

# Trends in clinical reproductive medicine research: 10 years of growth

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**Objective:** To study the most important metrics of publication in the field of reproductive medicine over the decade 2003–2012 to aid in discerning the clinical, social, and epidemiologic implications of this relatively new but rapidly emerging area in medical sciences.

**Design:** Bibliometric analysis of most-cited publications from Web of Science databases.

**Setting:** Not applicable.

**Patient(s):** None.

**Intervention(s):** None.

**Main Outcome Measure(s):** Most productive and frequently cited investigators, institutions, and countries and specific areas of research, scientific collaborations, and comparison of the growth of reproductive medicine research compared with other areas of medical investigation such as obstetrics and gynecology and related science categories.

**Result(s):** We found that 90 investigators with more than 1,000 citations had jointly published 4,010 articles. A continued rise in the impact factor of reproductive medicine journals was seen. The number of publications in reproductive medicine grew more rapidly compared with other science categories. Presently 22% of highly cited articles in reproductive medicine research are published in journals belonging to science categories outside reproductive medicine. The most-cited study groups are situated in the Netherlands, Belgium, Spain, the United States, and the United Kingdom, and collaborative studies have been increasing.

**Conclusion(s):** Reproductive medicine research and subsequent clinical development have attained scientific growth and maturity. High-quality research is increasingly being published in high-impact journals. The increase in (inter)national collaborations seems to be key to the field's success. (*Fertil Steril*® 2015;104:131–7. ©2015 by American Society for Reproductive Medicine.)

**Key Words:** Bibliometrics, citation analysis, impact factor, network analysis, reproductive medicine, scientific collaboration

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**R**eproductive medicine, which has been a rapidly developing area of medical science, is now coming to maturity. Its progress can be attributed largely to the introduction of novel techniques such as radioimmuno-

noassays for the assessment of reproductive hormones, along with novel compounds for ovarian stimulation such as the antiestrogen clomiphene citrate and exogenous gonadotropin hormones during the 1960s followed

by the direct clinical application of methods developed in reproductive science laboratories. Integration of knowledge culminated in 1978 in the first live birth from a human embryo generated in vitro using in vitro fertilization (IVF) (1), which paved the way to the development of a very successful and common treatment for human infertility globally. This pioneer work by Robert Edwards was awarded the Nobel prize in 2010. Now more than 5 million human beings have been born using this technology (2). According to statistics from Europe, more than half a million of IVF cycles are performed annually, resulting in 100,000 newborns

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and accounting for 1.5% of all European babies (3). Additional technologies extending the use of IVF have subsequently been developed and implemented, such as intracytoplasmic sperm injection (ICSI), preimplantation genetic diagnosis (PGD), and cryotechnology, which allows the freezing and storage of sperm, oocytes, embryos, and testicular and ovarian tissue.

For the development of such outstanding achievements, clinical medicine requires high-quality research and key publications, which become widely cited by other scientists (4). Indeed, analyses have identified the most widely cited articles in journals for the area of reproductive medicine (4–7). The geographical distribution of articles (8, 9) and the collaboration patterns (10) also have been investigated to some extent.

An increasing number of journals have appeared in the field of reproductive medicine, and the total number of articles published has grown each year (11). The established journals in the category of reproductive medicine show an ongoing trend toward rising impact factors (12), for the higher quartile journals ranging between 3 and 9. Moreover, reproductive medicine research is increasingly published in journals devoted to other science categories, such as endocrinology and metabolism, and general and internal medicine; it also has, at least to some extent, expanded into the highly ranked journals in other science categories such as genetics and immunology. Although this expansion into other areas of medicine has yet to be analyzed, the potential highlights the diversification of reproductive medicine research.

We have identified the most frequently cited investigators and institutions in reproductive medicine over the most recent 10-year period, and we have identified their specific areas of research and collaboration. Our current and comprehensive analysis [1] assesses highly cited reproductive medicine research published in the reproductive medicine science category supplemented with other relevant science categories; [2] identifies specific areas of successful research and collaboration in reproductive medicine among groups and countries; [3] identifies areas of research that have significantly influenced recent developments and may guide future developments of the field; and [4] compares reproductive medicine research with other areas of medical research of comparable size.

## MATERIALS AND METHODS

To identify and assess reproductive medicine research, we used a methodology that includes the following steps (see also Supplemental Fig. 1, available online).

### Bibliographic Research

All the articles we selected were published in journals in the first quartile of the Reproductive Biology category of the *Journal Citation Report* during the 2003–2012 period. The search was performed in Web of Science (WOS) and was limited to “articles” and “reviews” accessible on June 13, 2013. The search resulted in 21,909 articles (20,332 articles and 1,577 reviews). The citation data were updated on November 18, 19, and 20, 2013. This analysis was performed independently by the first author (R.A.-B.).

### Identification of Articles from the Most-cited Investigators

Our next step was to identify excellent research by selecting investigators publishing in journals in the first quartile of the reproductive biology category whose articles had more than 1,000 citations. A total of 90 investigators was selected. We then extended the search from these 90 most-cited investigators for more articles published in journals in first quartile of other science categories, such as obstetrics and gynecology; medicine, general and internal; and endocrinology and metabolism. We selected these three science categories because they are the most frequently used by researchers in reproductive medicine when publishing their articles. Moreover, general and internal medicine is the area that includes the most-cited multidisciplinary journals and the journals with the highest impact factors. As a result, we collected 4,010 articles. All data included in our tables and figures were extracted from these 4,010 articles.

### Number of Articles, Journals, and Science Categories

Total number of articles published on reproductive medicine in the highest impact factor quartile journals per science category are shown in Table 1. Two tables provided as additional supplementary material complement these data. Supplemental Table 1 (available online) compares the

**TABLE 1**

**Total number of papers published on reproductive medicine over a 10-year period (2003–2012) in the highest impact factor quartile journals, per science category.**

No. of papers	Journal	Science category
980	<i>Human Reproduction</i>	RB
891	<i>Fertility &amp; Sterility</i>	RB
385	<i>Reproductive BioMedicine Online</i>	RB
288	<i>Journal of Clinical Endocrinology &amp; Metabolism</i>	E&M
175	<i>Biology of Reproduction</i>	RB
145	<i>Human Reproduction Update</i>	RB
94	<i>Molecular Human Reproduction</i>	RB
77	<i>British Journal of Obstetrics and Gynaecology</i>	OG
72	<i>American Journal of Obstetrics &amp; Gynecology</i>	OG
54	<i>Obstetrics &amp; Gynecology</i>	OG
54	<i>Reproduction</i>	RB
51	<i>Endocrinology</i>	E&M
48	<i>Placenta</i>	RB
45	<i>Seminars in Reproductive Medicine</i>	RB
39	<i>Current Opinion in Obstetrics and Gynecology</i>	OG
37	<i>Cochrane Database</i>	MGI
36	<i>Contraception</i>	OG
35	<i>Reproductive Sciences</i>	RB
34	<i>New England Journal of Medicine</i>	MGI
31	<i>British Medical Journal</i>	MGI
27	<i>Gynecological Oncology</i>	OG
22	<i>Menopause</i>	OG
21	<i>The Lancet</i>	MGI
21	<i>Ultrasound in Obstetrics and Gynecology</i>	OG

Note: Total number of papers published (in journals with >20 articles): 3,662, of which 78% were published in RB journals, 9% in E&M, 9% in O&G, and 3% in MGI. E&M = endocrinology and metabolism; MGI = medicine, general and internal; OG = obstetrics and gynecology; RB = reproductive biology.

Aleixandre-Benavent. Trends in ART research. *Fertil Steril* 2015.

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