic medical treatments or exposure to a toxic environment.

**About Our Program**
Our Therapeutic Sperm Banking program was established in 1980, making it one of the first reproductive tissue banks in the Cleveland area. We offer comprehensive services and a reliable system for long-term preservation of human semen, epididymal aspirate and testicular tissue. The Reproductive Tissue Bank has been accredited by 2 independent agencies: the College of American Pathologists (CAP), the JCAHO and registered with the United States Food and Drug Administration (FDA).

**How is the Specimen Collected?**
Each patient is given a sterile collection cup for the collection of his specimen. Semen specimens are collected on-site at Cleveland Clinic's Andrology Center in a private room. We recommend collecting the sample at the laboratory because the sample’s freshness affects fertility. Within minutes after ejaculation, the number of motile sperm begins to drop rapidly. We advise patients to bank multiple samples (3 to 5 visits) to optimize the chances of a pregnancy with the least expensive and least invasive assisted reproductive method.

**How is the Specimen Cryopreserved?**
The samples are preserved in a cryoprotective media and stored in liquid nitrogen for long-term storage. Samples stored >20 years in our bank have resulted in successful pregnancies.

**Figure 21**: Total motile sperm count and sperm motility before and after freezing in patients with testicular cancer.
Does Sample Quality Matter?
Semen quality varies with each ejaculated specimen. In cases of poor semen quality, the Director of the Andrology Center will consult with the patient before his specimens are stored. In general, patients are encouraged to bank multiple specimens to increase the success rates.

How Does Cryopreservation Affect Sperm Quality?
It is reported that 40% of the patients utilizing cryopreserved samples have healthy, live births. Furthermore, chances for success are not affected by the type of ART or malignancy present.

Cryopreservation of Epididymal and Testicular Sperm.

Percutaneous Epididymal Sperm Aspiration (PESA)
PESA is performed for obstructive azoospermic patients. The aspirate is collected in warm human tubal fluid (HTF). The aspirate is examined for presence of sperm and checked for sperm motility.

Clinical Utility of the Procedure:
PESA samples with live sperm are cryopreserved utilizing the TEST yolk buffer as per established lab protocol. Samples can be retrieved from storage for future use in IVF/ICSI as per couple’s request.

Testicular sperm extraction (cTESE) or microsurgical sperm extraction (mTESE)
Both classic (cTESE) or microtesticular sperm Extraction (mTESE) are performed in non-obstructive azoospermic patients or in cases of failed PESA. Small samples of testicular tissue are carefully removed by the surgeon and placed in 200-250 microliters of HTF and examined under a bright field microscopy for the presence of sperm. Samples are transported in a portable incubator to the Andrology Center for careful examination under an inverted microscope. Testicular tissue are carefully minced with a Konte’s pestle to release the sperm and then examined for the presence of sperm. Enzymatic digestion is performed in samples where no spermatozoa are found on initial examination and examined for presence of sperm post digestion.

Clinical Utility of the Procedure:
TESE samples with live sperm are cryopreserved utilizing the TEST yolk buffer as per established lab protocol. Samples can be retrieved from storage for future use in IVF/ICSI as per couple’s request.
Shipping Out-of-Town Semen Specimens
Many patients utilize our Therapeutic Sperm Banking program from outside of Ohio. Cryopreserved semen specimens can be prepared for shipping to out-of-town facilities at any time. Request for transfer of sperm specimens must be accompanied by written permission from the sperm banker and the physician who will be utilizing the specimen for assisted reproduction.

Our Innovation
NextGen® Home Sperm Banking Kit for Men from Geographically-Remote Sites Seeking Fertility Preservation Services
The Home Sperm Banking kit was designed and co-developed by the Andrology Center. This novel system permits patients collect semen specimens in the privacy of their own homes and transport them in a way that allows sperm to retain functional and fertilizing capacity. Samples are shipped overnight utilizing our NextGen® kit to ensure their quick arrival to the Andrology Center.

Will the NextGen® Kit Affect Sperm Quality?
The NextGen® kit does not adversely affect sperm cryosurvival making it a possible alternative for patients who do not have ready access to a fertility clinic. Our collection kit provides an adequate number of sperm for use with advanced reproductive techniques.

For More Information on the NextGen® Kit
Interested patients can go online and view the details of the home kit, answers to frequently asked questions, information on physician referrals and payment options. www.ClevelandClinic.org/NextGen

For NextGen® Appointments:
Individuals interested in obtaining information about the NextGen® Home Sperm Banking Program should call 866.9BANKIN (866.922.6546).

Therapeutic Sperm Banking Appointments
Appointments are required for all visits to the Andrology Center. Repeat banking should be scheduled within 24 to 48 hours after the first appointment. Weekends are also available for subsequent sperm banking. The following information will be required before your first appointment:
• Letter of referral from physician
• Name, address and date of birth
• Medical record number for CCF patients

For more information or to make an appointment please call: 866.922.6546 or 216.444.8182 or visit us online at: http://my.clevelandclinic.org/services/urology-kidney/treatments-procedures/sperm-banking

Additional Services

Figure 26: The NextGen® Home Shipping kit includes a collection cup, preservative/transport media and ice pack.

Who Can Use the NextGen® Kit?
Men who live across the continental United States, North America and anywhere else that offers 24-hour shipping to the United States can take advantage of this kit.

NextGen® Can Be Utilized by:
• Men with cancer for future procreative use
• Men with underlying subfertility
• Men serving in the military
• Pre-vasectomy patients
• Patients subjected to occupational exposure of environmental pollutants

Demonstration of cryofreezer for storing semen samples
Mitochondrial Membrane Potential Assessment
Sperm functionality depends on mitochondrial function and is an important determinant of male fertility. MMP is being standardized in our lab with the MitoScreen Kit containing 5,5',6,6',tetrachloro-1,1',3,3'-tetraethylbenzimidazolcarboxyamine iodide (JC-1) using flow cytometry. The percentage of spermatozoa with intact MMP is reported.

Clinical Utility of test
Reports indicate that in vitro fertilization rate is correlated with the percentage of spermatozoa with intact MMP.

Flow Cytometric Assessment of Intra Cellular Reactive Oxygen Species (iROS)
Increased iROS production causes decreases sperm motility and may also cause premature acrosome reaction, lipid peroxidation, apoptosis, and reduction in mitochondria membrane potential. The test is being standardized using 2',7'–dichlorofluorescin diacetate (DCFDA), is a fluorogenic dye that measures hydroxyl, peroxyl reactive oxygen species (ROS) activity within the cell using flow cytometry. Results are expressed as DCF mean fluorescence intensity (MFI).

Clinical Utility of test
An inverse correlation has been reported between percent iROS levels and progressive motility, normal morphology and sperm viability.

Figure 27: Graphical plots demonstrating the A) percentage of sperm cells with intact mitochondrial membrane potential and B) percent intracellular ROS produced by live sperm cell.
Dedicated Patient Service

IUI and Sperm Banking – Patient Feedback

A. 

<table>
<thead>
<tr>
<th>Event</th>
<th>IUI (n=22)*</th>
<th>Sperm Banking (n=18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Had no appointment / Walk-in</td>
<td>33%</td>
<td>41%</td>
</tr>
<tr>
<td>Less than 24 hours</td>
<td>14%</td>
<td>28%</td>
</tr>
<tr>
<td>1 - 7 days</td>
<td>41%</td>
<td>41%</td>
</tr>
<tr>
<td>More than 7 days</td>
<td>6%</td>
<td>5%</td>
</tr>
</tbody>
</table>

B. 

<table>
<thead>
<tr>
<th>Result</th>
<th>IUI (n=23)*</th>
<th>Sperm Banking (n=18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exceeded my expectations</td>
<td>78%</td>
<td>22%</td>
</tr>
<tr>
<td>Met my expectations</td>
<td>48%</td>
<td>52%</td>
</tr>
</tbody>
</table>

Sperm Banking – Patient Feedback

- Explanation of the screening for infectious diseases (n=17): 82%
- Explanation of the semen collection and storage agreement (n=18): 83%
- Explanation of the pre and post-freeze components of banking results (n=17): 88%
- Explanation of the importance of freezing multiple samples (n=17): 88%

Semen Analysis – Patient Feedback

- Main Campus: 94% for explanation of the collection process, 93% for getting clear and understandable answers to your questions, 92% for knowledge level of lab technologists, 91% for cleanliness of facility, 90% for receiving compassionate care.
- Avon Lab: 90% for explanation of the collection process, 92% for getting clear and understandable answers to your questions, 97% for knowledge level of lab technologists, 94% for cleanliness of facility, 94% for receiving compassionate care.

Figure 28. Feedback on patient wait time for Andrology appointments.
A. Ninety five percent of patients had a wait time of less than one week to get an Andrology appointment.
B. Hundred percent of patients surveyed reported that the time it took to get Andrology appointment met their expectation.

Patients rated their experience on a scale of 1 to 10. 10 being highly satisfied.

Figure 29. How well the sperm banking process was explained to the patients.
More than 80% of sperm banking patients surveyed were satisfied with the explanation regarding key steps of sperm banking.

Patients rated their experience on a scale of 1 to 10. 10 being highly satisfied.

Figure 30. Evaluation of patient satisfaction with various aspects of their Andrology lab visit.
High satisfaction scores both at Main campus and at the Avon facility.

Over 90% of patients surveyed at both locations were highly satisfied with their Andrology visit.

Patients rated their experience on a scale of 1 to 10. 10 being highly satisfied.
Fertility Lab Services in Avon, Ohio

The Richard E. Jacobs Health Center (Avon), a Cleveland Clinic facility offers state-of-the-art services for diagnostic evaluation and management of male infertility. These include (but are not limited to):

1. Computer-Assisted Semen Analysis (CASA)
2. Leukoctyospermia Quantitation/Endtz (Peroxidase) Test
3. Sperm Morphology
4. Eosin-Nigrosin Test for Vitality
5. Special Staining for Azoospermic Patients
6. Sperm Preparation for Intrauterine Insemination
7. Antisperm Antibody Testing
8. Hypo-Osmotic Swelling (HOS) Test
9. Advanced Sperm Function Testing:
   • Reactive Oxygen Species
   • Total Antioxidant Capacity
   • DNA Damage
10. ORP by MOSIT™ test
11. Therapeutic Sperm Banking

Demonstration of an inverted microscope/micromanipulator for viewing testicular sperm

Semen Analysis – Patient Satisfaction

<table>
<thead>
<tr>
<th>Category</th>
<th>Main Campus (n=115)</th>
<th>Avon Lab (n=64)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 or below</td>
<td>6%</td>
<td>3%</td>
</tr>
<tr>
<td>8</td>
<td>17%</td>
<td>16%</td>
</tr>
<tr>
<td>9</td>
<td>17%</td>
<td>19%</td>
</tr>
<tr>
<td>10 - Very Satisfied</td>
<td>60%</td>
<td>63%</td>
</tr>
</tbody>
</table>

Figure 31. Overall patient satisfaction both at the main campus and Avon facility. The overall patient satisfaction score for Main campus was 94% for Andrology Lab and 98% for Avon Lab with a rating of 8-10. Patients rated their experience on a scale of 1 to 10, 10 being highly satisfied.

To schedule an appointment at this new location, please call 216.444.8182/440.695.4270 (7:30 am – 5:00 pm).
Make An Appointment

Andrology Center, Cleveland Clinic
Main Campus
10681 Carnegie Avenue, Building X11, OH 44106
216.444.8182
To schedule an appointment at the Main Campus Location, please call the toll free number at 800.223.2273 ext 48182 or call the direct lab line at 216.444.8182. Appointments are available on weekdays from 7:30 am to 3:00 pm. Limited appointments are available from 7:30 am to 10:30 am on Saturday.
Parking: Dedicated parking spaces for patients are available in the Building X parking lot. Parking is free for 1 hour.

Richard E. Jacobs Health Center
33100 Cleveland Clinic Blvd.
Avon, OH 44011
440.695.4270
To schedule an appointment at the Avon Family Health Center call toll free at 800.599.7771 or direct lab line at 440.695.4270. Appointments are available from 7:30 am to 3:00 pm on Wednesday and Friday.

Fairview Surgery Center
850 Columbia Rd. Westlake, Ohio 44145
440.808.4000
For special services offered such as testicular biopsies, please contact Dr. Sarah Vij.

Therapeutic Sperm Banking
Cleveland, OH or Avon, OH
1.866.9BANKIN
To schedule an appointment for sperm banking at either the main campus or the Avon fertility lab, please call toll free:
1.866.9BANKIN (866.922.6546)
Or 1.800.CCF.CARE (extension 4.8182)
Or call direct: 216.444.8182
An appointment is required for all visits. We can generally schedule one within 24 hours. After your first visit, weekend times are available for subsequent banking. At the time you make an appointment, we will request the following information:
• Name, address, phone number and date of birth
• Your Social Security Number (for registration purposes)
• Reason you are requesting sperm banking
• An order for sperm banking from your referring physician
• The name, address and phone number of your referring physician
• The starting date for chemotherapy, radiation therapy or surgery

View of the patient waiting area.

Recent books by Andrology staff on infertility topics
Instructions for Collecting a Semen Sample

Before Collecting the Sample:
• You should abstain from sex for 2-3 days but no more than 7 days.
• If you are collecting a sample from home, you will need a sterile collection container. The container can be picked up at the lab or your local pharmacy.
• The sample must be delivered to the lab within 60 minutes from the time of collection. The sample also needs to be kept at body temperature during transport.
• You should make an appointment for your test, even if you are collecting the sample at home. Please call 216.444.8182 to make an appointment.

Collecting the Sample:
• The sample must be collected by masturbation or in a special collection device.
• Lubricants or condoms should not be used because they can kill the sperm.
• Make sure the container lid is sealed tightly after collecting the sample.

After Collecting the Sample:
• Write your full name, date of birth and time of collection on the sample container.
• Immediately place the container close to the body. This ensures that the semen sample is kept at body temperature during transit to the laboratory.

Handling the Sample to The Lab Staff:
• Please bring a photo ID with you to the Center.
• Make sure the sample is received by the Andrology Center staff only.
• It is important to let the technologist know if you have lost any sample during collection.
Dr. Ashok Agarwal, Ph.D., HCLD | Director

Dr. Ashok Agarwal, PhD, HCLD, is the Director of the Andrology Center and Reproductive Tissue Bank and the Director of Research at the American Center for Reproductive Medicine. He is a Staff member in the Glickman Urological and Kidney Institute, Obstetrics-Gynecology and Women's Health Institute, Anatomic Pathology, and Immunology. Dr. Agarwal is also on the faculty of the Cleveland State University.

Dr. Agarwal is a board-certified Clinical Laboratory Director in Andrology by the American Board of Bioanalysis and an Inspector for the College of American Pathologists “Reproductive Laboratory Program” for accreditation of Andrology & IVF Laboratories. He served as the Chairman of the Board of the American College of Embryology from 2009 to 2012. He was the recipient of a 2011 Innovator Award for the development of “Remote Sperm Banking Kits” from Cleveland Clinic Innovations and a recipient of 2011 to 2018 Star Awards from the American Society for Reproductive Medicine. Dr. Agarwal received the 2011 and 2013 “Scholarship in Teaching Award” for his innovative Summer Internship Course and the 2013 Teaching Award for the Training Program in Advanced Reproductive Techniques from the Case Western Reserve University School of Medicine. Dr. Agarwal has published over 725 scientific papers and review articles in peer-reviewed scientific journals, authored over 200 book chapters, and presented over 825 papers at both national and international scientific meetings. Dr. Agarwal is the recipient of about 100 research grants. His current research interests are in identifying biological markers of oxidative stress, DNA damage and apoptosis using proteomic research tools and bioinformatics analysis as well as preserving fertility in patients with cancer. Dr. Agarwal is actively involved in laboratory and clinical studies assessing the efficacy of certain antioxidants in improving the fertility of male patients.

Dr. Sajal Gupta, MD | Technical Supervisor

Dr. Gupta holds the position of Assistant Professor at the Lerner College of Medicine of Case Western Reserve University and Project Staff in the Glickman Urological Institute and has served as the Assistant Coordinator of Research at the American Center for Reproductive Medicine since 2006. Dr. Gupta is the Technical Supervisor of the Andrology Center since 2008. She has done her residency in Obstetrics and Gynecology from University of Delhi. Sajal has received “Dr. Tommaso Falcone Award for Excellence in Female Infertility and Women’s Health Research” and the 2011 and 2013 Scholarship in Teaching Award from the Case Western Reserve Medical School.

Dr. Gupta has published over 85 articles in peer-reviewed scientific journals, authored more than 35 book chapters, and has presented over 65 abstracts at both national and international scientific meetings. She is a member of several professional societies. Dr. Gupta is an investigator on over 30 research grants. Her current research interests include the role of free radicals in male and female infertility, endometriosis, assisted reproductive techniques and gamete cryobiology.

Dr. Rakesh Sharma, Ph.D. | Asst. Technical Supervisor

Dr. Sharma is an Associate Professor at the Lerner College of Medicine of Case Western Reserve University and serves as the Coordinator and Assist. Technical Supervisor of the Andrology Center.

Dr. Sharma received his Ph.D. degree from Panjab University, Chandigarh, India. He completed his postdoctoral training at the Cleveland Clinic. Dr. Sharma has published over 235 scientific papers and 25 reviews in peer-reviewed scientific journals, authored 65 book chapters and presented 412 abstracts at both national and international scientific meetings. He is a member of several professional societies. Dr. Sharma is an investigator on 60 research grants. He is the recipient of the Cleveland Clinic Innovator Award, the 2011 and 2013 Scholarship in Teaching (SIT) Award from the CASE Medical School for his innovative Summer Internship Course and the 2012-2017 Star Award from the American Society for Reproductive Medicine.

His current research interests include the role of free radicals in the pathophysiology of male and female infertility, oxidative stress and DNA integrity, alterations in oxidative stress-related proteins, sperm proteomics apoptosis, and fertility preservation.
American Center for Reproductive Medicine (ACRM)

**Our Vision**

“To be a premier center for researchers interested in human reproduction, providing them individualized mentoring and high quality training opportunities that lead to technical, analytical, and intellectual expertise in the field.”

**Our Mission**

“To conduct cutting-edge research in human reproduction, as well as the causes of infertility, and to train physicians and scientists to advance the understanding of reproductive sciences.”

**Our Values**

“We believe in integrity, excellence, innovation, accountability, commitment, perseverance, teamwork and collaboration.”

**Our Story**

“Founded in 1993, the ACRM offers research fellowships, hands-on training in human assisted reproduction, and summer mentorship opportunities. We also offer diagnostic & therapeutic services for infertile couples and cancer patients. In the past 26 years, more than 1,000 scientists, physicians, researchers, reproductive medicine professionals and students from all over the world have trained at our Center.”

The **spermatozoa and oocyte** represent the personalized, hands-on ART training course offered annually since 2003 and the opportunity to learn the latest techniques in the fast changing subspecialty of Assisted Reproduction at one of the world’s premier ART Training Centers. 198 candidates from more than 32 countries have participated in this course.

The **DNA strand** represents the essence of the research fellowship in human reproduction, andrology and male infertility, offered at the ACRM since 1993. More than 500 scientists/physicians from over 55 countries have trained at the ACRM. The Center is currently focusing on the use of proteomics and bioinformatics to elucidate biomarkers of male infertility.

The **microscope and a hand holding the test tube** represent the routine and advanced diagnostic testing offered to infertility patients at the Andrology Center and Reproductive Tissue Bank, one of the largest state-of-the-art facilities in the country. Our staff has more than 3 decades of experience in assisting patients with male infertility.

The **open book and beaker** represent the Summer Internship program, offered annually since 2008. Nearly 270 interns have experienced bench research and scientific writing under the personalized mentorship of scientists/physicians and reproductive biologists worldwide.
Get To Know Our Center

The American Center for Reproductive Medicine is a research program of the Glickman Urological and Kidney Institute of the Cleveland Clinic. Established in 1993, the Center is dedicated to cutting-edge, disease-oriented translational research and to the education of physicians and scientists. Our Center is rated as a leading center of excellence at the world-class Cleveland Clinic.

The American Center for Reproductive Medicine enjoys an international reputation for excellence and innovation in human reproduction and male infertility research and is dedicated to disseminating its results. Research papers from the Center’s staff are selected regularly for publication in distinguished medical journals. The Center’s website has been ranked No. 1 for research in reproductive medicine and andrology since 2001 by Google and other top search engines, attracting close to 1,038,879 visitors to date.

Over the past 26 years, more than 500 physicians, scientists, biologists and medical/pre-med students from over 55 countries worldwide have received their research and ART training at the American Center for Reproductive Medicine.

For an up to date list of our publications, kindly visit us on ResearchGate. A Scopus Citation Report of our Research Publications by the American Center for Reproductive Medicine from 1993 to 2019 is available here.

We Have What You Need To Research Your Way to the Top!

The Laboratories
Research and Clinical Laboratories occupy over 5000 square feet of workspace with state-of-the-art instruments and facilities for advanced research in proteomics of male infertility and molecular markers of oxidative stress and DNA integrity.

Equipment
Instruments available in our facility include: computer assisted semen analyzers, luminometer for oxidative stress measurements, Accuri BD C6 flow cytometer, ChemiDoc Imager and equipment for western blotting, culture room equipped with a sterile hood, several incubators, teaching and regular microscopes, and Narishige micromanipulators fitted on an inverted phase-contrast microscope, spectrophotometers, ELISA plate reader, centrifuges, liquid nitrogen storage tanks, programmable freezers, cold room, etc.

Core Laboratories
Our research laboratories has ready access to over a dozen highly-specialized core laboratories within the Cleveland Clinic Lerner Research Institute. These include: proteomics, metabolomics, genomics, molecular biotechnology, molecular screening, flow cytometry, mass spectrometry, translational research and imaging, etc. For more information on these core laboratories, please visit: http://www.lerner.ccf.org/services.

IT Equipment
Along with office supplies, the office space for Fellows is equipped with over 2 dozen computers with laser printers, scanners, copiers, and all the necessary software such as EndNote for preparation of references for publication. All computers in the Center are connected to the Cleveland Clinic’s intranet that provides direct access to most online journals hosted by the Cleveland Clinic Alumni Library related to the field of medicine, urology, reproductive medicine, andrology, ob-gyn, etc.

Teamwork
A large collection of scientific journals, print and electronic journals/books, and other databases are available through the resourceful Cleveland Clinic Alumni Library. Specialized Medical Librarians are ever willing to help in research and use of electronic databases. Statistical research support is readily available from a team of biostatisticians working in the Department of Quantitative Health Sciences (QHS). Services for the design and creation of medical illustration for publication purposes are provided by the experts at The Center for Medical Art and Photography (CMAP) Arts and Photo. These artists also aid in the preparation of research posters and lecture slides for presentations at national meetings.

Take a sneak peek into our research laboratories.

Our Institution

Cleveland Clinic is ranked as one of the top Hospitals by U.S. News & World Report. Located in Cleveland, Ohio, Cleveland Clinic is a nonprofit, multispecialty academic medical center that integrates clinical and hospital care with research and education. Founded in 1921 by four renowned physicians with a vision of providing outstanding patient care based upon the principles of cooperation, compassion and innovation, it is the second largest group practice in the world with 4,200 physicians and scientists practicing and researching in more than 140 medical specialities. Today with more than 1400 beds on the Cleveland Clinic main campus and 5,895 beds system-wide, Cleveland Clinic is one of the largest and most respected hospitals in the country.

In addition to the main hospital located near Cleveland’s historic University Circle, the Cleveland Clinic operates nine regional hospitals, a children's hospital, and 18 full-service family health centers in Ohio, as well as hospitals in Florida, Las Vegas, Canada, and Abu Dhabi, employing more than 65,893 individuals and providing global world class medical care. Last year alone, nearly 8 million patients from 180 countries and all 50 states received their care at the Cleveland Clinic.

The main hospital campus, located near downtown Cleveland, occupies 167 acres and 44 buildings. It includes a hospital, an outpatient clinic, a children's hospital, cancer institute, eye institute, research institute, a medical school and supporting labs and facilities.

To learn more, visit www.clevelandclinic.org
Cleveland is the second largest city in the state of Ohio, after Cincinnati. Located on the southern shores of Lake Erie, Cleveland lies at the outflow of the Cuyahoga River into Lake Erie. The main campus of Cleveland Clinic is situated 5 miles east of downtown Cleveland. Case Western Reserve University and University Hospitals are within one mile of Cleveland Clinic. Cleveland State University and John Carroll University are also within a short distance of the Cleveland Clinic main campus. Nearby the Cleveland Clinic is University Circle, which serves as the cultural, medical and education center of Cleveland and Northeast Ohio. Medical research in the University Circle institutions places Cleveland as one of the major medical research environments in the country.

University Circle is also the home to the Cleveland Museum of Art, the Cleveland Institute of Music, the Cleveland Institute of Art, and the Museum of Natural History. The Cleveland Museum of Art houses one of the country’s most highly acclaimed art collections. The world-famous Cleveland Orchestra, performs regularly in the elegant Severance Hall. Playhouse Square is the home to several large theaters that host traveling Broadway plays and various other performances.

The University Circle area is walking distance from Cleveland’s historic Little Italy with its brick streets, a quaint and charming area of intimate Italian restaurants, antique and craft shops, and art galleries. The Coventry Village area is close to the Clinic’s main campus and popular with its shops and restaurants.

Cleveland hosts the Rock and Roll Hall of Fame and Museum, and the Great Lakes Science Center. Outdoor enthusiasts of all ages enjoy the ‘Emerald Necklace’, the Cleveland Metroparks network of parks that encircles the city, which offer a variety of recreational opportunities. When it comes to professional sports, Cleveland is the proud home to the Browns football, Cavaliers basketball, Indians baseball and Lake Erie Monsters hockey teams respectively. As the Great Lakes city on America’s North Coast, Cleveland offers abundant lakeshore for different activities.

Cleveland and its surrounding suburbs are home to nearly 3 million residents. A vibrant and versatile metropolitan area, Cleveland has nearly 80 residential communities. Fine residential areas are located within minutes of the Cleveland Clinic campus. Recognized as one of the best places to live and visit, Cleveland and North-East Ohio is bustling with exciting things to do for people of all ages.

For more information about Cleveland, visit these resources:
About Cleveland, Cleveland.com, Cleveland, The New American City, Positively Cleveland, Travel Cleveland, and Discover Ohio.
This state-of-the-art laboratory manual includes 20 clinical protocols used daily for the investigation of the infertile male, presented with easy to understand, step-by-step methodology. The protocols are arranged from routine to advanced laboratory procedures common to clinical practice, including computer-assisted semen analysis, sperm preparation for IUI by density gradient and swim-up, sperm cryopreservation, and sperm DNA fragmentation test by TUNEL method, among others. The methodology in each protocol follows best practice guidelines made clearer by professionally hand-drawn illustrations covering most of the important steps and equipment. The authors, hailing from the world-renowned Andrology Center at Cleveland Clinic, have over 50 years of combined first-hand experience in managing very busy diagnostic and research facilities in male infertility and andrology. The book will be an indispensable resource for thousands of laboratory technologists, clinicians and reproductive professionals (andrologists, embryologist, etc.) engaged in the diagnosis and management of infertile men around the world.

Foreword

This state-of-the-art laboratory manual contains protocols that can be used daily in the investigation of male infertility. In its 24 chapters, the book covers most of the common routine and advanced testing that is available at the present time. This text is unique in its emphasis in presenting test protocols in detail that allow immediate use in a clinical laboratory setting. It has a number of hand-drawn, artistic presentations of key equipment and procedures which add to the clarity. At the beginning of the text, information is presented to place clinical aspects of male infertility in context of the role of semen testing.

Drs Agarwal, Gupta, and Sharma combine their over 50 years of experience in running a state-of-the-art clinical andrology laboratory to provide an indispensable resource for thousands of clinicians, reproductive professionals (andrologists, embryologists), laboratory technicians, as well as other students of andrology lab testing. This experienced team has authored dozens of texts related to all aspects of male fertility. Their current book is a one of a kind work—a must-read for all with an interest in providing the highest quality and most accurate andrology testing for their patients.

Edmund Sabanegh, Jr., MD
Former Chairman, Department of Urology | The Cleveland Clinic | USA