Care Delivery for Male Infertility
The Present and Future

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KEYWORDS

• Male infertility • Insurance coverage • Health policy • Public policy • Infertility markets

KEY POINTS

- Although infertility is considered a disease and male factor infertility contributes to almost half of infertile couples, it is frequently not covered by insurance.
- States are increasingly passing state-level mandates to include coverage for fertility evaluation and treatment, and about half of these mandates include mention of male factor infertility in some form.
- Employers are increasingly electing to include fertility coverage to improve employee wellness and satisfaction.
- Venture capital firms are investing in fertility startups and clinics, including a growing number of companies focused on male infertility products.
- Reproductive health clinics should include initial evaluation of male and female partners to deliver the most effective and cost-efficient care.

INTRODUCTION

Infertility is defined as failure to conceive a pregnancy after 12 or more months of regular, unprotected intercourse or therapeutic donor insemination.[1] According to the American Society for Reproductive Medicine (ASRM), 8% to 15% of couples are unable to conceive during this period, and male factor is solely responsible in about 20% of these couples and contributes in an additional 30% to 40% of couples with infertility.[2] Although the ASRM, The National Institute for Healthcare and Care Excellence, and Centers for Disease Control and Prevention all recommend that both partners in a couple diagnosed with infertility should receive an evaluation, one survey from the National Survey of Family Growth indicates that male partners do not receive an evaluation in 18% to 27% of cases.[2–5] Indeed, although 17% of women aged 25 to 44 years reported ever using infertility services, only 9% of men in the same age range reported ever doing so.[6]

There are numerous potential reasons for this discrepancy, including social and cultural expectations and lack of insurance coverage for evaluation and treatment of male factor infertility. Infertility has been officially classified as a disease by numerous organizations, including the World Health Organization and the American Medical Association.[7,8] However, many insurance plans in the United States do not cover diagnostic testing or treatment of infertility and instead require patients to pay out of pocket for evaluation and care, even if they have coverage for other diseases and health conditions.[9] This lack of coverage can affect patient's health as well as place significant financial burden on patients and their families.[10]

In this review, the authors assess the current state of care delivery for male infertility care in the United States. They begin by examining the scope of male infertility as well as the unique burdens it places on patients. The authors then examine the importance of insurance coverage

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for male infertility care and current and proposed legislation relevant to male infertility. Next, they discuss the costs associated with male infertility care review increasing public awareness of male factor infertility and increasing market demand for services and coverage of infertility care broadly as well as specifically for men. Finally, this article is concluded with a discussion of potential systems-level innovations to policy, reimbursement, and practice structure to improve male infertility treatment delivery.

SCOPE OF MALE INFERTILITY AND IMPORTANCE OF MALE INFERTILITY EVALUATIONS AND TREATMENTS

Scope of Male Infertility

Male factor infertility contributes to 40% to 50% of overall infertility and affects approximately 7% of all men.[11] Despite this, 18% to 27% of infertile couples report that the male partner did not receive evaluation or treatment.[5] Given the large scope and potential impact of male infertility, it is important to consider why so few men get evaluated and the possible risks associated with this lack of care.

Importance of Male Fertility Evaluations

Evaluation of male infertility can benefit an infertile couple in 3 main ways. First, evaluation can identify and correct reversible causes of male infertility, such as varicoceles or hormone imbalances; second, it may identify irreversible conditions that may be amenable to assisted reproductive techniques and technologies, such as iatrogenic low sperm counts; third, it may identify irreversible conditions from which a male patient's sperm is not obtainable, such as certain Y chromosome microdeletions and therefore guide future reproductive decisions.

When men are not evaluated or treated for infertility, the burden of evaluation and treatment falls on the female partner. Treatments for male infertility, such as varicocelectomy, can down-stage the level of treatment and intervention necessary for couples to achieve pregnancy; as one study of 540 couples demonstrated, about 50% (271 patients) achieved a greater than 50% increase in total motile sperm count after varicocelectomy and 36.6% achieved pregnancy with a mean time to conception of 7 months, thus potentially decreasing the level of additional treatments or technology needed to bypass male factor infertility.[12]

Health Risks Associated with Male Infertility

In addition to placing the infertility burden on women, men not receiving male infertility evaluations may increase the risk that other serious medical diseases may be missed. Male infertility has been associated with a variety of significant health conditions, and evaluation and diagnostic testing can identify underlying pathology contributing to infertility and other potential health concerns. In one review of 536 male infertility evaluations, 6% of patients were found to have significant medical pathology, including 24 with cystic fibrosis mutations and other patients with karyotypic abnormalities, testis and prostate cancer, diabetes mellitus, and hypothyroidism.[13] Missing these diagnoses in male patients increases the risk that some of these genetic conditions may be passed on to offspring.

Furthermore, recent studies suggest that male infertility may be associated with increased future health risks, as summarized in **Fig. 1**. Male infertility has been associated with an increased risk of cardiovascular disease,[14] increased risk of developing germ cell testicular cancer,[15] increased risk of developing high-grade prostate cancer,[16] and overall increased mortality.[17] In one study of 2238 infertile men in Texas, patients diagnosed with azoospermia were overall 1.7 times more likely to develop cancer than the general population and 2.9 times more likely than other men evaluated for infertility.[18] Another recent retrospective review compared 76,343 men diagnosed with male factor infertility with a control group of 183,742 men who underwent vasectomy using Optum claims data from 2003 to 2016; this study found that infertile men had a higher risk of incidental hypertension, diabetes, hyperlipidemia, and heart disease when compared with those undergoing vasectomy regardless of education, socioeconomic status, race, and geographic location.[19] These studies suggest that infertility and semen quality may be a marker of overall health and that there may be a biological etiology to the relationship between fertility and future health, especially cardiometabolic health.

In addition to a direct impact on the patient's health, diagnosis of infertility has significant impact on quality of life. Couples are more likely to experience stress and marital discord; male partners in particular are more likely to report depression, erectile dysfunction, and sexual relationship problems.[20] In one study of 149 female patients undergoing treatment of infertility, global symptom scores, as measured by the Symptom Checklist-90, were equivalent to patients with cancer and in treatment of cardiac rehabilitation.[21] Indeed, multiple studies have demonstrated that psychological burden is one of the primary reasons that patients drop out of treatment of infertility.[22]

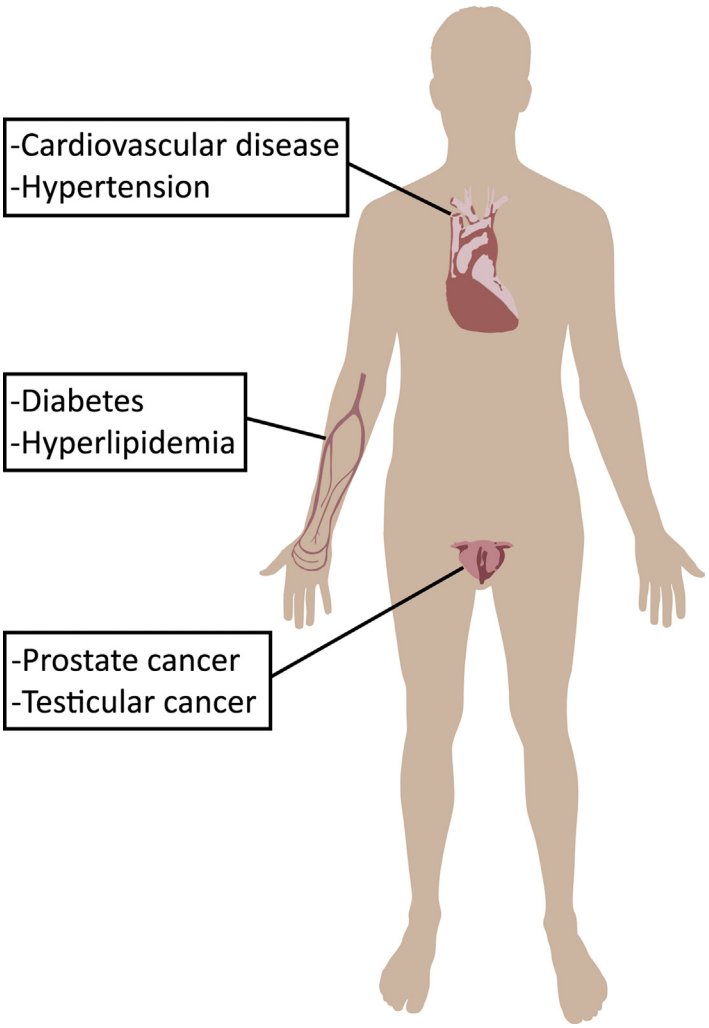

Fig. 1. Future health risks associated with male factor infertility.

INSURANCE COVERAGE FOR INFERTILITY CARE

Federal Coverage

The 2010 Patient Protection and Affordable Care Act (PPACA) remains the most recent large federal law to mandate insurance policies. Unfortunately, PPACA does not include infertility care in its list of essential health benefits and does not comment on whether insurance policies should cover infertility care, therefore leaving coverage to the discretion of private insurers and individual states.[23] Patients who are covered by federal insurance do not receive coverage for infertility evaluation or treatments. There have been 2 recent federal bills, HR 5965 and S 2960, both titled Access to Infertility Treatment and Care Act and introduced on May 24, 2018, which would have required health insurance coverage for the treatment of infertility; neither bill was passed by the House of Representatives or the Senate, respectively.

Federal legislation has also been introduced for increased infertility care, through fertility preservation, in the Department of Defense. A 2018 survey of 799 service women found that more than 30% of military women reported problems achieving pregnancy, significantly higher than the national average; the survey participants were broken into 4 categories, with the highest percentage of reported challenges (37%) in currently serving service women.[24] A similar 2014 study of 16,056 male veterans found that the prevalence of lifetime infertility was about 14%, also significantly higher than the national average.[25] As the percent of veterans involved in recent conflicts is projected to increase from 30% in 2013 to 45% in 2023, this suggests that a younger patient population with increased prevalence of infertility will have

increased need for fertility treatment.[26] As a result, Senate Bill 319, the Women Veterans and Families Health Services Act of 2019, was introduced in February 2019 and "would require the DoD to provide troops the option to freeze their eggs and sperm prior to deployment to a combat zone and store the specimens up to a year after leaving military service… [and] would require the Pentagon to establish a policy for retrieving eggs or sperm from seriously injured service members whose fertility or lives are at risk as a result of a wound or illness."[27] This legislation, although unlikely at the time of writing to be passed, speaks to an increased awareness of infertility on a federal level.

State Coverage

Because the future direction of federal coverage remains unclear due to ongoing judicial challenges to the PPACA, the authors also focus on state and private insurance coverage for male infertility. At the state level, 17 legislatures have passed laws mandating the inclusion of some sort of coverage for infertility evaluations and/or treatments with various exceptions, including employer size, religious status, and type of insurance plan. These variations by state are summarized in **Table 1**. Of these 17 states, only 9 included any discussion of evaluation or treatment of male infertility.[28] Recently, Delaware enacted legislation in June 2018 that mandates insurance coverage for infertility treatments including in vitro fertilization (IVF) as well as male-specific treatments such as cryopreservation and thawing of sperm, cryopreservation of testicular tissue, intracytoplasmic sperm injections, and microsurgical sperm aspiration. It included exceptions for vasectomy reversals, religious organizations, and employers with fewer than 50 employees.[29] These exclusions include self-employed and self-insured parties, such as large health care institutions. On January 1, 2020, New Hampshire legislation will go into effect that mandates coverage for diagnosis; "medically necessary" fertility treatment; and fertility preservation for patients undergoing surgery, chemo, radiation, or other medical treatments with a risk of impaired fertility. It specifies male factor as a cause of infertility, specifically azoospermia, but does not define male factor infertility evaluation or treatments. The New Hampshire coverage does not extend to the Small Business Health Options Program (coverage option for businesses with fewer than 50 employees).

Private Coverage

In terms of private insurance coverage offered by employers, little is known about male infertility coverage. In 2006, RESOLVE, a national infertility advocacy organization, hired the Mercer Organization to survey large employers (defined here as more than or equal to 200 employees) about current coverage policies. Of the 1800 companies contacted, 931 responded; whereas 63% reported providing insurance coverage for infertility evaluations, only 39% reported covering medical therapy and 22% reported covering IVF.[30] Of note, 91% of those respondents offering infertility treatments reported no increase in their medical costs as a result of this coverage. In recent years, studies have found significant growth in offerings of all types of infertility treatment coverage. A 2018 survey of employer-sponsored health plans also by the Mercer Organization reported increases in coverage, including IVF. Compared with the 2016 rates, 15% more of organizations with more than 20,000 employees reported covering IVF (44% versus 29%). This growth trend was smaller in organizations with more than 500 employees (28% in 2018 vs 25% in 2016).[31] Unfortunately, these surveys do not specifically evaluate coverage for male infertility, so little remains know for male partners.

This increase in private coverage offered by companies potentially represents an effort to retain employees and improve overall employee satisfaction. A 2016 survey of 702 patients who had received at least one IVF treatment found that patients with employer-provided infertility insurance coverage had higher satisfaction with their employer, including higher rates of recommending their employer as a great place to work and lower likelihoods of missing work due to infertility.[32] As the average age of first birth increases (from 24.9 years in 2000 to 26.3 in 2014), there is increased discussion and surveys in the business community about the benefits of offering infertility coverage to increase employee wellness and reduce attrition.[33,34] Indeed, this is in line with justification that Delaware cited in its decision to extend its state insurance mandate to include infertility: "According to the National Conference of State Legislatures, 15 states currently have laws regarding insurance coverage for infertility diagnosis or treatment, including 2 states that border Delaware, New Jersey and Maryland. This puts the State at a significant competitive disadvantage, as many reproductive age residents intentionally change employers and leave Delaware to gain more attractive fertility care benefits."[35] Increasingly, private infertility coverage seems to be viewed as a means of increasing employee retention and satisfaction without associated increase in costs.

Table 1
Summary of male-factor infertility coverage in states with laws related to infertility coverage

State	Male Factor Evaluation and Treatment Coverage Included in Law	Restrictions	Law/Code	Year(s) Enacted
AR	None	-	Ark. State. Ann. § 23-85-137, § 23-86-118	1987, 2011
CA	Diagnosis and treatment (medication and surgery) of conditions causing infertility must be offered to employers	-	Cal. Health & Safety Code §1374.55, Cal. Insurance Code §10119.6	1989
CT	Diagnosis and treatment of individuals unable to "produce conception"	-	Conn. Gen. Stat. §38a-509, §38a-536	1989, 2005
DE	Cryopreservation of sperm and testicular tissue, storage of sperm, surgery including microsurgical sperm aspiration	Correction of elective sterilization, experimental procedures[a], religious organizations	Delaware Insurance Code Title 18, § 3342, § 3556	2018
HI	None	-	Hawaii Rev. Stat. §431:10A-116.5, §432.1-604	1989, 2003
IL	None	-	Ill. Rev. Stat. ch. 215, §5/356m	1991, 1996
LA	None	-	La. Rev. Stat. Ann. §22:1036	2001
MD	None	-	Md. Insurance Code Ann. §15-810, Md. Health General Code Ann. §19-701	2000
MA	Diagnosis and treatment of infertility, including sperm procurement, processing, and banking	Correction of elective sterilization; experimental procedures[a]	Mass. Gen. Laws Ann. Ch. 175, §47H, ch. 176A, §8K, ch. 176B, §4J, ch. 176G, §4; 211 Code of Massachusetts Regulations 37.00	1987, 2010
MT	Undefined "infertility services" as a basic health care service	Only mandated for Health Maintenance Organizations (HMOs)	Mont. Code Ann. §33-22-1521, §33-31-102 [2] (v), et seq.	1987
NH	"Medically necessary fertility treatment," procurement and cryopreservation of sperm	Correction of elective sterilization, experimental procedures[a], small businesses	2020 NH RSA CHAPTER 417-G	2020

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Table 1
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State	Male Factor Evaluation and Treatment Coverage Included in Law	Restrictions	Law/Code	Year(s) Enacted
NJ	Diagnosis and treatment of infertility	Correction of elective sterilization; cryopreservation; experimental procedures[a]	N.J. Stat. Ann. §17:48A-7w, §17:48E-35.22, §17B:27-46.1x	2001
NY	Semen analysis; testis biopsy; correction of malformation, disease, or dysfunction resulting in infertility; fertility preservation medical treatments for people facing iatrogenic infertility caused by medical intervention; infertility drug coverage; prohibition of discrimination based on age, sex, sexual orientation, marital status, or gender identity	Correction of elective sterilizations; sex change procedure; cloning experimental medical or surgical procedures[a]; employers who self-insure are exempt	NY S.B. 6257 -B/A.B. 9759-B, N.Y. Insurance Law §3216 [13], §3221 [6] and §4303, FY 2020 New York State Budget	1990, 2002, 2011, 2020
OH	Diagnostic and exploratory procedures for testicular failure	Only mandated for HMOs	Ohio Rev. Code Ann §1751.01 (A) [7]	1991
RI	None	-	R.I. Gen. Laws §27-18-30, §27-19-23, §27-20-20 and §27-41-33	1989, 2007
TX	None	-	Tex. Insurance Code Ann. §1366.001 et seq.	1987, 2003
WV	Undefined "infertility services" as a basic health care service	Only mandated for HMOs	W. Va. Code §33-25A-2	1995

[a] Not otherwise defined.

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COST OF INFERTILITY CARE

Evaluating and treating infertility can be costly with high out-of-pocket expenses because infertility evaluation and treatments are rarely covered by insurance. Discussion and analysis of this financial burden frequently focuses on treatments for female patients; in particular, the high costs associated with IVF treatments are well documented in both academic literature and broader news coverage. In a 2014 assessment of 332 couples receiving infertility care at the University of California-San Francisco, 178 underwent IVF and reported average out-of-pocket costs of $19,234. Intrauterine insemination (IUI) out-of-pocket costs in this study were $2,623, and even patients who used only ovulation induction medications reported out-of-pocket expenses of $912.[36] These estimates are similar to those reported by the Society for Assisted Reproductive Technology, which estimates an average cost of one IVF cycle in the United States to be $10 to 15,000, and in the lay media, such as FertilityIQ, a Website and resource for couples with infertility, which reports an

average cost of about $20,000 per cycle of IVF according to its proprietary survey data of more than 23,000 patients; FertilityIQ additionally reports cumulative IVF costs for multiple cycles averaged between $40,000 and $60,000.[37,38]

Male infertility evaluation and treatment is also expensive. In one survey of 572 couples with male factor infertility, 0% to 25% reported coverage of expenses related to medications, sperm extraction, or freezing sperm.[9] In a survey of 111 patients from 2016 also conducted at the University of California-San Francisco, 64% of men who pursued fertility treatments reported spending more than $15,000 dollars of out of pocket and 16% reported spending more than $50,000 dollars. In addition, 47% of survey participants reported experiencing financial strain due to infertility treatments and 46% reported that their treatment options were limited due to expenses.[10] The median US household income in 2018 was estimated to be $63,179 in 2018; therefore, these estimates represent between 24% and 79% of median yearly income, certainly a substantial financial burden.[39] Prices and success rates, especially for male infertility care, are not commonly listed on Websites of hospitals or providers, making it difficult for patients to make informed decisions regarding their care.[40]

INCREASING PUBLIC AWARENESS AND MARKET DEMAND FOR SERVICES AND COVERAGE OF INFERTILITY CARE

As discussed earlier, infertility evaluation and treatment frequently fall to the female partner in an infertile couple. However, there has been increased media reporting in recent years about male factor infertility representing an increase in public awareness. For example, the New York Times Parenting column discussed "what to know and how to cope" with male infertility, and Good Morning America wrote about male infertility as part of its 2019 infertility awareness week, including spotlighting several patient stories.[41,42]

In addition to this media focused on education about male factor infertility, there has been increased media attention on fear and anxiety surrounding male infertility. In 2017, a meta-analysis of 185 studies with 42,935 men who provided sperm samples between 1973 and 2011 in North America, Europe, Australia, and New Zealand reported a significant decline in sperm concentrations and total sperm counts; the study reported an average decline of 1.4% per year and 52.4% overall in sperm concentrations and a decline of 1.6% per year and 59.3% overall in total sperm counts.[43] Following the publication of this study, multiple outlets such as GQ, Newsweek, Time, and CNN reported on the results with language including "male fertility death spiral," "sperm panic," "infertility crisis," and "men are doomed;" the outlets hypothesized contributing factors to the decline ranging from stress and obesity to climate change, electromagnetic fields, and global plastics production. Although difficult to correlate, there were spikes in Google searches related to "sperm count" around the time of this study publication and publicization, as demonstrated in the data from Google Trends in **Fig. 2**.

Broadly, it seems that there is increasing public awareness and concern about male factor infertility.

Meeting Increasing Market Demand for Infertility Care

The overall demand for infertility technologies, treatments, and services are projected to grow considerably in the upcoming years. Citing increasing infertility rates and growing social acceptance of assisted reproductive technologies, various reports project growth in all areas of infertility markets. For example, the infertility drugs market in the United States, valued at 795 million dollars in 2017, is projected to grow to 922.5 million in 2022 with a 3.0% compound annual growth rate (CAGR).[44] The global IVF services market was valued at 12.5 billion dollars in 2018 and is projected to grow to 25.5 billion by 2026 at a CAGR of 9.3%.[45] More broadly, the global fertility services market is projected to exceed 27 billion dollars by 2026, more than double its 2018 value of 13 billion dollars.[46] In particular, the global male infertility market is expected to grow from about 3.3 billion in 2019 to more than 5 billion dollars by 2026 at a CAGR of 5.3%. These market reports reflect increasing demand for fertility services and technologies in the United States and the rest of the world. Growth rates are particularly high in Asia-Pacific markets, which one report attributes in part to growing fertility tourism of patients who cannot afford treatment in their home countries.[47] The bulk of revenue predicted by the market projections for male infertility arise from increasing demand for assisted reproductive technologies and varicocele surgeries, although testing and medications also make up significant portions.[48]

Capitalizing on this projected increase in consumer demand and market value, a variety of new startups are developing new technologies and services and targeting men concerned about fertility. Some companies are focusing on sperm storage. Dadi, which raised a 5-million-dollar

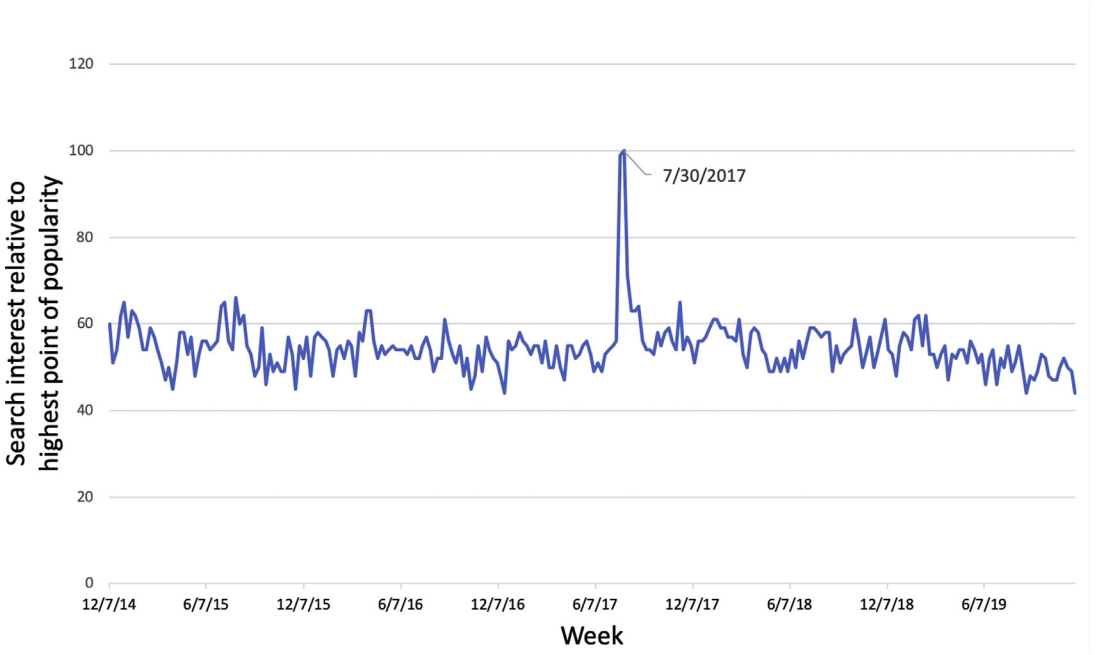

Fig. 2. Spike in Google searches for "sperm count" in July 2017, the same month of the publication of Levine and colleagues' study.

seed extension in 2019, is trying to capitalize on anxiety about declining sperm counts with advertising that urges users to "stop the clock." Legacy, on the other hand, markets itself as the "Swiss bank for sperm freezing" and raised 1.5 million dollars in a recent fundraising round led by Bain Capital. A handful of companies are developing devices that seek to improve fertility, such as Coolmen, a wearable that attaches to the testicles to keep them cool and increases sperm production (for best results they suggest wearing the device 8 hours per day). Several businesses are trying to directly address the high costs of infertility evaluation and treatment. For example, Future Family pays the upfront costs of a patient's care and converts these to a monthly payment plan for the consumer, and Carrot Fertility offers customizable fertility benefit packages to midsized companies seeking to offer this coverage to their employees.

Finally, several of these companies focus on home diagnostic devices for men. For example, the Trak Volume Cup, which retails for about 200 dollars, is a Food and Drug Administration–approved centrifugal device that allows men to measure semen volume and sperm count. The YO home sperm test, which retails for about 70 dollars, includes a microscope device that attaches to a smartphone to assess sperm count and motility. SpermCheck Fertility testing, which retails for about 25 dollars, is reminiscent of a pregnancy test with colored lines on a plastic collection device that tell the user if he has normal or low sperm count. All the devices advertise high clinical accuracies, which have been validated based on manufacturer-funded studies and published in peer-reviewed journals.[49–51] The proliferation and popularization of these types of diagnostic devices may increase the volume of patients seeking evaluation and treatment from a reproductive health specialist following at-home testing.

Potential Cost Savings Accrued from Treating Male Factor Infertility

With the media and startups helping to generate increased public interest in male factor infertility and demand for services, insurance companies may consider the potential cost-saving benefits of covering male evaluation and treatment. Varicocelectomy, for example, has consistently been demonstrated to be a more cost-effective treatment of infertility than pursuing empirical IVF or other assisted reproductive technologies. A study of the effectiveness and direct costs compared patients in 4 treatment modalities (observation, varicocelectomy, IUI, and IVF); this study demonstrated that the probability of live birth delivery following varicocelectomy was 72% versus 61% for IVF and that the average cost of delivery was $32,171 ($46,020 when adjusted for inflation since

publication).[52] These estimates did not include indirect costs, which likely increase the total cost of the IUI and IVF routes. In another study, the total indirect and direct cost per delivery after varicocelectomy was estimated to be $26,268 compared with $89,091 per delivery with intracytoplasmic sperm injection ($42,118 and $142,849, respectively when adjusted for inflation).[53]

Patients most likely to benefit from varicocelectomy in terms of pregnancy outcomes are those with oligospermia or asthenospermia, not those with azoospermia, highlighting the importance of medical evaluation with a reproductive specialist, not just direct-to-consumer testing.[54] However, even patients with azoospermia or severe oligospermia may benefit from surgical intervention. A recent study of 17 men with total sperm counts less than 2 million who underwent varicocele repair demonstrated a mean postoperative sperm concentration of 5.4 million with 1 spontaneous pregnancy and 2 successful pregnancies with IUI (total estimated cost per pregnancy $35,924).[55] Overall, advocates for better insurance coverage for male infertility treatments may be able to leverage increasing market demand and potential patient volume with insurance providers by demonstrating cost savings of male factor evaluation and treatment.

FUTURE INNOVATIONS IN FERTILITY CLINIC ORGANIZATIONS AND CLINICAL PRACTICE STRUCTURES

With significant growth in patient awareness, social acceptance, and financial investments in direct-to-consumer male infertility startups, what might the future of male reproductive health care delivery look like? In the Glazer survey of 572 couples with male factor infertility, 71.5% were referred to a male fertility specialist, most of whom were referred by the gynecologist of their female partners.[9] This reflects the fact that the typical fertility evaluation pathway frequently still begins with the female partner visiting an obstetrics and gynecology provider, which can create tensions when different providers,and practices are taking care of the male and female partners in an infertile couple, as well as generate redundant visit costs and potentially unnecessary interventions for the patients.

Integrated reproductive health practice systems in which urology and andrology are part of larger reproductive health practices with obstetrics, gynecology, and reproductive endocrinologists represent a potentially more efficient experience for patients and likely a cost reduction for the system through economies of scale and aligned practice incentives. Ideally, a couple would present to an integrated reproductive health practice as one infertile couple and receive appropriate evaluation and testing rather than pursuing 2 separate pathways. This type of problem-based practice structure, as opposed to individual specialty clinics, allows patients to receive multidisciplinary care in one setting and facilitates communication between providers. Integrated reproductive practices are possible not only in private practice but also in larger academic health systems; the University of Utah (https://healthcare.utah.edu/fertility/) and the University of Michigan (https://medicine.umich.edu/dept/center-reproductive-medicine), for example, have Centers for Reproductive Medicine with multiple urology providers working alongside obstetrics and gynecology providers to offer tailored counseling and treatment plans to patients. In addition, some male infertility procedures may be safely performed in office-based andrology practices with local anesthesia, further adding to the value of integrated clinics. One study demonstrated an 89% cost reduction in testicular and microepididymal sperm aspiration when performed in clinic instead of the operating room and a 62% cost reduction for vasectomy reversals with similar outcomes, representing significant potential savings to the system and the patient.[56]

In addition to investment in male and female infertility startups, there has been significant private equity interest in fertility clinics. In the past, as with much of health care delivery, fertility clinics were usually stand-alone, small regional practices. In 2014, the largest conglomerate of fertility clinics, IntegraMed, only accounted for 7.7% of national market share, and 73% of the other 452 clinics had less than 0.24% market share each, reflecting the fact that most were relatively small practices.[57] Venture capital investors seek to integrate clinics into national groups with standardized best practices, newer technologies, and more flexible payment plans for patients. These are relatively recent developments; for example, in 2016 Lee Equity Partners invested 200 million dollars in an Atlanta fertility clinic and donor egg bank to create Prelude Fertility.[58] Multiple horizontal mergers with larger clinics and new locations, including a 2019 partnership with Inception Fertility in San Francisco, have made Prelude one of the fastest-growing networks of fertility clinics and the largest provider of comprehensive fertility services in the United States, already surpassing the 2014 market volume of IntegraMed.[59]

Unfortunately, based on these authors' pursual of these clinics' Websites and advertisements, the clinics seem to focus on attracting female patients. For example, the imagery on Prelude Fertility's homepage seems to exclude men; there are

photos of babies and women, but the only men pictured are a gay male couple and pregnant woman with her male partner's head excluded from the frame. One Website for Colorado Center for Reproductive Medicine, which has expanded to 11 locations across the United States and Canada, includes patient education about male factor infertility but does not mention lower-cost treatment options for men such as medication or varicocelectomy. Overall, investment and expansion of fertility clinic networks in the United States do not seem to be focusing on male factor infertility evaluation or treatment in their plans for business or patients.

This investment in fertility clinic expansion means more options for patients to pursue reproductive health care; however, there are also potential drawbacks to such large-scale clinic development. Although updating technologies and merging existing clinics into national groups may help standardize care and achieve economies of scale for patients, having fertility clinics funded by venture capital could change the leadership dynamics in the clinics. Physicians may be concerned about a focus on profit returns often expected by venture capital investments. In addition, horizontal mergers between health care systems or providers are usually marketed as a means of achieving cost reduction by increasing efficiency through economies of scope and scale. However, recent studies have raised concerns that such mergers and acquisitions frequently actually result in higher costs and decreased quality.[60,61]

FUTURE DIRECTIONS AND SUMMARY

In the authors' opinion, the ideal reproductive health practice structure should include initial multidisciplinary evaluation of a couple as a single infertile "patient" with appropriate evaluation pathways simultaneously pursued for both partners. To destigmatize the male fertility evaluation process, practices could consider partnering with device companies that offer initial home testing kits to decrease the awkwardness for some patients of providing semen samples in clinic. Many reproductive-aged patients will also have higher expectations for the clinical and administrative experience, for example, online scheduling and digital communication through patient portals. Financial counseling should be offered as part of the clinic services to patients trying to navigate varied insurance coverage. Unfortunately, bundled payment options seem unlikely due to the complicated nature of fertility treatment and pregnancy outcomes; however, personalized payment plans should be considered and price estimates, including estimates for procedures, medications, and office appointments, should ideally be readily available and easily searchable.

As states increasingly mandate coverage for fertility care, more private companies elect to offer coverage as a means of promoting employee wellness, more people choose to pursue families later in life, better technology becomes available, and more patients are likely to seek evaluation and care for male factor infertility. Male reproductive health specialists should take an active role in organizing and delivering appropriate and cost-efficient fertility care.

DISCLOSURE

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REFERENCES

1. Practice Committee of American Society for Reproductive Medicine. Definitions of infertility and recurrent pregnancy loss: a committee opinion. FertilSteril 2013. https://doi.org/10.1016/j.fertnstert.2012.09.023.
2. Pfeifer S, Butts S, Dumesic D, et al. Diagnostic evaluation of the infertile male: a committee opinion. FertilSteril 2015. https://doi.org/10.1016/j.fertnstert.2014.12.103.
3. National Institute for Health and Care Excellence. Fertility Problems: Assessment and Treatment. Investigation of Fertility Problems and Management Strategies. (NICE clinical guideline 156). London, United Kingdom: National Institute for Health and Care Excellence; 2013. Available at: https://www.nice.org.uk/guidance/cg156/chapter/Recommendations#investigation-of-fertility-problems-and-management-strategies. Accessed November 25, 2019.
4. CDC: reproductive health: infertility FAQ. Available at: https://www.cdc.gov/reproductivehealth/infertility/index.htm. Accessed November 25, 2019.
5. Eisenberg ML, Lathi RB, Baker VL, et al. Frequency of the male infertility evaluation: Data from the national survey of family growth. J Urol 2013. https://doi.org/10.1016/j.juro.2012.08.239.
6. Chandra A, Copen CE, Stephen EH. Infertility service use in the United States: data from the national survey of family growth, 1982-2010. NatlHealth Stat Report 2014;(73):1–21.
7. Zegers-Hochschild F, Adamson GD, de Mouzon J, et al. International Committee for Monitoring Assisted Reproductive Technology (ICMART) and the World Health Organization (WHO) revised glossary

of ART terminology, 2009. FertilSteril 2009. https://doi.org/10.1016/j.fertnstert.2009.09.009.
8. Berg S. AMA backs global health experts in calling infertility a disease. AMA: Public Health. Available at: https://www.ama-assn.org/delivering-care/public-health/ama-backs-global-health-experts-calling-infertility-disease. Accessed November 25, 2019.
9. Glazer C, Anderson-Bialis J, Anderson-Bialis D, et al. PD29-09 evaluation, treatment, and insurance coverage for infertile couples with male factor infertility in the US. J Urol 2019. https://doi.org/10.1097/01.ju.0000556129.05868.6e.
10. Elliott PA, Hoffman J, Abad-Santos M, et al. Out-of-pocket costs for men undergoing infertility care and associated financial strain. UrolPract 2016. https://doi.org/10.1016/j.urpr.2015.07.010.
11. Kumar N, Singh A. Trends of male factor infertility, an important cause of infertility: a review of literature. J Hum Reprod Sci 2015. https://doi.org/10.4103/0974-1208.170370.
12. Cayan S, Erdemir F, Ozbey I, et al. Can varicocelectomy significantly change the way couples use assisted reproductive technologies? J Urol 2002;167(4):1749–52.
13. Kolettis PN, Sabanegh ES. Significant medical pathology discovered during a male infertility evaluation. J Urol 2001. https://doi.org/10.1016/S0022-5347(05)66104-6.
14. Eisenberg ML, Park Y, Hollenbeck AR, et al. Fatherhood and the risk of cardiovascular mortality in the NIH-AARP diet and health study. Hum Reprod 2011. https://doi.org/10.1093/humrep/der305.
15. Walsh TJ, Croughan MS, Schembri M, et al. Increased risk of testicular germ cell cancer among infertile men. Arch Intern Med 2009. https://doi.org/10.1001/archinternmed.2008.562.
16. Walsh TJ, Schembri M, Turek PJ, et al. Increased risk of high-grade prostate cancer among infertile men. Cancer 2010. https://doi.org/10.1002/cncr.25075.
17. Jensen TK, Jacobsen R, Christensen K, et al. Good semen quality and life expectancy: a cohort study of 43,277 men. Am J Epidemiol 2009. https://doi.org/10.1093/aje/kwp168.
18. Eisenberg ML, Betts P, Herder D, et al. Increased risk of cancer among azoospermic men. FertilSteril 2013. https://doi.org/10.1016/j.fertnstert.2013.05.022.
19. Eisenberg M, Kasman AM, Li S. PD29-08 male infertility and future health: does the association vary by sociodemographic factors? J Urol 2019. https://doi.org/10.1097/01.ju.0000556128.98244.7b.
20. Shindel AW, Nelson CJ, Naughton CK, et al. Sexual function and quality of life in the male partner of infertile couples: prevalence and correlates of dysfunction. J Urol 2008. https://doi.org/10.1016/j.juro.2007.10.069.
21. Domar AD, Zuttermeister PC, Friedman R. The psychological impact of infertility: a comparison with patients with other medical conditions. J PsychosomObstetGynaecol 1993;14(Suppl):45–52.
22. Rich CW, Domar AD. Addressing the emotional barriers to access to reproductive care. FertilSteril 2016. https://doi.org/10.1016/j.fertnstert.2016.02.017.
23. Patient Protection and Affordable Care Act. (2010). Compilation of Patient Protection and Affordable Care Act. Available at: http://housedocs.house.gov/energycommerce/ppacacon.pdf
24. Haring E, Kirby E, Perkins L, et al. Access to reproductive health care: the experiences of military women. 2018. Available at: https://www.servicewomen.org/wp-content/uploads/2018/12/2018ReproReport_SWAN-2.pdf. Accessed November 25, 2019.
25. Katon J, Cypel Y, Raza M, et al. Self-reported infertility among male and female veterans serving during operation enduring freedom/operation Iraqi freedom. J Women'sHealth (Larchmt) 2014. https://doi.org/10.1089/jwh.2013.4468.
26. Fenstermaker M, Paknikar S, Rambhatla A, et al. The state of men's health services in the veterans health administration. CurrUrol Rep 2017. https://doi.org/10.1007/s11934-017-0733-4.
27. Women Veterans and Families Health Services Act of 2019. S.319, 115th Cong. (2019). Available at: https://www.congress.gov/bill/116th-congress/senate-bill/319.
28. Dupree JM, Dickey RM, Lipshultz LI. Inequity between male and female coverage in state infertility laws. FertilSteril 2016. https://doi.org/10.1016/j.fertnstert.2016.02.025.
29. Title 18: Insurance Code, Delaware, §3342, 3556. (2018).Available at: (https://delcode.delaware.gov/title18/).
30. Mercer Health and Benefits. Employer experience with, and attitudes toward, coverage of infertility treatment. Mercer Health and Benefits. 2006. Available online: http://familybuilding.resolve.org/site/DocServer/Mercer-Resolve_Final_report.pdf. Accessed November 26 2019.
31. Umland B, Bernstein D. The needle starts to move on reproductive health benefits. Available at: https://www.mercer.us/our-thinking/healthcare/the-needle-starts-to-move-on-reproductive-health-benefits.html. Accessed November 25, 2019.
32. Impact of infertility insurance benefits on employee/employer relationship. Available at: https://resolve.org/wp-content/uploads/2017/10/Infertility-Insurance-Infographic-Oct17.pdf. Accessed November 25, 2019.
33. Mathews TJ, Hamilton BE. Mean age of mothers is on the rise: United States, 2000-2014. NCHS Data Brief 2016;(232):1–8.
34. Kholl A. Why your company should offer fertility benefits. Forbes; 2019. Available at: https://www.forbes.com/sites/alankohll/2019/04/10/why-your-company-

should-offer-fertility-benefits/#f50976876995. Acces sed November 26, 2019.
35. Delaware general assembly: senate Bill 139 original synopsis. Available at: https://legis.delaware.gov/BillDetail/26219. Accessed November 25, 2019.
36. Wu AK, Odisho AY, Washington SL, et al. Out-of-pocket fertility patient expense: Data from a multicenter prospective infertility cohort. J Urol 2014. https://doi.org/10.1016/j.juro.2013.08.083.
37. What is the cost of IVF? Society for assisted reproductive technology. Available at: https://www.sart.org/patients/frequently-asked-questions/. Accessed November 26, 2019.
38. Costs of IVF: Is IVF good value? FertilityIQ. Available at: https://www.fertilityiq.com/ivf-in-vitro-fertilization/costs-of-ivf#is-ivf-good-value. Accessed November 26, 2019.
39. Semega J, Kollar M, Creamer J, et al. Income and poverty in the United States 2018.
40. Seaman JA, Dupree JM, Deibert CM. MP46-20 finding male fertility care prices online-opaque at best. J Urol 2019. https://doi.org/10.1097/01.ju.0000556312.62054.1f.
41. Levine H. Male infertility: what to know and how to cope. NYTimes 2019. Available at: https://parenting.nytimes.com/becoming-a-parent/male-infertility.
42. What to know about male infertility, from causes to treatment options. GMA 2019. Available at: https://www.goodmorningamerica.com/wellness/story/male-infertility-treatment-options-62558954.
43. Levine H, Jørgensen N, Martino-Andrade A, et al. Temporal trends in sperm count: a systematic review and meta-regression analysis. Hum ReprodUpdate 2017. https://doi.org/10.1093/humupd/dmx022.
44. Drugs for infertility: global markets to 2022. BCC Research. Wellsely, MA. April 2018.
45. Pandey S, Sumant O. IVF services market: opportunity analysis and industry forecast: Allied Market Research;Portland, Oregon 2019-2026 2019.
46. Sumant O, Joshi K. Fertility services market: global opportunity analysis and industry forecast 2019-2026. Fremont, CA: BIS Research; 2019.
47. Asia-Pacific in-vitro fertilization amrket: analysis and forecast 2019-2029. BIS Reaserch. Fremont, CA. May 2019.
48. Male infertility market size, share and trends and segment forecasts 2026. Francisco, CA: Grand View Research. San; 2019.
49. Fredriksen LL, Epperson J, Hong K, et al. Design and validation of the trak® volume cup - a dual purpose semen collection and volume measurement device for diagnosing hypospermia. FertilSteril 2018. https://doi.org/10.1016/j.fertnstert.2018.07.777.
50. Agarwal A, PannerSelvam MK, Sharma R, et al. Home sperm testing device versus laboratory sperm quality analyzer: comparison of motile sperm concentration. FertilSteril 2018. https://doi.org/10.1016/j.fertnstert.2018.08.049.
51. Niederberger C. Spermcheck fertility, an immunodiagnostic home test that detects normozoospermia and severe oligozoospermia. J Urol 2010. https://doi.org/10.1016/j.juro.2010.07.044.
52. Penson DF, Paltiel AD, Krumholz HM, et al. The cost-effectiveness of treatment for varicocele related infertility. J Urol 2002. https://doi.org/10.1016/S0022-5347(05)64175-4.
53. Schlegel PN. Is assisted reproduction the optimal treatment for varicocele- associated male infertility? A cost-effectiveness analysis. Urology 1997. https://doi.org/10.1016/S0090-4295(96)00379-2.
54. Chiles KA, Schlegel PN. Cost-effectiveness of varicocele surgery in the era of assisted reproductive technology. Asian J Androl 2016. https://doi.org/10.4103/1008-682X.172644.
55. Dubin JM, Greer AB, Kohn TP, et al. Men with severe oligospermia appear to benefit from varicocele repair: a cost-effectiveness analysis of assisted reproductive technology. Urology 2018. https://doi.org/10.1016/j.urology.2017.10.010.
56. Alom M, Ziegelmann M, Savage J, et al. Office-based andrology and male infertility procedures-a costeffective alternative. TranslAndrol Urol 2017. https://doi.org/10.21037/tau.2017.07.34.
57. Fertility clinics: Q1. 2017. Available at: http://capstoneheadwaters.com/sites/default/files/Capstone Fertility Clinics Report Q1 2017.pdf#page=4.
58. Robbins R. Investors see big money in infertility. And they're transforming the industry. Stat News 2017. Available at: https://www.statnews.com/2017/12/04/infertility-industry-investment/.
59. Prelude fertility and inception establish the largest provider of comprehensive fertility services in the U.S. Business Wire; 2019. Available at: https://www.businesswire.com/news/home/20190328005158/en/Prelude-Fertility-Inception-Establish-Largest-Provider-Comprehensive.
60. Gale AH. Bigger but not better: hospital mergers increase costs and do not improve quality. Mo Med 2015;112(1):4–5.
61. Haas S, Gawande A, Reynolds ME. The risks to patient safety from health system expansions. JAMA 2018. https://doi.org/10.1001/jama.2018.2074.