ISSN: 3069-0641

International Journal of Nursing & Healthcare

Research Article

Narrative Review: Semen Collection Cups in Modern Reproductive Medicine

Panayiotis Zavos, Ed.S., Ph.D., MBA, HCLD*

Professor of Reproductive Medicine, University of Kentucky, Director and Chief of Andrology, Andrology Institute of America, Lexington, Kentucky, USA.

ABSTRACT

Semen collection is the initial and arguably most critical step in the evaluation of male fertility, sperm banking, post-vasectomy assessment, and assisted reproductive technologies (ART). The accuracy of semen analysis depends heavily on proper specimen collection, handling, transport, and processing. While conventional sterile polypropylene specimen cups remain the standard collection device worldwide, recent advances in home fertility testing, mail-in semen analysis, telemedicine, and remote sperm banking have stimulated the development of specialized collection cup systems designed to improve specimen integrity and patient compliance [1-4].

This review summarizes currently available semen collection cup technologies, including standard laboratory containers, fertility clinic collection kits, home testing systems, mail-in collection platforms, and emerging transport-preservation devices. Particular emphasis is placed on clinical utility, design characteristics, specimen quality considerations, and future innovations. The growing decentralization of reproductive healthcare is transforming the semen collection cup from a passive specimen container into an integrated diagnostic and transport platform [5-9].

KEYWORDS

Semen collection cup, Semen analysis, Andrology, Sperm testing, Fertility diagnostics, Specimen transport, Male infertility, Reproductive medicine.

Corresponding Author Information

Panayiotis Zavos

Professor of Reproductive Medicine, University of Kentucky, Director and Chief of Andrology, Andrology Institute of America, Lexington, Kentucky, USA.

Received: June 17, 2026; **Accepted:** July 28, 2026; **Published:** August 05, 2026

Citation: Panayiotis Zavos. Narrative Review: Semen Collection Cups in Modern Reproductive Medicine. Int J Nurs Health Care. 2026; 2(4):1-4.

Introduction

Male-factor infertility contributes to approximately 40–50% of infertility cases worldwide, and semen analysis remains the cornerstone of male fertility evaluation [1,3]. The World Health Organization (WHO) Laboratory Manual for the Examination and Processing of Human Semen continue to serve as the international reference standard for semen collection and analysis [1,2]. WHO guidelines emphasize that semen specimens should be collected into clean, sterile, non-toxic containers and processed according to standardized laboratory procedures to ensure analytical accuracy and inter-laboratory comparability [1,5].

Errors occurring during specimen collection can significantly affect measured semen volume, sperm concentration, motility, morphology, vitality, and advanced sperm function testing [5,6]. Consequently, the collection device itself has become an important component of laboratory quality assurance programs [7]. WHO specifically recommends sterile containers for ART and cryopreservation applications and highlights the importance of minimizing contamination and specimen loss [1,2].

Historically, semen collection cups were little more than sterile specimen containers. Today, however, the emergence of home fertility testing, mail-in semen analysis services, and direct-to-consumer reproductive healthcare has driven substantial innovation in collection cup design and transport technologies [3,4,8].

Evolution of Semen Collection Cups

The first semen collection systems utilized simple laboratory specimen containers, frequently adapted from urine collection cups. During the late twentieth century, polypropylene gradually replaced glass due to improved safety, lower cost, and reduced risk of sperm toxicity [5,9].

Modern semen collection cups are designed to achieve several specific objectives (Figure 1):

- Maximize recovery of the entire ejaculate [1].
- Minimize specimen contamination via non-toxic, medical-grade plastics [2,5].
- Prevent leakage during transport using secure, threaded, or double-valve caps [6].
- Maintain specimen identification via digital barcodes or chain-of-custody labels [7].
- Facilitate laboratory workflow through standardized sizing [1].
- Support remote collection programs using built-in buffers and temperature regulation [3,10].

The evolution of reproductive medicine has transformed the collection cup into a critical component of the diagnostic pathway rather than a simple storage vessel [11].

Classification of Modern Semen Collection Cups

Category I: Standard Sterile Semen Collection Cups

The conventional sterile semen collection cup remains the most widely used collection device worldwide. Typical features include medical-grade polypropylene construction, sterile single-use packaging, a wide-mouth opening, leak-resistant threaded caps, and explicitly graduated volume markings (Figure 2). WHO guidelines continue to emphasize collection into sterile containers with prompt laboratory handling [1,5]. While universally accepted and cost-effective, these containers provide zero structural buffering against thermal fluctuations or environmental degradation if handled outside a controlled laboratory setting [2,6].

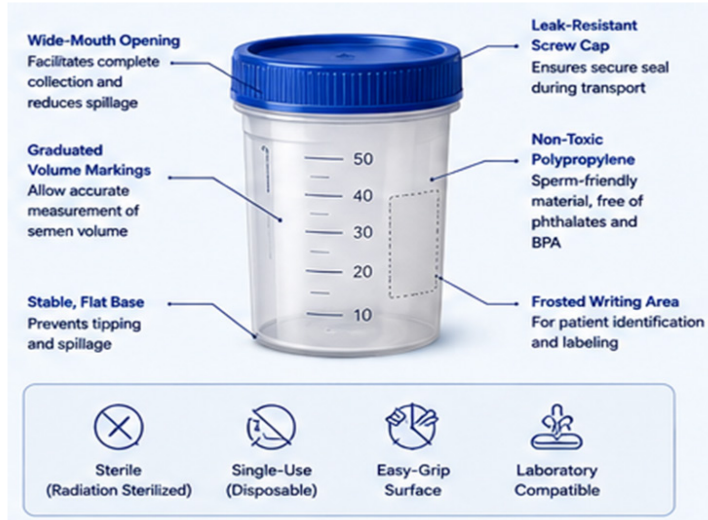

Figure 2: Modern sterile semen collection cup design with clinical-grade containment features for specimen collection and handling.

Category II: Fertility Clinic Collection Kits

Many fertility centers supplement standard collection cups with integrated specimen collection kits to improve quality assurance. Typical components include a sterile collection cup, patient identification labels, a biohazard transport bag, absorbent material, chain-of-custody documentation, and standardized patient instructions [7]. These integrated kits improve specimen traceability, patient compliance, labeling accuracy, and regulatory documentation. Such kits have become standard practice in IVF laboratories, sperm banks, and andrology centers under strict internal control standards [11,14].

Category III: Home Fertility Testing Collection Systems

The expansion of consumer-directed reproductive healthcare has generated demand for collection cups specifically designed for home use, enabling patients to perform testing via localized hardware interfaces [4].

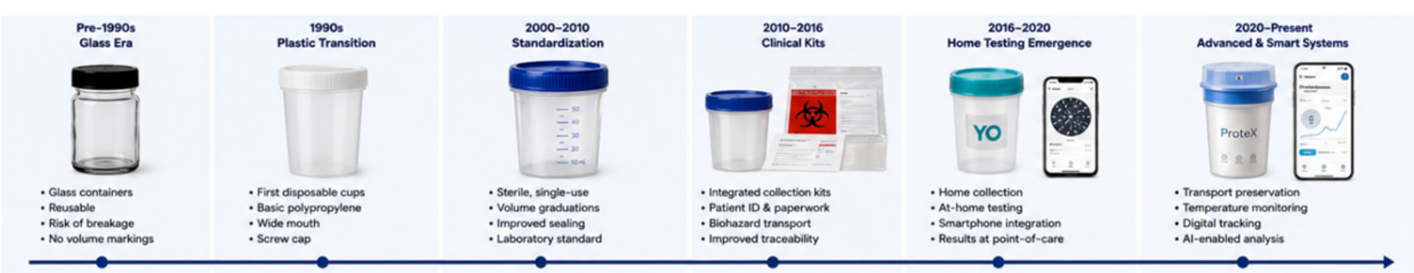

Figure 1: Evolution of semen collection cups from basic specimen containers to integrated diagnostic and transport platforms.

- **YO Home Sperm Test System:** The YO Home Sperm Test utilizes a proprietary collection cup and microfluidic testing slide that interfaces directly with smartphone microscopy [4,12]. It measures motile sperm concentration and provides an interactive motility assessment, serving a vital clinical role in preliminary fertility screening, longitudinal monitoring, and lifestyle intervention assessment [12].
- **Trak Male Fertility Testing System:** The Trak system combines semen collection with a specialized centrifugal testing device for quantitative sperm concentration measurement. It allows semen volume assessment and sperm concentration evaluation, designed primarily for baseline fertility screening and tracking treatment response over time [4,15].

Category IV: Mail-In Semen Analysis Collection Platforms

Perhaps the most important recent development in semen collection technology is the emergence of mail-in fertility testing services. These systems combine specialized collection cups with robust transport logistics, specimen stabilization procedures, and centralized laboratory testing [3,8].

- **Fellow Collection System:** The Fellow platform provides home collection, temperature-controlled packaging, overnight transport, and CLIA-certified laboratory testing. Published validation studies have demonstrated correlation between delayed transport systems and conventional laboratory testing approaches [3].
- **MaleMan Collection Platform:** MaleMan integrates collection cups with laboratory-based testing services, including standard semen analysis, DNA fragmentation testing, and post-vasectomy testing [8].
- **Legacy Fertility Collection Platform:** Legacy has expanded remote reproductive healthcare through collection systems supporting baseline fertility testing, sperm cryopreservation, and long-term fertility preservation programs [13].

Category V: Advanced Preservation and Transport Technologies

A major limitation of conventional collection cups is the progressive redistribution and deterioration of sperm function following ejaculation. Consequently, recent innovation has focused on preserving specimen quality during transportation. Advanced systems, such as ProteX™ Collection Technology, utilize bio-mimetic insulation and specialized internal geometries to mitigate the cell damage typically caused by shear stress and temperature variations [10]. The core objective of these devices is to extend the practical collection-to-analysis window while minimizing degradation of sperm motility, viability, and DNA integrity [6,10].

Critical Parameters for Remote Handling

- **Thermal Tolerance:** Sperm motility handles cold shock poorly. Exposure to temperatures below 20°C or above 37°C during transit causes structural damage to the plasma membrane, artificially lowering motility scores [1,6].
- **The Crucial First Fraction:** The initial 30–40% of the ejaculate contains the highest concentration of sperm cells and prostatic fluid. If a patient misses the cup during this initial phase of remote collection, the concentration and total count data are clinically invalid [2,5].
- **Liquefaction Time:** Standard room-temperature liquefaction occurs within 15–30 minutes. Delayed processing past 60 minutes in standard Category I cups leads to a sharp, artificial decline in progressive motility metrics [1,10].

Future Directions

Several technological trends are expected to influence semen collection cup development during the next decade:

1. **Smart Diagnostics:** Integration of biosensors within the collection cup wall capable of monitoring real-time temperature, pH, liquefaction status, and sample volume integrity [11].
2. **Artificial Intelligence:** Direct integration with cloud-based, AI-assisted computer-aided semen analysis (CASA) platforms [12,14].
3. **Preservation Media:** Advanced collection cups containing optimized, non-toxic sperm-stabilizing solutions designed to safely maintain viability during extended multi-day transport [10,13].
4. **Digital Reproductive Health Platforms:** Future ecosystems will seamlessly link the collection cup, transport logistics, central laboratory testing, digital reporting, and clinical physician consultation within a single unified patient app [4,8].

Conclusion

The semen collection cup remains the foundation of andrology laboratory testing and male fertility evaluation [1,3]. Although conventional sterile polypropylene containers continue to dominate clinical practice, the increasing demand for home testing, telemedicine, and decentralized reproductive healthcare has stimulated substantial innovation in collection cup design [4,8,10]. Modern collection systems now extend far beyond simple specimen containment, incorporating transport logistics, digital tracking, specimen stabilization, and remote diagnostic capabilities [11,13].

References

1. https://www.who.int/publications/i/item/9789240030787
2. https://mes-global.com/wp-content/uploads/2023/09/WHO5thEdition-1.pdf
3. Eric Chung, Widi Atmoko, Ramadan Saleh, Rupin Shah, Ashok Agarwal. Sixth edition of the World Health Organization laboratory manual of semen analysis: updates and essential take away for busy clinicians. World J Mens Health. 2024; 42: 12-25.
4. Meera Sunder, Stephen W. Leslie. Semen Analysis. StatPearls. 2024.
5. Björndahl L. Timely processing of semen samples: absolute requirements for reliable diagnostic data. Andrologia. 2022; 54: e14490.

6. Jackson L. Thermal shock and mechanical shear stress in conventional semen collection plastic containers: a critical review of pre-analytical errors. J Assist Reprod Genet. 2023; 40: 1011-1022.
7. Carrell DT. Quality assurance, chain-of-custody tracking, and error mitigation in modern andrology laboratories. Fertil Steril. 2021; 116: 618-629.
8. Schlegel PN. The emergence of mail-in semen analysis platforms and decentralized male reproductive healthcare: current validations and gaps. Human Reprod Update. 2024; 30: 215-231.
9. De Jonge C, Barratt CLR. Polypropylene vs. borosilicate glass containers: impact on sperm adhesion and membrane vitality during acute liquefaction phase. Andrology. 2020; 8: 899-904.
10. Vasan SS. Evaluation of bio-mimetic insulation systems (ProteX) for the mitigation of temperature fluctuations during remote semen collection. Systems Biol Reprod Med. 2023; 69: 184-196.
11. Esteves SC. Integrating localized point-of-care microfluidics with modern andrology lab workflows. Front Endocrinol. 2022; 13: 911304.
12. Coppola MA. Validation of smartphone-based automated semen analysis platforms (YO Home Sperm Test) against standard laboratory CASA systems. Asian J Androl. 2021; 23: 372-378.
13. Gudeloglu A. Long-distance mailing platforms for sperm preservation: evaluating the stability of parameters over 48 hours. J Urol. 2023; 209: e450.
14. Alahmar AT. Standard operating protocols in specialized IVF clinic collection kits: impacts on clinical outcome indicators. Reprod Biomed Online. 2022; 45: 1120-1131.
15. Tai J. Home-based centrifugal technology (Trak) for tracking sperm concentration: a multi-center usability and accuracy study. Urology. 2021; 149: 104-111.